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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: 11. 26, 2015** **Test Report No.: HCT-A-1511-F007** **Test Site: HCT CO., LTD.**

FCC ID: XHG-R850

Equipment Type:	**LTE Mobile Router**
Model Name:	**R850**
Testing has been carried out in accordance with:	**47CFR §2.1093** **ANSI/ IEEE C95.1 – 1992** **IEEE 1528-2013**
Date of Test:	**10/30/ 2015 ~ 11/09/ 2015**

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

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

Tested By	Reviewed By
Parkinho	
In-Ho Park **Test Engineer / SAR Team** **Certification Division**	**Dong-Seob Kim** **Technical Manager / SAR Team** **Certification Division**

Version

Rev.	DATE	DESCRIPTION
HCT-A-1511-F007	11. 26, 2015	First Approval Report

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1. Attestation of Test Result of Device Under Test

Attestation of SAR test result			
Applicant Name:	Franklin Technology Inc.		
FCC ID:	XHG-R850		
Model:	R850		
EUT Type	LTE Mobile Router		
Application Type:	Certification		
The Highest Reported SAR (W/Kg)			
Band	**Tx. Frequency (MHz)**	**Equipment Class**	**Reported 1g SAR (W/kg) Hotspot**
LTE Band 4 (AWS)	1 710.7 ~ 1 754.3	PCB	1.20
LTE Band 12	699.7 ~ 715.3	PCB	0.98
LTE Band 25 (PCS)	1 850.7 ~ 1 914.3	PCB	0.66
LTE Band 26 (Cell)	814.7 ~ 848.3	PCB	0.56
LTE Band 41	2 498.5 ~ 2 687.5	PCB	0.47
802.11b	2 412 - 2 462	DTS	0.19
Simultaneous SAR per KDB 690783 D01v01r03			1.39
Date(s) of Tests:	10/30/ 2015 ~ 11/09/ 2015		

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2. Device Under Test Description

2.1 DUT specification

Device Wireless specification overview		
Band & Mode	**Operating Mode**	**Tx. Frequency**
LTE Band 2	Data	1850.7 ~ 1909.3 MHz
LTE Band 4 (AWS)	Data	1 710.7 ~ 1 754.3 MHz
LTE Band 5	Data	824.7 ~ 848.3 MHz
LTE Band 12	Data	699.7 ~ 715.3 MHz
LTE Band 25 (PCS)	Data	1 850.7 ~ 1 914.3 MHz
LTE Band 26 (Cell)	Data	814.7 ~ 848.3 MHz
LTE TDD Band 41	Data	2 498.5 ~ 2 687.5 MHz
2.4 GHz WLAN	Data	2 412 ~ 2 462 MHz
Device Description		
Back Cover	Normal Battery cover	
Battery Options	Standard	
Hardware Version:	REV1.0	
Software Version :	J120F.001	
Device Serial Numbers	Several samples with identical hardware were used to SAR testing. The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics	

2.2 DUT Wireless mode

Wireless Modulation	Band	Operating Mode		Duty Cycle
LTE Band	2	Data (QPSK, 16QAM)		100 % (FDD)
	4 (AWS)	Data (QPSK, 16QAM)		100 % (FDD)
	5	Data (QPSK, 16QAM)		100 % (FDD)
	12	Data (QPSK, 16QAM)		100 % (FDD)
	25 (PCS)	Data (QPSK, 16QAM)		100 % (FDD)
	26 (Cell)	Data (QPSK, 16QAM)		100 % (FDD)
	41	Data (QPSK, 16QAM)		63.3 % (TDD)
2.4 GHz WLAN		Data	802.11 b, 802.11 g, 802.11 n (HT20)	100 %

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2.3 LTE information

Item.	Description
Frequency Range:	Band 2: 1 850.7 MHz ~ 1 909.3 MHz
	Band 4: 1 710.7 MHz ~ 1 754.3 MHz
	Band 5: 824.7 MHz ~ 848.3 MHz
	Band 12: 699.7 MHz ~ 715.3 MHz
	Band 25: 1 850.7 MHz ~ 1 914.3 MHz
	Band 26: 814.7 MHz ~ 848.3 MHz
	Band 41: 2 498.5 MHz ~ 2 687.5 MHz
Channel Bandwidths	Band 2: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
	Band 4: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
	Band 5: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz
	Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz
	Band 25: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
	Band 26: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz
	Band 41: 5 MHz, 10 MHz, 15 MHz, 20 MHz

Channel Number s& Frequencies(MHz):

Band 2

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)
18607	1850.7	18615	1851.5	18625	1852.5	18650	1855.0	18675	1857.5	18700	1860.0
18900	1880.0	18900	1880.0	18900	1880.0	18900	1880.0	18900	1880.0	18900	1880.0
19193	1909.3	19185	1908.5	19175	1907.5	19150	1905.0	19125	1902.5	19100	1900.0

Band 4

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)
19957	1 710.7	19965	1 711.5	19975	1 712.5	20000	1 715.0	20025	1 717.5	20050	1 720.0
20175	1 732.5	20175	1 732.5	20175	1 732.5	20175	1 732.5	20175	1 732.5	20175	1 732.5
20393	1 754.3	20385	1 753.5	20375	1 752.5	20350	1 750.0	20325	1 747.5	20300	1 745.0

Band 5

1.4 MHz		3 MHz		5 MHz		10 MHz	
Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
20407	824.7	20415	825.5	20425	826.5	20450	829.0
20525	836.5	20525	836.5	20525	836.5	20525	836.5
20643	848.3	20635	847.5	20625	846.5	20600	844.0

Band 12

1.4 MHz		3 MHz		5 MHz		10 MHz	
Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
23017	699.7	23025	700.5	23035	701.5	23060	704.0
23095	707.5	23095	707.5	23095	707.5	23095	707.5
23173	715.3	23165	714.5	23155	713.5	23130	711.0

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	1 850.7	26055	1 851.5	26065	1 852.5	26090	1 855.0	26115	1 857.5	26140	1 860.0
26365	1 882.5	26365	1 882.5	26365	1 882.5	26365	1 882.5	26365	1 882.5	26365	1 882.5
26683	1 914.3	26675	1 913.5	26665	1 912.5	26640	1 910.0	26615	1 907.5	26590	1 905.0

Band 26									
1.4 MHz		3 MHz		5 MHz		10 MHz		15 MHz	
Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
26697	814.7	26705	815.5	26715	816.5	26750	820.0	26775	822.5
26865	831.5	26865	831.5	26865	831.5	26865	831.5	26865	831.5
27033	848.3	27025	847.5	27015	846.5	26990	844.0	26965	841.5

Band 41							
5 MHz		10 MHz		15 MHz		20 MHz	
Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
39675	2498.5	39700	2501.0	39725	2503.5	39750	2506.0
40148	2545.8	40160	2547.0	40173	2548.3	40185	2549.5
40620	2593.0	40620	2593.0	40620	2593.0	40620	2593.0
41093	2640.3	41080	2639.0	41068	2637.8	41055	2636.5
41565	2687.5	41540	2685.0	41515	2682.5	41490	2680.0

Item.	Description
UE Category	UE Category 4
Modulations Supported in UL	QPSK, 16QAM
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 (Manufacturer attestation to be provided)
	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	This device doesn't support LTE Carrier Aggregation for US Bands
LTE Release 10 information	This device does not support full CA features on 3GPP Release 10. It supports a maximum of 3 carriers in the downlink. All uplink communications are identical to the Release 8 specifications. Uplink communications are done on the PCC. Due to carrier capability, only the combinations listed above are supported. The following LTE Release 10 features are not supported. Relay, HetNet, Enhanced MIMO, eICI, WiFi offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.
Description of the test equipment, software, etc.	LTE SAR Testing was performed using a CMW500. UE transmits with maximum output power during SAR testing.

2.4 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 D05 SAR for LTE Devices v02r04
- FCC KDB Publication 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB Publication 447498 D01 General SAR Guidance v06
- FCC KDB Publication 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- FCC KDB Publication 865664 D02 SAR Reporting v01r02

2.5 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.

2.5.1 Maximum Output Power

Mode / Band		Modulated Average (dBm)
LTE Band 4 (AWS)	Maximum	23.7
	Nominal	22.7
LTE Band 12	Maximum	23.5
	Nominal	22.5
LTE Band 25	Maximum	22.5
	Nominal	21.5
LTE Band 26 (Cell)	Maximum	23.5
	Nominal	22.5
LTE Band 41	Maximum	23.7
	Nominal	22.7

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	16.5
	Nominal	15.5
IEEE 802.11g (2.4 GHz)	Maximum	13.5
	Nominal	12.5
IEEE 802.11n (2.4 GHz)	Maximum	13.5
	Nominal	12.5

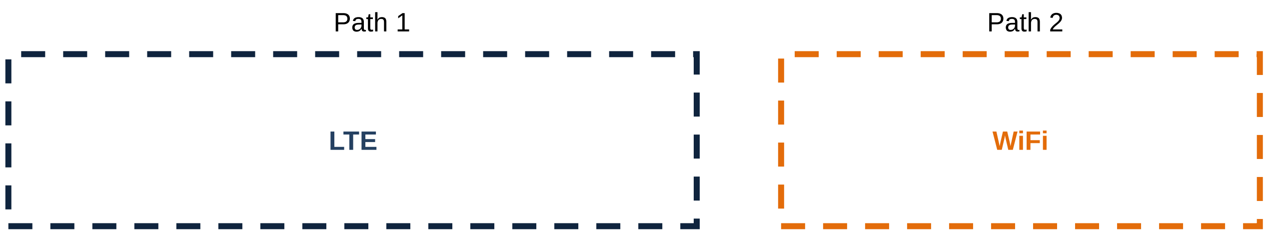
2.6 DUT Antenna Locations

Device Edges / Sides for SAR Testing						
Mode	**Rear**	**Front**	**Left**	**Right**	**Bottom**	**Top**
LTE Band 4	Yes	Yes	Yes	Yes	No	Yes
LTE Band 12	Yes	Yes	Yes	Yes	No	Yes
LTE Band 25	Yes	Yes	Yes	Yes	No	Yes
LTE Band 26	Yes	Yes	Yes	Yes	No	Yes
LTE Band 41	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	Yes	Yes	No

Note; All test configurations are based on front view.

2.7 SAR Summation Scenario

According to FCC KDB 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the EUT are shown below paths and are mode in same rectangle to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.



Simultaneous transmission paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB 447498 D01v06.

Simultaneous Transmission Scenarios	
Applicable Combination	Hotspot
LTE+ 2.4 GHz WiFi	Yes

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

2.8 SAR Test Exclusions Applied

Licensed Transmitter(s)

This device supports both LTE Band 2, LTE Band 25 and LTE 5, LTE Band 26. Since the supported frequency span for LTE Band 2 and LTE Band 5 falls completely within the supported frequency span for LTE Band 25 and LTE Band 26, both LTE bands have the same target power, and both LTE bands share the same transmission path, SAR was only assessed for LTE Band 25 and LTE Band 26.
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 D05v02r04.

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., Ne York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

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

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

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 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.

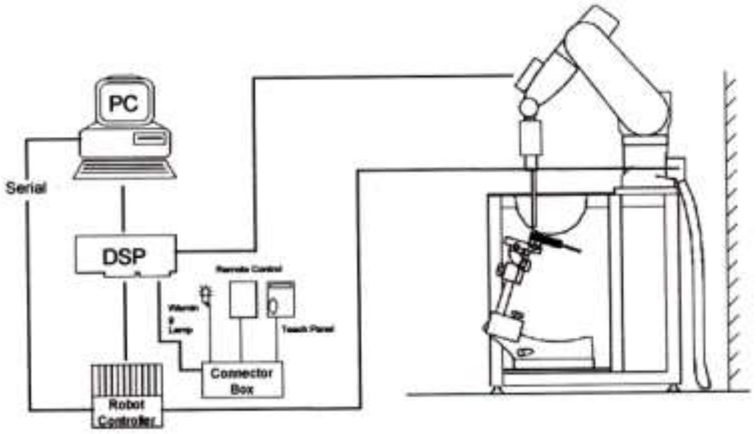


Figure 2. HCT SAR Lab. Test Measurement Set-up

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 DASY E-FIELD PROBE SYSTEM

Isotropic SAR Probe			
Probe type	ET3DV6	ES3DV3	EXDV4
Appearance			
Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)		
Calibration	IEEE 1528-2013, IEC 62209-1, IEC 62209-2, KDB 865664		
Frequency	10 MHz to 2.3 GHz Linearity: ± 0.2 dB (30 MHz to 2.3 GHz)	10 MHz to 4 GHz Linearity: ± 0.2 dB (30 MHz to 4 GHz)	10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.2 dB in TSL (rotation around probe axis) ± 0.4 dB in TSL (rotation normal to probe axis)	± 0.2 dB in TSL (rotation around probe axis) ± 0.3 dB in TSL (rotation normal to probe axis)	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB	10 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.0 mm
Application	General dosimetry up to 2.3 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones	General dosimetry up to 6 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones

The SAR measurements were conducted with the dosimetric probe ET3DV6, ES3DV3 and EX3DV4(depending on the frequency), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multitier line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches a maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY 4 & 5 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

4.3 SAM Phantom

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

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

Fig. 4-1 SAM Phantom

Triple Modular Phantom consists of tree identical modules which can be installed and removed separately without emptying the liquid. It includes three reference points for phantom installation. Covers prevent evaporation of the liquid. Phantom material is resistant to DGBE based tissue simulating liquids. The MFP V5.1 will be delivered including wooden support only (non-standard SPEAG support).
Applicable for system performance Cheek from 700 MHz to 6 GHz (MFP V5.1C) as well as dosimetric evaluations for body-worn operation.

Shell Thickness	2.0 mm ± 0.2 mm
Filling Volume	approx. 8.1 L
Dimensions	830 mm x 500 mm (L x W)

Fig. 4-2. MFP V5.1C

4.4 Device Holder for Transmitters

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

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

Fig. 4-3. Device Holder

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>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5±1 mm</td><td>$\frac{1}{2}\delta \cdot \ln(2)\pm0.5$ mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30°±1°</td><td>20°±1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan Spatial resolution: Δx_{Area}, Δy_{Area}</td><td>$\leq$ 2 GHz: $\leq$15 mm
2-3 GHz: $\leq$12 mm</td><td>3-4 GHz: $\leq$12 mm
4-6 GHz: $\leq$10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan Spatial resolution: Δx_{zoom}, Δy_{zoom}</td><td>$\leq$ 2 GHz: $\leq$8mm
2-3 GHz: $\leq$5mm*</td><td>3-4 GHz: $\leq$5 mm*
4-6 GHz: $\leq$4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan Spatial resolution normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3-4 GHz: $\leq$4 mm
4-5 GHz: $\leq$3 mm
5-6 GHz: $\leq$2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{zoom}(1)$: between 1st two Points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3-4 GHz: $\leq$3 mm
4-5 GHz: $\leq$2.5 mm
5-6 GHz: $\leq$2 mm</td></tr>
<tr><td>$\Delta z_{zoom}(n>1)$: between subsequent Points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3-4 GHz: $\geq$28 mm
4-5 GHz: $\geq$25 mm
5-6 GHz: $\geq$22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

6. DESCRIPTION OF TEST POSITION

6.1 Body Holster/Belt Clip Configurations

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

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

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

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

"See the Test SET-UP Photo"

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

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

6.2 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-dips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-4). Per FCC KDB Publication 648474 D04v01r03 Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in Body-worn accessories. The Body-worn accessory procedures in FCC KDB Publication 447498 D01v06 should be used to test for Body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the Body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body- worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body- worn accessory with a headset attached to the handset.

Figure 6-4
Sample Body-Worn Diagram

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

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

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

6.3 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06v02r01 where SAR test considerations for handsets (LxW≥9cmx5 cm) are based on *a* composite test separation distance of 10 mm from the front back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the Body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some Body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 publication procedures. The "Portable Hotspot* feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

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 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r04 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).

8.1.1 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.

8.1.2 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.

8.1.3 A-MPR

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

8.1.4 Required RB Size and RB offsets for SAR testing

According to FCC KDB 941225 D05v02r04

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.

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

8.1.5 LTE(TDD) Considerations

According to KDB 941225 D05v02r03, for Time-Division Duplex (TDD) systems, SAR must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP LTE TDD configurations.

SAR was tested with the highest transmission duty factor (63.33 %) using Uplink-downlink configuration 0 and Special subframe configuration 6.

LTE TDD Band 41 supports 3GPP TS 36.211 section 4.2 for Type 2 Frame and Table 4.2-2 for uplink-downlink configurations and Table 4.2-1 for Special subframe configurations.

Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS)

<table>
<tr><th rowspan="3">Special subframe configuration</th><th colspan="3">Normal cyclic prefix in downlink</th><th colspan="3">Extended cyclic prefix in downlink</th></tr>
<tr><th rowspan="2">DwPTS</th><th colspan="2">UpPTS</th><th rowspan="2">DwPTS</th><th colspan="2">UpPTS</th></tr>
<tr><th>Normal cyclic prefix in uplink</th><th>Extended cyclic prefix in uplink</th><th>Normal cyclic prefix in uplink</th><th>Extended cyclic prefix in uplink</th></tr>
<tr><td>0</td><td>$6592 \cdot T_s$</td><td rowspan="5">$2192 \cdot T_s$</td><td rowspan="5">$2560 \cdot T_s$</td><td>$7680 \cdot T_s$</td><td rowspan="4">$2192 \cdot T_s$</td><td rowspan="4">$2560 \cdot T_s$</td></tr>
<tr><td>1</td><td>$19760 \cdot T_s$</td><td>$20480 \cdot T_s$</td></tr>
<tr><td>2</td><td>$21952 \cdot T_s$</td><td>$23040 \cdot T_s$</td></tr>
<tr><td>3</td><td>$24144 \cdot T_s$</td><td>$25600 \cdot T_s$</td></tr>
<tr><td>4</td><td>$26336 \cdot T_s$</td><td>$7680 \cdot T_s$</td><td rowspan="4">$4384 \cdot T_s$</td><td rowspan="4">$5120 \cdot T_s$</td></tr>
<tr><td>5</td><td>$6592 \cdot T_s$</td><td rowspan="5">$4384 \cdot T_s$</td><td rowspan="5">$5120 \cdot T_s$</td><td>$20480 \cdot T_s$</td></tr>
<tr><td>6</td><td>$19760 \cdot T_s$</td><td>$23040 \cdot T_s$</td></tr>
<tr><td>7</td><td>$21952 \cdot T_s$</td><td>$12800 \cdot T_s$</td></tr>
<tr><td>8</td><td>$24144 \cdot T_s$</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>9</td><td>$13168 \cdot T_s$</td><td>-</td><td>-</td><td>-</td></tr>
</table>

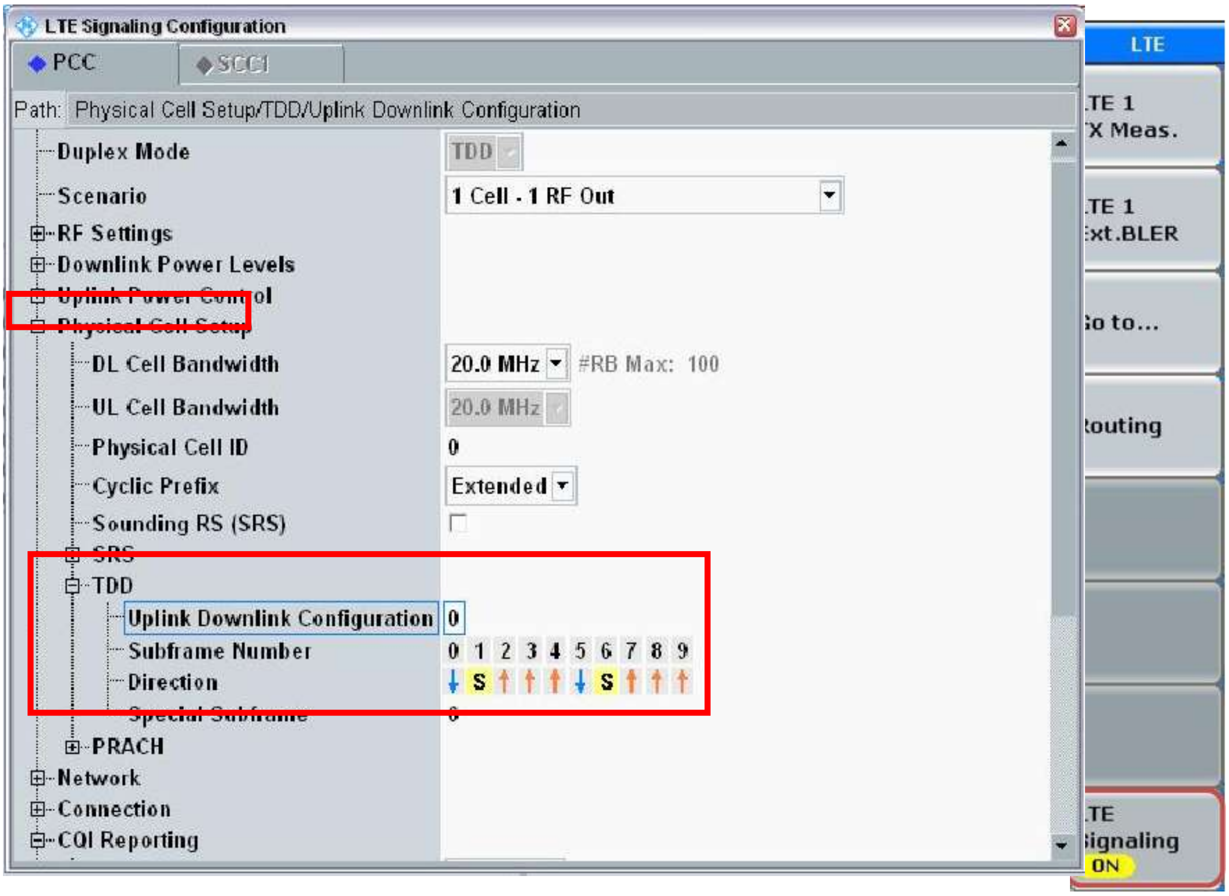
Table 4.2-2: Uplink-downlink configurations.

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Calculated Duty Cycle – Extended cyclic prefix in uplink x (T_s) x # of S + # of U
Example for calculated Duty Cycle for Uplink-Downlink Configuration 0:
Calculated Duty Cycle = 5120 x [1/(15000 x 2048)] x 2 + 6 ms = 63.33 %
Where
T_s = 1/(15000 x 2048) seconds

LTE Band 41
Conducted Power Measured Results
LTE TDD Band 41 setup method (CMW-500).

- Physical Cell Setup Menu
- Sub-menu “TDD” and set “Uplink Downlink Configuration” to “0”
- Turn the cell on using “ON : OFF” Key



8.2 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

8.2.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR system to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92-96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

8.2.2 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating nest to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg for 1g SAR and ≤ 1.0 W/kg for 10g SAR, no additional testing for the remaining test position is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg for 1g SAR and ≤ 2.0 W/kg for 10g SAR or all test positions are measured.

8.2.3 2.4 GHz SAR test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS is that exposure configuration.
2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

8.2.4 OFDM Transmission Mode and SAR Test channel Selection

For the 2.4 GHz, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate and lowest order 802.11 g/n mode. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11g then 802.11n, is used for SAR measurement. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

8.2.5 Initial Test configuration Procedure

For OFDM, in both 2.4 GHz, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output power is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements.

8.2.6 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position on procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg for 1g SAR and ≤ 3.0 W/kg for 10g SAR, no additional SAR tests for the subsequent test configurations are required.

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 LTE

- LTE Band 4 Maximum Conducted Power

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				19957	20175	20393	[dB]	[dB]
				1710.7 MHz	1732.5 MHz	1754.3 MHz		
1.4 MHz	QPSK	1	0	22.08	22.39	23.21	0	0
		1	3	22.27	22.38	23.07	0	0
		1	5	22.32	22.45	23.02	0	0
		3	0	22.25	22.44	23.21	0	0
		3	1	22.25	22.35	23.07	0	0
		3	3	22.35	22.48	23.10	0	0
		6	0	21.28	21.45	22.22	0-1	1
	16QAM	1	0	21.55	21.75	22.56	0-1	1
		1	3	21.58	21.86	22.44	0-1	1
		1	5	21.65	21.76	22.41	0-1	1
		3	0	21.29	21.50	22.30	0-1	1
		3	1	21.29	21.41	22.18	0-1	1
		3	3	21.38	21.54	22.21	0-1	1
		6	0	20.51	20.67	21.47	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				19965	20175	20385	[dB]	[dB]
				1711.5 MHz	1732.5 MHz	1753.5 MHz		
3 MHz	QPSK	1	0	22.15	22.46	23.26	0	0
		1	7	22.60	22.56	23.27	0	0
		1	14	22.75	22.58	23.19	0	0
		8	0	21.28	21.33	22.16	0-1	1
		8	3	21.58	21.49	22.27	0-1	1
		8	7	21.84	21.46	22.24	0-1	1
		15	0	21.44	21.44	22.18	0-1	1
	16QAM	1	0	21.40	21.75	22.52	0-1	1
		1	7	21.98	21.85	22.62	0-1	1
		1	14	22.13	21.92	22.53	0-1	1
		8	0	20.47	20.42	21.36	0-2	2
		8	3	20.78	20.70	21.50	0-2	2
		8	7	20.81	20.56	21.47	0-2	2
		15	0	20.38	20.38	21.37	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				19975 1712.5 MHz	20175 1732.5 MHz	20375 1752.5 MHz	[dB]	[dB]
5 MHz	QPSK	1	0	21.98	22.55	23.20	0	0
		1	12	22.89	22.49	23.24	0	0
		1	24	22.86	22.47	22.98	0	0
		12	0	21.40	21.46	22.22	0-1	1
		12	6	21.93	21.48	22.23	0-1	1
		12	11	21.89	21.43	22.23	0-1	1
		25	0	21.70	21.58	22.26	0-1	1
	16QAM	1	0	21.27	21.97	22.46	0-1	1
		1	12	22.05	21.91	22.45	0-1	1
		1	24	22.02	21.80	22.30	0-1	1
		12	0	20.42	20.39	21.38	0-2	2
		12	6	20.85	20.39	21.40	0-2	2
		12	11	20.84	20.34	21.39	0-2	2
		25	0	20.62	20.48	21.31	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				20000 1712.5 MHz	20175 1732.5 MHz	20350 1752.5 MHz	[dB]	[dB]
10 MHz	QPSK	1	0	22.33	22.54	23.16	0	0
		1	24	22.80	22.38	23.12	0	0
		1	49	22.73	22.71	23.11	0	0
		25	0	21.79	21.68	22.16	0-1	1
		25	12	21.84	21.52	22.07	0-1	1
		25	24	21.97	21.55	22.23	0-1	1
		50	0	21.88	21.55	22.11	0-1	1
	16QAM	1	0	21.62	21.95	22.53	0-1	1
		1	24	22.07	21.79	22.53	0-1	1
		1	49	21.92	21.91	22.44	0-1	1
		25	0	20.70	20.59	21.14	0-2	2
		25	12	20.85	20.41	21.06	0-2	2
		25	24	20.94	20.62	21.39	0-2	2
		50	0	20.77	20.46	21.25	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max. Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				20025 1717.5 MHz	20175 1732.5 MHz	20325 1747.5 MHz	[dB]	[dB]
15 MHz	QPSK	1	0	22.52	22.88	23.24	0	0
		1	36	23.39	22.63	23.35	0	0
		1	74	22.79	23.05	23.30	0	0
		36	0	22.25	21.84	22.29	0-1	1
		36	18	22.13	21.78	22.38	0-1	1
		36	38	21.86	21.75	22.45	0-1	1
		75	0	22.06	21.86	22.46	0-1	1
	16QAM	1	0	21.81	22.29	22.49	0-1	1
		1	36	22.56	21.92	22.62	0-1	1
		1	74	21.96	22.30	22.47	0-1	1
		36	0	21.13	20.75	21.28	0-2	2
		36	18	21.10	20.79	21.37	0-2	2
		36	38	20.89	20.91	21.48	0-2	2
		75	0	20.95	20.77	21.47	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max. Average Power (dBm)	MPR Allowed Per 3GPP	MPR
				20175 1732.5 MHz	[dB]	[dB]
20 MHz	QPSK	1	0	22.63	0	0
		1	49	22.83	0	0
		1	99	23.13	0	0
		50	0	21.95	0-1	1
		50	25	21.96	0-1	1
		50	49	22.06	0-1	1
		100	0	21.99	0-1	1
	16QAM	1	0	21.84	0-1	1
		1	49	21.99	0-1	1
		1	99	22.43	0-1	1
		50	0	20.93	0-2	2
		50	25	20.86	0-2	2
		50	49	20.95	0-2	2
		100	0	20.90	0-2	2

Note: LTE Band 4 (AWS) at 20 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02r03, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing.

- LTE Band 12 Maximum Conducted Power

Bandwidth	Modulation	RB Size	RB Offset	Max. Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				23017	23095	23173	[dB]	[dB]
				699.7 MHz	707.5 MHz	715.3 MHz		
1.4 MHz	QPSK	1	0	22.84	22.38	22.44	0	0
		1	3	22.98	22.36	22.27	0	0
		1	5	23.06	22.45	22.07	0	0
		3	0	22.94	22.42	22.01	0	0
		3	1	22.83	22.37	21.83	0	0
		3	3	23.06	22.51	22.30	0	0
		6	0	22.03	21.65	21.28	0-1	1
	16QAM	1	0	22.23	21.66	21.70	0-1	1
		1	3	22.38	21.75	22.04	0-1	1
		1	5	22.37	21.71	22.34	0-1	1
		3	0	21.97	21.51	22.32	0-1	1
		3	1	21.87	21.50	22.27	0-1	1
		3	3	22.11	21.54	22.22	0-1	1
		6	0	21.02	20.64	20.32	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max. Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				23025	23095	23165	[dB]	[dB]
				700.5 MHz	707.5 MHz	714.5 MHz		
3 MHz	QPSK	1	0	22.76	22.48	22.57	0	0
		1	7	23.20	22.44	22.43	0	0
		1	14	22.97	22.66	22.24	0	0
		8	0	21.90	21.22	21.28	0-1	1
		8	3	22.29	21.51	21.33	0-1	1
		8	7	22.33	21.57	21.20	0-1	1
		15	0	22.19	21.52	21.50	0-1	1
	16QAM	1	0	22.13	21.65	21.99	0-1	1
		1	7	22.48	21.76	21.80	0-1	1
		1	14	22.45	21.95	21.46	0-1	1
		8	0	20.87	20.22	20.15	0-2	2
		8	3	21.13	20.50	20.27	0-2	2
		8	7	21.16	20.57	20.16	0-2	2
		15	0	21.08	20.48	20.42	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				23035	23095	23155	[dB]	[dB]
				701.5 MHz	707.5 MHz	713.5 MHz		
5 MHz	QPSK	1	0	22.58	22.17	22.60	0	0
		1	12	23.14	22.39	22.59	0	0
		1	24	22.73	22.66	21.96	0	0
		12	0	22.14	21.32	21.38	0-1	1
		12	6	22.21	21.48	21.24	0-1	1
		12	11	21.91	21.60	21.33	0-1	1
		25	0	22.05	21.54	21.64	0-1	1
	16QAM	1	0	21.96	21.37	21.81	0-1	1
		1	12	22.24	21.77	21.73	0-1	1
		1	24	22.02	22.04	21.25	0-1	1
		12	0	21.01	20.12	20.39	0-2	2
		12	6	20.99	20.42	20.27	0-2	2
		12	11	20.72	20.56	20.24	0-2	2
		25	0	20.92	20.47	20.47	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)	MPR Allowed Per 3GPP	MPR
				23095	[dB]	[dB]
				707.5 MHz		
10 MHz	QPSK	1	0	22.75	0	0
		1	24	22.32	0	0
		1	49	22.69	0	0
		25	0	21.38	0-1	1
		25	12	21.34	0-1	1
		25	24	21.72	0-1	1
		50	0	21.55	0-1	1
	16QAM	1	0	22.04	0-1	1
		1	24	21.66	0-1	1
		1	49	21.91	0-1	1
		25	0	20.26	0-2	2
		25	12	20.26	0-2	2
		25	24	20.46	0-2	2
		50	0	20.46	0-2	2

Note: LTE Band 12 at 10 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02r03, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing.

- LTE Band 25 Maximum Conducted Power

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	21.82	21.90	21.85	0	0
		1	3	21.75	21.84	21.50	0	0
		1	5	21.77	21.94	21.40	0	0
		3	0	21.78	21.93	21.73	0	0
		3	1	21.75	21.83	21.58	0	0
		3	3	21.90	21.96	21.51	0	0
		6	0	20.77	21.00	20.79	0-1	1
	16QAM	1	0	20.98	21.25	21.05	0-1	1
		1	3	20.93	21.06	20.87	0-1	1
		1	5	20.91	21.29	20.73	0-1	1
		3	0	20.71	21.01	20.79	0-1	1
		3	1	20.70	20.92	20.65	0-1	1
		3	3	20.73	21.05	20.60	0-1	1
		6	0	19.82	19.99	19.84	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	21.85	21.90	22.03	0	0
		1	7	21.79	22.02	21.87	0	0
		1	14	21.79	21.90	21.32	0	0
		8	0	20.50	20.83	20.89	0-1	1
		8	3	20.71	21.05	21.02	0-1	1
		8	7	20.65	21.03	20.83	0-1	1
		15	0	20.62	20.98	20.91	0-1	1
	16QAM	1	0	20.84	21.22	21.26	0-1	1
		1	7	20.96	21.27	21.29	0-1	1
		1	14	20.79	21.13	20.74	0-1	1
		8	0	19.51	19.85	19.92	0-2	2
		8	3	19.73	19.94	20.16	0-2	2
		8	7	19.68	19.91	19.98	0-2	2
		15	0	19.62	19.83	20.02	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	21.56	21.79	21.46	0	0
		1	12	21.67	21.93	21.87	0	0
		1	24	21.77	21.62	21.18	0	0
		12	0	20.52	20.78	20.76	0-1	1
		12	6	20.59	20.96	20.97	0-1	1
		12	11	20.55	20.96	20.90	0-1	1
		25	0	20.62	20.92	20.92	0-1	1
	16QAM	1	0	20.68	20.92	20.85	0-1	1
		1	12	20.77	21.08	21.29	0-1	1
		1	24	21.05	20.80	20.59	0-1	1
		12	0	19.49	19.74	19.85	0-2	2
		12	6	19.56	19.91	19.95	0-2	2
		12	11	19.52	19.89	19.88	0-2	2
		25	0	19.59	19.83	19.90	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	21.80	21.72	21.32	0	0
		1	24	21.88	21.81	21.56	0	0
		1	49	21.94	21.66	21.37	0	0
		25	0	20.60	20.97	20.61	0-1	1
		25	12	20.91	20.80	20.70	0-1	1
		25	24	21.04	20.81	20.95	0-1	1
		50	0	20.97	20.81	20.67	0-1	1
	16QAM	1	0	20.84	21.01	20.72	0-1	1
		1	24	20.89	20.96	20.97	0-1	1
		1	49	20.93	20.83	20.80	0-1	1
		25	0	19.57	19.82	19.62	0-2	2
		25	12	19.65	19.83	19.78	0-2	2
		25	24	19.83	19.85	20.04	0-2	2
		50	0	19.73	19.77	19.77	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26115 1857.5 MHz	26365 1882.5 MHz	26615 1907.5 MHz	[dB]	[dB]
15 MHz	QPSK	1	0	21.93	21.55	21.58	0	0
		1	36	22.20	21.99	21.76	0	0
		1	74	21.33	21.88	21.62	0	0
		36	0	21.02	20.91	20.49	0-1	1
		36	18	21.17	21.05	20.75	0-1	1
		36	38	20.66	20.98	20.99	0-1	1
		75	0	20.67	20.93	20.75	0-1	1
	16QAM	1	0	20.96	20.83	20.95	0-1	1
		1	36	21.48	21.30	21.04	0-1	1
		1	74	20.55	21.06	21.02	0-1	1
		36	0	19.77	19.75	19.34	0-2	2
		36	18	19.91	19.98	19.70	0-2	2
		36	38	19.64	20.00	19.94	0-2	2
		75	0	19.64	19.86	19.69	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26140 1860 MHz	26365 1882.5 MHz	26590 1905 MHz	[dB]	[dB]
20 MHz	QPSK	1	0	21.79	21.25	21.77	0	0
		1	49	22.13	22.05	21.50	0	0
		1	99	21.51	21.68	21.63	0	0
		50	0	21.22	20.90	20.81	0-1	1
		50	25	20.71	21.00	20.61	0-1	1
		50	49	20.41	21.06	20.84	0-1	1
		100	0	20.60	20.93	20.66	0-1	1
	16QAM	1	0	20.77	20.71	20.86	0-1	1
		1	49	21.09	21.18	20.80	0-1	1
		1	99	20.87	20.83	21.00	0-1	1
		50	0	19.95	19.80	19.69	0-2	2
		50	25	19.69	19.92	19.70	0-2	2
		50	49	19.48	20.08	19.93	0-2	2
		100	0	19.68	19.85	19.53	0-2	2

- LTE Band 26 Maximum Conducted Power

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26697 814.7 MHz	26865 831.5 MHz	27033 848.3 MHz	[dB]	[dB]
1.4 MHz	QPSK	1	0	22.49	23.42	22.46	0	0
		1	3	22.50	23.33	22.10	0	0
		1	5	22.61	23.43	22.15	0	0
		3	0	22.63	23.40	22.32	0	0
		3	1	22.50	23.32	22.12	0	0
		3	3	22.67	23.45	22.23	0	0
		6	0	21.44	22.41	21.28	0-1	1
	16QAM	1	0	21.58	22.48	21.56	0-1	1
		1	3	21.65	22.43	21.40	0-1	1
		1	5	21.73	22.39	21.59	0-1	1
		3	0	21.48	22.31	21.20	0-1	1
		3	1	21.40	22.24	21.16	0-1	1
		3	3	21.54	22.37	21.26	0-1	1
		6	0	20.54	21.47	20.55	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26705 815.5 MHz	26865 831.5 MHz	27025 847.5 MHz	[dB]	[dB]
3 MHz	QPSK	1	0	22.52	23.22	23.05	0	0
		1	7	22.55	23.35	22.60	0	0
		1	14	22.00	23.07	22.09	0	0
		8	0	21.23	22.11	21.75	0-1	1
		8	3	21.38	22.41	21.65	0-1	1
		8	7	21.07	22.17	21.19	0-1	1
		15	0	21.24	22.19	21.62	0-1	1
	16QAM	1	0	21.66	22.40	22.42	0-1	1
		1	7	21.70	22.49	22.08	0-1	1
		1	14	21.42	22.20	21.39	0-1	1
		8	0	20.45	21.24	20.87	0-2	2
		8	3	20.60	21.43	20.78	0-2	2
		8	7	20.27	21.29	20.44	0-2	2
		15	0	20.40	21.28	20.85	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26715	26865	27015	[dB]	[dB]
				816.5 MHz	831.5 MHz	846.5 MHz		
5 MHz	QPSK	1	0	22.50	22.85	22.97	0	0
		1	12	22.22	23.40	23.02	0	0
		1	24	21.56	22.76	22.05	0	0
		12	0	21.17	22.07	21.95	0-1	1
		12	6	21.23	22.36	21.95	0-1	1
		12	11	20.76	22.14	21.65	0-1	1
		25	0	21.20	22.17	22.10	0-1	1
	16QAM	1	0	21.59	21.97	22.09	0-1	1
		1	12	21.30	22.45	22.36	0-1	1
		1	24	20.72	21.92	21.21	0-1	1
		12	0	20.21	21.15	20.83	0-2	2
		12	6	20.12	21.44	20.82	0-2	2
		12	11	19.63	21.21	20.74	0-2	2
		25	0	20.07	21.24	21.19	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)			MPR Allowed Per 3GPP	MPR
				26750	26865	26990	[dB]	[dB]
				820 MHz	831.5 MHz	844 MHz		
10 MHz	QPSK	1	0	22.38	22.44	22.19	0	0
		1	24	21.55	23.26	23.23	0	0
		1	49	21.89	22.06	22.07	0	0
		25	0	20.77	22.11	21.81	0-1	1
		25	12	20.61	21.97	22.08	0-1	1
		25	24	20.80	21.70	22.06	0-1	1
		50	0	20.81	22.03	21.88	0-1	1
	16QAM	1	0	21.74	21.90	21.51	0-1	1
		1	24	20.90	22.40	22.36	0-1	1
		1	49	21.09	21.23	21.26	0-1	1
		25	0	19.62	21.01	20.67	0-2	2
		25	12	19.69	21.05	20.93	0-2	2
		25	24	20.03	20.77	21.15	0-2	2
		50	0	19.91	20.92	20.78	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max.Average Power (dBm)	MPR Allowed Per 3GPP	MPR
				26865	[dB]	[dB]
				831.5 MHz		
15 MHz	QPSK	1	0	22.25	0	0
		1	36	23.44	0	0
		1	74	22.28	0	0
		36	0	22.12	0-1	1
		36	18	22.36	0-1	1
		36	38	21.48	0-1	1
		75	0	21.99	0-1	1
	16QAM	1	0	21.51	0-1	1
		1	36	22.49	0-1	1
		1	74	21.65	0-1	1
		36	0	21.19	0-2	2
		36	18	21.24	0-2	2
		36	38	20.58	0-2	2
		75	0	20.87	0-2	2

Note: LTE Band 26 at 15 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02r03, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing.

- LTE TDD Band 41 Maximum Conducted Power

Bandwidth	Modulation	RB Size	RB Offset	Max. Average Power (dBm)					MPR Allowed Per 3GPP	MPR
				39675	40148	40620	41093	41565	[dB]	[dB]
				2498.5MHz	2545.8MHz	2593 MHz	2640.3MHz	2687.5MHz		
5 MHz	QPSK	1	0	22.11	22.32	22.78	23.26	22.93	0	0
		1	12	22.46	22.49	23.00	23.43	23.05	0	0
		1	24	22.33	22.30	22.80	23.32	22.84	0	0
		12	0	21.12	21.25	21.71	22.16	21.90	0-1	1
		12	6	21.36	21.37	21.84	22.37	22.00	0-1	1
		12	11	21.30	21.33	21.81	22.29	21.94	0-1	1
		25	0	21.42	21.41	21.89	22.42	22.04	0-1	1
	16QAM	1	0	21.36	21.48	21.97	22.47	22.15	0-1	1
		1	12	21.59	21.63	22.17	22.64	22.26	0-1	1
		1	24	21.45	21.44	21.96	22.52	22.04	0-1	1
		12	0	20.12	20.32	20.76	21.15	20.99	0-2	2
		12	6	20.36	20.44	20.89	21.36	21.10	0-2	2
		12	11	20.29	20.39	20.85	21.28	21.04	0-2	2
		25	0	20.40	20.48	20.94	21.41	21.07	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max. Average Power (dBm)					MPR Allowed Per 3GPP	MPR
				39700	40160	40620	41080	41540	[dB]	[dB]
				2501MHz	2547MHz	2593MHz	2639 MHz	2685 MHz		
10 MHz	QPSK	1	0	22.32	22.35	22.76	23.09	23.00	0	0
		1	24	22.47	22.28	22.92	23.33	23.03	0	0
		1	49	22.88	22.22	22.91	23.48	22.91	0	0
		25	0	21.45	21.25	21.83	22.21	21.98	0-1	1
		25	12	21.34	21.12	21.73	22.14	21.87	0-1	1
		25	24	21.62	21.26	21.86	22.30	21.97	0-1	1
		50	0	21.46	21.22	21.81	22.22	21.94	0-1	1
	16QAM	1	0	21.54	21.68	21.94	22.31	22.24	0-1	1
		1	24	21.59	21.48	22.11	22.44	22.19	0-1	1
		1	49	22.00	21.38	22.07	22.68	22.13	0-1	1
		25	0	20.41	20.30	20.86	21.17	21.06	0-2	2
		25	12	20.36	20.21	20.80	21.13	20.99	0-2	2
		25	24	20.61	20.32	20.90	21.28	21.06	0-2	2
		50	0	20.45	20.29	20.86	21.21	21.04	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max. Average Power (dBm)					MPR Allowed Per 3GPP	MPR
				39725	40173	40620	41068	41515	[dB]	[dB]
				2503.5 MHz	2548.3 MHz	2593 MHz	2637.8 MHz	2682.5 MHz		
15 MHz	QPSK	1	0	22.51	22.68	22.93	23.29	23.40	0	0
		1	36	22.91	22.61	23.10	23.42	23.15	0	0
		1	74	23.13	22.61	23.17	23.47	23.08	0	0
		36	0	21.62	21.53	21.96	22.23	22.28	0-1	1
		36	18	21.83	21.58	22.04	22.40	22.18	0-1	1
		36	39	22.07	21.43	21.94	22.42	22.08	0-1	1
		75	0	21.79	21.55	21.95	22.33	22.12	0-1	1
	16QAM	1	0	21.74	21.84	22.11	22.44	22.62	0-1	1
		1	36	22.05	21.77	22.26	22.62	22.36	0-1	1
		1	74	22.37	21.76	22.33	22.69	22.28	0-1	1
		36	0	20.54	20.54	20.95	21.13	21.24	0-2	2
		36	18	20.77	20.60	21.03	21.33	21.21	0-2	2
		36	39	21.01	20.44	20.93	21.36	21.12	0-2	2
		75	0	20.78	20.60	20.99	21.29	21.20	0-2	2

Bandwidth	Modulation	RB Size	RB Offset	Max. Average Power (dBm)					MPR Allowed Per 3GPP	MPR
				39750	40185	40620	41055	41490	[dB]	[dB]
				2506MHz	2549.5MHz	2593MHz	2636.5MHz	2680MHz		
20 MHz	QPSK	1	0	22.24	22.48	22.74	22.99	23.35	0	0
		1	49	23.14	22.67	23.17	23.46	23.34	0	0
		1	99	22.97	22.38	23.07	23.40	23.01	0	0
		50	0	21.85	21.54	21.97	22.23	22.47	0-1	1
		50	25	22.11	21.55	21.98	22.41	22.28	0-1	1
		50	49	22.12	21.48	22.09	22.49	22.25	0-1	1
		100	0	21.93	21.56	21.95	22.27	22.28	0-1	1
	16QAM	1	0	21.48	21.65	21.93	22.10	22.55	0-1	1
		1	49	22.37	21.82	22.31	22.67	22.53	0-1	1
		1	99	22.08	21.54	22.24	22.68	22.21	0-1	1
		50	0	20.82	20.61	21.02	21.22	21.49	0-2	2
		50	25	21.12	20.62	21.04	21.40	21.31	0-2	2
		50	49	21.12	20.54	21.14	21.47	21.26	0-2	2
		100	0	20.92	20.62	21.00	21.25	21.29	0-2	2

Note;

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

9.2 WiFi

IEEE 802.11 Average RF Power

Mode	Freq.	Channel	IEEE 802.11 (2.4 GHz) Conducted Power
	[MHz]		[dBm]
802.11b	2412	1	14.85
	2437	6	16.05
	2462	11	16.48
802.11g	2412	1	12.88
	2437	6	12.87
	2462	11	12.25
802.11n	2412	1	12.09
	2437	6	12.83
	2462	11	12.10

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

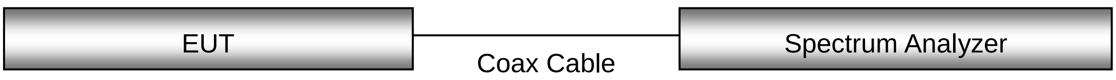
▪ Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.

▪ For transmission mode with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.

▪ For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.

▪ For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.

Test Configuration



10. SYSTEM VERIFICATION

10.1 Tissue Verification

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

Table for Body Tissue Verification									
Date of Tests	Tissue Temp	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
10/30/2015	20.0	750B	700	0.942	55.11	0.959	55.730	-1.77%	-1.11%
			725	0.965	54.79	0.961	55.629	0.42%	-1.51%
			750	0.988	54.50	0.963	55.53	2.60%	-1.85%
11/03/2015	20.3	835B	820	0.938	56.68	0.969	55.258	-3.20%	2.57%
			835	0.951	56.60	0.970	55.200	-1.96%	2.54%
			850	0.970	56.44	0.988	55.154	-1.82%	2.33%
11/05/2015	19.9	1800B	1710	1.436	52.25	1.463	53.537	-1.85%	-2.40%
			1750	1.476	52.15	1.488	53.432	-0.81%	-2.40%
			1800	1.520	51.90	1.520	53.300	0.00%	-2.63%
11/04/2015	19.7	1900B	1850	1.487	55.12	1.520	53.300	-2.17%	3.41%
			1900	1.550	55.00	1.520	53.300	1.97%	3.19%
			1910	1.551	55.04	1.520	53.300	2.04%	3.26%
11/09/2015	21.0	2450B	2400	1.870	51.76	1.902	52.770	-1.68%	-1.91%
			2450	1.930	51.50	1.950	52.700	-1.03%	-2.28%
			2500	2.000	51.50	2.021	52.640	-1.04%	-2.17%
11/02/2015	20.2	2600B	2500	2.068	54.61	2.021	52.640	2.33%	3.74%
			2600	2.200	54.30	2.163	52.510	1.71%	3.41%
			2650	2.260	54.21	2.305	52.380	-1.95%	3.49%

10.2 System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at 750 MHz/ 835 MHz / 1 800 MHz / 1 900 MHz / 2 450 MHz/ 2 600 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]	[%]	[%]
750	10/30/2015	3076	1014	Body	20.2	20.0	8.49	0.832	8.32	- 2.00	± 10
835	11/03/2015	3903	441	Body	20.5	20.3	9.34	0.909	9.09	- 2.68	± 10
1 800	11/05/2015	3903	2d007	Body	20.1	19.9	38.3	3.72	37.2	- 2.87	± 10
1 900	11/04/2015	3863	5d032	Body	19.9	19.7	40.9	4.25	42.5	+ 3.91	± 10
2 450	11/09/2015	3903	743	Body	21.2	21.0	52.1	4.94	49.4	- 5.18	± 10
2 600	11/02/2015	3903	1015	Body	20.4	20.2	55.4	5.65	56.5	+ 1.99	± 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 Hotspot SAR Measurement Results

LTE Band 4 (AWS) Hotspot SAR															
Frequency		Mode	Band width	Tune-Up Limit	Meas. Power	Power Drift	Test Position	RB Size	RB offset	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(dBm)	(dBm)	(dB)					(mm)	(W/kg)		(W/kg)	
1 732.5	20175	QPSK	20	23.7	23.13	0.076	Rear	1	99	1:1	10	1.05	1.140	**1.197**	1
1 732.5	20175	QPSK	20	22.7	22.06	-0.107	Rear	50	49	1:1	10	0.715	1.159	0.829	-
1 732.5	20175	QPSK	20	22.7	21.99	-0.029	Rear	100	0	1:1	10	0.557	1.178	0.656	-
1 732.5	20175	QPSK	20	23.7	23.13	-0.077	Front	1	99	1:1	10	0.768	1.140	0.876	-
1 732.5	20175	QPSK	20	22.7	22.06	0.004	Front	50	49	1:1	10	0.567	1.159	0.657	-
1 732.5	20175	QPSK	20	23.7	23.13	-0.057	Left	1	99	1:1	10	0.565	1.140	0.644	-
1 732.5	20175	QPSK	20	22.7	22.06	-0.051	Left	50	49	1:1	10	0.425	1.159	0.492	-
1 732.5	20175	QPSK	20	23.7	23.13	-0.115	Right	1	99	1:1	10	0.289	1.140	0.330	-
1 732.5	20175	QPSK	20	22.7	22.06	-0.081	Right	50	49	1:1	10	0.211	1.159	0.245	-
1 732.5	20175	QPSK	20	23.7	23.13	0.070	Top	1	99	1:1	10	0.826	1.140	0.942	-
1 732.5	20175	QPSK	20	22.7	22.06	-0.038	Top	50	49	1:1	10	0.557	1.159	0.645	-
1 732.5	20175	QPSK	20	22.7	21.99	-0.022	Top	100	0	1:1	10	0.378	1.178	0.445	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (Mw/g) Averaged over 1 gram								

LTE Band 12 Hotspot SAR															
Frequency		Mode	Band width	Tune-Up Limit	Meas. Power	Power Drift	Test Position	RB Size	RB offset	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(dBm)	(dBm)	(dB)					(mm)	(W/kg)		(W/kg)	
707.5	23095	QPSK	10	23.5	22.75	0.010	Rear	1	0	1:1	10	0.656	1.189	0.780	-
707.5	23095	QPSK	10	22.5	21.72	0.112	Rear	25	24	1:1	10	0.534	1.197	0.639	-
707.5	23095	QPSK	10	23.5	22.75	0.110	Front	1	0	1:1	10	0.824	1.189	**0.979**	2
707.5	23095	QPSK	10	22.5	21.72	-0.009	Front	25	24	1:1	10	0.684	1.197	0.819	-
707.5	23095	QPSK	10	22.5	21.55	-0.134	Front	50	0	1:1	10	0.652	1.245	0.811	-
707.5	23095	QPSK	10	23.5	22.75	0.123	Left	1	0	1:1	10	0.262	1.189	0.311	-
707.5	23095	QPSK	10	22.5	21.72	0.079	Left	25	24	1:1	10	0.223	1.197	0.267	-
707.5	23095	QPSK	10	23.5	22.75	0.025	Right	1	0	1:1	10	0.129	1.189	0.153	-
707.5	23095	QPSK	10	22.5	21.72	-0.062	Right	25	24	1:1	10	0.108	1.197	0.129	-
707.5	23095	QPSK	10	23.5	22.75	0.006	Top	1	0	1:1	10	0.210	1.189	0.250	-
707.5	23095	QPSK	10	22.5	21.72	-0.002	Top	25	24	1:1	10	0.154	1.197	0.184	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (Mw/g) Averaged over 1 gram								

LTE Band 25 Hotspot SAR															
Frequency		Mode	Band width	Tune-Up Limit	Meas. Power	Power Drift	Test Position	RB Size	RB offset	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(dBm)	(dBm)	(dB)					(mm)	(W/kg)		(W/kg)	
1 860.0	26140	QPSK	20	22.5	22.13	-0.041	Rear	1	49	1:1	10	0.379	1.089	0.413	-
1 860.0	26140	QPSK	20	21.5	21.22	-0.061	Rear	50	0	1:1	10	0.538	1.067	0.574	-
1 860.0	26140	QPSK	20	22.5	22.13	-0.137	Front	1	49	1:1	10	0.267	1.089	0.291	-
1 860.0	26140	QPSK	20	21.5	21.22	-0.135	Front	50	0	1:1	10	0.392	1.067	0.418	-
1 860.0	26140	QPSK	20	22.5	22.13	-0.177	Left	1	49	1:1	10	0.070	1.089	0.076	-
1 860.0	26140	QPSK	20	21.5	21.22	0.113	Left	50	0	1:1	10	0.095	1.067	0.101	-
1 860.0	26140	QPSK	20	22.5	22.13	-0.143	Right	1	49	1:1	10	0.018	1.089	0.020	-
1 860.0	26140	QPSK	20	21.5	21.22	-0.180	Right	50	0	1:1	10	0.028	1.067	0.030	-
1 860.0	26140	QPSK	20	22.5	22.13	-0.047	Top	1	49	1:1	10	0.413	1.089	0.450	-
1 860.0	26140	QPSK	20	21.5	21.22	0.048	Top	50	0	1:1	10	0.619	1.067	**0.660**	3
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (Mw/g) Averaged over 1 gram								

LTE Band 26 Hotspot SAR															
Frequency		Mode	Band width	Tune-Up Limit	Meas. Power	Power Drift	Test Position	RB Size	RB offset	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(dBm)	(dBm)	(dB)					(mm)	(W/kg)		(W/kg)	
831.5	26865	QPSK	15	23.5	23.44	0.103	Rear	1	36	1:1	10	0.456	1.014	0.462	-
831.5	26865	QPSK	15	22.5	22.36	-0.005	Rear	36	18	1:1	10	0.426	1.033	0.440	-
831.5	26865	QPSK	15	23.5	23.44	0.046	Front	1	36	1:1	10	0.549	1.014	**0.557**	4
831.5	26865	QPSK	15	22.5	22.36	-0.027	Front	36	18	1:1	10	0.507	1.033	0.524	-
831.5	26865	QPSK	15	23.5	23.44	-0.071	Left	1	36	1:1	10	0.198	1.014	0.201	-
831.5	26865	QPSK	15	22.5	22.36	-0.036	Left	36	18	1:1	10	0.184	1.033	0.190	-
831.5	26865	QPSK	15	23.5	23.44	-0.067	Right	1	36	1:1	10	0.168	1.014	0.170	-
831.5	26865	QPSK	15	22.5	22.36	-0.118	Right	36	18	1:1	10	0.152	1.033	0.157	-
831.5	26865	QPSK	15	23.5	23.44	0.061	Top	1	36	1:1	10	0.111	1.014	0.113	-
831.5	26865	QPSK	15	22.5	22.36	-0.160	Top	36	18	1:1	10	0.092	1.033	0.095	-
ANSI/ IEEE C95.1 - 1992 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram								

LTE Band 41 Hotspot SAR

Frequency MHz	Frequency Ch.	Mode	Band width (MHz)	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	RB Size	RB offset	Duty Cycle	Distance (mm)	Meas. SAR (W/kg)	Scaling Factor	Scaled SAR (W/kg)	Plot No.
2 636.5	41055	QPSK	20	23.7	23.46	0.064	Rear	1	49	1:1.58	10	0.284	1.057	0.300	-
2 636.5	41055	QPSK	20	22.7	22.49	0.020	Rear	50	49	1:1.58	10	0.223	1.050	0.234	-
2 636.5	41055	QPSK	20	23.7	23.46	-0.052	Front	1	49	1:1.58	10	0.447	1.057	**0.472**	5
2 636.5	41055	QPSK	20	22.7	22.49	0.036	Front	50	49	1:1.58	10	0.378	1.050	0.397	-
2 636.5	41055	QPSK	20	23.7	23.46	-0.018	Right	1	49	1:1.58	10	0.226	1.057	0.239	-
2 636.5	41055	QPSK	20	22.7	22.49	0.009	Right	50	49	1:1.58	10	0.177	1.050	0.186	-
2 636.5	41055	QPSK	20	23.7	23.46	0.061	Top	1	49	1:1.58	10	0.136	1.057	0.144	-
2 636.5	41055	QPSK	20	22.7	22.49	-0.036	Top	50	49	1:1.58	10	0.115	1.050	0.121	-
ANSI/ IEEE C95.1 - 1992 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population							Body 1.6 W/kg (mW/g) Averaged over 1 gram								

DTS Hotspot SAR

Frequency MHz	Frequency Ch.	Mode	Band width (MHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Duty Cycle	Distance (mm)	Area Scan Peak SAR (W/kg)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Scaled SAR (W/kg)	Plot No.
2 462	11	802.11b	22	1	16.5	16.48	-0.073	Rear	100	10	0.224	0.145	1.005	1.000	0.146	-
2 462	11	802.11b	22	1	16.5	16.48		Front	100	10	0.237		1.005	1.000		-
2 462	11	802.11b	22	1	16.5	16.48	0.043	Left	100	10	0.297	0.190	1.005	1.000	**0.191**	6
2 462	11	802.11b	22	1	16.5	16.48		Right	100	10	0.0679		1.005	1.000		-
2 462	11	802.11b	22	1	16.5	16.48		Bottom	100	10	0.0968		1.005	1.000		-
ANSI/ IEEE C95.1 - 1992 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg (mW/g) 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. Per FCC KDB 648474 D04v01r03, SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was ≤ 1.2 W/kg, no additional SAR evaluation using a headset cable were required.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Consideration for LTE Devices in FCC KDB 941225 D05v02r04.
2. According to FCC KDB 941225 D05v02r04:
   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 dialed for all SAR tests by setting NS=01 on the base station simulator.
5. TDD LTE was tested using UL-DL configuration 0 with 6 UL subframes and 2S subframes using extended cyclic prefix only and special subframe configuration 6. SAR tests were performed at maximum output power and worst-case transmission duty factor in extended cyclic prefix. Per 3GPP 36.211 Sec. 4, the duty factor using extended cyclic prefix is 0.633(cf=1.58).
6. Pre-installed VOIP applications are considered.
7. SAR test reduction is applied using the following criteria:
   Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is >0.8 W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel. Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are >0.8 W/kg, Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation <1.45 W/kg. Testing for 16-QAM modulation is not required because the reported SAR for QPSK is <1.45 W/kg and its output power is not more than 0.5 dB higher than that a QPSK. Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is <1.45 W/kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.

WLAN Notes:

1. For held-to-ear and hotspot operations, the initial test position procedures were applied. For initial test position, the highest extrapolated peak SAR will be used. When reported SAR for the initial test position is ≤ 0.4 W/kg for 1g SAR and ≤ 1.0 W/kg for 10g SAR, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR results is ≤ 0.8 W/kg for 1g SAR and ≤ 2.0 W/kg for 10g SAR or all test position are measured.
2. Per KDB 248227 D01v02r02 justification for test configurations of 2.4 GHz WiFi Single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11 g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
3. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
4. The device was configured to transmit continuously at the required data rated, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated WLAN test reports.

12. Simultaneous SAR Analysis

12.1 Simultaneous Transmission Summation for Hotspot

Simultaneous Transmission Summation Scenario with 2.4 GHz WLAN					
Exposure condition	Distance (mm)	Band	WWAN SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	∑ 1-g SAR (W/kg)
Hotspot	10	LTE Band 4	1.197	0.191	**1.388**
		LTE Band 12	0.979	0.191	1.170
		LTE Band 25	0.660	0.191	0.851
		LTE Band 26	0.557	0.191	0.748
		LTE Band 41	0.472	0.191	0.663

12.2 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit. And therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528-2013.

13. 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	Repeated SAR	Largest to Smallest SAR Ratio	Plot No.
MHz	Channel				(W/kg)	(W/kg)		
1 732.5	20175	LTE Band 4	Standard	Rear (1RB, 99offset)	1.05	0.905	1.16	7
707.5	23095	LTE Band 12	Standard	Front (1RB, 0offset)	0.824	0.810	1.02	8

14. MEASUREMENT UNCERTAINTY

Uncertainty (700 MHz ~ 2600 MHz)						
Error Description	Tol (± %)	Prob. dist.	Div.	c_i	Standard Uncertainty (± %)	v_{eff}
1. Measurement System						
Probe Calibration	6.00	N	1	1	6.00	∞
Axial Isotropy	4.70	R	1.73	0.7	1.90	∞
Hemispherical Isotropy	9.60	R	1.73	0.7	3.88	∞
Boundary Effects	1.00	R	1.73	1	0.58	∞
Linearity	4.70	R	1.73	1	2.71	∞
System Detection Limits	1.00	R	1.73	1	0.58	∞
Readout Electronics	0.30	N	1.00	1	0.30	∞
Response Time	0.8	R	1.73	1	0.46	∞
Integration Time	2.6	R	1.73	1	1.50	∞
RF Ambient Conditions	3.00	R	1.73	1	1.73	∞
Probe Positioner	0.40	R	1.73	1	0.23	∞
Probe Positioning	2.90	R	1.73	1	1.67	∞
Max SAR Eval	1.00	R	1.73	1	0.58	∞
2.Test Sample Related						
Device Positioning	2.25	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.)	2.70	N	1	0.64	1.73	∞
Liquid Permitivity(target)	5.00	R	1.73	0.6	1.73	∞
Liquid Permitivity(meas.)	1.90	N	1	0.6	1.14	∞
Combind Standard Uncertainty					10.67	
Coverage Factor for 95 %					k=2	
Expanded STD Uncertainty					21.34	

15. 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	Robot RX90B L	F01/5K09A1/A/01	N/A	N/A	N/A
Staubli	Robot ControllerCS7MB	F01/5K09A1/C/01	N/A	N/A	N/A
SPEAG	Light Alignment Sensor	265	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D221340.01	N/A	N/A	N/A
SPEAG	DAE4	1225	03/18/2015	Annual	03/18/2016
SPEAG	DAE4	1417	01/27/2015	Annual	01/27/2016
SPEAG	E-Field Probe EX3DV4	3903	09/28/2015	Annual	09/28/2016
SPEAG	E-Field Probe EX3DV4	3863	08/27/2015	Annual	08/27/2016
SPEAG	E-Field Probe ES3DV3	3076	07/20/2015	Annual	07/20/2016
SPEAG	Dipole D750V3	1014	07/23/2015	Annual	07/23/2016
SPEAG	Dipole D835V2	441	01/23/2015	Annual	01/23/2016
SPEAG	Dipole D1800V2	2d007	02/19/2015	Annual	02/19/2016
SPEAG	Dipole D1900V2	5d032	05/20/2015	Annual	05/20/2016
SPEAG	Dipole D2450V2	743	05/19/2015	Annual	05/19/2016
SPEAG	Dipole D2600V2	1015	03/25/2015	Annual	03/25/2016
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	05/26/2015	Annual	05/26/2016
HP	Dirextional Bridge	86205A	05/20/2015	Annual	05/20/2016
Agilent	Base Station E5515C	GB44400269	02/09/2015	Annual	02/09/2016
HP	Signal Generator N5182A	MY4770230	05/13/2015	Annual	05/13/2016
Agilent	MXA Signal Analyzer N9020A	MY50510407	03/23/2015	Annual	03/23/2016
HP	Network Analyzer 8753ES	JP39240221	03/23/2015	Annual	03/23/2016
R&S	Base Station CMW500	100990	12/05/2014	Annual	12/05/2015

NOTE:
1. The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Verification measurement is performed by HCT Lab. before each test. The brain/body simulating material is calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity (dielectric constant) of the brain/body-equivalent material.

16. CONCLUSION

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

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

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.

17. REFERENCES

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Attachment 1. – SAR Test Plots

Test Laboratory: HCT CO., LTD
EUT Type: LTE Mobile Router
Liquid Temperature: 19.9 ℃
Ambient Temperature: 20.1 ℃
Test Date: 11/05/2015
Plot No.: 1

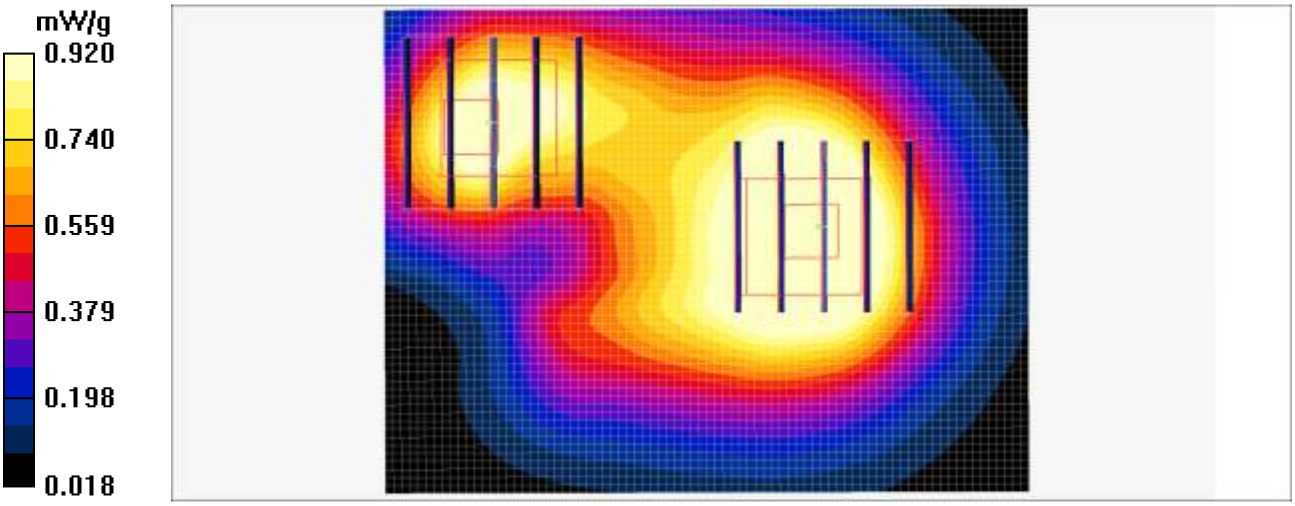
DUT: R850; Type: Bar

Communication System: LTE Band 4; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1732.5 MHz; σ = 1.46 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.94, 7.94, 7.94); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

LTE4 Body Rear QPSK 20MHz 1RB 99offset 20175ch/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.25 mW/g
LTE4 Body Rear QPSK 20MHz 1RB 99offset 20175ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.7 V/m; Power Drift = 0.076 dB
Peak SAR (extrapolated) = 1.63 W/kg
SAR(1 g) = 1.05 mW/g; SAR(10 g) = 0.662 mW/g
Maximum value of SAR (measured) = 1.23 mW/g
LTE4 Body Rear QPSK 20MHz 1RB 99offset 20175ch/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.7 V/m; Power Drift = 0.076 dB
Peak SAR (extrapolated) = 1.36 W/kg
SAR(1 g) = 0.783 mW/g; SAR(10 g) = 0.455 mW/g
Maximum value of SAR (measured) = 0.920 mW/g



Test Laboratory: HCT CO., LTD
EUT Type: LTE Mobile Router
Liquid Temperature: 20.0 ℃
Ambient Temperature: 20.2 ℃
Test Date: 10/30/2015
Plot No.: 2

DUT: R850; Type: Bar

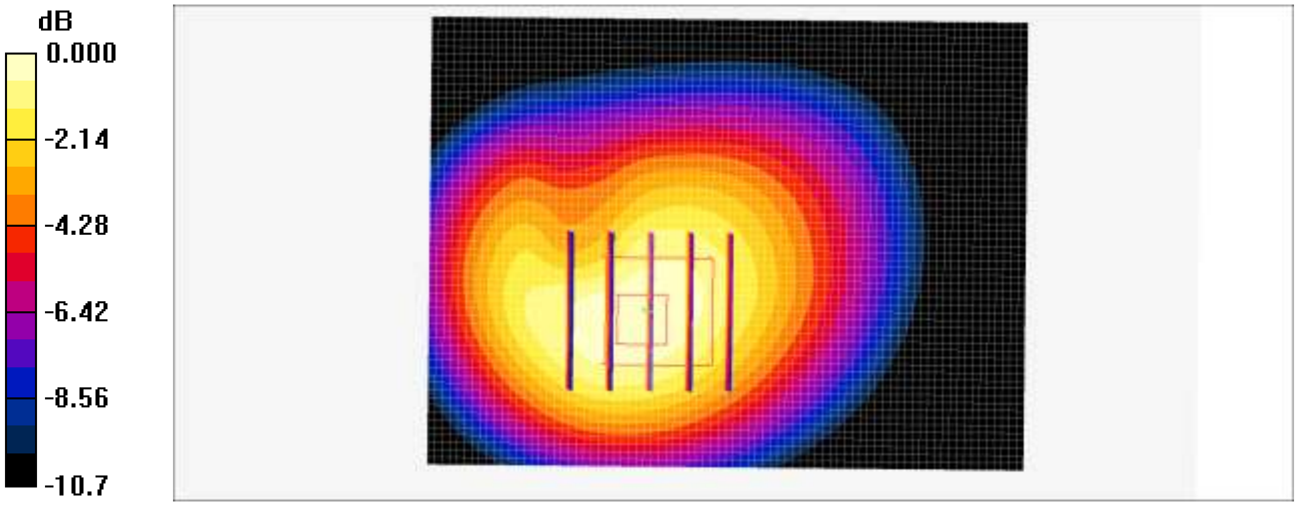
Communication System: LTE band 12; Frequency: 707.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 707.5 MHz; σ = 0.948 mho/m; ε_r = 55; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3076; ConvF(5.58, 5.58, 5.58); Calibrated: 2015-07-20
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

LTE12 Body Front QPSK 10MHz 1RB 0offset 23095ch/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.959 mW/g

LTE12 Body Front QPSK 10MHz 1RB 0offset 23095ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.7 V/m; Power Drift = 0.110 dB
Peak SAR (extrapolated) = 1.22 W/kg
SAR(1 g) = 0.824 mW/g; SAR(10 g) = 0.551 mW/g
Maximum value of SAR (measured) = 0.953 mW/g



0 dB = 0.953mW/g

Test Laboratory: HCT CO., LTD
EUT Type: LTE Mobile Router
Liquid Temperature: 19.7 ℃
Ambient Temperature: 19.9 ℃
Test Date: 11/04/2015
Plot No.: 3

DUT: R850; Type: Bar

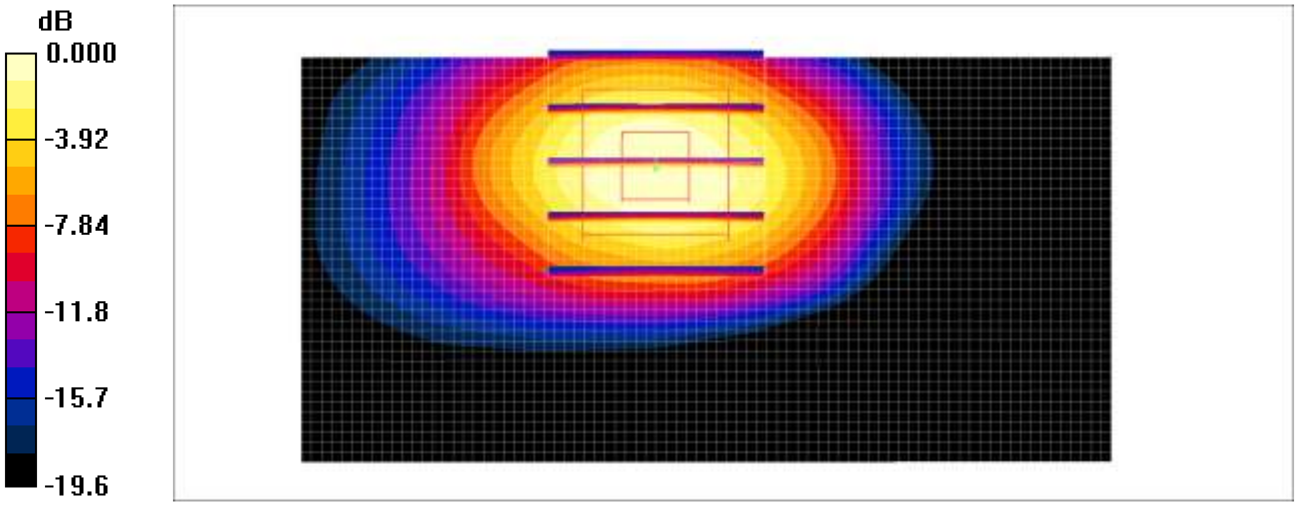
Communication System: LTE Band 25; Frequency: 1860 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1860 MHz; σ = 1.5 mho/m; ε_r = 55.1; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(7.48, 7.48, 7.48); Calibrated: 2015-08-27
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

LTE25 Body Top QPSK 20MHz 50RB 0offset 26140ch/Area Scan (81x41x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.967 mW/g

LTE25 Body Top QPSK 20MHz 50RB 0offset 26140ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.2 V/m; Power Drift = 0.048 dB
Peak SAR (extrapolated) = 1.11 W/kg
SAR(1 g) = 0.619 mW/g; SAR(10 g) = 0.315 mW/g
Maximum value of SAR (measured) = 0.873 mW/g



0 dB = 0.873mW/g

Test Laboratory: HCT CO., LTD
EUT Type: LTE Mobile Router
Liquid Temperature: 20.3 ℃
Ambient Temperature: 20.5 ℃
Test Date: 11/03/2015
Plot No.: 4

DUT: R850; Type: Bar

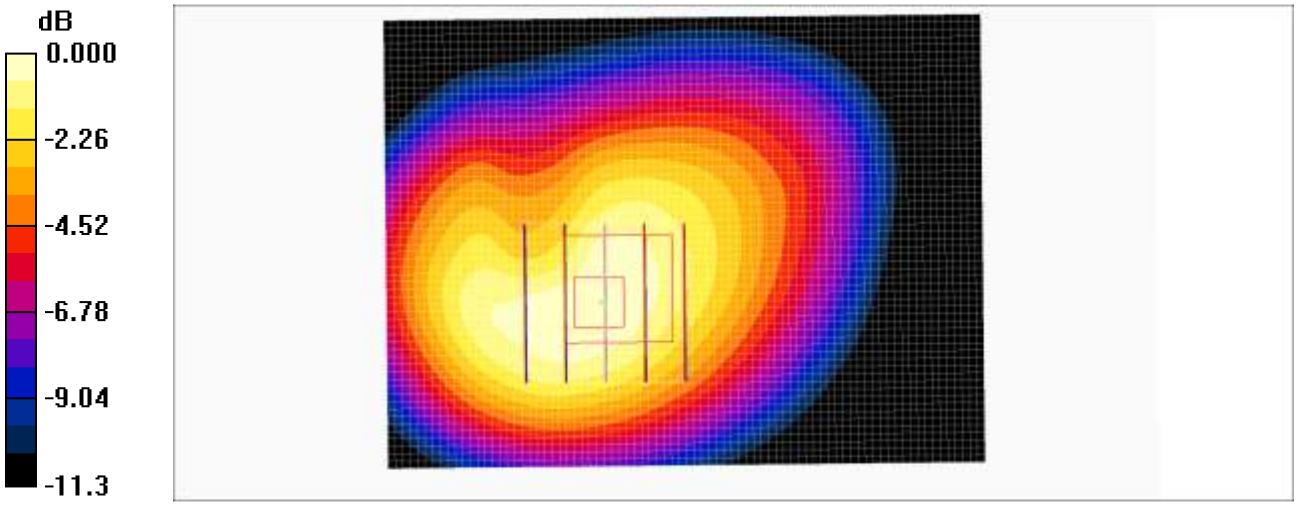
Communication System: LTE Band 26; Frequency: 831.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 831.5 MHz; σ = 0.946 mho/m; ε_r = 56.6; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(10.05, 10.05, 10.05); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

LTE26 Body Front QPSK 15MHz 1RB 36offset 26865ch/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.685 mW/g

LTE26 Body Front QPSK 15MHz 1RB 36offset 26865ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.8 V/m; Power Drift = 0.046 dB
Peak SAR (extrapolated) = 0.794 W/kg
SAR(1 g) = 0.549 mW/g; SAR(10 g) = 0.371 mW/g
Maximum value of SAR (measured) = 0.677 mW/g



0 dB = 0.677mW/g

Test Laboratory: HCT CO., LTD
EUT Type: LTE Mobile Router
Liquid Temperature: 20.2 ℃
Ambient Temperature: 20.4 ℃
Test Date: 11/02/2015
Plot No.: 5

DUT: R850; Type: Bar

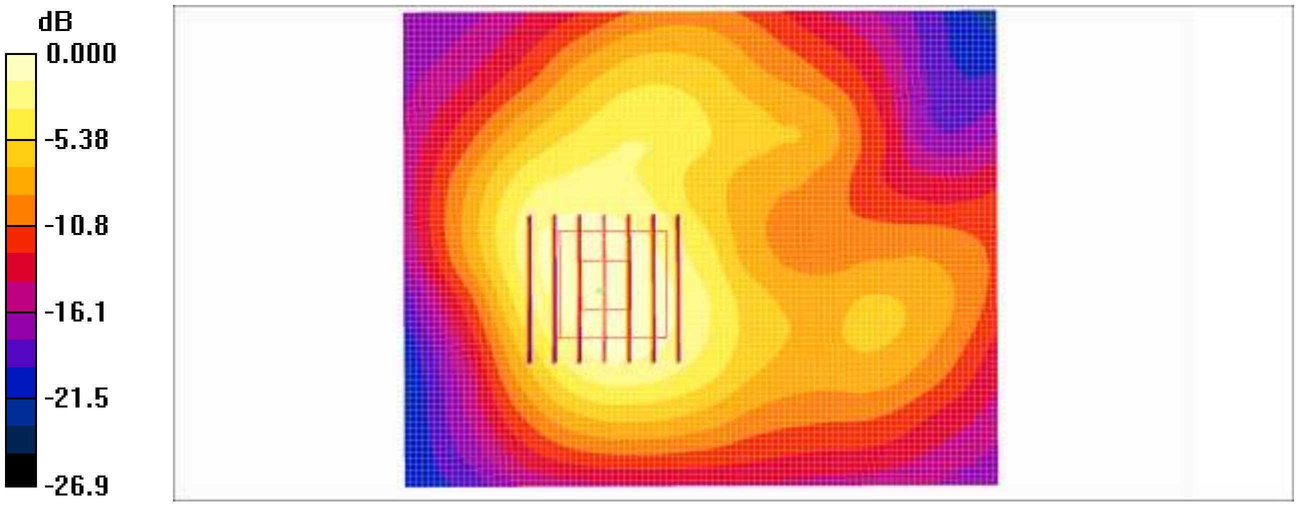
Communication System: LTE Band 41 (FCC); Frequency: 2636.5 MHz;Duty Cycle: 1:1.58
Medium parameters used (interpolated): f = 2636.5 MHz; σ = 2.25 mho/m; ε_r = 54.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.22, 7.22, 7.22); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

LTE41 Body Front QPSK 20MHz 1RB 49offset 41055ch/Area Scan (81x101x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.677 mW/g

LTE41 Body Front QPSK 20MHz 1RB 49offset 41055ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.56 V/m; Power Drift = -0.052 dB
Peak SAR (extrapolated) = 0.851 W/kg
SAR(1 g) = 0.447 mW/g; SAR(10 g) = 0.236 mW/g
Maximum value of SAR (measured) = 0.639 mW/g



0 dB = 0.639mW/g

Test Laboratory: HCT CO., LTD
EUT Type: LTE Mobile Router
Liquid Temperature: 21.0 ℃
Ambient Temperature: 21.2 ℃
Test Date: 11/09/2015
Plot No.: 6

DUT: R850; Type: Bar

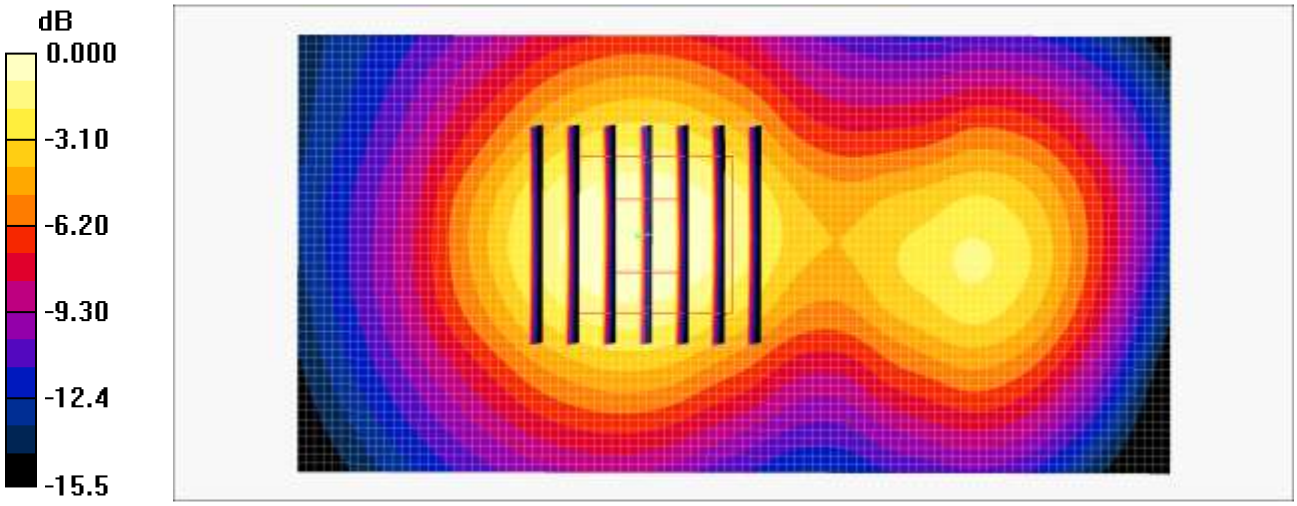
Communication System: 2450MHz FCC; Frequency: 2462 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2462 MHz; σ = 1.94 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.38, 7.38, 7.38); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

802.11b Body Left 11ch 1Mbps/Area Scan (51x101x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.297 mW/g

802.11b Body Left 11ch 1Mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.56 V/m; Power Drift = 0.043 dB
Peak SAR (extrapolated) = 0.380 W/kg
SAR(1 g) = 0.190 mW/g; SAR(10 g) = 0.096 mW/g
Maximum value of SAR (measured) = 0.281 mW/g



0 dB = 0.281mW/g

Test Laboratory: HCT CO., LTD
EUT Type: LTE Mobile Router
Liquid Temperature: 19.9 ℃
Ambient Temperature: 20.1 ℃
Test Date: 11/05/2015
Plot No.: 7

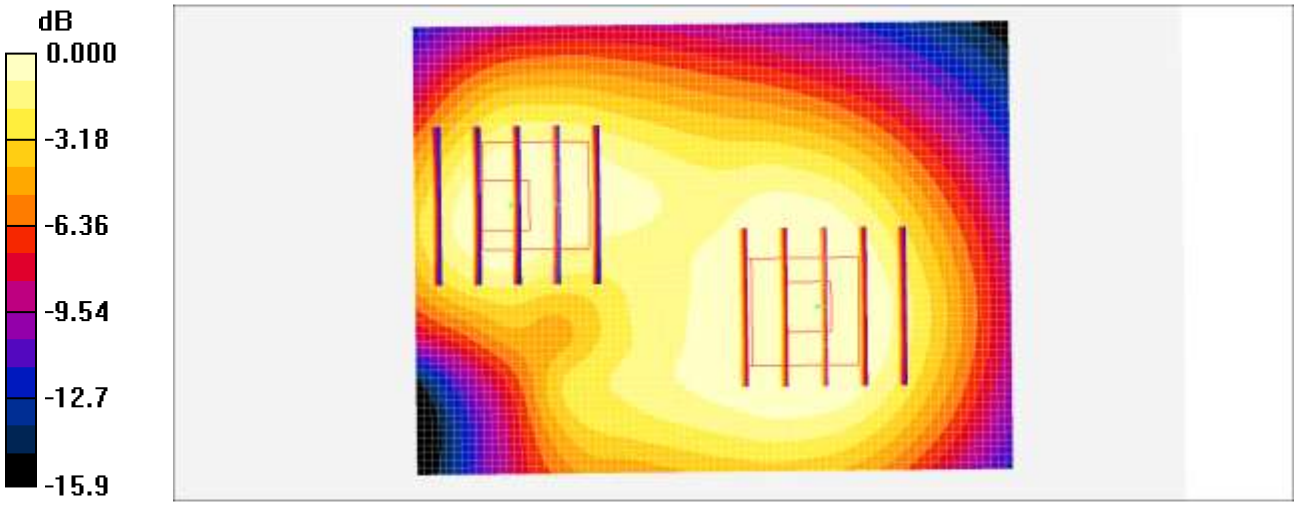
DUT: R850; Type: Bar

Communication System: LTE Band 4; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1732.5 MHz; σ = 1.46 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.94, 7.94, 7.94); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

LTE4 Body Rear QPSK 20MHz 1RB 99offset 20175ch/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.08 mW/g
LTE4 Body Rear QPSK 20MHz 1RB 99offset 20175ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.0 V/m; Power Drift = -0.115 dB
Peak SAR (extrapolated) = 1.34 W/kg
SAR(1 g) = 0.905 mW/g; SAR(10 g) = 0.593 mW/g
Maximum value of SAR (measured) = 1.04 mW/g
LTE4 Body Rear QPSK 20MHz 1RB 99offset 20175ch/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.0 V/m; Power Drift = -0.115 dB
Peak SAR (extrapolated) = 1.22 W/kg
SAR(1 g) = 0.735 mW/g; SAR(10 g) = 0.446 mW/g
Maximum value of SAR (measured) = 0.879 mW/g



0 dB = 0.879mW/g

Test Laboratory: HCT CO., LTD
EUT Type: LTE Mobile Router
Liquid Temperature: 20.0 ℃
Ambient Temperature: 20.2 ℃
Test Date: 10/30/2015
Plot No.: 8

DUT: R850; Type: Bar

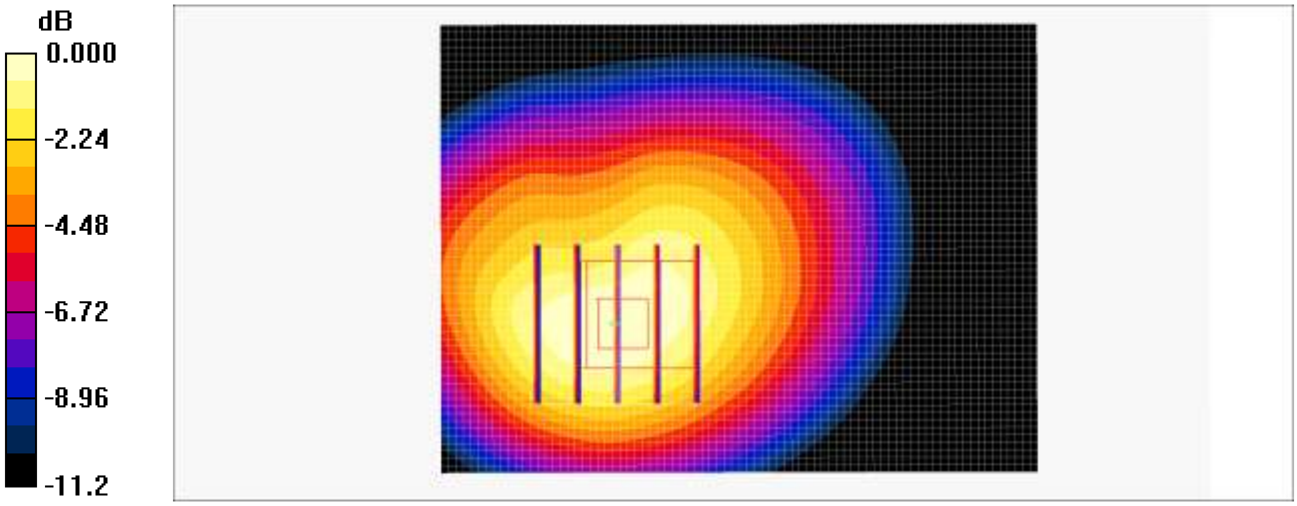
Communication System: LTE band 12; Frequency: 707.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 707.5 MHz; σ = 0.948 mho/m; ε_r = 55; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3076; ConvF(5.58, 5.58, 5.58); Calibrated: 2015-07-20
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

LTE12 Body Front QPSK 10MHz 1RB 0offset 23095ch/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.940 mW/g

LTE12 Body Front QPSK 10MHz 1RB 0offset 23095ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.0 V/m; Power Drift = -0.050 dB
Peak SAR (extrapolated) = 1.19 W/kg
SAR(1 g) = 0.810 mW/g; SAR(10 g) = 0.544 mW/g
Maximum value of SAR (measured) = 0.938 mW/g



0 dB = 0.938mW/g

Attachment 2. – Dipole Verification Plots

■ Verification Data (750 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.0 ℃
Test Date: 10/30/2015

DUT: Dipole 750 MHz; Type: D750V3

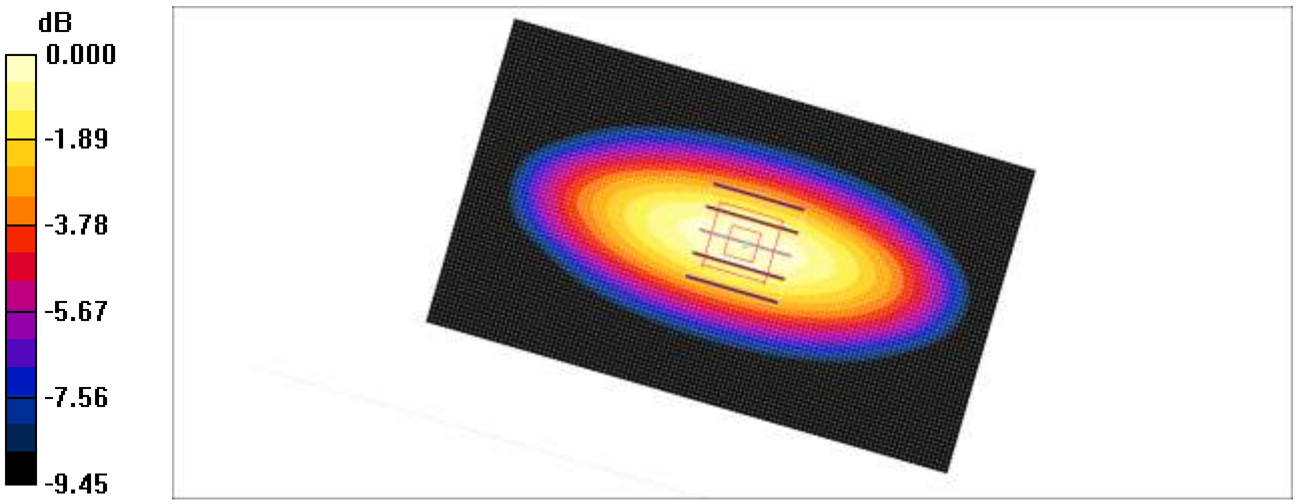
Communication System: CW; Frequency: 750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 750 MHz; σ = 0.988 mho/m; ε_r = 54.5; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3076; ConvF(5.58, 5.58, 5.58); Calibrated: 2015-07-20
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

Verification Body 750 MHz/Area Scan (121x71x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.881 mW/g

Verification Body 750 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 30.3 V/m; Power Drift = 0.002 dB
Peak SAR (extrapolated) = 1.18 W/kg
SAR(1 g) = 0.832 mW/g; SAR(10 g) = 0.559 mW/g
Maximum value of SAR (measured) = 0.897 mW/g



0 dB = 0.897mW/g

■ Verification Data (835 MHz Body)

Test Laboratory: HCT CO., LTD

Input Power 100 mW (20 dBm)

Liquid Temp: 20.3 ℃

Test Date: 11/03/2015

DUT: Dipole 835 MHz; Type: D835V2

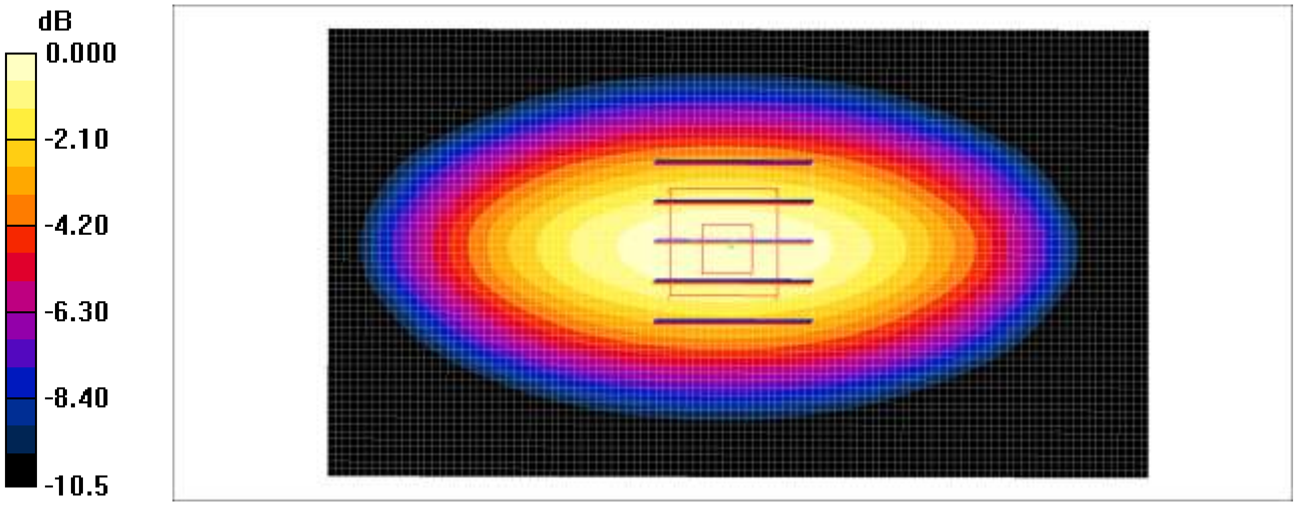
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 835 MHz; σ = 0.951 mho/m; ε_r = 56.6; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(10.05, 10.05, 10.05); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

835 MHz Body Verification/Area Scan (111x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.989 mW/g

835 MHz Body Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 32.2 V/m; Power Drift = 0.023 dB
Peak SAR (extrapolated) = 1.34 W/kg
SAR(1 g) = 0.909 mW/g; SAR(10 g) = 0.593 mW/g
Maximum value of SAR (measured) = 0.982 mW/g



0 dB = 0.982mW/g

■ Verification Data (1 800 MHz Body)

Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	19.9 ℃
Test Date:	11/05/2015

DUT: Dipole 1800 MHz; Type: D1800V2

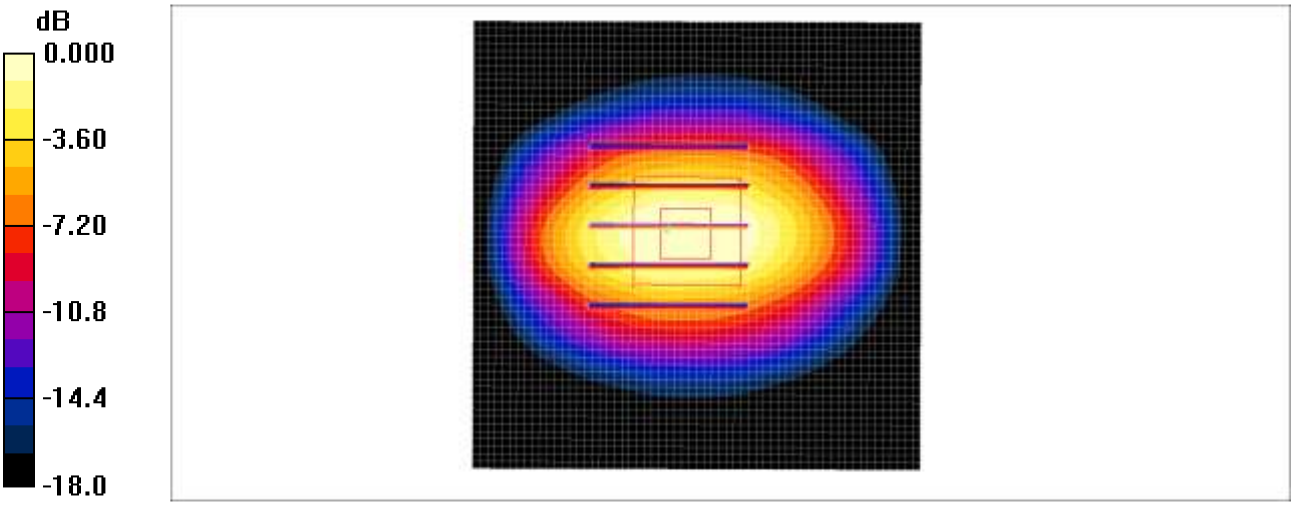
Communication System: CW; Frequency: 1800 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1800 MHz; σ = 1.52 mho/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.94, 7.94, 7.94); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

1800 MHz Body Verification/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 4.44 mW/g

1800 MHz Body Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 51.4 V/m; Power Drift = 0.006 dB
Peak SAR (extrapolated) = 6.66 W/kg
SAR(1 g) = 3.72 mW/g; SAR(10 g) = 1.97 mW/g
Maximum value of SAR (measured) = 4.09 mW/g



0 dB = 4.09mW/g

■ Verification Data (1 900 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 19.7 ℃
Test Date: 11/04/2015

DUT: Dipole 1900 MHz; Type: D1900V2

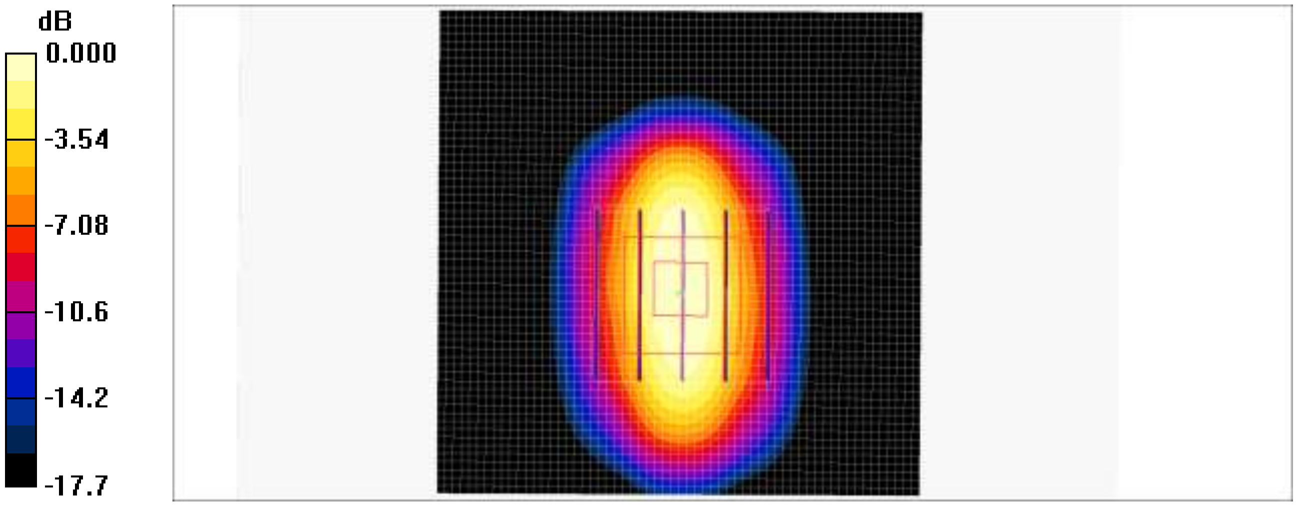
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.55 mho/m; ε_r = 55; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF(7.48, 7.48, 7.48); Calibrated: 2015-08-27
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1225; Calibrated: 2015-03-18
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

1900 MHz Body Verification/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.49 mW/g

1900 MHz Body Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 54.4 V/m; Power Drift = -0.017 dB
Peak SAR (extrapolated) = 8.42 W/kg
SAR(1 g) = 4.25 mW/g; SAR(10 g) = 2.08 mW/g
Maximum value of SAR (measured) = 4.83 mW/g



0 dB = 4.83mW/g

Verification Data (2 450 MHz Body)

Test Laboratory: HCT CO., LTD

Input Power 100 mW (20 dBm)

Liquid Temp: 21.0 ℃

Test Date: 11/09/2015

DUT: Dipole 2450 MHz; Type: D2450V2

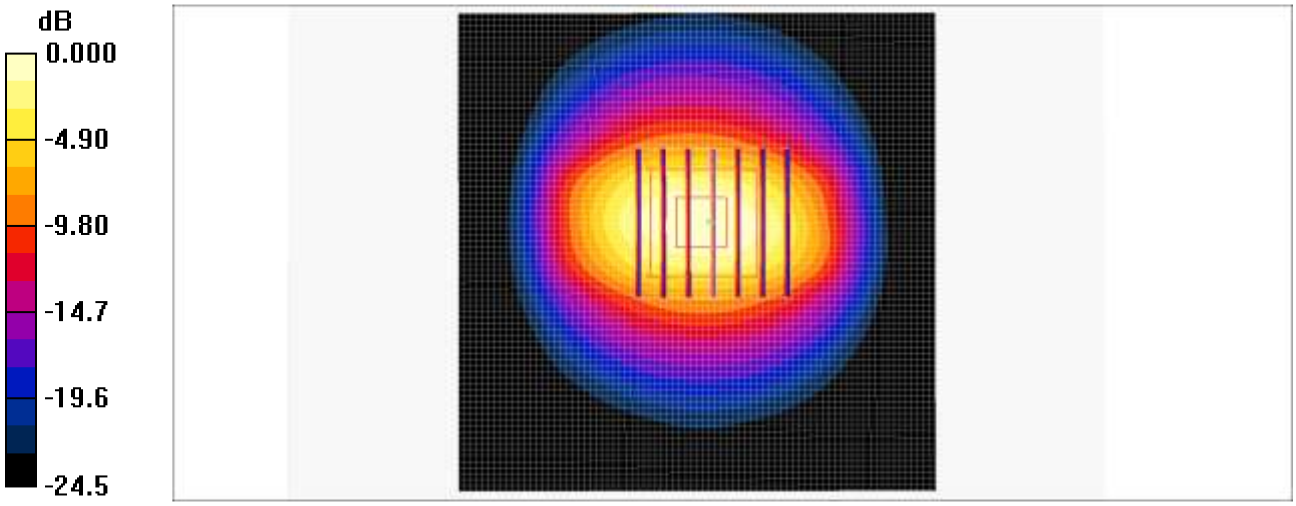
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.93 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.38, 7.38, 7.38); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

2450MHz Body Verification/Area Scan (81x81x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 7.79 mW/g

2450MHz Body Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 47.1 V/m; Power Drift = -0.037 dB
Peak SAR (extrapolated) = 10.7 W/kg
SAR(1 g) = 4.94 mW/g; SAR(10 g) = 2.22 mW/g
Maximum value of SAR (measured) = 7.70 mW/g



0 dB = 7.70mW/g

Verification Data (2 600 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 20.2 ℃
Test Date: 11/02/2015

DUT: Dipole 2600 MHz; Type: D2600V2

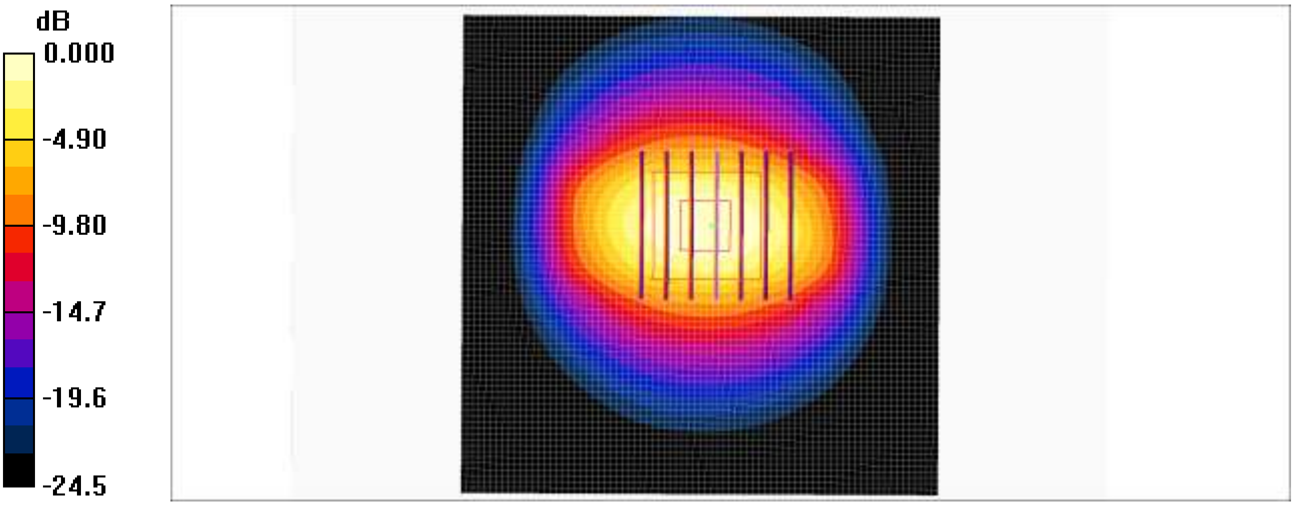
Communication System: CW; Frequency: 2600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2600 MHz; σ = 2.2 mho/m; ε_r = 54.3; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(7.22, 7.22, 7.22); Calibrated: 2015-09-28
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1417; Calibrated: 2015-01-27
- Phantom: Triple Flat Phantom
- Measurement SW: DASY4, V4.7 Build 80
- Postprocessing SW: SEMCAD, V1.8 Build 186

2600MHz Body Verification/Area Scan (81x81x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 9.02 mW/g

2600MHz Body Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 46.8 V/m; Power Drift = -0.050 dB
Peak SAR (extrapolated) = 12.3 W/kg
SAR(1 g) = 5.65 mW/g; SAR(10 g) = 2.53 mW/g
Maximum value of SAR (measured) = 8.83 mW/g



0 dB = 8.83mW/g

Attachment 3. – Probe Calibration Data

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

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

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

Accreditation No.: SCS 0108

Client **HCT (Dymstec)**

Certificate No: **EX3-3903_Sep15**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3903
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 28, 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	Israe Elnaouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 30, 2015

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

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

Accreditation No.: **SCS 0108**

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:3903

Manufactured: September 4, 2012
Calibrated: September 28, 2015

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.41	0.36	0.56	± 10.1 %
DCP (mV)[B]	103.7	108.6	99.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	145.2	±2.7 %
		Y	0.0	0.0	1.0		134.4	
		Z	0.0	0.0	1.0		143.6	

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

[A] The uncertainties of 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:3903

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
835	41.5	0.90	9.84	9.84	9.84	0.20	1.58	± 12.0 %
900	41.5	0.97	9.68	9.68	9.68	0.22	1.40	± 12.0 %
1450	40.5	1.20	8.25	8.25	8.25	0.17	1.55	± 12.0 %
1750	40.1	1.37	8.29	8.29	8.29	0.37	0.80	± 12.0 %
1900	40.0	1.40	8.03	8.03	8.03	0.37	0.80	± 12.0 %
1950	40.0	1.40	7.84	7.84	7.84	0.33	0.88	± 12.0 %
2300	39.5	1.67	7.69	7.69	7.69	0.35	0.83	± 12.0 %
2450	39.2	1.80	7.35	7.35	7.35	0.42	0.80	± 12.0 %
2600	39.0	1.96	7.09	7.09	7.09	0.26	1.13	± 12.0 %
5200	36.0	4.66	5.28	5.28	5.28	0.40	1.80	± 13.1 %
5300	35.9	4.76	5.08	5.08	5.08	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.91	4.91	4.91	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.70	4.70	4.70	0.45	1.80	± 13.1 %
5800	35.3	5.27	4.60	4.60	4.60	0.45	1.80	± 13.1 %

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

[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:3903

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)
835	55.2	0.97	10.05	10.05	10.05	0.23	1.29	± 12.0 %
1750	53.4	1.49	7.94	7.94	7.94	0.39	0.85	± 12.0 %
1900	53.3	1.52	7.72	7.72	7.72	0.34	0.87	± 12.0 %
2300	52.9	1.81	7.57	7.57	7.57	0.42	0.80	± 12.0 %
2450	52.7	1.95	7.38	7.38	7.38	0.31	0.95	± 12.0 %
2600	52.5	2.16	7.22	7.22	7.22	0.22	0.95	± 12.0 %
5200	49.0	5.30	4.57	4.57	4.57	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.42	4.42	4.42	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.88	3.88	3.88	0.60	1.90	± 13.1 %
5600	48.5	5.77	3.74	3.74	3.74	0.60	1.90	± 13.1 %
5800	48.2	6.00	4.05	4.05	4.05	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.

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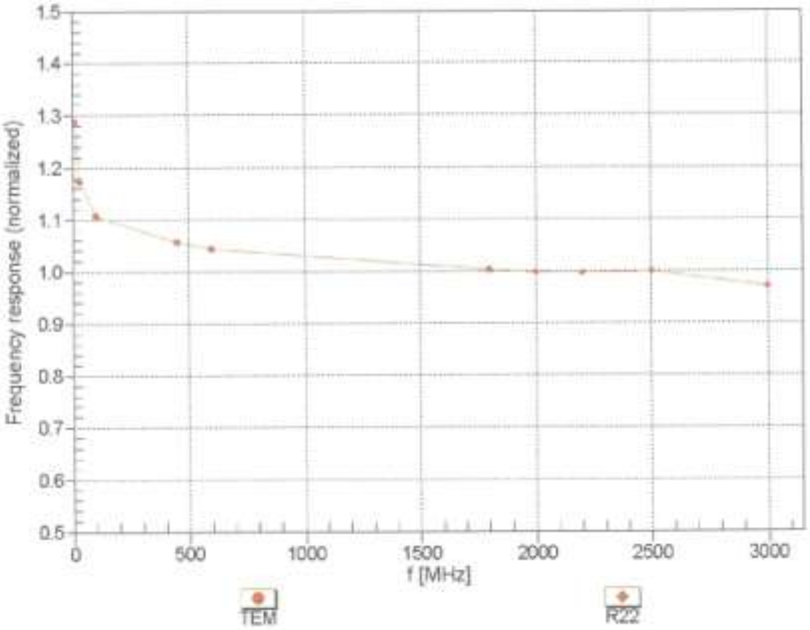
EX3DV4– SN:3903 September 28, 2015

Frequency Response of E-Field

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



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

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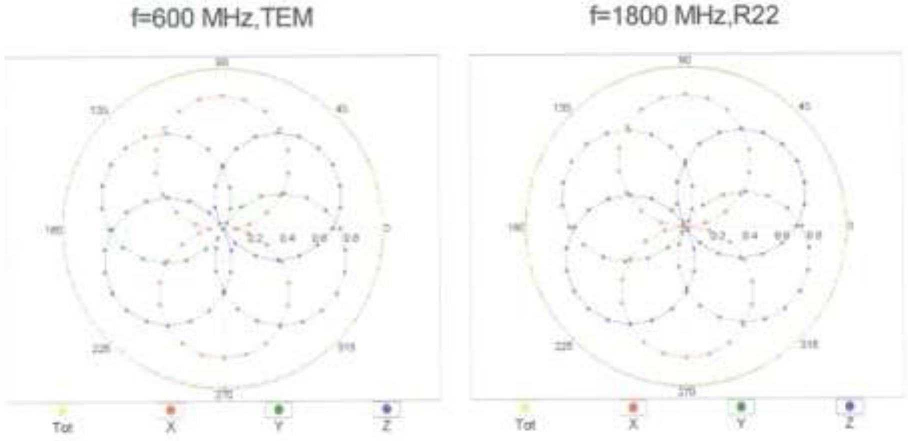
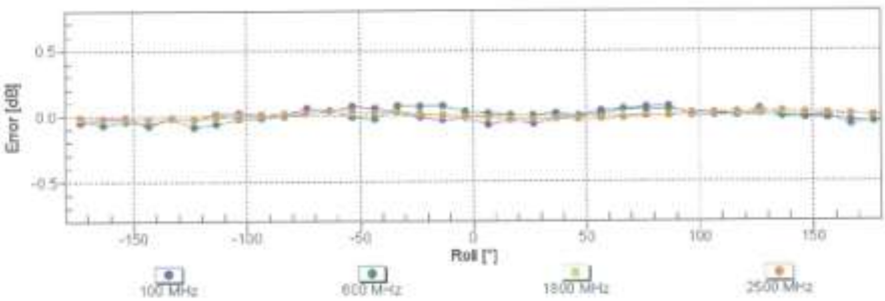
EX3DV4– SN:3903 September 28, 2015

Receiving Pattern (ϕ), $\vartheta = 0°$





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

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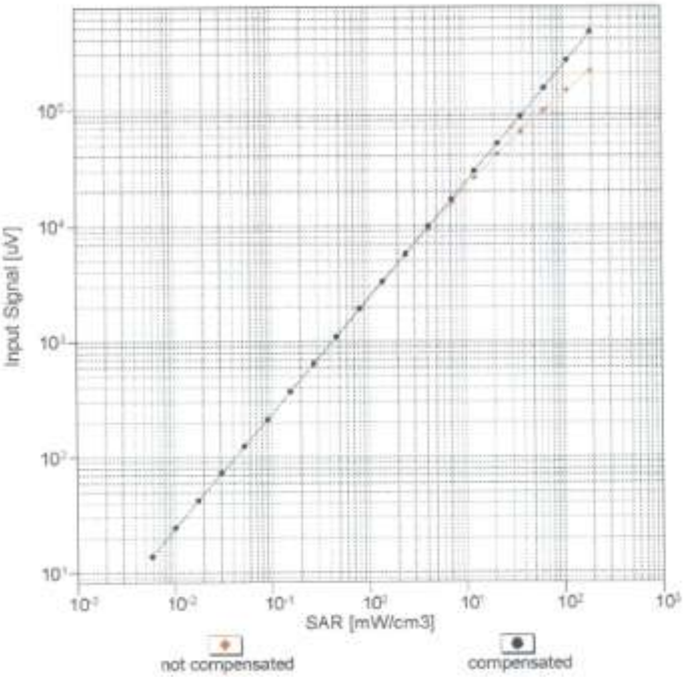
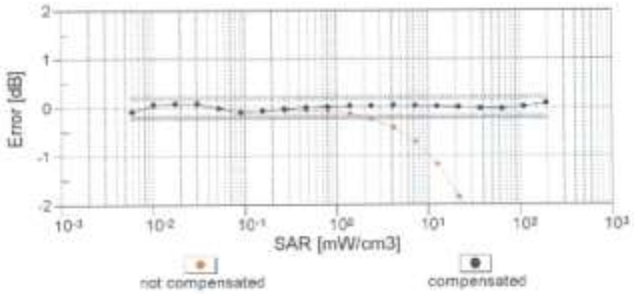
EX3DV4– SN:3903 September 28, 2015

Dynamic Range f(SAR$_{head}$)

(TEM cell , f_{eval}= 1900 MHz)



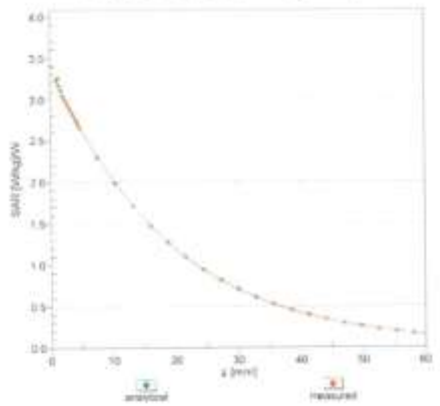


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

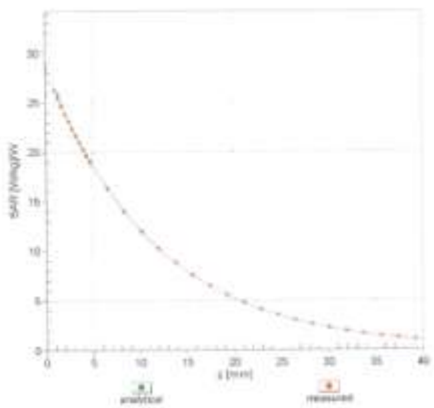
Certificate No: EX3-3903_Sep15 Page 9 of 11

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

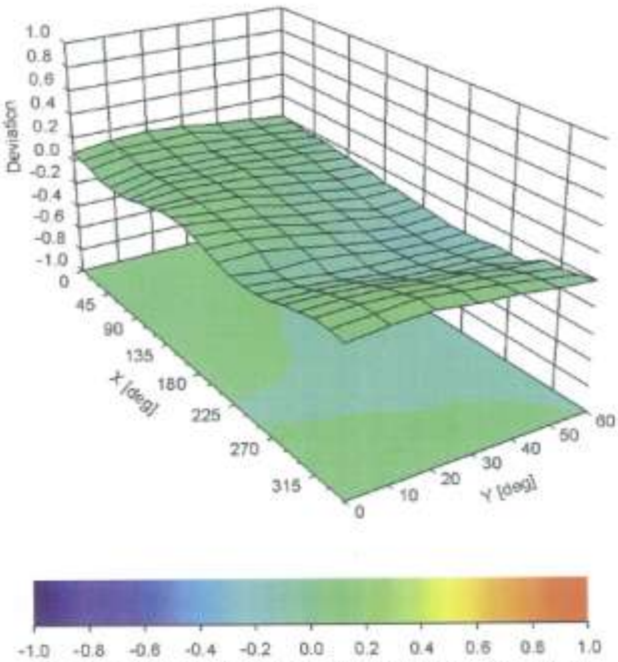


f = 1900 MHz,WGLS R22 (H_convF)



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:3903

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-33.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **EX3-3863_Aug15**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3863
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:	August 27, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 29, 2015

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

Certificate No: EX3-3863_Aug15 Page 1 of 11

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Multilateral Agreement for the recognition of calibration certificates

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:3863

Manufactured: February 2, 2012
Calibrated: August 27, 2015

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.37	0.35	0.45	± 10.1 %
DCP (mV)[B]	101.9	103.9	98.9	

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	131.8	±2.7 %
		Y	0.0	0.0	1.0		129.9	
		Z	0.0	0.0	1.0		126.4	

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

[A] The uncertainties of 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:3863

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	11.89	11.89	11.89	0.00	1.00	± 13.3 %
450	43.5	0.87	10.31	10.31	10.31	0.17	1.30	± 13.3 %
750	41.9	0.89	9.83	9.83	9.83	0.24	1.21	± 12.0 %
835	41.5	0.90	9.46	9.46	9.46	0.21	1.30	± 12.0 %
900	41.5	0.97	9.28	9.28	9.28	0.26	1.11	± 12.0 %
1450	40.5	1.20	8.31	8.31	8.31	0.15	1.81	± 12.0 %
1750	40.1	1.37	8.18	8.18	8.18	0.36	0.90	± 12.0 %
1900	40.0	1.40	7.84	7.84	7.84	0.21	1.07	± 12.0 %
1950	40.0	1.40	7.60	7.60	7.60	0.31	0.80	± 12.0 %
2450	39.2	1.80	7.04	7.04	7.04	0.27	0.98	± 12.0 %
2600	39.0	1.96	6.84	6.84	6.84	0.27	1.04	± 12.0 %
3500	37.9	2.91	6.77	6.77	6.77	0.38	1.06	± 13.1 %
5250	35.9	4.71	4.94	4.94	4.94	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.44	4.44	4.44	0.45	1.80	± 13.1 %
5750	35.4	5.22	4.65	4.65	4.65	0.45	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[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:3863

Calibration Parameter Determined in Body Tissue Simulating Media

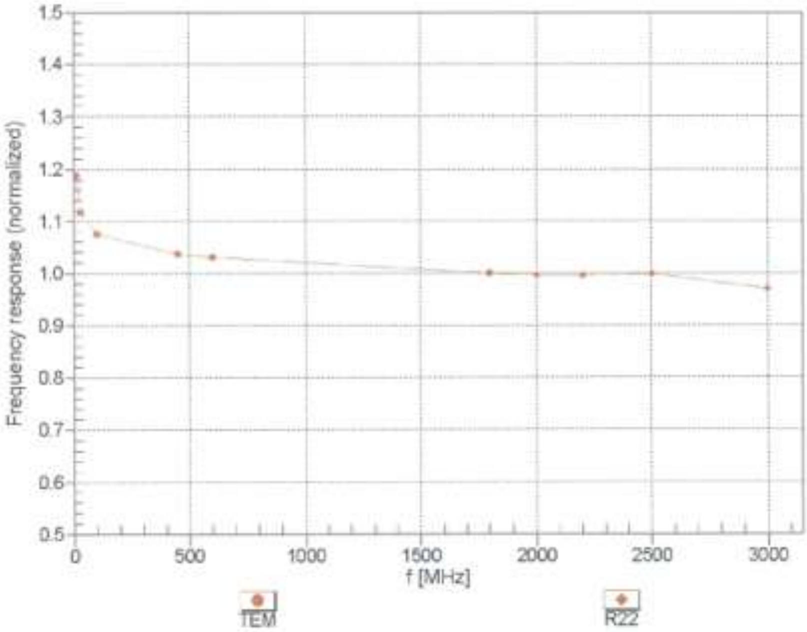
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	11.68	11.68	11.68	0.00	1.00	± 13.3 %
450	56.7	0.94	10.67	10.67	10.67	0.10	1.20	± 13.3 %
750	55.5	0.96	9.76	9.76	9.76	0.25	1.16	± 12.0 %
835	55.2	0.97	9.40	9.40	9.40	0.23	1.44	± 12.0 %
1750	53.4	1.49	7.73	7.73	7.73	0.24	1.01	± 12.0 %
1900	53.3	1.52	7.48	7.48	7.48	0.39	0.80	± 12.0 %
2450	52.7	1.95	7.11	7.11	7.11	0.31	0.80	± 12.0 %
2600	52.5	2.16	6.97	6.97	6.97	0.33	0.80	± 12.0 %
5250	48.9	5.36	4.44	4.44	4.44	0.40	1.90	± 13.1 %
5600	48.5	5.77	3.77	3.77	3.77	0.50	1.90	± 13.1 %
5750	48.3	5.94	4.08	4.08	4.08	0.50	1.90	± 13.1 %

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

EX3DV4– SN:3863 August 27, 2015

Frequency Response of E-Field

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



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

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74, Seoicheon-ro 578 beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383. Rep. of KOREA
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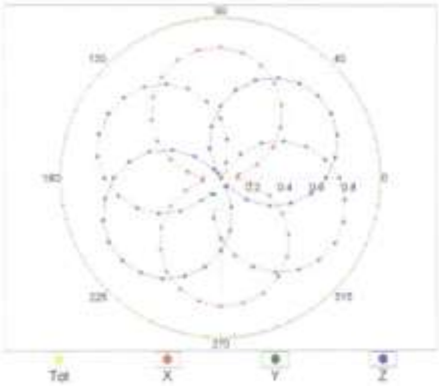
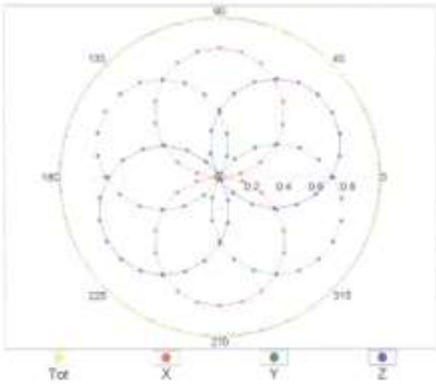
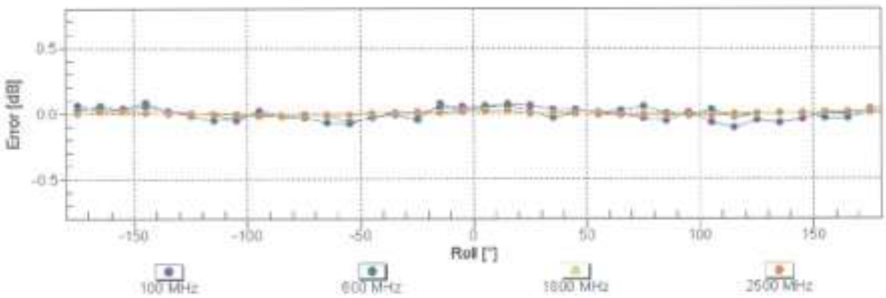
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

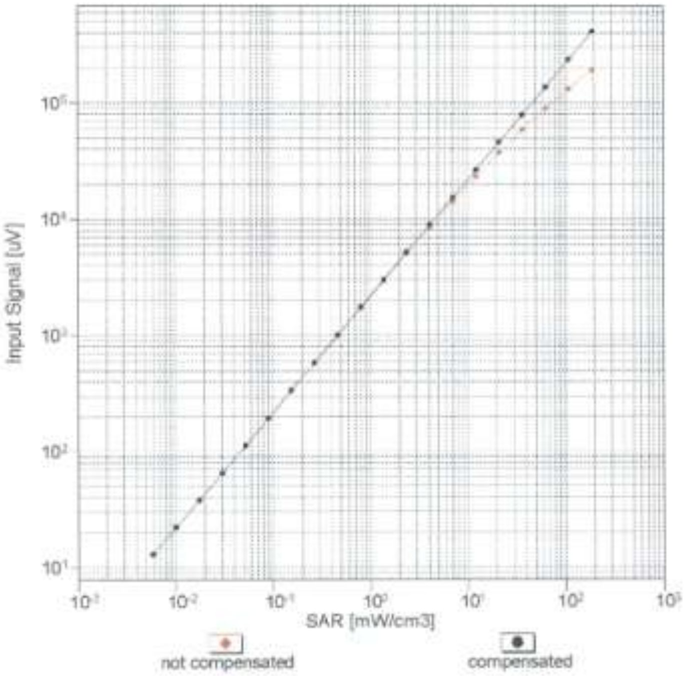


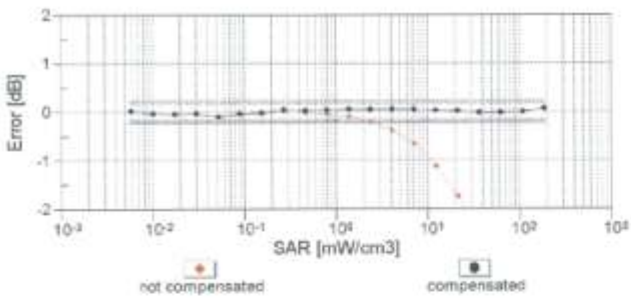


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

EX3DV4– SN:3863 August 27, 2015

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



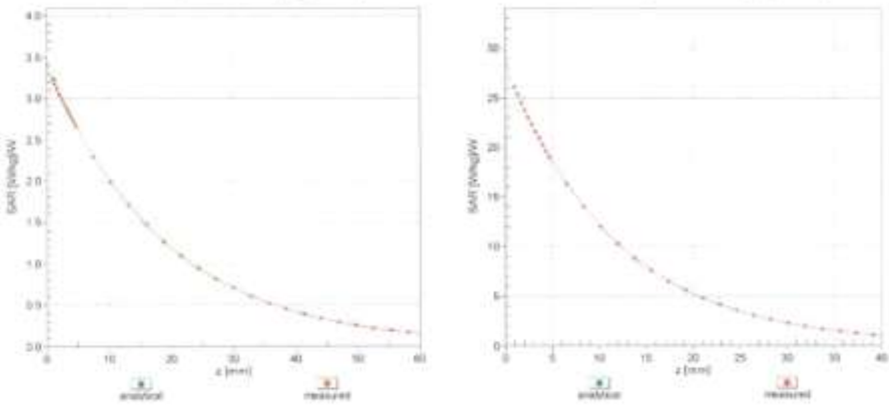


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: EX3-3863_Aug15 Page 9 of 11

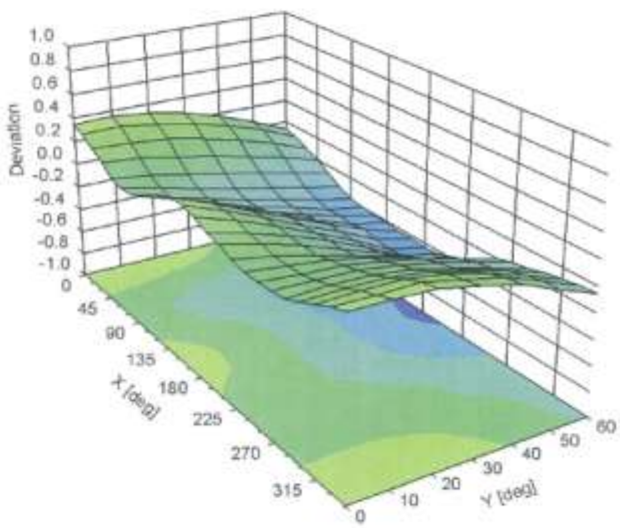
EX3DV4– SN:3863 August 27, 2015

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: EX3-3863_Aug15 Page 10 of 11

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	105.3
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: **ES3-3076_Jul15**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3076
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:	July 20, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
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Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
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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: July 23, 2015

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Certificate No: ES3-3076_Jul15 Page 1 of 11

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Accreditation No.: **SCS 0108**

Glossary:

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ConvF	sensitivity in TSL / NORMx,y,z
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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 ES3DV3

SN:3076

Manufactured: June 29, 2005
Calibrated: July 20, 2015

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

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ES3DV3– SN:3076 July 20, 2015

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3076

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.26	1.29	1.20	± 10.1 %
DCP (mV)[B]	103.4	102.8	104.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	213.7	±3.8 %
		Y	0.0	0.0	1.0		205.9	
		Z	0.0	0.0	1.0		204.2	

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.

Certificate No: ES3-3076_Jul15 Page 4 of 11

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3076

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	6.43	6.43	6.43	0.20	1.60	± 13.3 %
750	41.9	0.89	6.24	6.24	6.24	0.53	1.36	± 12.0 %
835	41.5	0.90	6.01	6.01	6.01	0.29	1.95	± 12.0 %
900	41.5	0.97	5.89	5.89	5.89	0.70	1.22	± 12.0 %
1450	40.5	1.20	5.17	5.17	5.17	0.26	2.14	± 12.0 %
1750	40.1	1.37	5.12	5.12	5.12	0.62	1.33	± 12.0 %
1900	40.0	1.40	4.96	4.96	4.96	0.69	1.27	± 12.0 %
1950	40.0	1.40	4.82	4.82	4.82	0.78	1.17	± 12.0 %
2300	39.5	1.67	4.70	4.70	4.70	0.66	1.36	± 12.0 %
2450	39.2	1.80	4.41	4.41	4.41	0.78	1.27	± 12.0 %
2600	39.0	1.96	4.30	4.30	4.30	0.80	1.25	± 12.0 %

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3076

Calibration Parameter Determined in Body Tissue Simulating Media

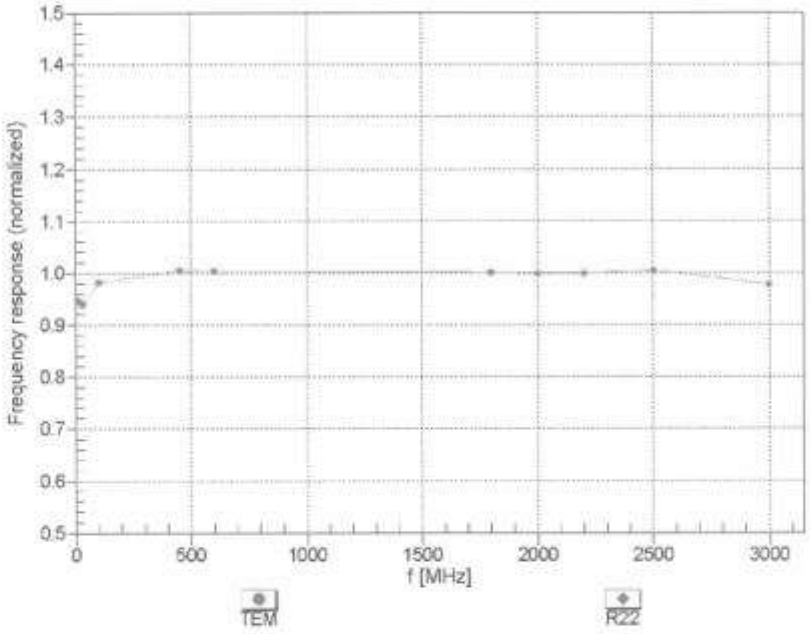
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
450	56.7	0.94	6.66	6.66	6.66	0.13	1.50	± 13.3 %
750	55.5	0.96	5.58	5.58	5.58	0.80	1.14	± 12.0 %
835	55.2	0.97	5.51	5.51	5.51	0.31	1.87	± 12.0 %
1750	53.4	1.49	4.78	4.78	4.78	0.53	1.51	± 12.0 %
1900	53.3	1.52	4.61	4.61	4.61	0.44	1.67	± 12.0 %
2450	52.7	1.95	4.25	4.25	4.25	0.71	1.20	± 12.0 %
2600	52.5	2.16	4.13	4.13	4.13	0.80	1.15	± 12.0 %

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

ES3DV3– SN:3076 July 20, 2015

Frequency Response of E-Field

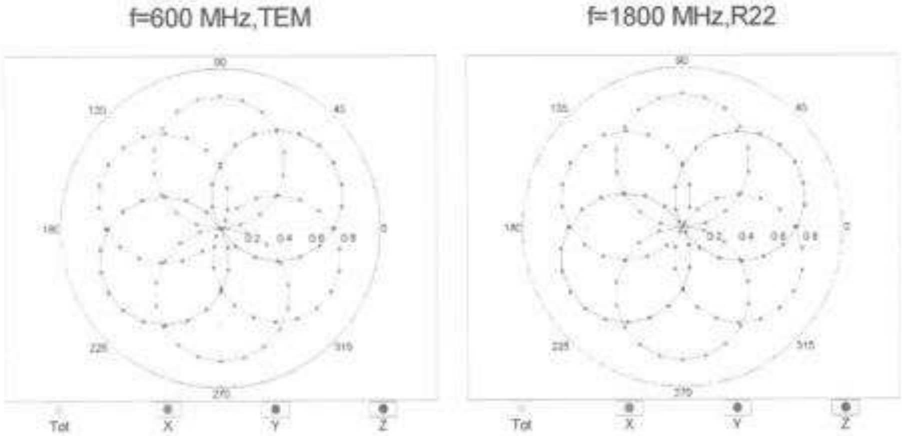
(TEM-Cell:ifi110 EXX, Waveguide: R22)

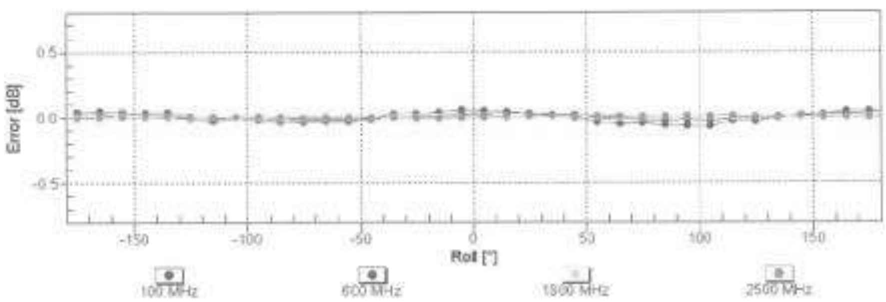


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

ES3DV3– SN:3076 July 20, 2015

Receiving Pattern (ϕ), ϑ = 0°



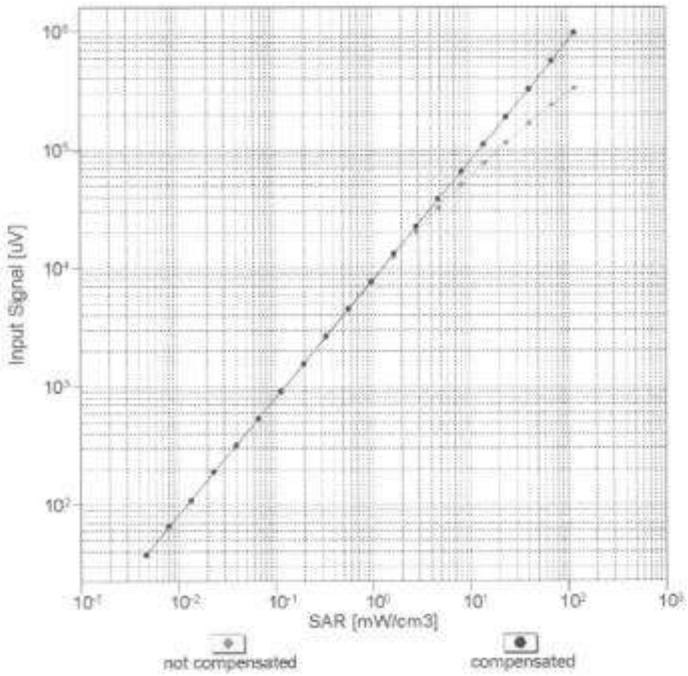


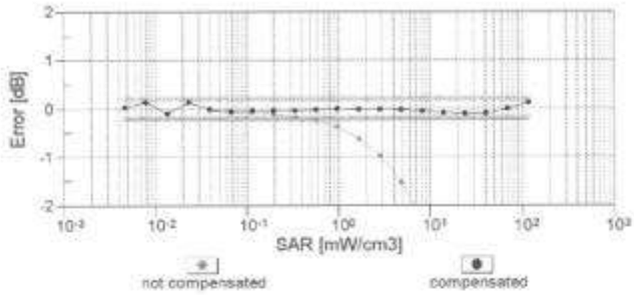
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: ES3-3076_Jul15 Page 8 of 11

Dynamic Range f(SAR$_{head}$)

(TEM cell , f_{eval}= 1900 MHz)

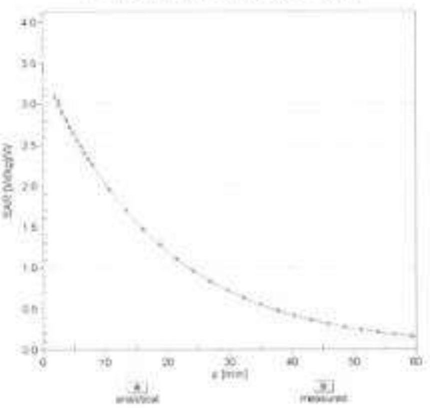


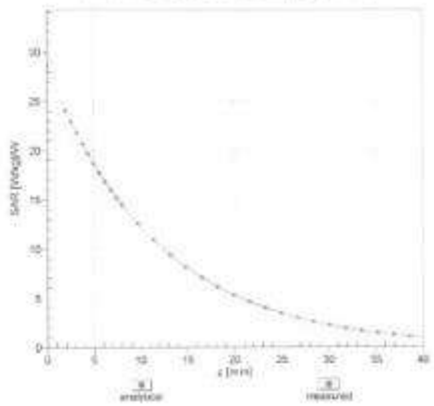


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ES3DV3– SN:3076 July 20, 2015

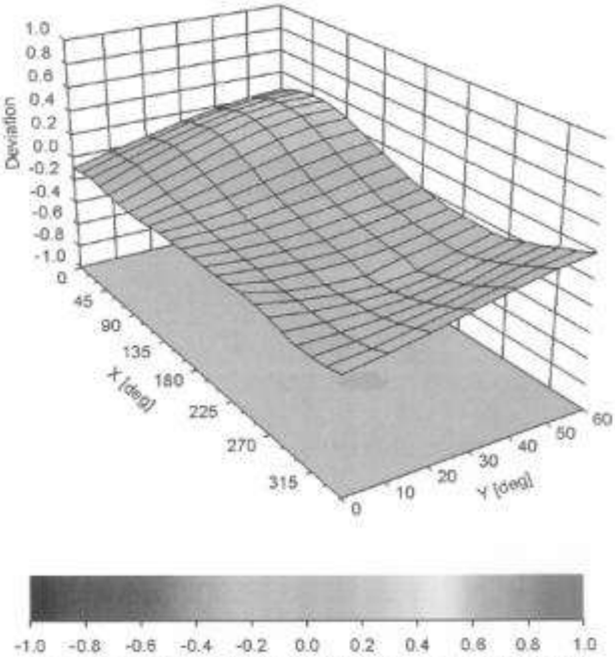
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: ES3-3076_Jul15 Page 10 of 11

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3076

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-35.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Attachment 4. – Dipole Calibration Data

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **D750V3-1014_Jul15**

CALIBRATION CERTIFICATE

Object: D750V3 - SN: 1014

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

Calibration date: July 23, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

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

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

Issued: July 23, 2015

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

Certificate No: D750V3-1014_Jul15 Page 1 of 8

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The Swiss Accreditation Service is one of the signatories to the EA 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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.5 ± 6 %	0.90 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	2.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.15 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.33 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	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.1 ± 6 %	0.98 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	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.49 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.60 W/kg ± 16.5 % (k=2)**

Certificate No: D750V3-1014_Jul15 Page 3 of 8

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 Ω + 1.7 jΩ
Return Loss	- 27.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.1 Ω - 1.3 jΩ
Return Loss	- 36.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.036 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 22, 2010

DASY5 Validation Report for Head TSL

Date: 14.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

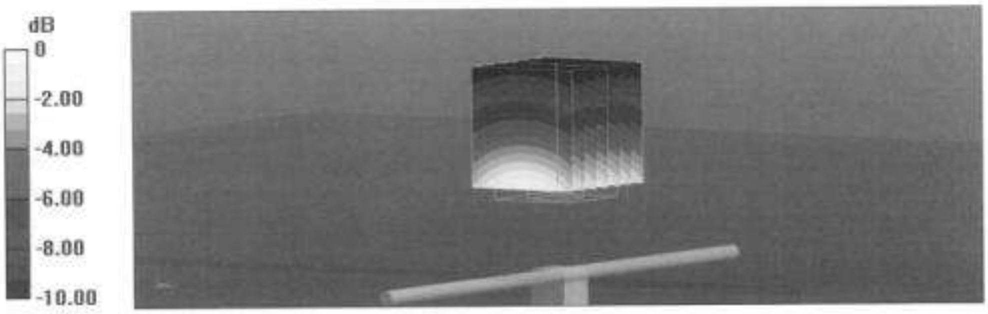
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1014

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.9 S/m; ε_r = 42.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.44, 6.44, 6.44); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

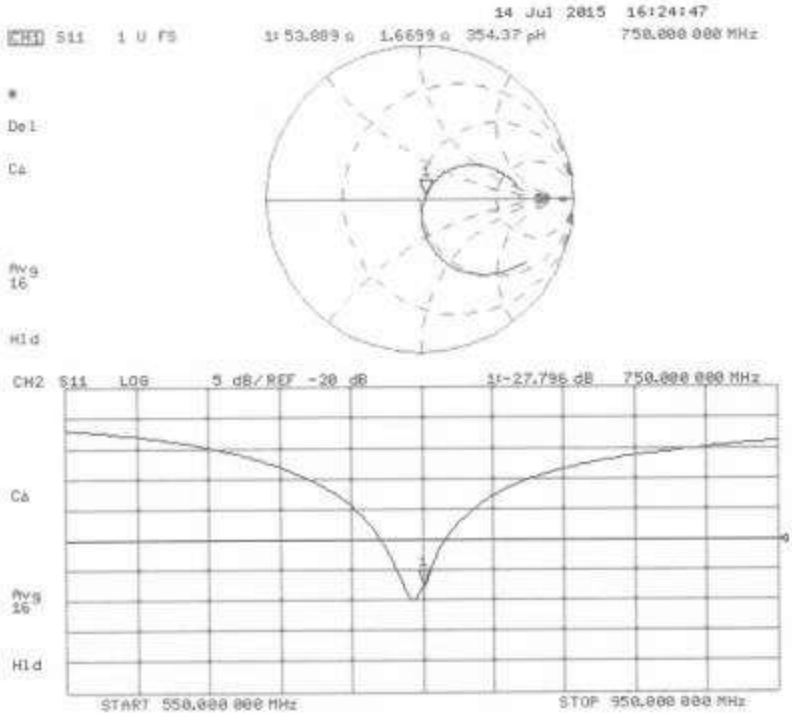
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.32 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.05 W/kg
SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.34 W/kg
Maximum value of SAR (measured) = 2.40 W/kg



0 dB = 2.40 W/kg = 3.80 dBW/kg

Certificate No: D750V3-1014_Jul15 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D750V3-1014_Jul15 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 23.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

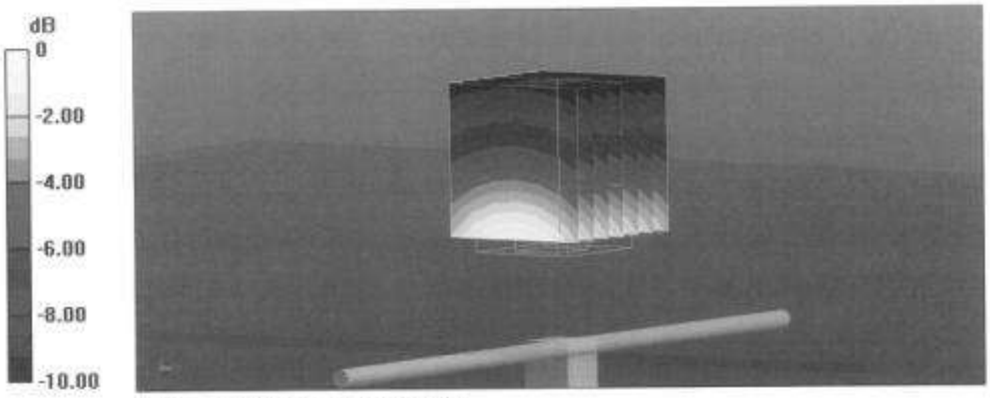
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1014

Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.98 S/m; ε_r = 55.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.21, 6.21, 6.21); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

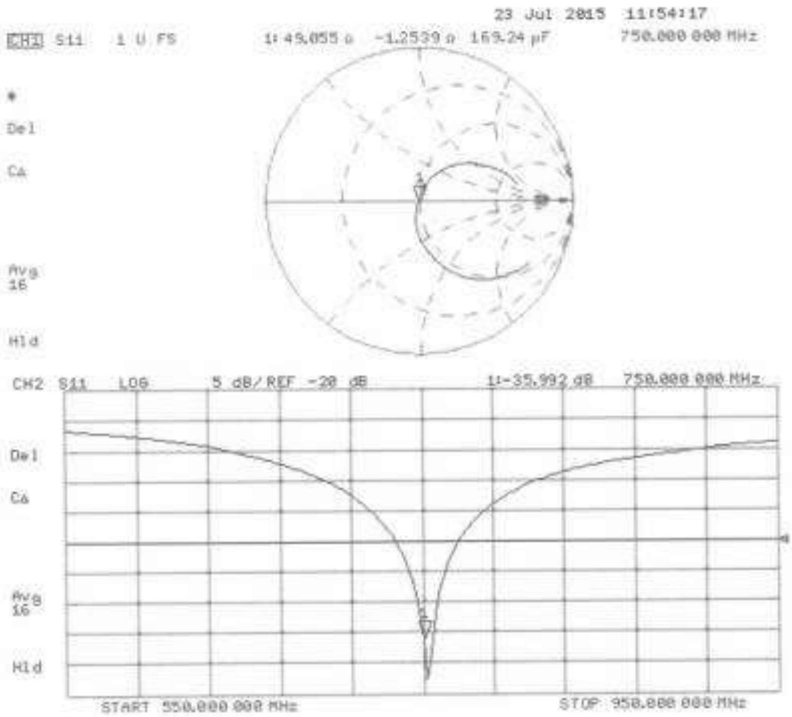
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.42 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.15 W/kg
SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.42 W/kg
Maximum value of SAR (measured) = 2.51 W/kg



0 dB = 2.51 W/kg = 4.00 dBW/kg

Certificate No: D750V3-1014_Jul15 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D750V3-1014_Jul15 Page 8 of 8

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Accreditation No.: SCS 0108

Client **HCT (Dymstec)** Certificate No: **D835V2-441_Jan15**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 441
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 23, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: January 26, 2015

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Certificate No: D835V2-441_Jan15 Page 1 of 8

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.5 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.21 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.04 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.8 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.34 W/kg ± 17.0 % (k=2)**

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

Certificate No: D835V2-441_Jan15 Page 3 of 8

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.369 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 09, 2001

DASY5 Validation Report for Head TSL

Date: 22.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

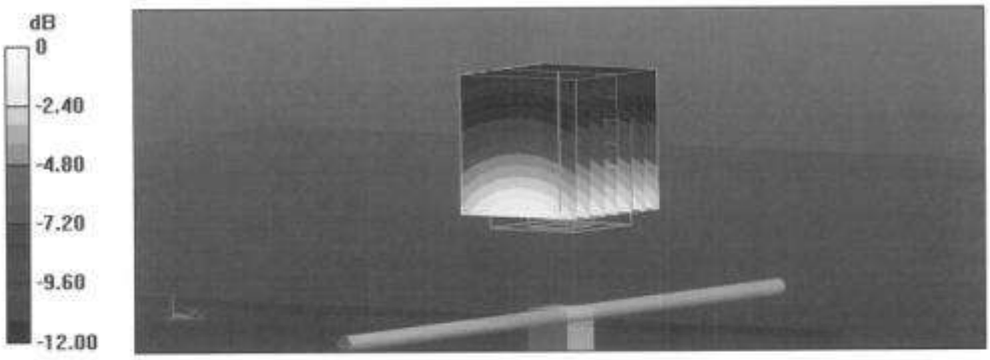
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 441

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

DASY52 Configuration:

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

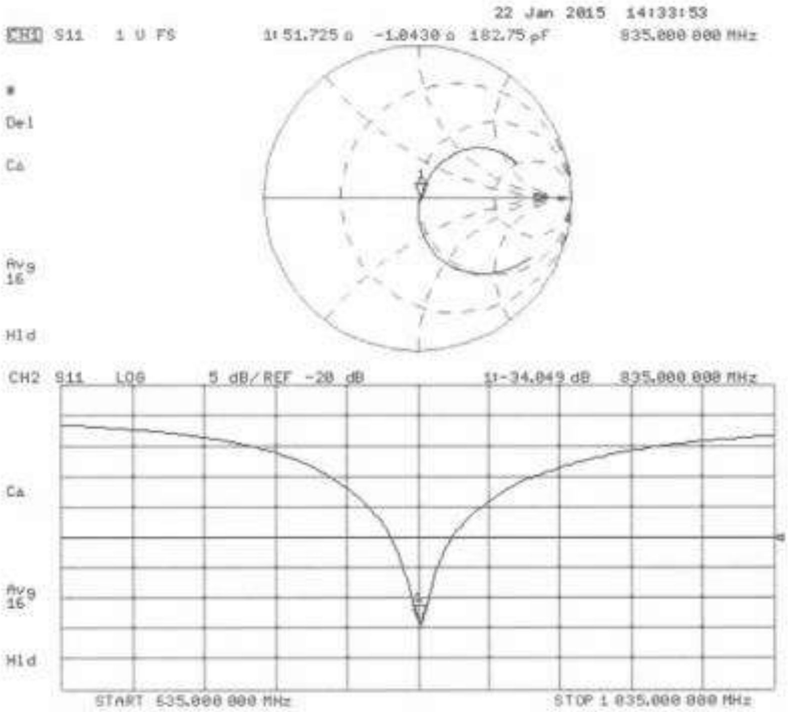
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.43 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 3.49 W/kg
SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.54 W/kg
Maximum value of SAR (measured) = 2.76 W/kg



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

Certificate No: D835V2-441_Jan15 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D835V2-441_Jan15 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 23.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

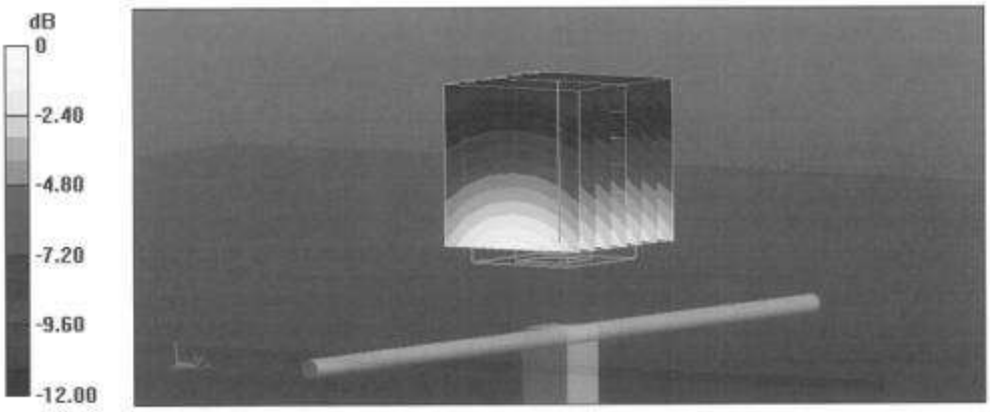
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 441

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

DASY52 Configuration:

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

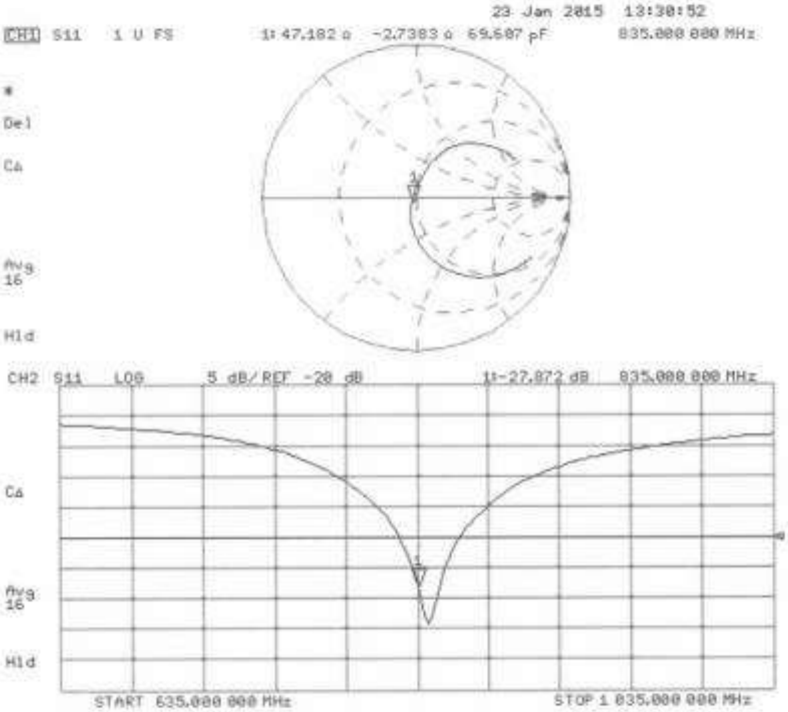
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.59 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.53 W/kg
SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 2.80 W/kg



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

Certificate No: D835V2-441_Jan15 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D835V2-441_Jan15 Page 8 of 8

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Accreditation No.: SCS 0108

Client **HCT (Dymstec)**

Certificate No: **D1800V2-2d007_Feb15**

CALIBRATION CERTIFICATE

Object	D1800V2 - SN: 2d007
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	February 19, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: February 20, 2015

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

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D1800V2-2d007_Feb15 Page 2 of 8

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.7 ± 6 %	1.44 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.82 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**38.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.12 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	51.7 ± 6 %	1.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.67 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**38.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.3 W/kg ± 16.5 % (k=2)**

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74, Seoicheon-ro 578 beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383. Rep. of KOREA
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Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.3 Ω - 6.9 jΩ
Return Loss	- 22.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.9 Ω - 7.1 jΩ
Return Loss	- 20.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 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	July 23, 2001

DASY5 Validation Report for Head TSL

Date: 19.02.2015

Test Laboratory: SPEAG, Zurich, Switzerland

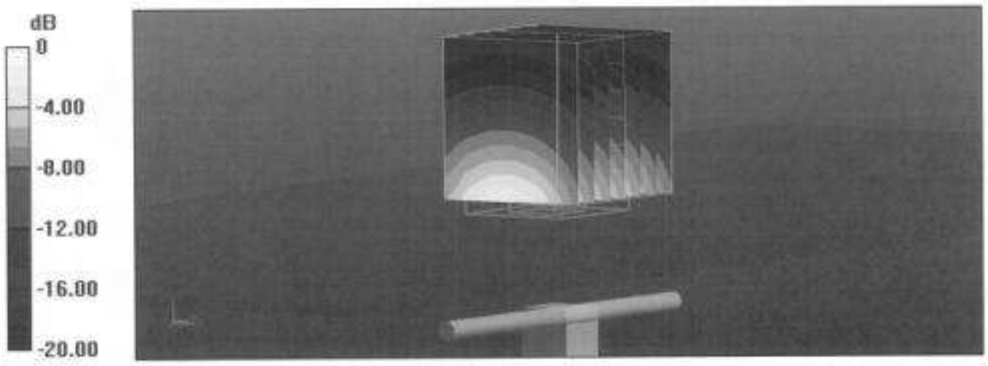
DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d007

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.44 S/m; ε_r = 38.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

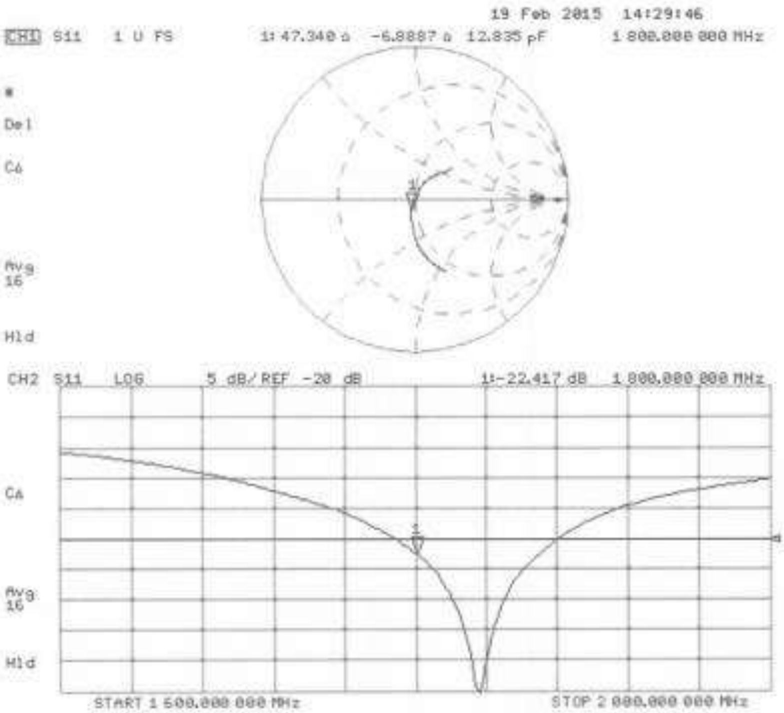
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.45 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 9.82 W/kg; SAR(10 g) = 5.12 W/kg
Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

Certificate No: D1800V2-2d007_Feb15 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D1800V2-2d007_Feb15 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 19.02.2015

Test Laboratory: SPEAG, Zurich, Switzerland

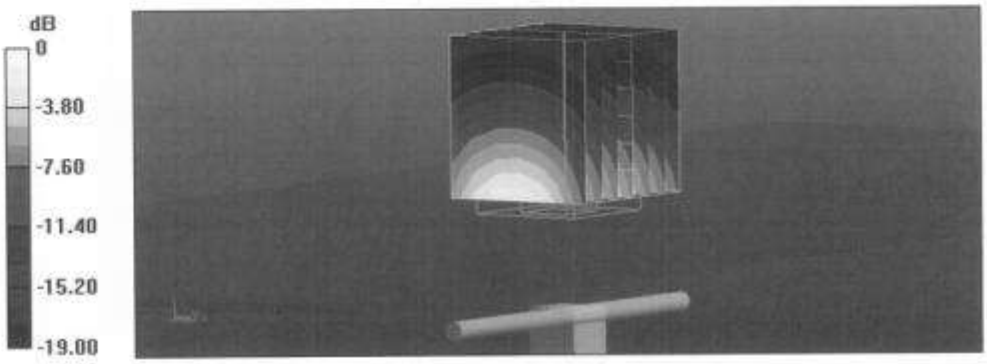
DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d007

Communication System: UID 0 - CW; Frequency: 1800 MHz
Medium parameters used: f = 1800 MHz; σ = 1.53 S/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.77, 4.77, 4.77); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

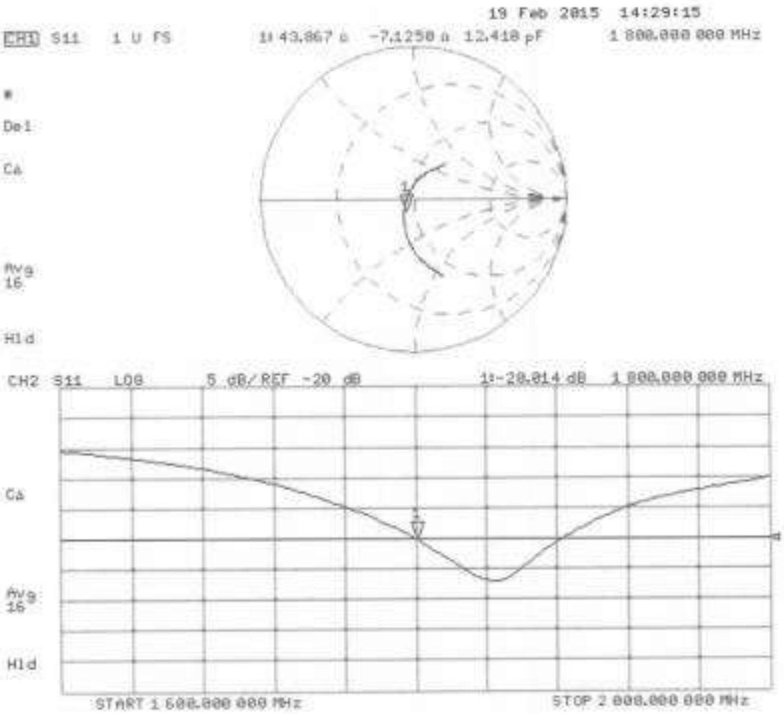
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.07 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.9 W/kg
SAR(1 g) = 9.67 W/kg; SAR(10 g) = 5.1 W/kg
Maximum value of SAR (measured) = 12.1 W/kg



0 dB = 12.1 W/kg = 10.83 dBW/kg

Certificate No: D1800V2-2d007_Feb15 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D1800V2-2d007_Feb15 Page 8 of 8

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Accreditation No.: SCS 0108

Client **HCT (Dymstec)**

Certificate No: **D1900V2-5d032_May15**

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d032

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

Calibration date: May 20, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

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

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

Issued: May 20, 2015

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D1900V2-5d032_May15 Page 2 of 8

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**41.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.4 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.7 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.9 W/kg ± 17.0 % (k=2)**

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

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 17, 2003

DASY5 Validation Report for Head TSL

Date: 20.05.2015

Test Laboratory: SPEAG, Zurich, Switzerland

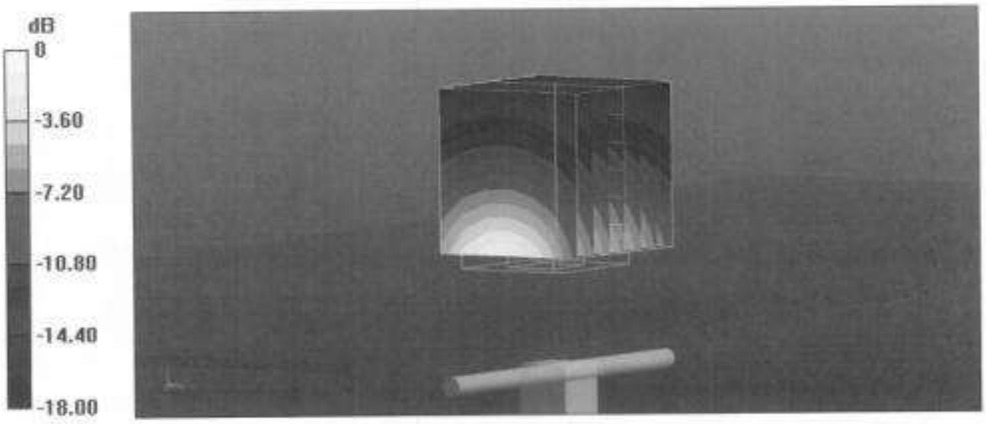
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032

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

DASY52 Configuration:

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

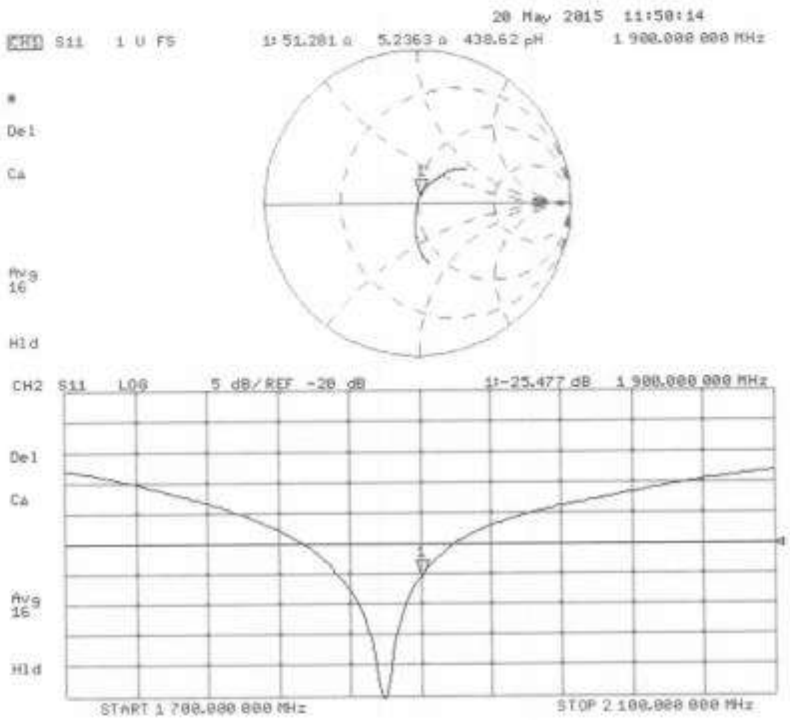
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.00 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.6 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.33 W/kg
Maximum value of SAR (measured) = 12.7 W/kg



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

Certificate No: D1900V2-5d032_May15 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d032_May15 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 20.05.2015

Test Laboratory: SPEAG, Zurich, Switzerland

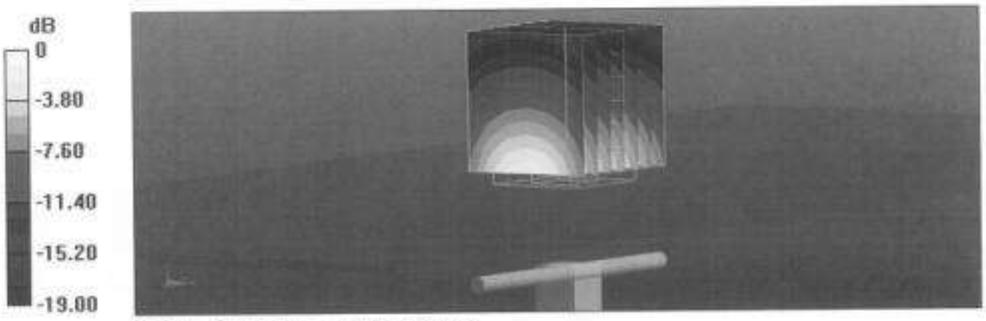
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d032

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

DASY52 Configuration:

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

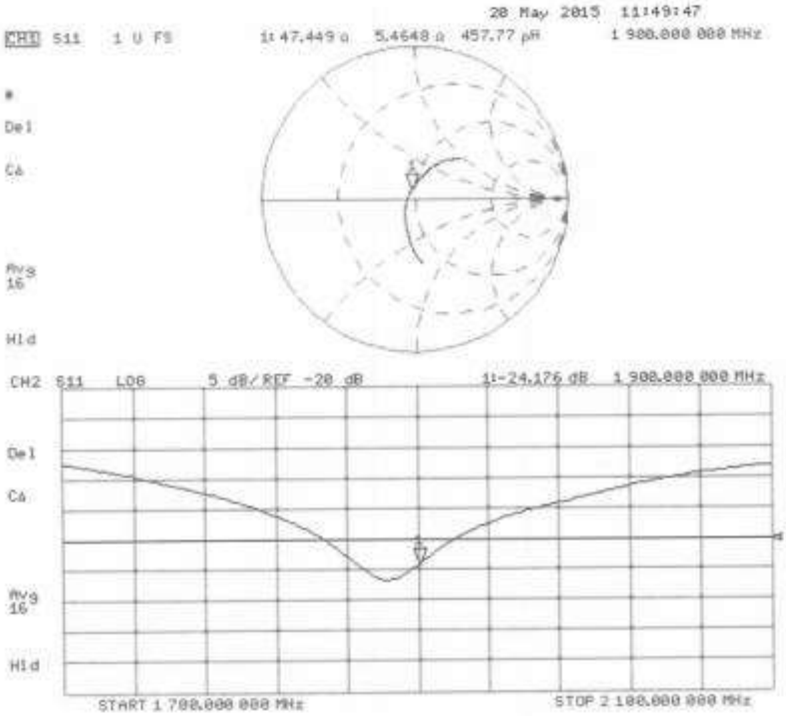
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.54 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 17.3 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.41 W/kg
Maximum value of SAR (measured) = 12.8 W/kg



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

Certificate No: D1900V2-5d032_May15 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d032_May15 Page 8 of 8

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Accreditation No.: SCS 0108

Client: HCT (Dymstec)

Certificate No: D2450V2-743_May15

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 743
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 19, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

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

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

Issued: May 20, 2015

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Certificate No: D2450V2-743_May15 Page 1 of 8

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.0 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.7 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**52.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.4 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	54.2 Ω + 4.4 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.4 Ω + 6.1 jΩ
Return Loss	- 24.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 01, 2003

Certificate No: D2450V2-743_May15 Page 4 of 8

DASY5 Validation Report for Head TSL

Date: 19.05.2015

Test Laboratory: SPEAG, Zurich, Switzerland

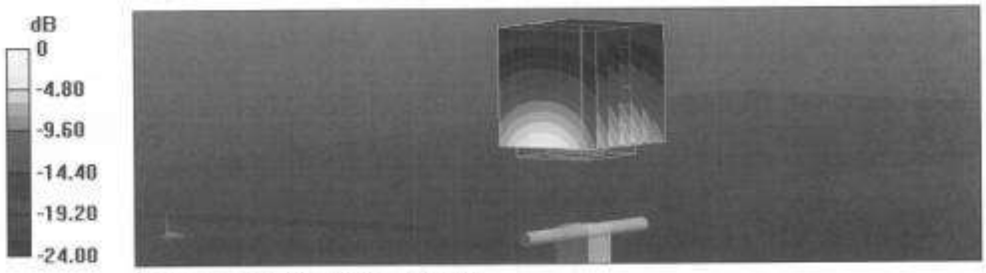
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 743

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.84 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.54, 4.54, 4.54); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

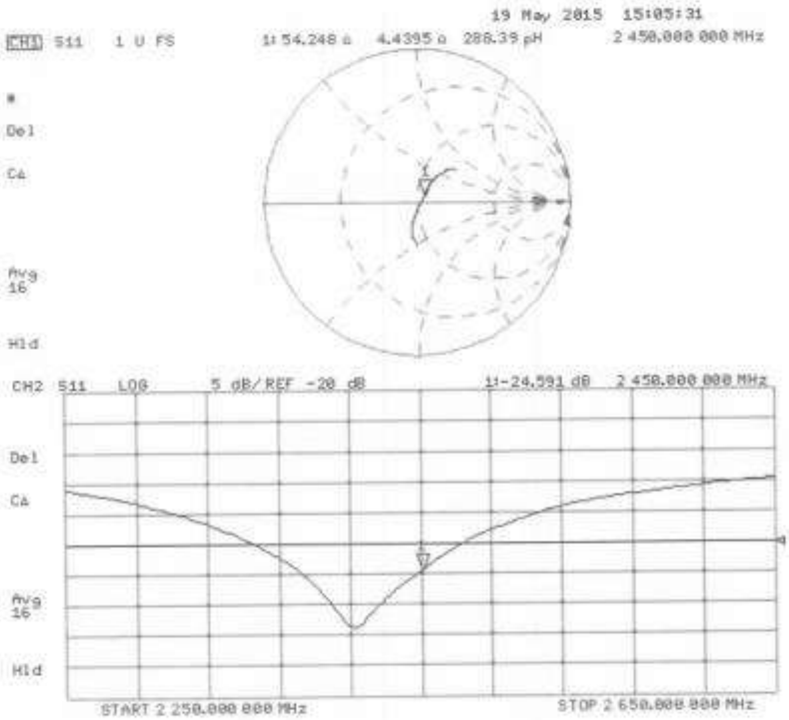
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.4 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 28.0 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.32 W/kg
Maximum value of SAR (measured) = 17.7 W/kg



0 dB = 17.7 W/kg = 12.48 dBW/kg

Certificate No: D2450V2-743_May15 Page 5 of 8

Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 19.05.2015

Test Laboratory: SPEAG, Zurich, Switzerland

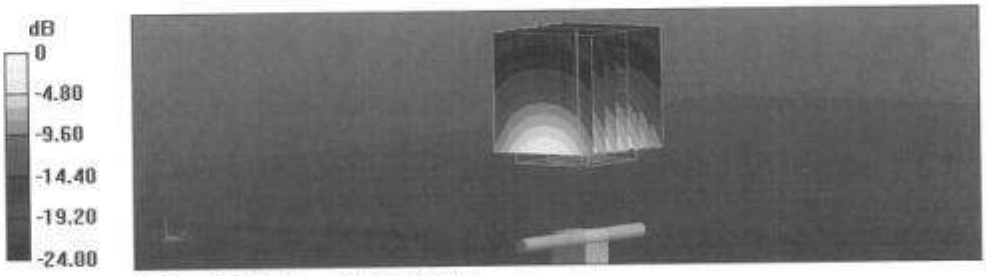
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 743

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ε_r = 50.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

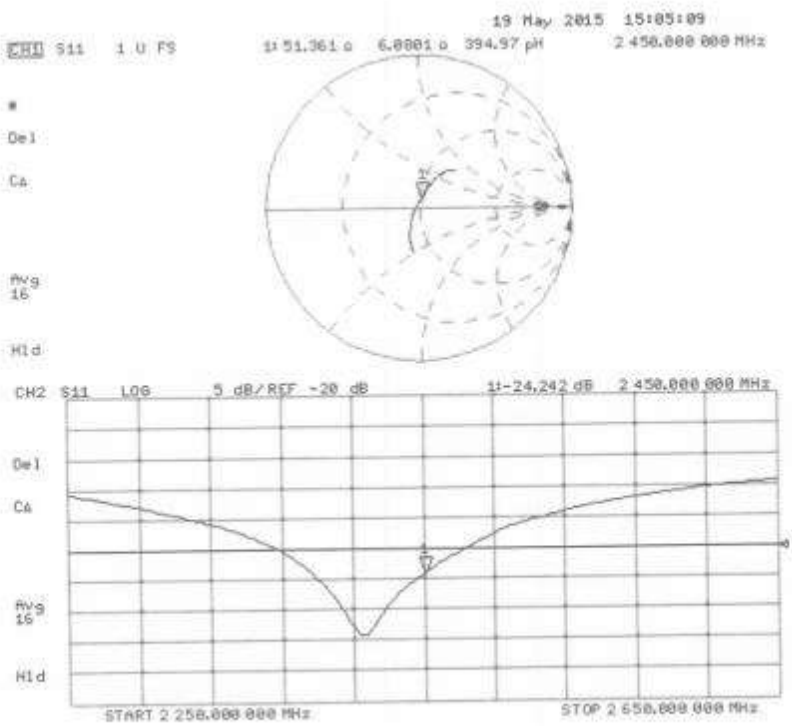
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.12 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.2 W/kg
Maximum value of SAR (measured) = 17.7 W/kg



0 dB = 17.7 W/kg = 12.48 dBW/kg

Certificate No: D2450V2-743_May15 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-743_May15 Page 8 of 8

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **D2600V2-1015_Mar15**

CALIBRATION CERTIFICATE

Object: D2600V2 - SN: 1015

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

Calibration date: March 25, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: March 25, 2015

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Accreditation No.: SCS 0108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.2 ± 6 %	2.00 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**56.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.3 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	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.3 ± 6 %	2.20 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**55.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.27 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.8 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	50.0 Ω - 2.1 jΩ
Return Loss	- 33.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω - 1.9 jΩ
Return Loss	- 27.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 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	October 30, 2007

DASY5 Validation Report for Head TSL

Date: 20.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

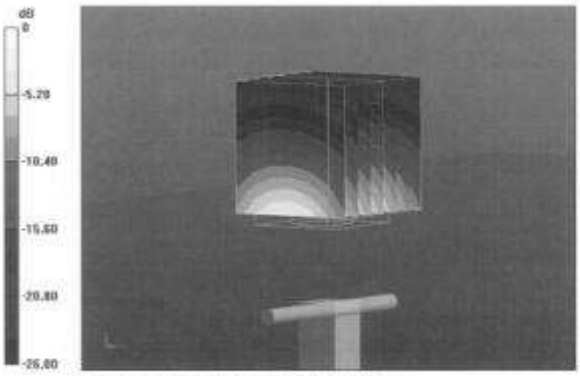
DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1015

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2 S/m; ε_r = 37.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

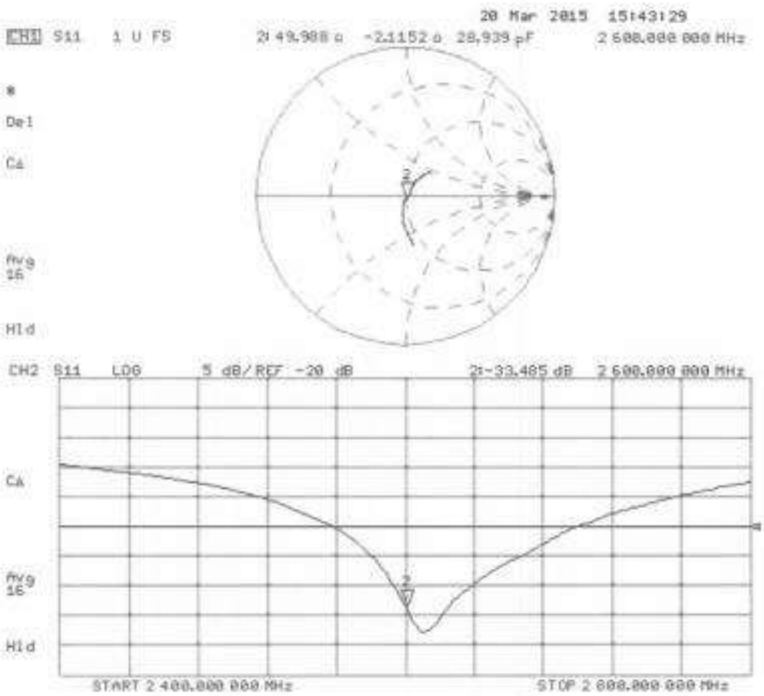
- Probe: ES3DV3 - SN3205; ConvF(4.49, 4.49, 4.49); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.2 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 30.4 W/kg
SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.4 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

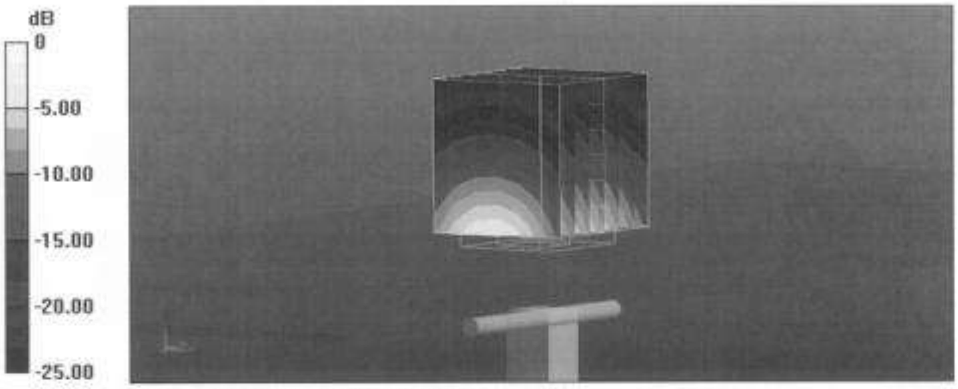
DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1015

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.2 S/m; ε_r = 50.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

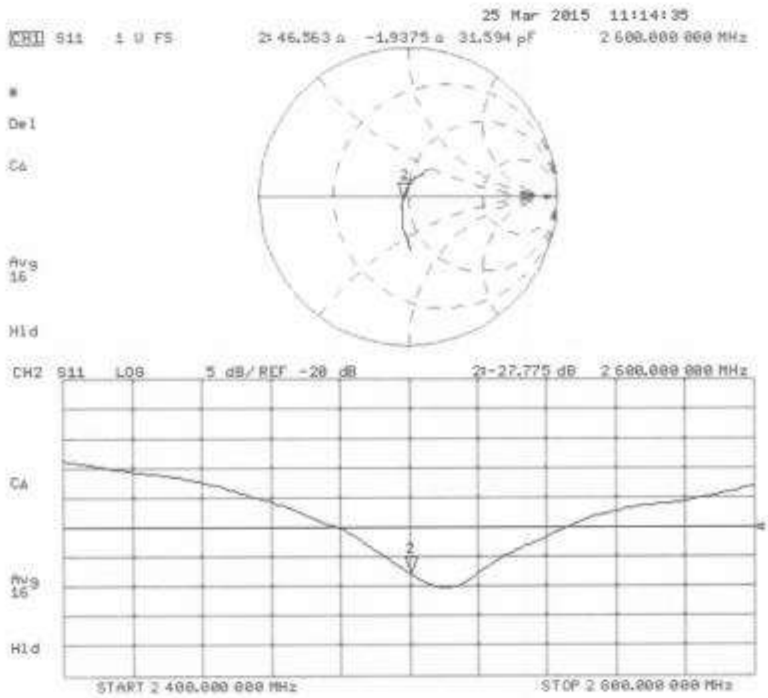
- Probe: ES3DV3 - SN3205; ConvF(4.13, 4.13, 4.13); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.03 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 29.2 W/kg
SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.27 W/kg
Maximum value of SAR (measured) = 18.6 W/kg



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

Impedance Measurement Plot for Body TSL



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

Salt: 99 % Pure Sodium Chloride Sugar: 98 % Pure Sucrose

Water: De-ionized, 16M resistivity HEC: Hydroxyethyl Cellulose

DGBE: 99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether

Composition of the Tissue Equivalent Matter

HCT CO., LTD.
74, Seoicheon-ro 578 beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383. Rep. of KOREA
TEL: +82 31 645 6300 FAX: +82 31 645 6401

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 1528-2003 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
11	3076	ES3DV3	Body	750	1014	2015.08.12	55.3	0.93	PASS	PASS	PASS	N/A	N/A	N/A
5	3903	EX3DV4	Body	835	441	2015.10.08	55.4	0.97	PASS	PASS	PASS	N/A	N/A	N/A
5	3903	EX3DV4	Body	1800	2d007	2015.10.08	53.1	1.54	PASS	PASS	PASS	N/A	N/A	N/A
1	3863	EX3DV4	Body	1900	5d032	2015.09.15	52.6	1.54	PASS	PASS	PASS	N/A	N/A	N/A
5	3903	EX3DV4	Body	2450	743	2015.10.08	53.5	1.92	PASS	PASS	PASS	OFDM	N/A	PASS
5	3903	EX3DV4	Body	2600	1015	2015.10.08	52.7	2.14	PASS	PASS	PASS	NA	N/A	NA

SAR System Validation Summary

Note;

All measurement were performed using probes calibrated for CW signal only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 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.