Maxwell

TEST REPORT

Report Reference No..................... :	**MWR1409002907**
FCC ID.. :	**RQQHLT-E415**
Compiled by (position+printed name+signature)..:	File administrators Martin Ao
Supervised by (position+printed name+signature)..:	Test Engineer Martin Ao
Approved by (position+printed name+signature)..:	Manager Dixon Hao
Date of issue....................................:	Sep 20, 2014
Representative Laboratory Name ..:	**Maxwell International Co., Ltd.**
Address..:	Room 509, Hongfa center building, Baoan District, Shenzhen, Guangdong, China
Testing Laboratory Name ....:	**The Testing and Technology Center for Industrial Products of Shenzhen Entry-Exit Inspection and Quarantine Bureau**
Address..:	No.289, 8th Industry Road, NanshanDistrict,Shenzhen,Guangdong
Applicant's name............................:	**HYUNDAI CORPORATION**
Address..:	140-2, Kye-dong, Chongro-ku, Seoul, South Korea
Test specification .... :	
Standard ....:	**ANSI C95.1–1999**
	47CFR §2.1093
TRF Originator..................................:	Maxwell International Co., Ltd.
Master TRF......................................:	Dated 2011-05

Test item description ....:	Mobile Phone
Trade Mark ....:	HYUNDAI
Manufacturer..................................:	**WASAM TECHNOLOGY (SHEN ZHEN) CO.,LTD.**
Model/Type reference.......................:	E415
Listed Models ....:	/
Operation Frequency.........................	GSM 850MHz/PCS1900MHz/WiFi2450/BT/WCDMA Band II/WCDMA Band V
Modulation Type	GSM(GMSK), Bluetooth(GFSK,8DPSK,Π/4DQPSK), DSSS(CCK,DQPSK,DBPSK),OFDM(64QAM,16QAM,QPSK, BPSK);QPSK(WCDMA)
Hardware version ....:	HYUNDAI_W407_V1.0
Software version ....:	HYUNDAI_W407_V1.0
Rating ....:	DC 3.70V
Result...:	**PASS**

TEST REPORT

Test Report No. :	**MWR1409002907**	Sep 20, 2014 Date of issue

Equipment under Test	:	Mobile Phone
Model /Type	:	E415
Listed Models	:	/
Applicant	:	**HYUNDAI CORPORATION**
Address	:	140-2, Kye-dong, Chongro-ku, Seoul, South Korea
Manufacturer	:	**WASAM TECHNOLOGY (SHEN ZHEN) CO.,LTD.**
Address	:	B,F Building, (Hengqiang Industrial Park), Bogang Taifeng Industrial Zone, Shajing Town, Bao'an District, Shenzhen, China.

Test Result:	**PASS**

Contents

1. TEST STANDARDS

The tests were performed according to following standards:

IEEE Std C95.1, 1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.
IEEE Std 1528™-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
KDB 447498 D01 Mobile Portable RF Exposure v05r01: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB 616217 D04 SAR for laptop and tablets v01: SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers
KDB865664 D01 SAR measurement 100 MHz to 6 GHz v02: SAR Measurement Requirements for 100 MHz to 6 GHz
KDB865664 D02 SAR Reporting v01: RF Exposure Compliance Reporting and Documentation Considerations
KDB248227: SAR measurement procedures for 802.112abg transmitters
FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation:Portable Devices
KDB648474 D04 SAR Handsets Multi Xmiter and Ant v01: SAR Evaluation Considerations for Wireless Handsets.
KDB941225 D06 Hot Spot SAR v01: SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities
KDB941225 D03 Test Reduction GSM_GPRS_EDGE V01 : Recommended SAR Test Reduction Procedures for GSM/GPRS/EDGE

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	Sep 10, 2014
Testing commenced on	:	Sep 12, 2014
Testing concluded on	:	Sep 16, 2014

2.2. Product Description

The **HYUNDAI CORPORATION**'s Model: E415 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

Name of EUT	Mobile Phone
Model Number	E415
FCC ID	RQQHLT-E415
Modilation Type	GMSK for GSM/GPRS;QPSK for WCDMA
Antenna Type	Internal
Supported Hotspot	Yes,when hot spots opened,WCDMA band II/V power will not reduced
GSM/EDGE/GPRS	Supported GPRS
Extreme temp. Tolerance	-30°C to +50°C
Extreme vol. Limits	3.40VDC to 4.20VDC (nominal: 3.70VDC)
GSM Operation Frequency Band	GSM 850MHz/ PCS 1900MHz
GSM Release Version	R99
GPRS operation mode	Class B
GPRS Multislot Class	12
EGPRS Multislot Class	Only support downlink mode
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit

2.3. Statement of Compliance

The maximum of results of SAR found during testing for E415 are follows:

Exposure Configuration	Technolohy Band	Highest Reported SAR 1g(W/Kg)	Equipment Class
Head (Separation Distance 0mm)	GSM850	**0.564**	PCE
	PCS1900	0.420	
	WCDMA Band V	0.516	
	WCDMA Band II	0.486	
	WLAN2450	0.612	DTS
Body-worn (Separation Distance 10mm)	GSM850	**0.867**	PCE
	PCS1900	0.676	
	WCDMA Band V	0.499	
	WCDMA Band II	0.734	
	WLAN2450	0.668	DTS

The SAR values found for the Mobile Phone are below the maximum recommended levels of 1.6W/Kg as averaged over any 1g tissue accordintg to the ANSI C95.1-1999.
For body worn operation,this devices has been tested and meets FCC RF exposure guidelines when used with any accessory that conrtains no metal and which provides a minimum separation distance of 10mm between this devices and the body of the user.User of other accessories may not ensure compliance with FCC RF exposure guidelines.
The EUT battery must be fully charged and checked periodically during the test to ascertain iniform power output.

GSM/WCDMA & WLAN Mode

Test Position	GSM850 Reported SAR1g (W/Kg)	GSM1900 Reported SAR1g (W/Kg)	WCDMA Band II Reported SAR1g (W/Kg)	WCDMA Band V Reported SAR1g (W/Kg)	WLAN Reported SAR1g (W/Kg)	Summation Reported SAR(1g) (W/kg)	SAR –to-peak-location Separation Ratio	Simultaneous Measurement Required?
Left Hand Touch	0.564	0.287	0.314	0.475	0.612	1.176	N/A	No
Left Hand Title	0.262	0.084	0.091	0.190	0.362	0.624	N/A	No
Right Hand Touch	0.547	0.420	0.486	0.516	0.513	1.060	N/A	No
Right Hand Title	0.283	0.066	0.064	0.212	0.268	0.551	N/A	No
Body-Front Side	0.606	0.604	0.643	0.418	0.471	1.114	N/A	No
Body-Rear Side	0.867	0.676	0.734	0.499	0.668	1.535	N/A	No
Body-Left Side	0.714	0.431	0.390	0.358	0.389	1.103	N/A	No
Body-Right Side	0.443	0.336	0.140	0.323	0.233	0.676	N/A	No
Body-Top Side	N/A	N/A	N/A	N/A	0.385	N/A	N/A	No
Body-Bottom Side	0.759	0.631	0.264	0.352	N/A	N/A	N/A	No

GSM/WCDMA & BT Mode

Test Position	GSM850 Reported SAR1g (W/Kg)	GSM1900 Reported SAR1g (W/Kg)	WCDMA Band II Reported SAR1g (W/Kg)	WCDMA Band V Reported SAR1g (W/Kg)	Bluetooth Estimated SAR (W/Kg)	Summation Reported SAR(1g) (W/kg)	SAR –to-peak-location Separation Ratio	Simultaneous Measurement Required?
Left Hand Touch	0.564	0.287	0.314	0.475	0.265	0.829	N/A	No
Left Hand Title	0.262	0.084	0.091	0.190	0.265	0.527	N/A	No
Right Hand Touch	0.547	0.420	0.486	0.516	0.265	0.812	N/A	No
Right Hand Title	0.283	0.066	0.064	0.212	0.265	0.548	N/A	No
Body-Front Side	0.606	0.604	0.643	0.418	0.133	0.739	N/A	No
Body-Rear Side	0.867	0.676	0.734	0.499	0.133	1.000	N/A	No
Body-Left Side	0.714	0.431	0.390	0.358	0.133	0.847	N/A	No
Body-Right Side	0.443	0.336	0.140	0.323	0.133	0.576	N/A	No
Body-Top Side	N/A	N/A	N/A	N/A	0.133	N/A	N/A	No
Body-Bottom Side	0.759	0.631	0.264	0.352	N/A	N/A	N/A	No

Note:1. The value with green color is the maximum values of standalone
2. The value with blue color is the maximum values of $\sum SAR_{1g}$
Accordint to the above tables,the highest sum of reported SAR values is 1.176W/Kg for Head and 1.535W/Kg for Body.

2.4. Equipment under Test

Power supply system utilised

Power supply voltage	:	○	120V / 60 Hz	○	115V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 3.70 V

2.5. Short description of the Equipment under Test (EUT)

2.5.1 General Description

E415 is subscriber equipment in the WCDMA/GSM system. The HSPA/UMTS frequency band is Band II, Band IV; The GSM/GPRS/EDGE (EDGE downlink only) frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900, but only Band II and Band V and GSM850 and PCS1900 bands test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, HSPA/UMTS and GSM/GPRS/EDGE protocol processing, voice, video MMS service, GPS, AGPS and WIFI etc. Externally it provides micro SD card interface, earphone port (to provide voice service) and SIM card interface. It also provides Bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other Bluetooth devices.

2.5.2 EUT Identity

IMEI No.	
SIM 1	135790246811220
SIM 2	135790246811228

NOTE: Unless otherwise noted in the report, the functional boards installed in the units shall be selected from the below list, but not means all the functional boards listed below shall be installed in one unit.

2.6. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

○	Power Cable	Length (m) :	/
		Shield :	/
		Detachable :	/
○	Multimeter	Manufacturer :	/
		Model No. :	/

2.7. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery
AE2	Charger

AE1
Model: E415
Capacitance: 1400mAh
Nominal Voltage: 3.70V
AE2:
Model: E415

*AE ID: is used to identify the test sample in the lab internally.

2.8. Note

1. The EUT is a Mobile Phone with WCDMA/GSM/GPRS,WiFi and Bluetooth fuction,The functions of the EUT listed as below:

	Test Standards	Reference Report
GSM/GPRS	FCC Part 22/FCC Part 24	MWR1409002901
WCDMA	FCC Part 22/FCC Part 24	MWR1409002902
Bluetooth	FCC Part 15 C 15.247	MWR1409002903
BLE	FCC Part 15 C 15.247	MWR1409002904
WiFi	FCC Part 15 C 15.247	MWR1409002905
USB Port	FCC Part 15 B	MWR1409002906
SAR	FCC Part 2 §2.1093	MWR1409002907

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

The Testing and Technology Center for Industrial Products of Shenzhen Entry-Exit Inspection and Quarantine Bureau
No.289, 8th Industry Road, Nanshan District, Shenzhen, Guangdong, China

The sites are constructed in conformance with the requirements
of ANSI C63.7, ANSI C63.4 (2009) and CISPR Publication 22.

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L2872

The Testing and Technology Center for Industrial Products of Shenzhen Entry-Exit Inspection and Quarantine Bureau has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: May 11, 2014. Valid time is until May 12, 2017.
Environmental conditions

3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	18-25 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

3.4. SAR Limits

FCC Limit (1g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

3.5. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Calibration	Calibration Interval
Data Acquisition Electronics DAEx	SPEAG	DAE4	1315	2013/11/25	1
E-field Probe	SPEAG	ES3DV3	3109	2013/11/29	1
System Validation Dipole D835V2	SPEAG	D835V2	4d134	2013/12/13	3
System Validation Dipole 1900V2	SPEAG	D1900V2	5d150	2013/12/12	3
System Validation Dipole 2450V2	SPEAG	D2450V2	884	2013/12/11	3
Network analyzer	Agilent	8753E	US37390562	2014/03/18	1
Universal Radio Communication Tester	ROHDE & SCHWARZ	CMU200	112012	2013/10/26	1
Dielectric Probe Kit	Agilent	85070E	US44020288	/	/
Power meter	Agilent	E4417A	GB41292254	2013/10/26	1
Power sensor	Agilent	8481H	MY41095360	2013/10/26	1
Signal generator	IFR	2032	203002/100	2013/10/26	1
Amplifier	AR	75A250	302205	2013/10/26	1

4. SAR Measurements System configuration

4.1. SAR Measurement Set-up

The DASY5 system for performing compliance tests consists of the following items:

A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).

A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

A unit to operate the optical surface detector which is connected to the EOC.

The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.

The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY5 software and SEMCAD data evaluation software.

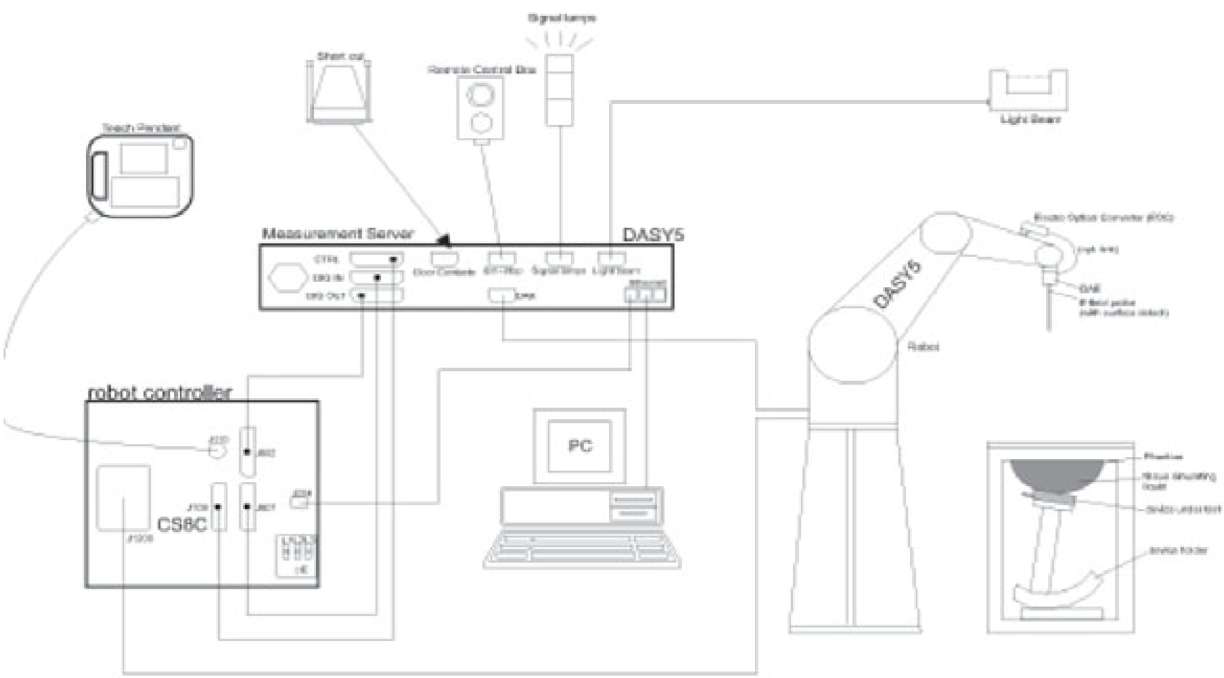
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld mobile phones.

Tissue simulating liquid mixed according to the given recipes.

System validation dipoles allowing to validate the proper functioning of the system.



4.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

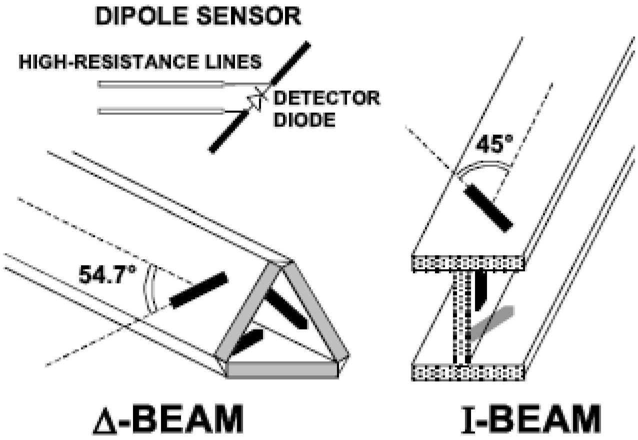
Probe Specification

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	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
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



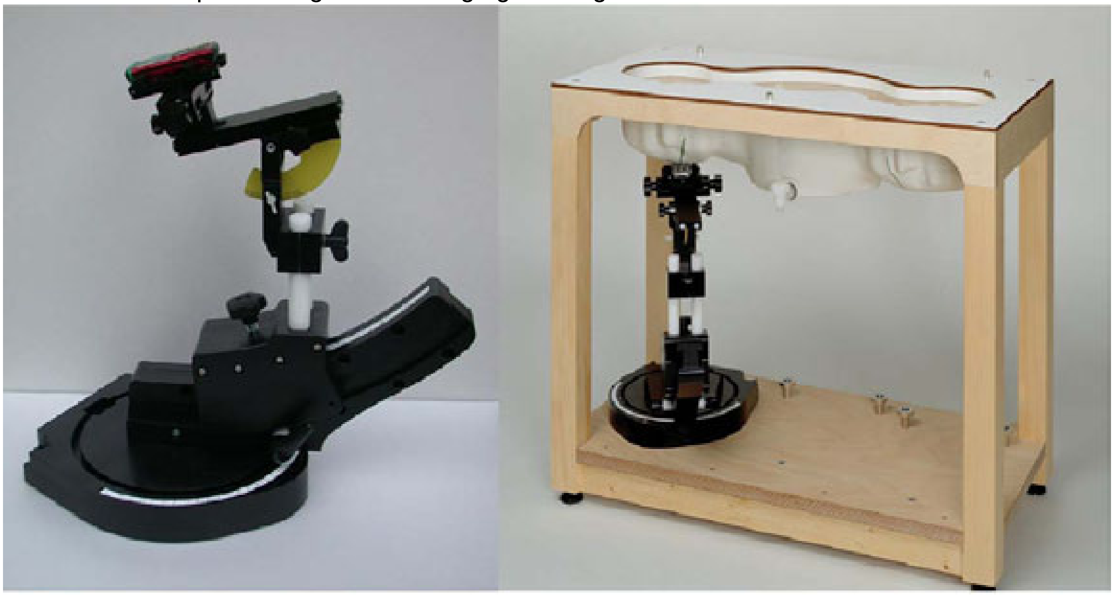
4.3. Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

4.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

4.5. Scanning Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. ± 5 %.

The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

Zoom Scan
Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

Spatial Peak Detection
The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses.The DASY5 system allows evaluations that combine measured data and robot positions, such as: • maximum search • extrapolation • boundary correction • peak search for averaged SAR During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard’s method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard’s method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

4.6. Data Storage and Evaluation

Data Storage
The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension “.DA4”. The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation
The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters: - Sensitivity Normi, ai0, ai1, ai2

- Conversion factor ConvFi
- Diode compression point Dcpi

Device parameters: - Frequency f
- Crest factor cf

Media parameters: - Conductivity σ
- Density ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

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

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcpi = diode compression point (DASY parameter)

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

$$\text{E}-\text{fieldprobes}: \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\text{H}-\text{fieldprobes}: \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

4.7. Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It’s satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

Target Frequency (MHz)	Head		Body	
	ε_r	$\sigma(S/m)$	ε_r	$\sigma(S/m)$
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94

835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

4.8. Tissue equivalent liquid properties

Dielectric performance of Head and Body tissue simulating liquid

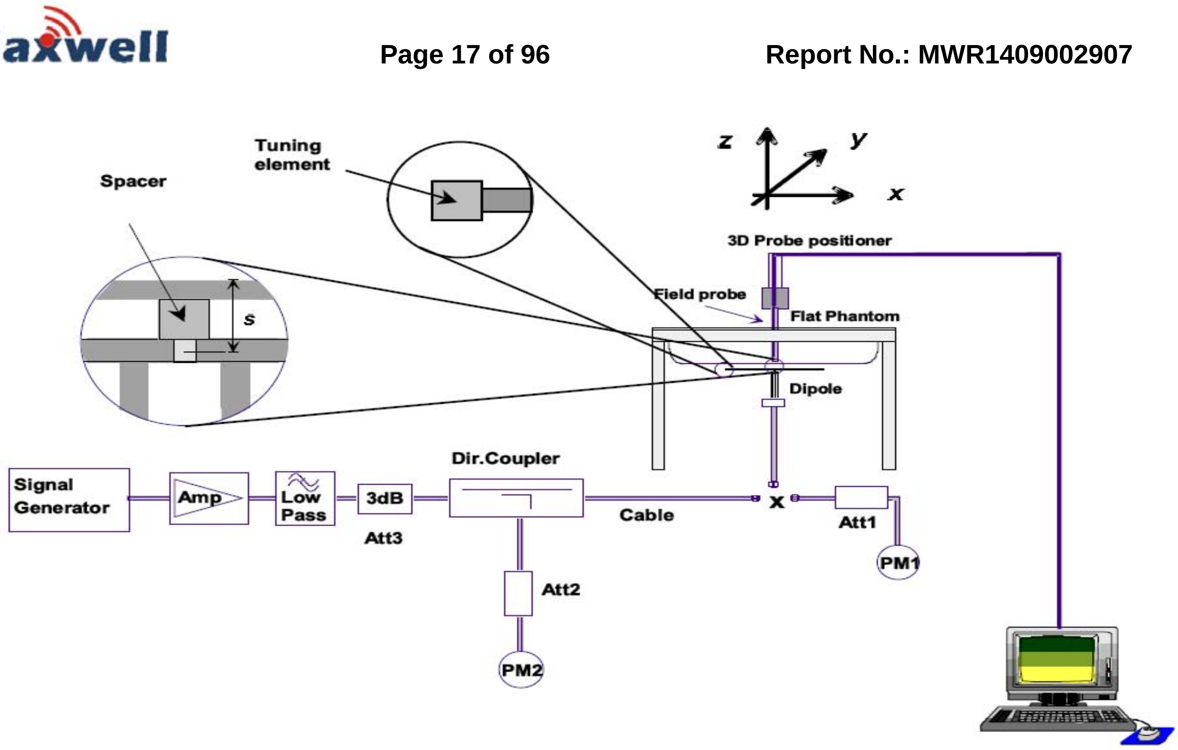
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Data
		ε_r	σ	ε_r	Dev. %	σ	Dev. %		
850H	824	41.56	0.90	41.90	0.8%	0.92	2.4%	22 degree	2014-09-12
	835	41.50	0.90	41.70	0.5%	0.93	3.5%		
	837	41.50	0.90	41.70	0.5%	0.93	3.4%		
	849	41.50	0.92	41.50	0.1%	0.94	3.0%		
1900H	1850	40.00	1.40	39.90	-0.2%	1.34	-4.5%	22 degree	2014-09-13
	1880	40.00	1.40	39.90	-0.2%	1.37	-2.2%		
	1900	40.00	1.40	39.80	-0.6%	1.39	-0.7%		
	1910	40.00	1.40	39.70	-0.7%	1.40	0.0%		
2450H	2412	39.27	1.77	39.40	0.3%	1.77	0.4%	22 degree	2014-09-14
	2437	39.22	1.79	39.20	0.0%	1.81	1.0%		
	2450	39.20	1.80	39.20	0.0%	1.82	1.1%		
	2462	39.18	1.81	39.20	0.1%	1.84	1.4%		
850B	824	55.24	0.97	53.60	-3.0%	0.95	-1.5%	22 degree	2014-09-15
	835	55.20	0.97	53.40	-3.2%	0.97	-0.4%		
	837	55.19	0.97	53.40	-3.3%	0.97	-0.6%		
	849	55.16	0.99	53.30	-3.4%	0.98	-0.6%		
1900B	1850	53.30	1.52	53.20	-0.2%	1.47	-3.5%	22 degree	2014-09-16
	1880	53.30	1.52	52.90	-0.7%	1.49	-2.0%		
	1900	53.30	1.52	52.90	-0.8%	1.51	-0.5%		
	1910	53.30	1.52	52.80	-0.9%	1.52	0.3%		
2450B	2412	52.75	1.91	52.70	0.1%	1.98	3.6%	22 degree	2014-09-14
	2437	52.72	1.94	52.60	-0.2%	2.01	3.7%		
	2450	52.70	1.95	52.60	-0.2%	2.03	3.9%		
	2462	52.68	1.97	52.60	-0.2%	2.04	3.9%		

4.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



The output power on dipole port must be calibrated to 24 dBm (250mW) before dipole is connected.

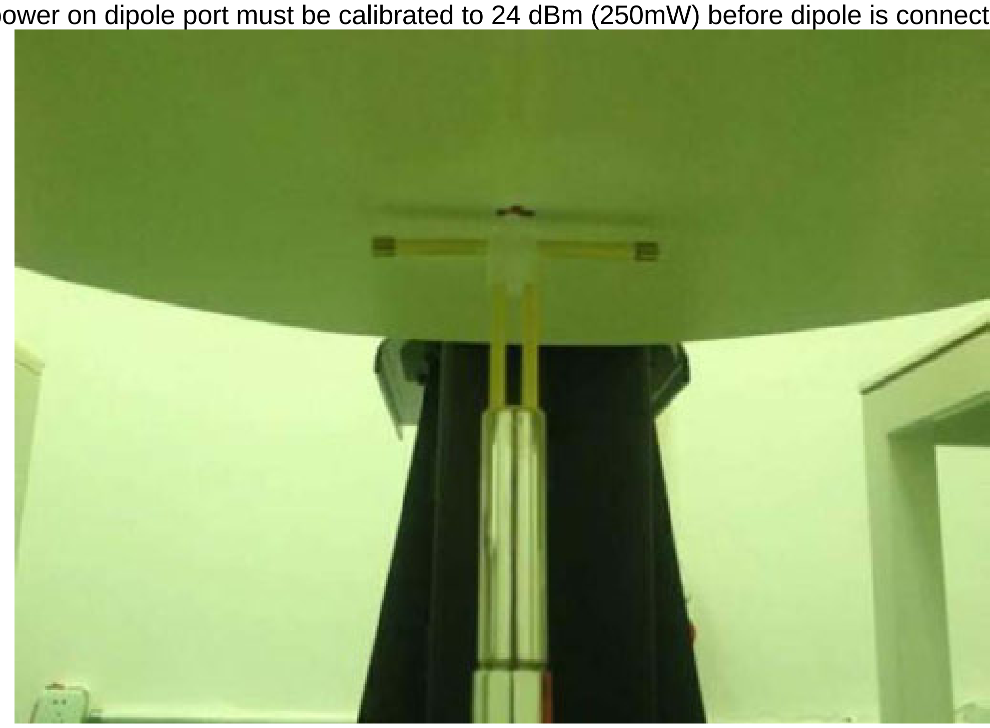


Photo of Dipole Setup

System Validation of Head

Measurement is made at temperature 22.0 ℃ and relative humidity 55%.							
Liquid temperature during the test: 22.0℃							
Measurement Date: 835MHz Sep 12th, 2014;1900MHz Sep 13th;2014, 2450MHz Sep 14th;2014							
Verification results	Frequency (MHz)	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
	835	1.55	2.38	1.60	2.44	3.23%	2.52%
	1900	5.08	9.71	4.90	9.48	-3.54%	-2.34%
	2450	6.05	13.0	6.22	13.7	2.81%	5.39%

System Validation of Body

Measurement is made at temperature 22.0 ℃ and relative humidity 55%.							
Liquid temperature during the test: 22.0℃							
Measurement Date: 835MHz Sep 15th, 2014;1900MHz Sep 16th;2014, 2450MHz Sep 14th;2014							
Verification results	Frequency (MHz)	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
	835	1.54	2.32	1.60	2.41	3.90%	3.88%
	1900	5.26	9.98	5.25	9.93	-0.19%	-0.50%
	2450	5.98	12.90	6.20	12.5	3.68%	-3.10%

4.10. SAR measurement procedure

4.10.1 Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in Picture 11.1.

Step 1: The tests described in 11.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

a). all device positions (cheek and tilt, for both left and right sides of the SAM phantom;

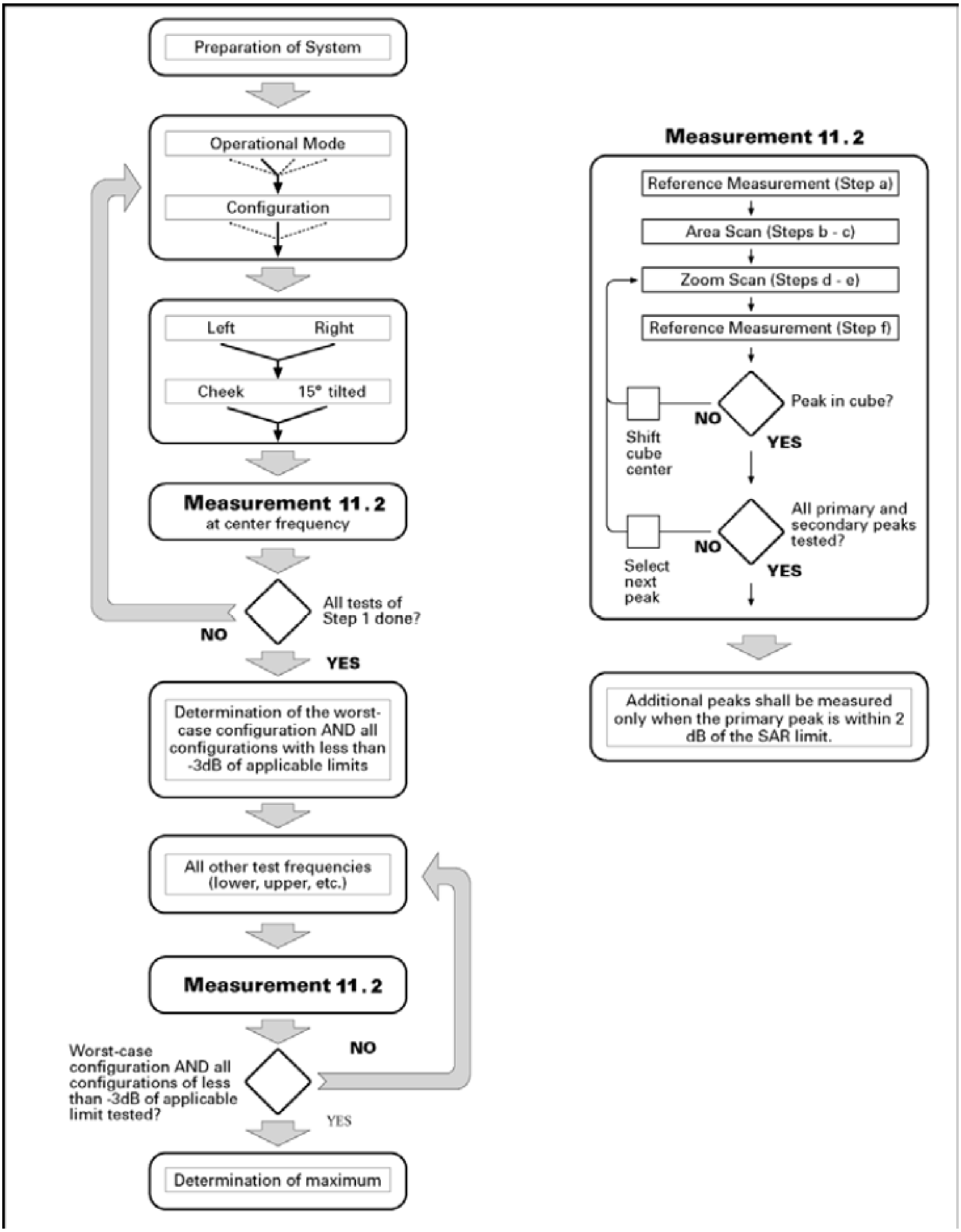
b). all configurations for each device position in a), e.g., antenna extended and retracted, and

c). all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., $N_c > 3$), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

Step 2: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 11.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

Step 3: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.



Picture 10.1 Block diagram of the tests to be performed

4.10.2 General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2003. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

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

4.10.3 Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. 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 that the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

4.10.4 Power Drift

To control the output power stability during the SAR test, DASY5 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Table 14.1 to Table 14.11 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

4.10.4 Area Scan Based 1-g SAR

4.10.4.1 Requirement of KDB

According to the KDB447498 D01 v05, when the implementation is based the specific polynomial fit algorithm as presented at the 29th Bioelectromagnetics Society meeting (2007) and the estimated 1-g SAR is ≤ 1.2 W/kg, a zoom scan measurement is not required provided it is also not needed for any other purpose; for example, if the peak SAR location required for simultaneous transmission SAR test exclusion can be determined accurately by the SAR system or manually to discriminate between distinctive peaks and scattered noisy SAR distributions from area scans.
There must not be any warning or alert messages due to various measurement concerns identified by the SAR system; for example, noise in measurements, peaks too close to scan boundary, peaks are too sharp, spatial resolution and uncertainty issues etc. The SAR system verification must also demonstrate that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR (See Annex B). When all the SAR results for each exposure condition in a frequency band and wireless mode are based on estimated 1-g SAR, the 1-g SAR for the highest SAR configuration must be determined by a zoom scan.

4.10.4.2 Fast SAR Algorithms

The approach is based on the area scan measurement applying a frequency dependent attenuation parameter. This attenuation parameter was empirically determined by analyzing a large number of phones. The MOTOROLA FAST SAR was developed and validated by the MOTOROLA Research Group in Ft. Lauderdale.
In the initial study, an approximation algorithm based on Linear fit was developed. The accuracy of the algorithm has been demonstrated across a broad frequency range (136-2450 MHz) and for both 1- and 10-g averaged SAR using a sample of 264 SAR measurements from 55 wireless handsets. For the sample size studied, the root-mean-squared errors of the algorithm are 1.2% and 5.8% for 1- and 10-g averaged SAR, respectively
In the second step, the same research group optimized the fitting algorithm to an Polynomial fit whereby the frequency validity was extended to cover the range 30-6000MHz. Details of this study can be found in the BEMS 2007 Proceedings.
Both algorithms are implemented in DASY software.

5. TEST CONDITIONS AND RESULTS

5.1. Conducted Power Results

Max Conducted power measurement results and power drift from tune-up tolerance provide by manufacturer:

GM 850		Burst Conducted power (dBm)				Average power (dBm)		
		Channel 128	Channel 190	Channel 251		Channel 128	Channel 190	Channel 251
GSM		32.45	32.52	32.67	-9.03dB	23.42	23.49	23.64
GPRS (GMSK)	1TX slot	32.32	32.45	32.61	-9.03dB	23.29	23.42	23.58
	2TX slot	30.08	30.26	30.41	-6.02dB	24.06	23.42	24.39
	3TX slot	28.45	28.57	28.76	-4.26dB	**24.19**	**24.24**	**24.50**
	4TX slot	27.03	27.15	27.28	-3.01dB	24.02	24.31	24.27
EGPRS (GMSK)	1TX slot	32.29	32.41	32.54	-9.03dB	23.26	23.38	23.51
	2TX slot	30.01	30.20	30.38	-6.02dB	23.99	24.18	24.36
	3TX slot	28.42	28.55	28.76	-4.26dB	**24.16**	**24.29**	**24.50**
	4TX slot	26.98	27.12	27.22	-3.01dB	23.97	24.11	24.21
GM 1900		Burst Conducted power (dBm)				Average power (dBm)		
		Channel 512	Channel 661	Channel 810		Channel 512	Channel 661	Channel 810
GSM		29.90	29.58	29.14	-9.03dB	20.87	20.55	20.11
GPRS (GMSK)	1TX slot	29.81	29.49	29.12	-9.03dB	20.78	20.46	20.09
	2TX slot	28.33	28.29	28.04	-6.02dB	22.31	22.27	22.02
	3TX slot	27.22	27.16	27.02	-4.26dB	**22.96**	**22.90**	**22.76**
	4TX slot	25.03	24.94	24.78	-3.01dB	22.02	21.93	21.77
EGPRS (GMSK)	1TX slot	29.77	29.44	29.12	-9.03dB	20.74	20.41	20.09
	2TX slot	28.28	28.23	28.01	-6.02dB	22.26	22.21	21.99
	3TX slot	27.16	27.11	26.94	-4.26dB	**22.90**	**22.85**	**22.68**
	4TX slot	25.00	24.81	24.72	-3.01dB	21.99	21.80	21.71

NOTES:
1) Division Factors
To average the power, the division factor is as follows:
1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB
2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB
3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB
4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB
According to the conducted power as above, the body measurements are performed with 3Txslots for GPRS850 and GPRS1900.
Note: According to the KDB941225 D03, "when SAR tests for EDGE or EGPRS mode is necessary, GMSK modulation should be used".

Conducted power measurement WCDMA FDD Band II (1900MHz)

Output power WCDMA FDD Band II/dBm			
Mode	Channel/Frequency		
	9262/1852.4MHz	9400/1880.0MHz	9538/1907.6MHz
RMC 12.2kbps	23.67	23.89	23.41
RMC 64kbps	23.55	23.85	23.37
RMC 144kbps	23.51	23.85	23.33
RMC 384kbps	23.51	23.85	23.32
HSDPA Sub test 1	23.22	23.41	23.05
HSDPA Sub test 2	23.14	23.28	22.97
HSDPA Sub test 3	22.85	22.94	22.68
HSDPA Sub test 4	22.63	22.76	22.44
HSUPA Sub test 1	23.20	23.34	23.00
HSUPA Sub test 2	21.04	21.26	21.01
HSUPA Sub test 3	22.46	22.67	22.24
HSUPA Sub test 4	21.04	21.22	21.01
HSUPA Sub test 5	23.20	23.30	23.00

Output power WCDMA FDD Band V/dBm			
Mode	Channel/Frequency		
	4132/826.4MHz	4182/836.6MHz	4233/846.6MHz
RMC 12.2kbps	23.78	23.45	23.23
RMC 64kbps	23.74	23.45	23.23
RMC 144kbps	23.74	23.45	23.23
RMC 384kbps	23.74	23.45	23.23
HSDPA Sub test 1	23.13	23.32	23.06
HSDPA Sub test 2	22.44	22.56	22.02
HSDPA Sub test 3	21.21	21.41	21.11
HSDPA Sub test 4	20.96	21.23	20.84
HSUPA Sub test 1	23.43	23.80	23.40
HSUPA Sub test 2	21.42	21.71	21.25
HSUPA Sub test 3	22.36	22.54	22.29
HSUPA Sub test 4	21.42	21.69	21.20
HSUPA Sub test 5	23.40	23.74	23.40

Note: HSUPA body SAR are not required, because maximum average output power of each RF channel with HSDPA active is not 1/4 dB higher than that measured without HSUPA and the maximum SAR for WCDMA Band II and WCDMA Band V are not above 75% of the SAR limit.

WLAN

Mode	Channel	Frequency (MHz)	Worst case Data rate of worst case	Conducted Output Power (dBm)	
				Peak	Average
802.11b	1	2412	1Mbps	22.51	18.11
	6	2437	1Mbps	22.16	17.85
	11	2462	1Mbps	22.72	18.24
802.11g	1	2412	6Mbps	21.70	16.22
	6	2437	6Mbps	21.32	16.16
	11	2462	6Mbps	21.95	16.27
802.11n(20MHz)	1	2412	6.5 Mbps	21.81	15.31
	6	2437	6.5 Mbps	22.00	15.39
	11	2462	6.5 Mbps	22.22	15.42
802.11n(40MHz)	3	2422	13.5 Mbps	20.61	13.37
	6	2437	13.5 Mbps	20.43	13.32
	9	2452	13.5 Mbps	20.76	13.43

Note: SAR is not required for 802.11b/g/n channels if the output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels, and for each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 0.25dB higher than those measured at the lowest data rate. According to the above conducted power, the EUT should not be tested for “802.11b/g/n”.

Bluetooth

Mode	Channel	Frequency (MHz)	Conducted Peak Output Power (dBm)
BLE-GFSK	00	2402	1.33
	19	2440	1.17
	39	2480	1.20
GFSK	00	2402	6.65
	39	2441	7.54
	78	2480	7.98
8DPSK	00	2402	6.48
	39	2441	7.41
	78	2480	7.75
π/4DQPSK	00	2402	6.91
	39	2441	7.74
	78	2480	7.56

Manufacturing tolerance

GSM Speech

GSM 850 (Peak)			
Channel	Channel 251	Channel 190	Channel 190
Target (dBm)	32.00	32.00	32.00
Tolerance ±(dB)	1	1	1
GSM 1900 (Peak)			
Channel	Channel 810	Channel 661	Channel 512
Target (dBm)	29.00	29.00	29.00
Tolerance ±(dB)	1	1	1

GPRS (GMSK Modulation)

GSM 850 GPRS (Peak)				
Channel		251	190	128
1 Txslot	Target (dBm)	32.0	32.0	32.0
	Tolerance ±(dB)	1	1	1
2 Txslot	Target (dBm)	30.0	30.0	30.0
	Tolerance ±(dB)	1	1	1
3 Txslot	Target (dBm)	28.0	28.0	28.0
	Tolerance ±(dB)	1	1	1
4 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance ±(dB)	1	1	1
GSM 850 EDGE (Peak)				
Channel		251	190	128
1 Txslot	Target (dBm)	32.0	32.0	32.0
	Tolerance ±(dB)	1	1	1
2 Txslot	Target (dBm)	30.0	30.0	30.0
	Tolerance ±(dB)	1	1	1
3 Txslot	Target (dBm)	28.0	28.0	28.0
	Tolerance ±(dB)	1	1	1
4 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance ±(dB)	1	1	1
GSM 1900 GPRS (Peak)				
Channel		810	661	512
1 Txslot	Target (dBm)	29.0	29.0	29.0
	Tolerance ±(dB)	1	1	1
2 Txslot	Target (dBm)	28.0	28.0	28.0
	Tolerance ±(dB)	1	1	1
3 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance ±(dB)	1	1	1
4 Txslot	Target (dBm)	25.0	25.0	25.0
	Tolerance ±(dB)	1	1	1
GSM 1900 EDGE (Peak)				
Channel		810	661	512
1 Txslot	Target (dBm)	29.0	29.0	29.0
	Tolerance ±(dB)	1	1	1
2 Txslot	Target (dBm)	28.0	28.0	28.0
	Tolerance ±(dB)	1	1	1
3 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance ±(dB)	1	1	1
4 Txslot	Target (dBm)	25.0	25.0	25.0
	Tolerance ±(dB)	1	1	1

WCDMA

WCDMA Band V			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSDPA(sub-test 1)			
Channel	Channel 4132	Channel 4182	Channel 4233

Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSDPA(sub-test 2)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSDPA(sub-test 3)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSDPA(sub-test 4)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSUPA(sub-test 1)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSUPA(sub-test 2)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSUPA(sub-test 3)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSUPA(sub-test 4)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1	1	1
WCDMA Band V HSUPA(sub-test 5)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1
WCDMA Band II			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1
WCDMA Band II HSDPA(sub-test 1)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1
WCDMA Band II HSDPA(sub-test 2)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1
WCDMA Band II HSDPA(sub-test 3)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1	1	1
WCDMA Band II HSDPA(sub-test 4)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1	1	1
WCDMA Band II HSUPA(sub-test 1)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1
WCDMA Band II HSUPA(sub-test 2)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0

Tolerance ±(dB)	1	1	1
WCDMA Band II HSUPA(sub-test 3)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance ±(dB)	1	1	1
WCDMA Band II HSUPA(sub-test 4)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1	1	1
WCDMA Band II HSUPA(sub-test 5)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	23.0	23.0	23.0
Tolerance ±(dB)	1	1	1

WLAN

802.11b (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	17.5	17.5	17.5
Tolerance ±(dB)	1	1	1
802.11g (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15.5	15.5	15.5
Tolerance ±(dB)	1	1	1
802.11n(20MHz) (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1	1	1
802.11n(40MHz) (Average)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	13.0	13.0	13.0
Tolerance ±(dB)	1	1	1

Bluetooth

BLE-GFSK (Peak)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	1.00	1.00	1.00
Tolerance ±(dB)	1	1	1
GFSK (Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	7.00	7.00	7.00
Tolerance ±(dB)	1	1	1
8DPSK (Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	7.00	7.00	7.00
Tolerance ±(dB)	1	1	1
π/4DQPSK (Peak)			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	7.00	7.00	7.00
Tolerance ±(dB)	1	1	1

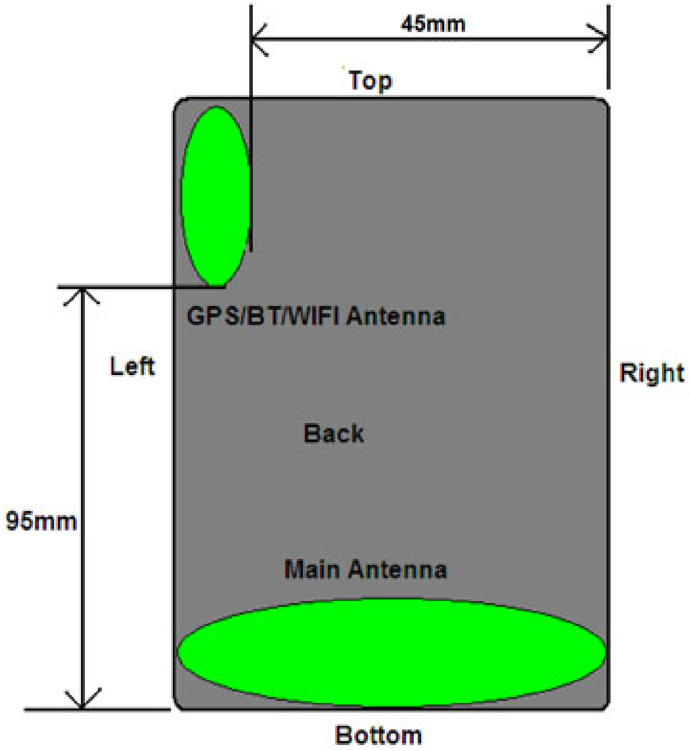
5.2. Simultaneous TX SAR Considerations

5.2.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For the DUT,the BT and WiFi modules sharing same antenna,GSM and WCDMA module sharing a single antenna, So we can get following combination that can transmit signal simultaneously.

Air-Interface	Band (MHz)	Type	Simultaneous Transmissions	Voice over Digital Transport(Data)
GSM	850	VO	Yes,WLAN or BT	N/A
	1900	VO		
	GPRS/EDGE	DT	Yes,WLAN or BT	N/A
WCDMA	Band II/Band V	DT	Yes,WLAN or BT	N/A
WLAN	2450	DT	Yes,GSM,GPRS,EDGE,WCDMA	Yes
BT	2441	DT	Yes,GSM,GPRS,EDGE,WCDMA	N/A
Note:VO-Voice Service only;DT-Digital Transport				

5.2.2 Transmit Antenna Separation Distances



5.2.2 SAR Measurement Positions

According to the KDB941225 D06 Hot Spot SAR v01, the edges with less than 2.5 cm distance to the antennas need to be tested for SAR.

SAR measurement positions						
Mode	Front	Rear	Left edge	Right edge	Top edge	Bottom edge
Main antenna(GSM/WCDMA)	Yes	Yes	Yes	Yes	No	Yes
WLAN	Yes	Yes	Yes	Yes	Yes	No

5.2.3 Standalone SAR Test Exclusion Considerations

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

Appendix A

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

Picture 12.2 Power Thresholds

5.2.4 Standalone SAR Test Exclusion Considerations and Estimated SAR

Per KDB447498 D01,the SAR exclusion threshold for distance <50mm is defined by the following equation:

$$\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} * \sqrt{\text{Frequency (GHz)}} \leq 3.0$$

Based on the above equation,Bluetooth SAR was required:

Head Evaluation=[$10^{(8/10)}$/5]*(2.480$^{1/2}$)=2.0<3.0

Body Evaluation=[$10^{(8/10)}$/10]*(2.480$^{1/2}$)=1.0<3.0

For conditions where the estimated SAR is overly conservative for certain conditios,the test lab may choose to perform standalone SAR measurements and use the measured SAR to determine simultaneous transmission SAR test exclusion.

Based on the above equation,WiFi SAR was required:

Head Evaluation=[$10^{(18.5/10)}$/5]*(2.462$^{1/2}$)=21.0>3.0

Body Evaluation=[$10^{(18/10)}$/10]*(2.462$^{1/2}$)=11.0>3.0

When standalone SAR is not required to be measured per FCC KDB 447498 D01,the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\text{(max.power of channel,including tune-up tolerance,mW)}}{\text{(min.test separation distance,mm)}} * \frac{\sqrt{f(GHz)}}{7.5}$$

Per FCC KD B447498 D01,simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the transmitting antenna in a specific a physical test configuration is ≤1.6 W/Kg.When the sum is greater than the SAR limit,SAR test exclusion is determined by the SAR to peak location separation ratio.

$$\text{Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{\text{(peak location separation,mm)}} < 0.04$$

For Bluetooth,the Estimated SAR for Head at 5mm for estimate and 10mm to Estimated Body SAR(Hotspot open and Hotspot closed)

Estimated SAR_{Head}=((6.3096mW)/5mm)*(1.5748/7.5)=0.265W/Kg

Estimated SAR_{Body}=((6.3096mW)/10mm)*(1.5748/7.5)=0.133W/Kg

5.2.5 Evaluation of Simultaneous SAR

GSM/WCDMA & WLAN Mode

Test Position	GSM850 Reported SAR1g (W/Kg)	GSM1900 Reported SAR1g (W/Kg)	WCDMA Band II Reported SAR1g (W/Kg)	WCDMA Band V Reported SAR1g (W/Kg)	WLAN Reported SAR1g (W/Kg)	Summation Reported SAR(1g) (W/kg)	SAR –to-peak-location Separation Ratio	Simultaneous Measurement Required?
Left Hand Touch	0.564	0.287	0.314	0.475	0.612	1.176	N/A	No
Left Hand Title	0.262	0.084	0.091	0.190	0.362	0.624	N/A	No
Right Hand Touch	0.547	0.420	0.486	0.516	0.513	1.060	N/A	No
Right Hand Title	0.283	0.066	0.064	0.212	0.268	0.551	N/A	No
Body-Front Side	0.606	0.604	0.643	0.418	0.471	1.114	N/A	No
Body-Rear Side	0.867	0.676	0.734	0.499	0.668	1.535	N/A	No
Body-Left Side	0.714	0.431	0.390	0.358	0.389	1.103	N/A	No
Body-Right Side	0.443	0.336	0.140	0.323	0.233	0.676	N/A	No
Body-Top Side	N/A	N/A	N/A	N/A	0.385	N/A	N/A	No
Body-Bottom Side	0.759	0.631	0.264	0.352	N/A	N/A	N/A	No

GSM/WCDMA & BT Mode

Test Position	GSM850 Reported SAR1g (W/Kg)	GSM1900 Reported SAR1g (W/Kg)	WCDMA Band II Reported SAR1g (W/Kg)	WCDMA Band V Reported SAR1g (W/Kg)	Bluetooth Estimated SAR (W/Kg)	Summation Reported SAR(1g) (W/kg)	SAR –to-peak-location Separation Ratio	Simultaneous Measurement Required?
Left Hand Touch	0.564	0.287	0.314	0.475	0.265	0.829	N/A	No
Left Hand Title	0.262	0.084	0.091	0.190	0.265	0.527	N/A	No
Right Hand Touch	0.547	0.420	0.486	0.516	0.265	0.812	N/A	No
Right Hand Title	0.283	0.066	0.064	0.212	0.265	0.548	N/A	No
Body-Front Side	0.606	0.604	0.643	0.418	0.133	0.739	N/A	No
Body-Rear Side	0.867	0.676	0.734	0.499	0.133	1.000	N/A	No
Body-Left Side	0.714	0.431	0.390	0.358	0.133	0.847	N/A	No
Body-Right Side	0.443	0.336	0.140	0.323	0.133	0.576	N/A	No
Body-Top Side	N/A	N/A	N/A	N/A	0.133	N/A	N/A	No
Body-Bottom Side	0.759	0.631	0.264	0.352	N/A	N/A	N/A	No

Note:1. The value with green color is the maximum values of standalone
2. The value with blue color is the maximum values of $\sum SAR_{1g}$

5.3. SAR Measurement Results

The product with 2 SIMs and 2 SIMs(SIM1 and SIM2) can not used Simultaneous, we tested 2 SIMs(SIM1 and SIM2) and recorded worst case at SIM 1

It is determined by user manual for the distance between the EUT and the phantom bottom.The distance is 10mm and just applied to the condition of body worn accessory.

The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} * 10^{(Ptarget-Pmeasured))/10}$$

$$\text{Scaling factor} = 10^{(Ptarget-Pmeasured))/10}$$

$$\text{Reported SAR} = \text{Measured SAR} * \text{Scaling factor}$$

Where P_{target} is the power of manufacturing upper limit;
$P_{measured}$ is the measured power;
Measured SAR is measured SAR at measured power which including power drift)
Reported SAR which including Power Drift and Scaling factor

Duty Cycle

Test Mode	Duty Cycle
Speech for GSM850/1900	1:8.3
GPRS850/1900	1:277
WCDMA	1:1
WiFi2450	1:1

SAR Values (GSM850-Head)

Test Freq. Ch	MHz	Side	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over 1g(W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
190	836.60	Left	Touch	33.00	32.52	0.504	0.10	1.12	0.564	1.60	1
190	836.60	Left	Tilt	33.00	32.52	0.234	-0.03	1.12	0.262	1.60	--
190	836.60	Right	Touch	33.00	32.52	0.488	0.11	1.12	0.547	1.60	--
190	836.60	Right	Tilt	33.00	32.52	0.253	0.08	1.12	0.283	1.60	--

Note: 1.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤ transmission band ≤200MHz;

SAR Values (GSM850-Body)

Test Freq. Ch	MHz	Mode (number of timeslots)	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over 1g(W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
190	836.60	GPRS (3)	Front	29.00	28.57	0.546	-0.12	1.11	0.606	1.60	--
190	836.60	GPRS (3)	Rear	29.00	28.57	0.781	-0.08	1.11	0.867	1.60	2
190	836.60	GPRS (3)	Left	29.00	28.57	0.643	0.10	1.11	0.714	1.60	--
190	836.60	GPRS (3)	Right	29.00	28.57	0.399	0.12	1.11	0.443	1.60	--
190	836.60	GPRS (3)	Bottom	29.00	28.57	0.684	-0.01	1.11	0.759	1.60	--
251	848.80	GPRS (3)	Rear	29.00	28.76	0.668	-0.01	1.06	0.708	1.60	--
128	824.20	GPRS (3)	Rear	29.00	28.45	0.657	0.03	1.14	0.749	1.60	--
190	836.60	EDGE(3)	Rear	29.00	28.55	0.702	0.05	1.11	0.779	1.60	--
190	836.60	Speech	Rear with Headset	33.00	32.52	0.681	-0.04	1.12	0.763	1.60	--

Note: 1.The distance between the EUT and the phantom bottom is 10mm.
2.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤ transmission band ≤200MHz;
≤ 0.4W/Kg and transmission band >200MHz

SAR Values (GSM1900-Head)

Test Freq. Ch	MHz	Side	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over 1g(W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
661	1880.0	Left	Touch	30.00	29.58	0.261	0.09	1.10	0.287	1.60	--
661	1880.0	Left	Tilt	30.00	29.58	0.076	0.02	1.10	0.084	1.60	--
661	1880.0	Right	Touch	30.00	29.58	0.382	0.11	1.10	0.420	1.60	3
661	1880.0	Right	Tilt	30.00	29.58	0.060	-0.01	1.10	0.066	1.60	--

Note: 1.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤ transmission band ≤200MHz;

SAR Values (GSM1900-Body)

Test Freq. Ch	MHz	Mode (number of timeslots)	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over 1g(W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
661	1880.0	GPRS (3)	Front	28.00	27.16	0.499	-0.10	1.21	0.604	1.60	--
661	1880.0	GPRS (3)	Rear	28.00	27.16	0.559	-0.12	1.21	0.676	1.60	4
661	1880.0	GPRS (3)	Left	28.00	27.16	0.356	-0.01	1.21	0.431	1.60	--
661	1880.0	GPRS (3)	Right	28.00	27.16	0.278	0.11	1.21	0.336	1.60	--
661	1880.0	GPRS (3)	Bottom	28.00	27.16	0.314	-0.08	1.21	0.380	1.60	--
661	1880.0	EDGE(3)	Rear	28.00	27.11	0.513	-0.06	1.23	0.631	1.60	--
661	1880.0	Speech	Rear with Headset	30.00	29.58	0.522	0.03	1.10	0.574	1.60	--

Note: 1.The distance between the EUT and the phantom bottom is 10mm.
2.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤ transmission band ≤200MHz;
≤ 0.4W/Kg and transmission band >200MHz

SAR Values (WCDMA Band V-Head)

Test Frequency Ch	MHz	Side	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over 1g(W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
4182	836.40	Left	Touch	24.00	23.45	0.417	-0.14	1.14	0.475	1.60	5
4182	836.40	Left	Tilt	24.00	23.45	0.167	-0.12	1.14	0.190	1.60	--
4182	836.40	Right	Touch	24.00	23.45	0.453	-0.05	1.14	0.516	1.60	--
4182	836.40	Right	Tilt	24.00	23.45	0.186	-0.11	1.14	0.212	1.60	--

Note: 1.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤transmission band ≤200MHz;

SAR Values (WCDMABand V-Body)

Test Frequency Ch	MHz	Mode (number of timeslots)	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over 1g(W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
4182	836.40	RMC	Front	24.00	23.45	0.367	-0.12	1.14	0.418	1.60	--
4182	836.40	RMC	Rear	24.00	23.45	0.438	0.14	1.14	0.499	1.60	6
4182	836.40	RMC	Left	24.00	23.45	0.314	-0.11	1.14	0.358	1.60	--
4182	836.40	RMC	Right	24.00	23.45	0.283	-0.05	1.14	0.323	1.60	--
4182	836.40	RMC	Bottom	24.00	23.45	0.309	-0.13	1.14	0.352	1.60	--
4182	836.40	Speech	Rear with Headset	24.00	23.45	0.415	0.02	1.14	0.473	1.60	--

Note: 1.The distance between the EUT and the phantom bottom is 10mm.
2.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤transmission band ≤200MHz;
≤ 0.4W/Kg and transmission band >200MHz

SAR Values (WCDMA Band II -Head)

Test Frequency		Side	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over 1g(W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
Ch	MHz										
9400	1880.0	Left	Touch	24.00	23.89	0.305	-0.11	1.03	0.314	1.60	--
9400	1880.0	Left	Tilt	24.00	23.89	0.088	-0.15	1.03	0.091	1.60	--
9400	1880.0	Right	Touch	24.00	23.89	0.472	0.06	1.03	0.486	1.60	7
9400	1880.0	Right	Tilt	24.00	23.89	0.062	-0.14	1.03	0.064	1.60	---

Note: 1.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤transmission band ≤200MHz;

SAR Values (WCDMA Band II -Body)

Test Frequency		Mode (number of timeslots)	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over 1g(W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
Ch	MHz										
9400	1880.0	RMC	Front	24.00	23.89	0.624	-0.12	1.05	0.643	1.60	--
9400	1880.0	RMC	Rear	24.00	23.89	0.713	-0.09	1.05	0.734	1.60	8
9400	1880.0	RMC	Left	24.00	23.89	0.379	-0.11	1.05	0.390	1.60	--
9400	1880.0	RMC	Right	24.00	23.89	0.136	0.06	1.05	0.140	1.60	--
9400	1880.0	RMC	Bottom	24.00	23.89	0.256	-0.14	1.05	0.264	1.60	--
9400	1880.0	Speech	Rear with Headset	24.00	23.89	0.682	-0.07	1.05	0.702	1.60	--

Note: 1.The distance between the EUT and the phantom bottom is 10mm.
2.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤ transmission band ≤200MHz;
≤ 0.4W/Kg and transmission band >200MHz

SAR Values (WLAN2450-Head)

Test Frequency		Side	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over1g (W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
Ch	MHz										
6	2437	Left	Touch	18.50	17.85	0.528	0.01	1.16	0.612	1.60	9
6	2437	Left	Tilt	18.50	17.85	0.312	0.12	1.16	0.362	1.60	--
6	2437	Right	Touch	18.50	17.85	0.442	-0.17	1.16	0.513	1.60	--
6	2437	Right	Tilt	18.50	17.85	0.231	-0.10	1.16	0.268	1.60	--

Note: 1.According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤transmission band ≤200MHz;

SAR Values (WLAN2450-Body)

Test Frequency		Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Measurement SAR over 1g(W/kg)	Power drift	Scaling Factor	Reported SAR over1g (W/kg)	SAR limit 1g (W/kg)	Ref. Plot #
Ch	MHz									
6	2437	Front	18.50	17.85	0.406	-0.12	1.16	0.471	1.60	--
6	2437	Rear	18.50	17.85	0.562	-0.14	1.16	0.668	1.60	10
6	2437	Left	18.50	17.85	0.335	-0.05	1.16	0.389	1.60	--
6	2437	Right	18.50	17.85	0.201	-0.09	1.16	0.233	1.60	--
6	2437	Top	18.50	17.85	0.332	-0.14	1.16	0.385	1.60	--

Note: 1. According to KDB447498,When the 1-g SAR for the mid-band channel,or the channel with highest output power satidfy the following conditions,testing of the other channels in the band is not required.
≤0.8W/Kg and transmission band ≤100MHz;
≤0.6W/Kg and 100MHz ≤transmission band ≤200MHz;
≤ 0.4W/Kg and transmission band >200MHz
3.Accoding to KDB 248227,Each channel should be tested at the lowest data rate in each mode.

5.4. SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. The following procedures are applied to determine if repeated measurements are required.

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

5.5. Measurement Uncertainty (300MHz-3GHz)

According to IEEE 1528:2013										
No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	5.50%	N	1	1	1	5.50%	5.50%	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90%	∞
3	Hemispherical isotropy	B	9.60%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90%	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70%	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50%	∞

10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
11	RF ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
12	Probe positioned mech. restrictions	B	0.40%	R	$\sqrt{3}$	1	1	0.20%	0.20%	∞
13	Probe positioning with respect to phantom shell	B	2.90%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
14	Max.SAR evalation	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
Test Sample Related										
15	Test sample positioning	A	1.86%	N	1	1	1	1.86%	1.86%	∞
16	Device holder uncertainty	A	1.70%	N	1	1	1	1.70%	1.70%	∞
17	Drift of output power	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
Phantom and Set-up										
18	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
19	Liquid conductivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
20	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	∞
21	Liquid permittivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.64	0.43	0.10%	0.07%	∞
Combined standard uncertainty	$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	/	10.20%	10.00%	∞
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$		/	R	K=2	/	/	20.40%	20.00%	∞

5.6. System Check Results

System Performance Check at 835 MHz Head

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d134

Date/Time: 09/12/2014 AM

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 835 MHz; σ = 0.93 S/m; ε_r = 41.70; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3109; ConvF(6.00,6.00, 6.00); Calibrated: 11/29/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.5 (6469)

Area Scan (61x91x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 2.65 mW/g

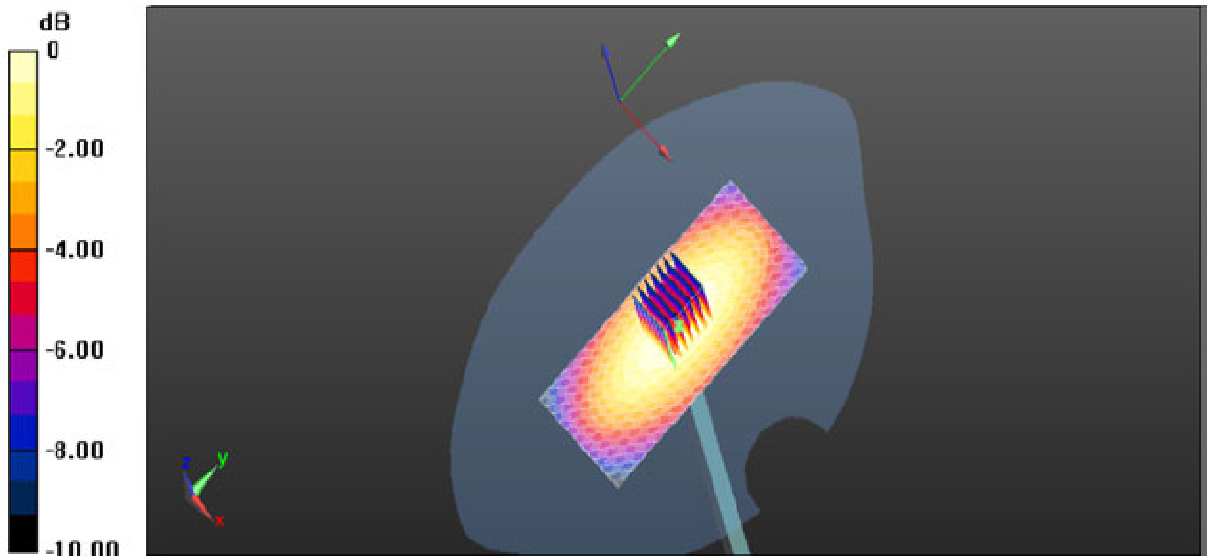
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.40 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 3.67 W/kg

SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.60 mW/g

Maximum value of SAR (measured) = 2.64 mW/g



0 dB = 2.64mW/g=4.22dB mW/g

System Performance Check 835MHz Head 250mW

System Performance Check at 835 MHz Body

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d134

Date/Time: 09/15/2014 AM

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 835 MHz; σ = 0.97 S/m; ε_r = 53.40; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3109; ConvF(5.99, 5.99, 5.99); Calibrated: 11/29/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.5 (6469)

Area Scan (61x91x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 2.58 mW/g

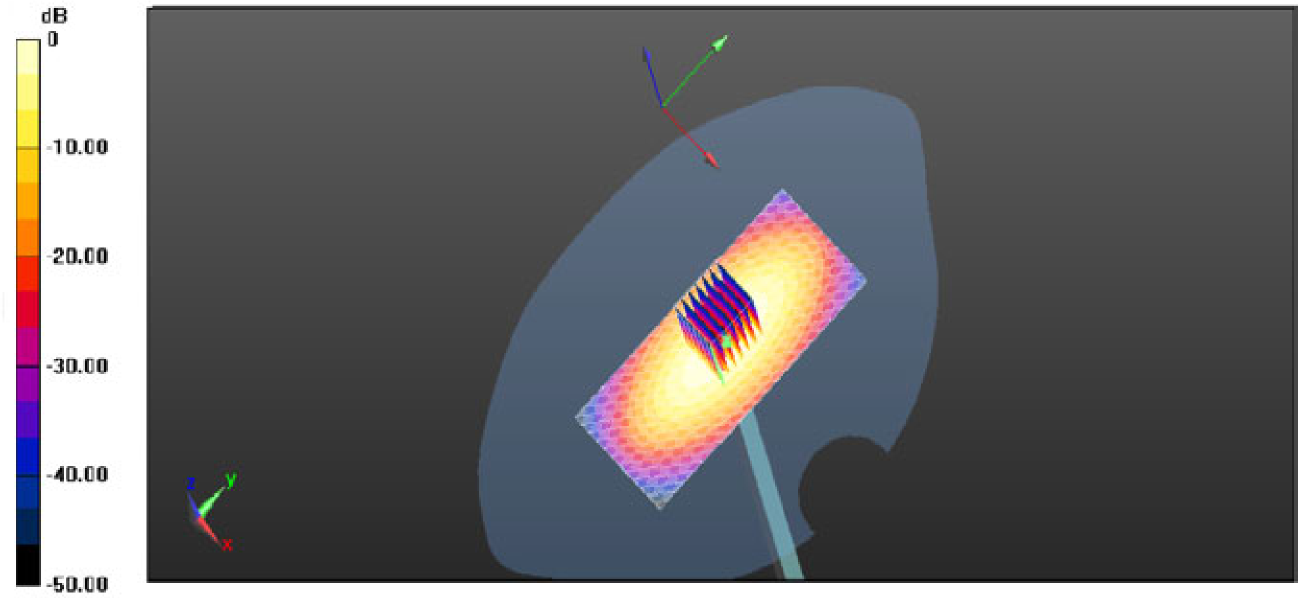
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 51.90 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 3.573 W/kg

SAR(1 g) = 2.41 mW/g; SAR(10 g) = 1.60 mW/g

Maximum value of SAR (measured) = 2.60 mW/g



0 dB = 2.60 mW/g = 4.15 dB mW/g

System Performance Check 835MHz Body 250mW

System Performance Check at 1900 MHz Head

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d150

Date/Time: 09/13/2014 AM

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 1900 MHz; σ = 1.39 S/m; ε_r = 39.80; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3109; ConvF(5.07, 5.07, 5.07); Calibrated: 11/29/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (61x91x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 11.4 W/kg

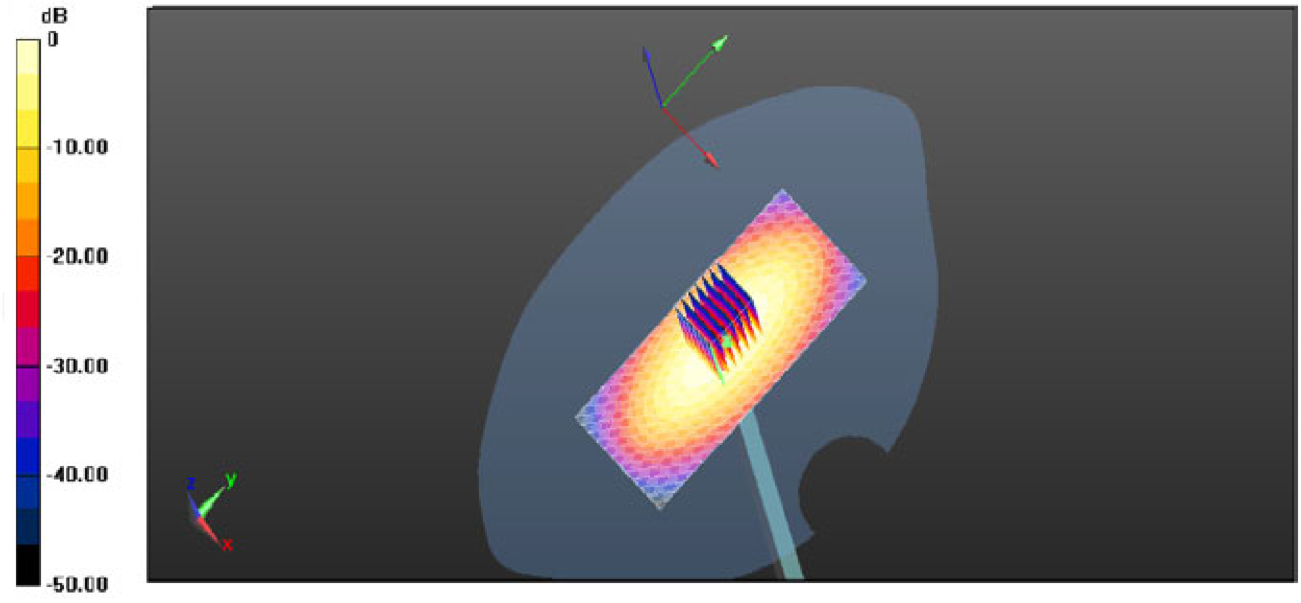
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value =85.5 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.48 W/kg; SAR(10 g) = 4.90 W/kg

Maximum value of SAR (measured) = 10.7 W/kg



0 dB = 10.7 mW/g = 10.29 dB mW/g

System Performance Check 1900MHz Body 250mW

System Performance Check at 1900 MHz Body

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d150

Date/Time: 09/16/2014 AM

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 1900 MHz; σ = 1.51 S/m; ε_r =52.90; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3109; ConvF(4.62, 4.62, 4.62); Calibrated: 11/29/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (61x91x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 12.2 mW/g

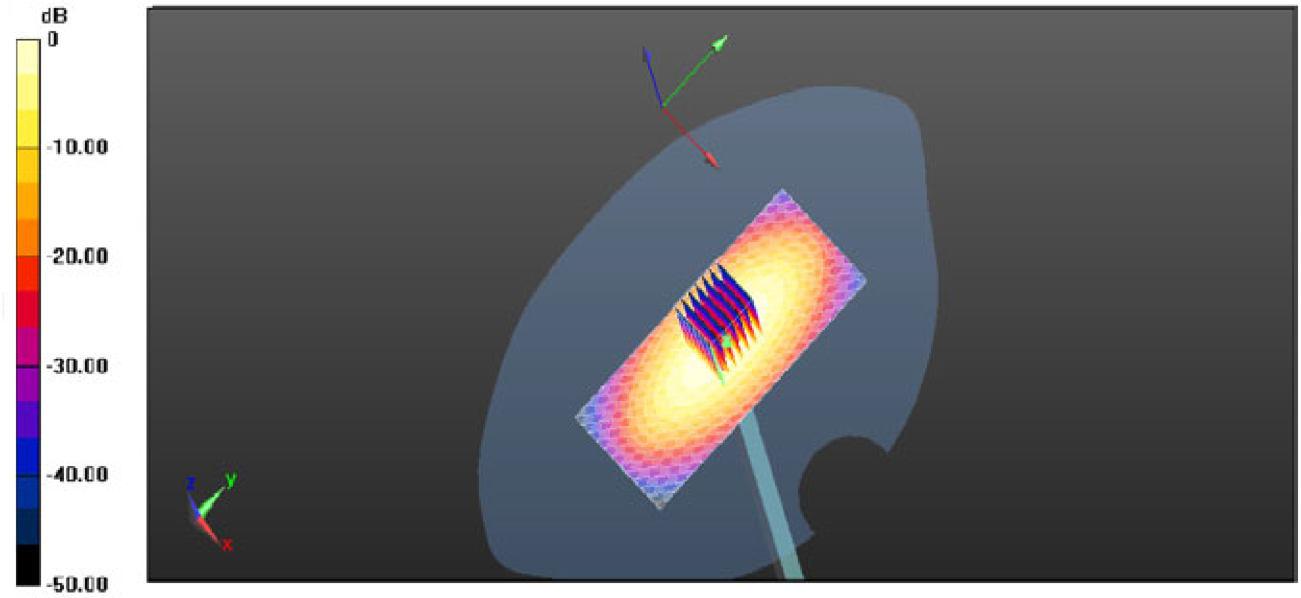
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 82.5 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.93 mW/g; SAR(10 g) = 5.25 mW/g

Maximum value of SAR (measured) = 11.3 mW/g



0 dB = 11.3 mW/g = 10.53 dB mW/g

System Performance Check 1900MHz Body 250mW

System Performance Check at 2450 MHz Head

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 884

Date/Time: 09/14/2014 AM

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 2450 MHz; σ = 1.82 S/m; ε_r = 39.20; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3109; ConvF(4.73, 4.73, 4.73); Calibrated: 11/29/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (61x91x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 18.2 mW/g

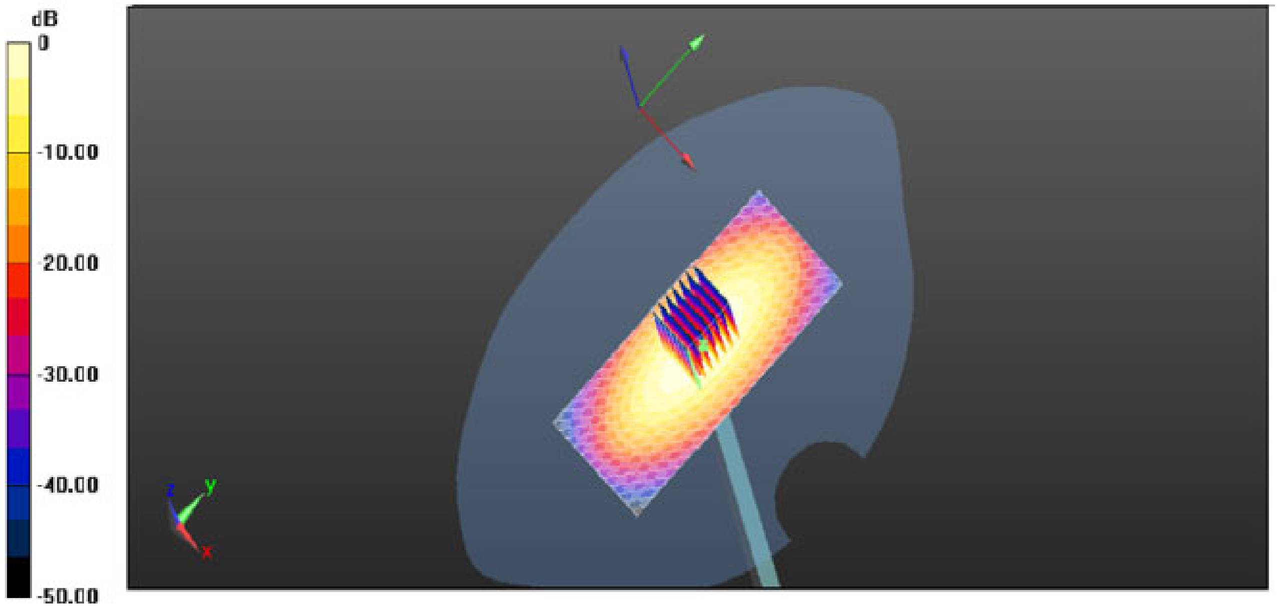
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.8 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 30.00 mW/g

SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.22 mW/g

Maximum value of SAR (measured) = 15.9 mW/g



0 dB = 15.9 mW/g = 12.01 dB mW/g

System Performance Check 2450MHz Head 250mW

System Performance Check at 2450 MHz Body

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 884

Date/Time: 09/14/2014 PM

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 2450 MHz; σ = 2.03 S/m; ε_r = 52.60; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3109; ConvF(4.35, 4.35, 4.35); Calibrated: 11/29/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (61x91x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 16 mW/g

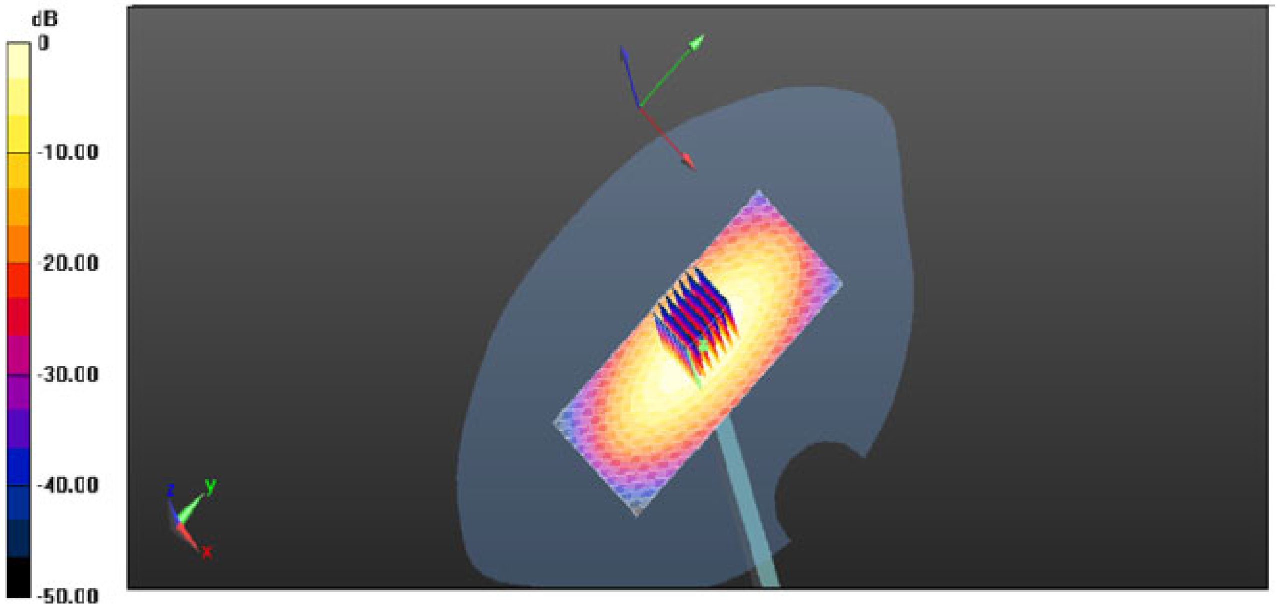
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 81.2 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 25.4 mW/g

SAR(1 g) = 12.5 mW/g; SAR(10 g) = 6.20 mW/g

Maximum value of SAR (measured) = 14.4 mW/g



0 dB = 14.4 mW/g = 11.58 dB mW/g

System Performance Check 2450MHz Body 250mW

5.7. SAR Test Graph Results

SAR plots for **the highest measured SAR** in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02

GSM850 Left Head Touch Middle Channel

Communication System: Customer System; Frequency: 836.6 MHz;Duty Cycle:1:8.3

Medium parameters used (interpolated): f = 836.2 MHz; σ = 0.93 S/m; ε_r = 41.70; ρ = 1000 kg/m^3

Phantom section : Flat Section

Probe: ES3DV3 - SN3109; ConvF(6.00, 6.00, 6.00); Calibrated: 11/29/2013;

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (81x81x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) =0.540 W/kg

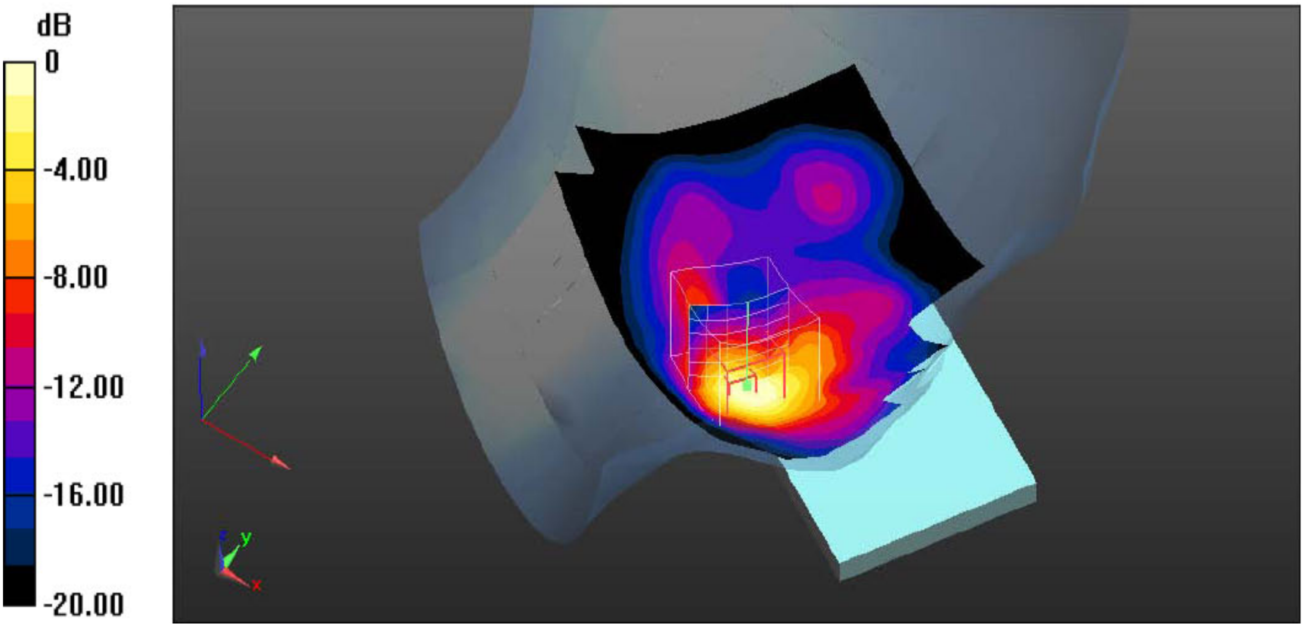
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.865 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.837 W/kg

SAR(1 g) = 0.504 W/Kg; SAR(10 g) = 0.328 W/Kg

Maximum value of SAR (measured) = 0.584 W/kg



0 dB = 0.584 W/kg = -2.34 dB W/kg

Plot 1:Left Head Touch (GSM850 Middle Channel)

GSM850 GPRS 3TS Body Rear Side Middle Channel

Communication System: Customer System; Frequency: 836.6 MHz;Duty Cycle:1:2.77

Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.97 S/m; ε_r = 53.40; ρ = 1000 kg/m^3

Phantom section : Body- worn

Probe: ES3DV3 – SN3109; ConvF(5.99, 5.99, 5.99); Calibrated: 11/29/2013;

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (101x81x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 0.854 W/kg

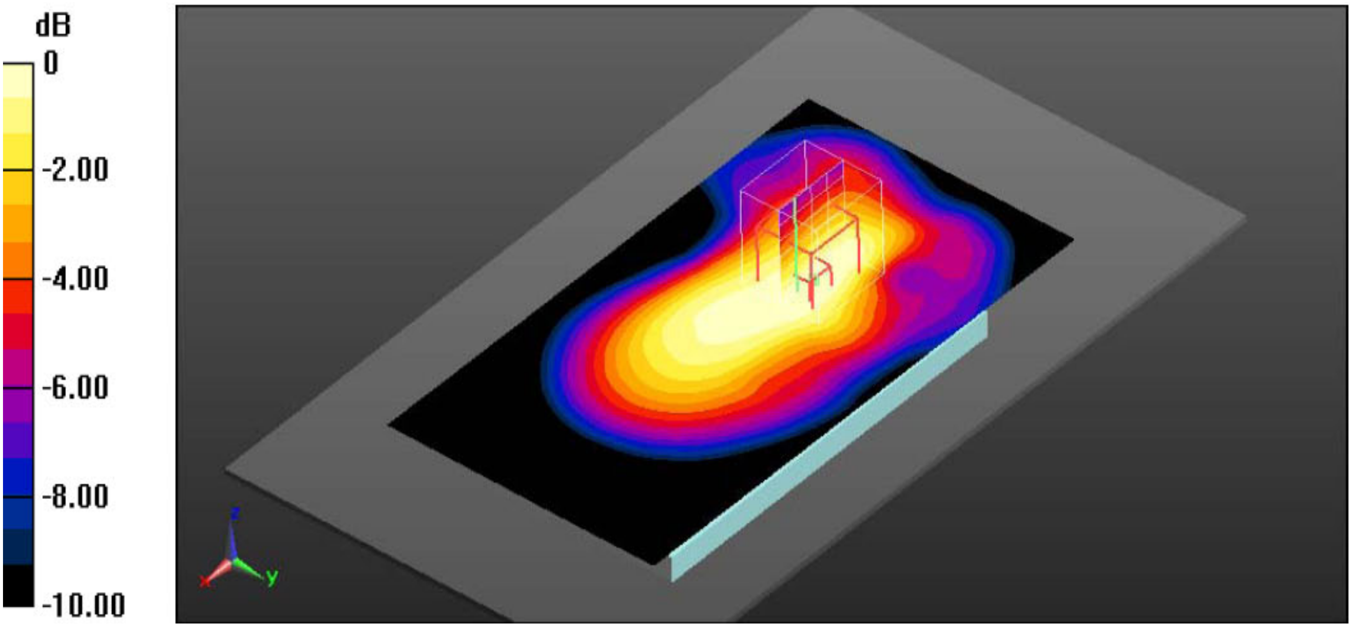
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 28.238 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 1.224 W/kg

SAR(1 g) = 0.781 W/kg; SAR(10 g) = 0.535 W/kg

Maximum value of SAR (measured) = 0.835 W/kg



0dB = 0.835 W/kg = -0.783 dBW/kg

Plot 2: Body Rear Side (GSM850 GPRS 3TS Middle Channel)

GSM1900 Right Head Touch Middle Channel

Communication System: Customer System; Frequency: 1880.0 MHz;Duty Cycle:1:8.3

Medium parameters used (interpolated): f = 1880.0 MHz; σ =1.37 S/m; ε_r = 39.90; ρ = 1000 kg/m^3

Phantom section : Flat Section

Probe: ES3DV3 - SN3109; ConvF(5.07, 5.07, 5.07); Calibrated: 11/29/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x81x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 0.419 mW/g

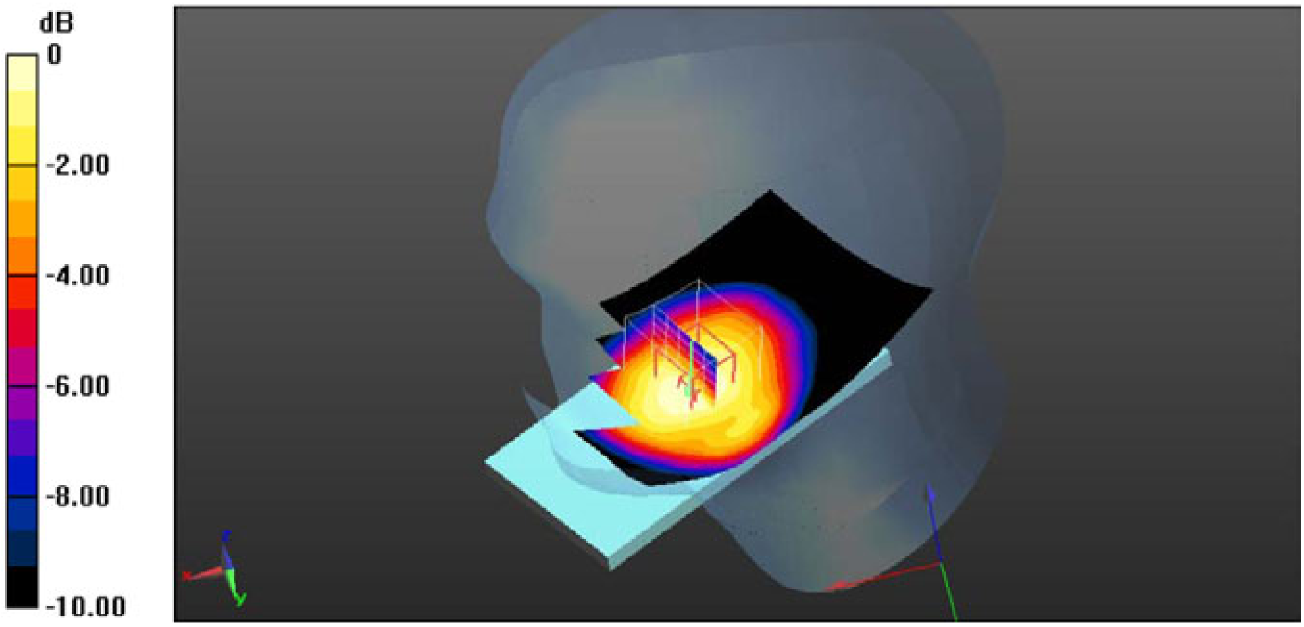
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 14.5036 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.652 mW/g

SAR(1 g) = 0.382 mW/g; SAR(10 g) = 0.225 mW/g

Maximum value of SAR (measured) = 0.404 W/kg



0dB = 0.404 W/kg = -4.51 dB W/kg

Plot 3: Right Head Touch (GSM1900 Middle Channel)

GSM1900 GPRS 3TS Body Rear Side Middle Channel

Communication System: Customer System; Frequency: 1880.0 MHz;Duty Cycle:1:2.77

Medium parameters used (interpolated): f = 1880.0 MHz; σ = 1.49 S/m; ε_r = 52.90; ρ = 1000 kg/m^3

Phantom section : Body- worn

Probe: ES3DV3 - SN3109; ConvF(4.62, 4.62, 4.62); Calibrated: 11/29/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x81x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 0.946 W/kg

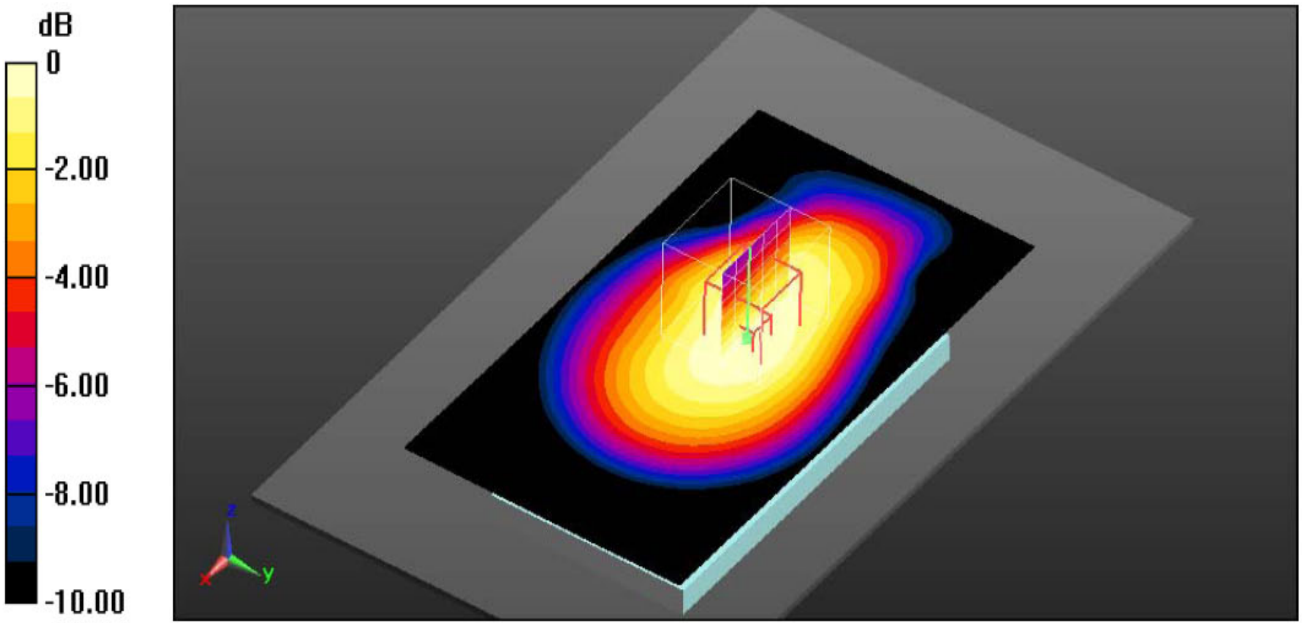
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 18.439 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 0.964 W/kg

SAR(1 g) = 0.559 W/kg; SAR(10 g) = 0.316 W/kg

Maximum value of SAR (measured) = 0.600 W/kg



0dB = 0.600 W/kg = -2.22 dBW/kg

Plot 4: Body Rear Side (GSM1900 GPRS 3TS Middle Channel)

WCDMA Band V Right Head Touch Middle Channel

Communication System: Customer System; Frequency: 836.4 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 836.4 MHz; σ = 0.93 S/m; ε_r = 41.70; ρ = 1000 kg/m^3

Phantom section : Flat Section

Probe: ES3DV3 - SN3109; ConvF(6.00, 6.00, 6.00); Calibrated: 11/29/2013;

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (81x101x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 0.451 W/kg

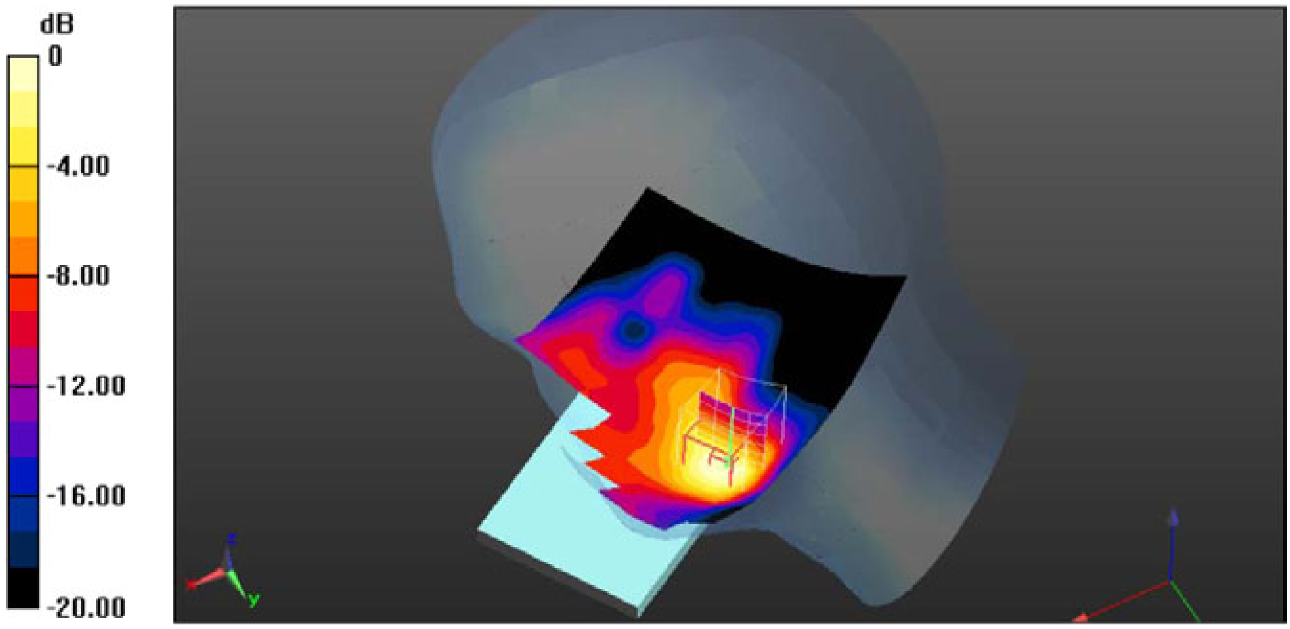
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.716 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.703 W/kg

SAR(1 g) = 0.453 W/kg; SAR(10 g) = 0.287 W/kg

Maximum value of SAR (measured) = 0.490 W/kg



0dB = 0.490 W/kg = -3.10 dBW/kg

Plot 5: Right Head Touch (WCDMA Band V Middle Channel)

WCDMA Band V RMC Body Rear Side Middle Channel

Communication System: Customer System; Frequency: 836.4 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 836.4 MHz; σ = 0.97 S/m; ε_r = 53.40; ρ = 1000 kg/m^3

Phantom section : Body- worn

Probe: ES3DV3 – SN3109; ConvF(5.99, 5.99, 5.99); Calibrated: 11/29/2013;

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (81x101x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 0.556 W/kg

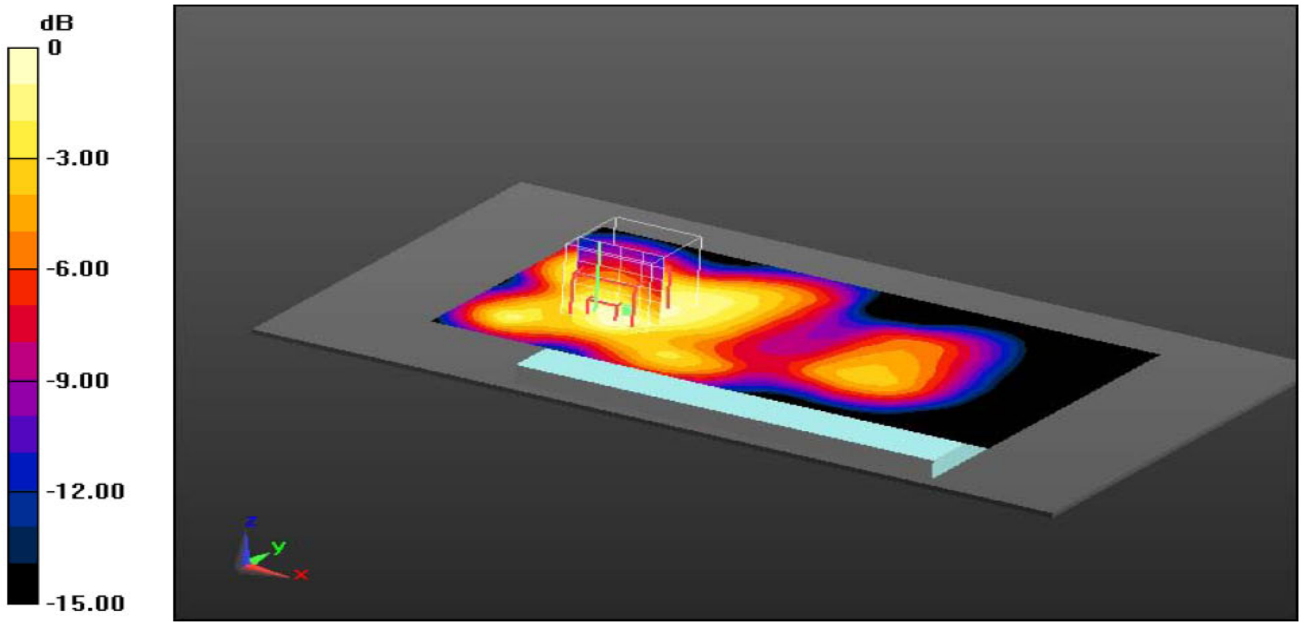
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.747 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 0.835 W/kg

SAR(1 g) = 0.438 W/kg; SAR(10 g) = 0.231 W/kg

Maximum value of SAR (measured) = 0.556 W/kg



0dB = 0.556 W/kg = -2.55 dBW/kg

Plot 6: Body Rear Side (WCDMA Band V RMC Middle Channel)

WCDMA Band II Right Head Touch Middle Channel

Communication System: Customer System; Frequency: 1880.0 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 1880.0 MHz; σ =1.37 S/m; ε_r = 39.90; ρ = 1000 kg/m^3

Phantom section : Flat Section

Probe: ES3DV3 - SN3109; ConvF(5.07, 5.07, 5.07); Calibrated: 11/29/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (81x101x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 0.445 W/kg

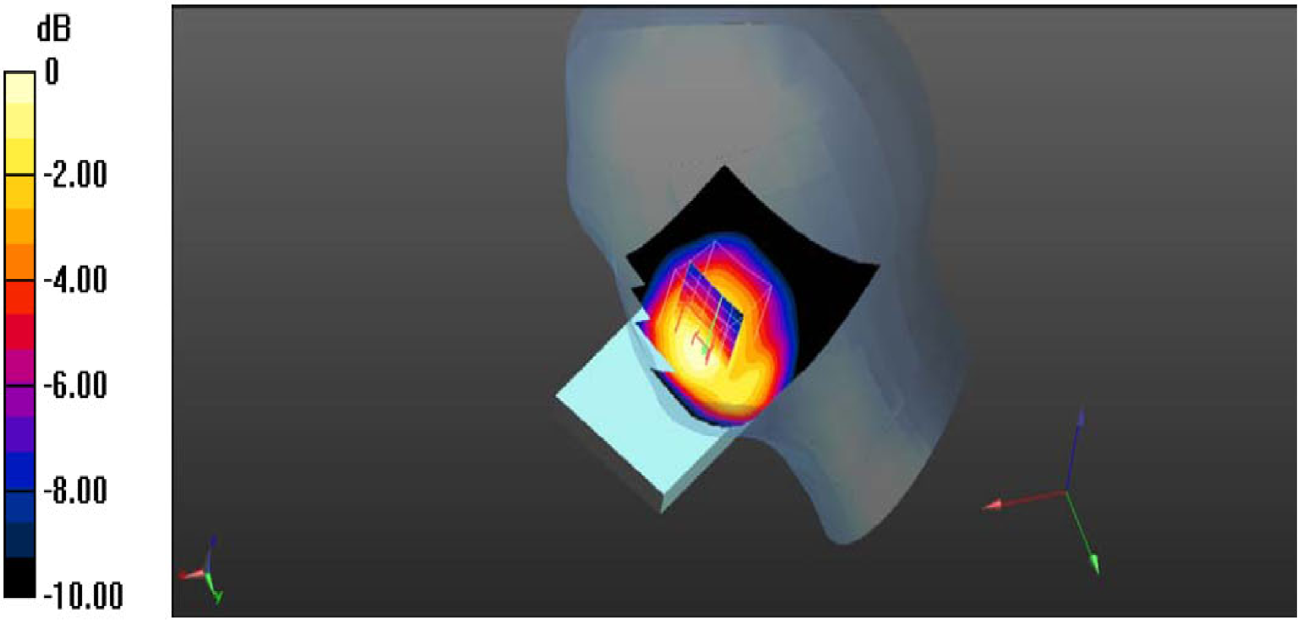
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 16.420 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.883 W/kg

SAR(1 g) = 0.472 W/kg; SAR(10 g) = 0.244 W/kg

Maximum value of SAR (measured) = 0.532 W/kg



0dB = 0.532 W/kg = -2.74 dBW/kg

Plot 7: Right Head Touch (WCDMA Band II Middle Channel)

WCDMA Band II RMC Body Rear Side Middle Channel

Communication System: Customer System; Frequency: 1880.0 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 1880.0 MHz; σ = 1.49 S/m; ε_r = 52.90; ρ = 1000 kg/m^3

Phantom section : Body- worn

Probe: ES3DV3 - SN3109; ConvF(4.62, 4.62, 4.62); Calibrated: 11/29/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (81x101x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 0.854 W/kg

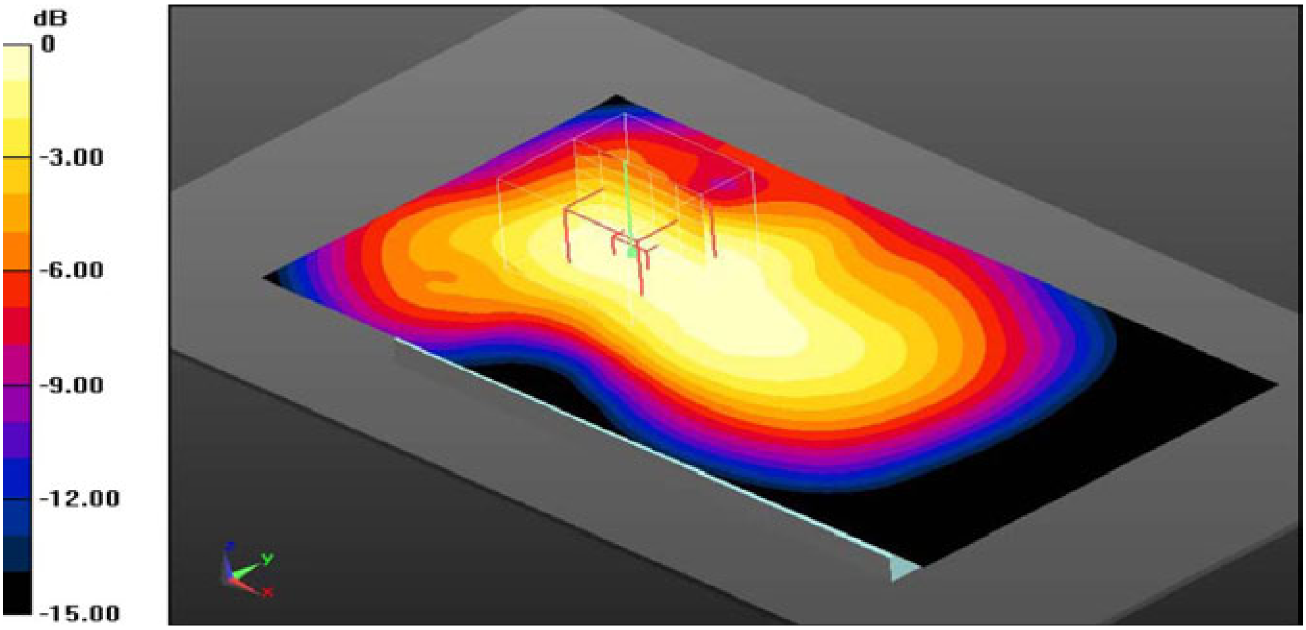
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 28.238 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 1.124 W/kg

SAR(1 g) = 0.713 W/kg; SAR(10 g) = 0.525 W/kg

Maximum value of SAR (measured) = 0.835 W/kg



0dB = 0.835 W/kg = -0.78 dBW/kg

Plot 8: Body Rear Side (WCDMA Band II RMC Middle Channel)

Left Head Touch (WiFi2450 Middle Channel-Channel 6-2437MHz (1Mbps))

Communication System: Customer System; Frequency: 2437.0 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 2437.0 MHz; σ = 1.81 S/m; ε_r = 39.20; ρ = 1000 kg/m^3

Phantom section : Flat Section

Probe: ES3DV3 - SN3109; ConvF(4.73, 4.73, 4.73); Calibrated: 11/29/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (81x81x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) =0.411 W/kg

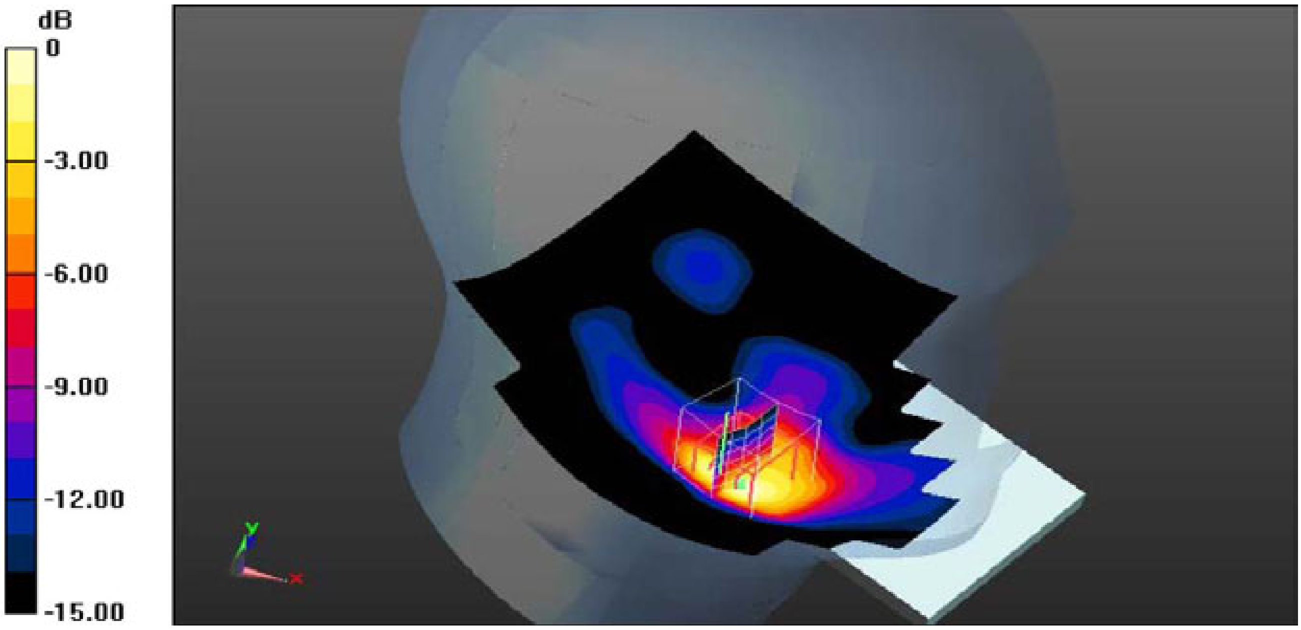
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 11.626 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.27 W/kg

SAR(1 g) = 0.528 W/kg; SAR(10 g) = 0.231 W/kg

Maximum value of SAR (measured) = 0.599 W/kg



0 dB = 0.599 W/kg = -2.23 dB W/kg

Plot 9: Left Head Touch (WiFi2450 Middle Channel-Channel 6-2437MHz (1Mbps))

Body- worn Rear Side (WiFi2450 Middle Channel-Channel 6-2437MHz (1Mbps))

Communication System: Customer System; Frequency: 2437.0 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 2437.0 MHz; σ = 2.01 S/m; ε_r = 52.60; ρ = 1000 kg/m^3

Phantom section : Body- worn

Probe: ES3DV3 - SN3109; ConvF(4.35, 4.35, 4.35); Calibrated: 11/29/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 11/25/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x81x1): Measurement grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) =0.542 W/kg

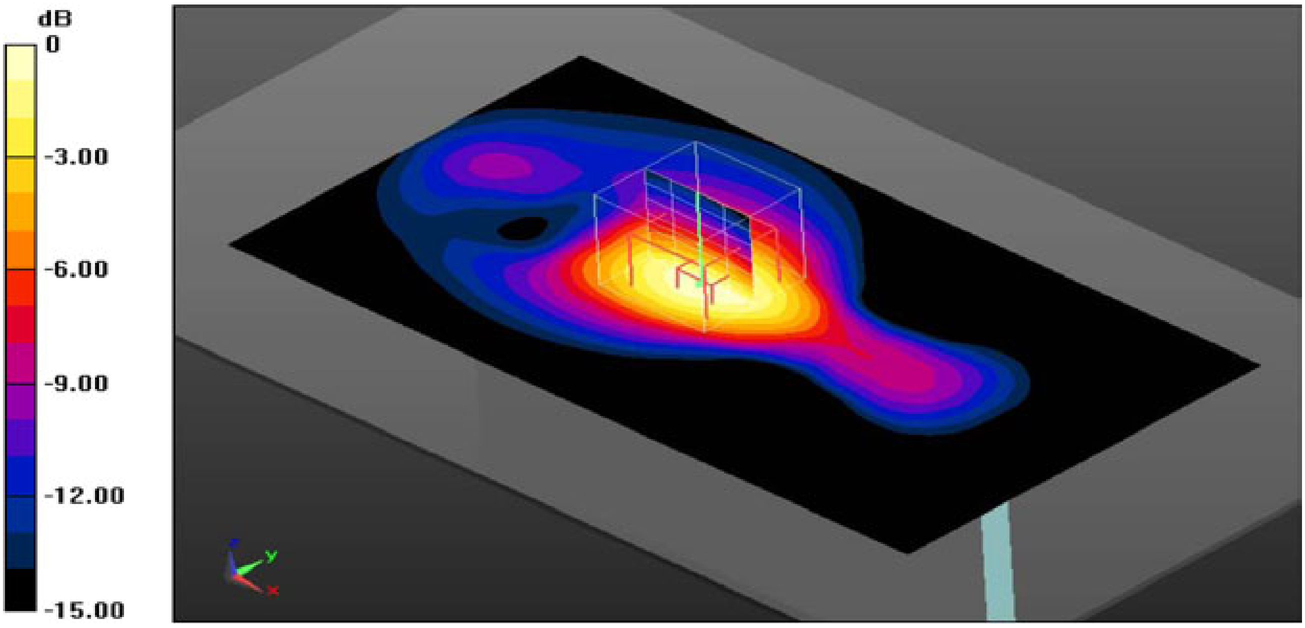
Zoom Scan (5x5x5)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 12.632 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 1.07 W/kg

SAR(1 g) = 0.562 W/kg; SAR(10 g) = 0.243 W/kg

Maximum value of SAR (measured) = 0.676 W/kg



0 dB = 0.676 W/kg = -1.70 dB W/kg

Plot 10: Body- worn Rear Side (WiFi2450 Middle Channel-Channel 6-2437MHz (1Mbps))

6. Calibration Certificate

6.1. Probe Calibration Ceriticate

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ilac-MRA CNAS 校准 CNAS L0442

Client SZJTT Certificate No: J13-2-3046

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3109

Calibration Procedure(s) TMC-OS-E-02-195
Calibration Procedures for Dosimetric E-field Probes

Calibration date: November 29, 2013

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Power sensor NRP-Z91	101547	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Power sensor NRP-Z91	101548	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Reference10dBAttenuator	BT0520	12-Dec-12(TMC,No.JZ12-867)	Dec-14
Reference20dBAttenuator	BT0267	12-Dec-12(TMC,No.JZ12-866)	Dec-14
Reference Probe EX3DV4	SN 3846	03-Sep-13(SPEAG,No.EX3-3846_Sep13)	Sep-14
DAE4	SN 777	22-Feb-13 (SPEAG, DAE4-777_Feb13)	Feb -14
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	01-Jul-13 (TMC, No.JW13-045)	Jun-14
Network Analyzer E5071C	MY46110673	15-Feb-13 (TMC, No.JZ13-781)	Feb-14

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: December 2, 2013

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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 θ=0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

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 300MHz to 3GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (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; VRx,y,z:*A,B,C 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≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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±50MHz to±100MHz.
- *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).

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Probe ES3DV3

SN: 3109

Calibrated: November 29, 2013

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY – Parameters of Probe: ES3DV3 - SN: 3109

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	1.15	1.20	1.19	±10.8%
DCP(mV)[B]	102.8	104.8	103.2	

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	187.0	±2.3%
		Y	0.0	0.0	1.0		195.4	
		Z	0.0	0.0	1.0		193.3	

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

[A] The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5 and Page 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly 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 – Parameters of Probe: ES3DV3 - SN: 3109

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	Depth (mm)	Unct. (k=2)
850	41.5	0.92	6.00	6.00	6.00	0.46	1.47	±12%
900	41.5	0.97	6.15	6.15	6.15	0.32	1.80	±12%
1810	40.0	1.40	5.05	5.05	5.05	0.36	1.95	±12%
1900	40.0	1.40	5.07	5.07	5.07	0.34	2.23	±12%
2450	39.2	1.80	4.73	4.73	4.73	1.07	1.00	±12%

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

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DASY – Parameters of Probe: ES3DV3 - SN: 3109

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	Depth (mm)	Unct. (k=2)
850	55.2	0.99	5.99	5.99	5.99	0.36	1.72	±12%
900	55.0	1.05	6.07	6.07	6.07	0.39	1.62	±12%
1810	53.3	1.52	4.71	4.71	4.71	0.32	2.57	±12%
1900	53.3	1.52	4.62	4.62	4.62	0.40	2.09	±12%
2450	52.7	1.95	4.35	4.35	4.35	0.72	1.36	±12%

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

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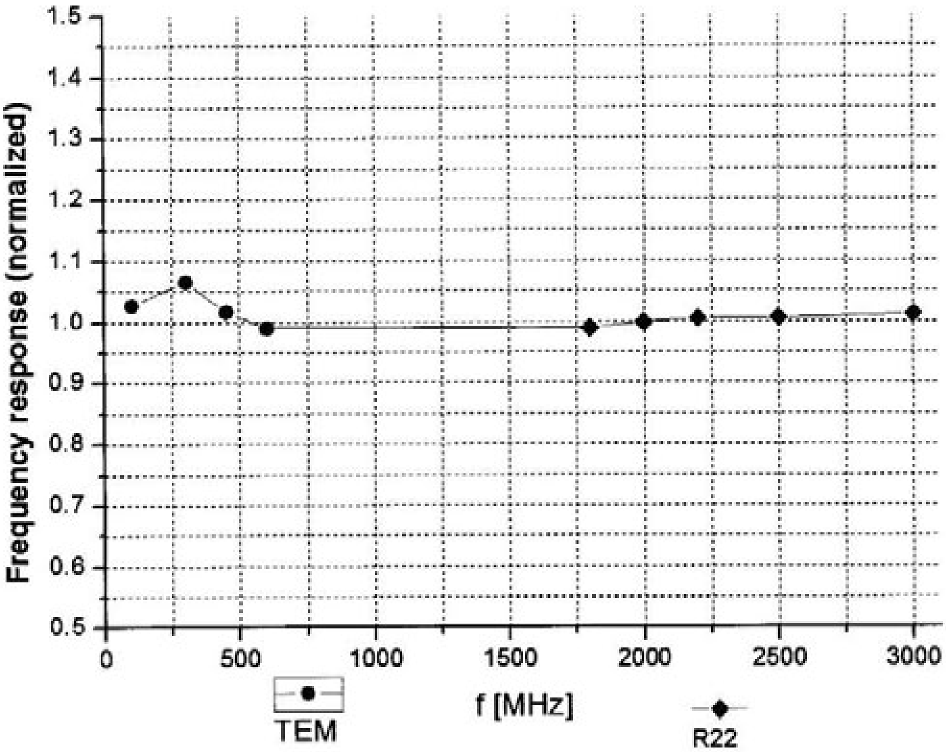
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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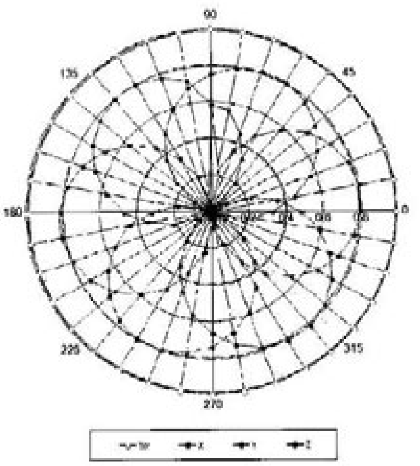
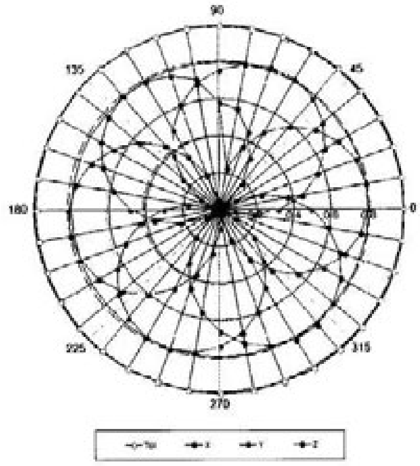
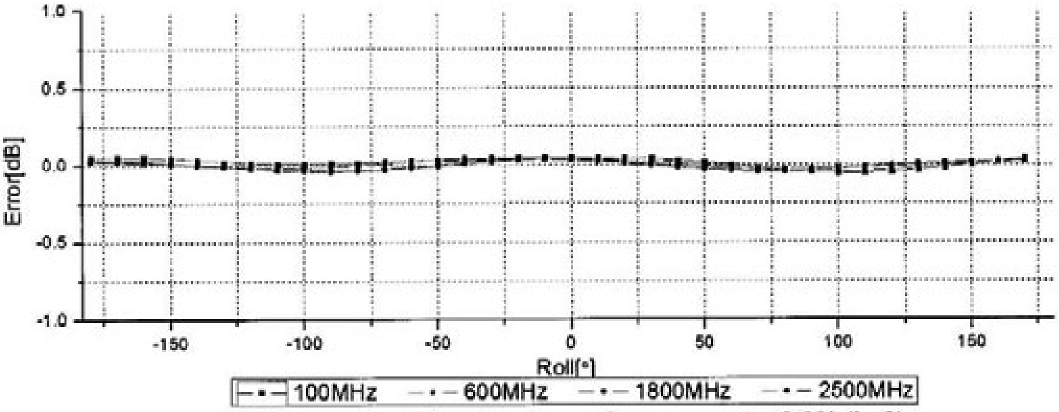
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)

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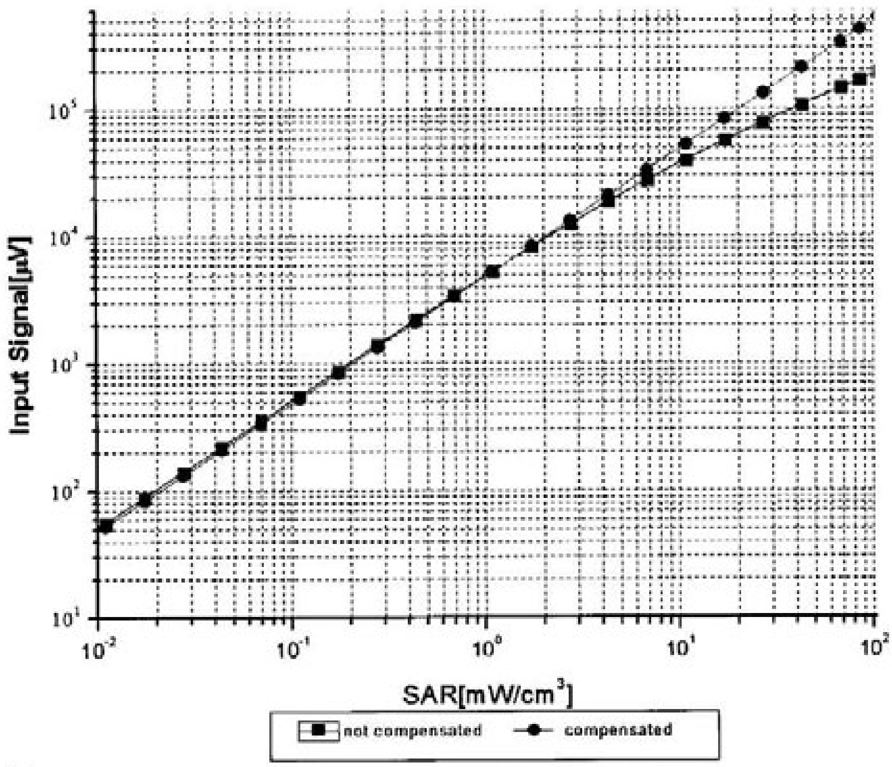
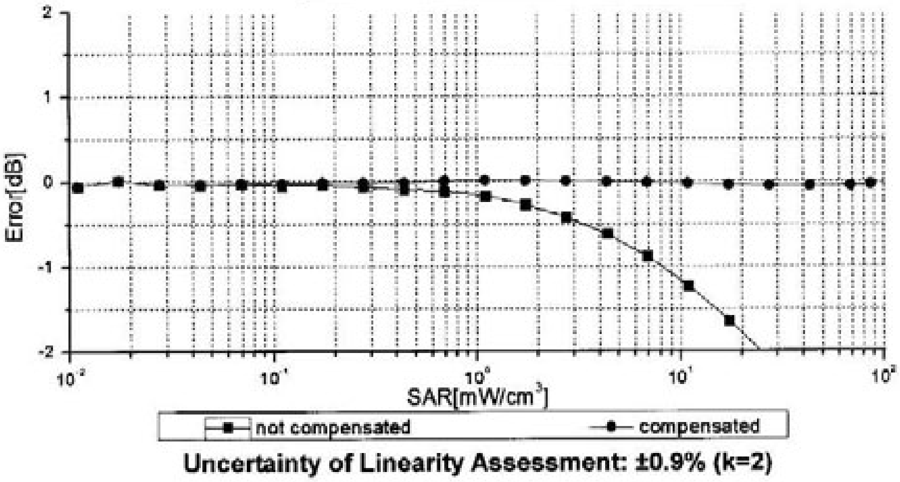
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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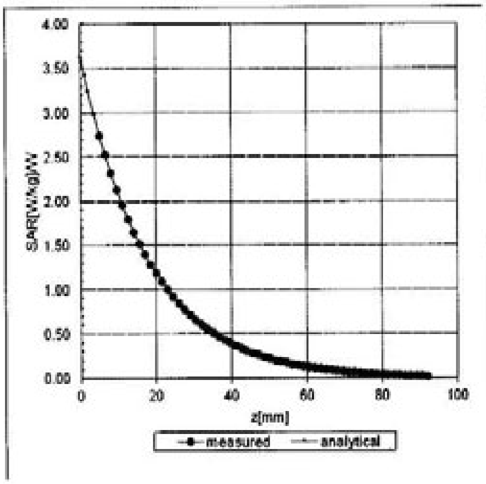
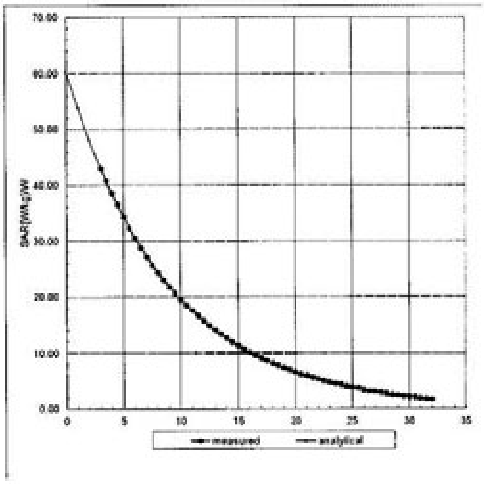
Conversion Factor Assessment

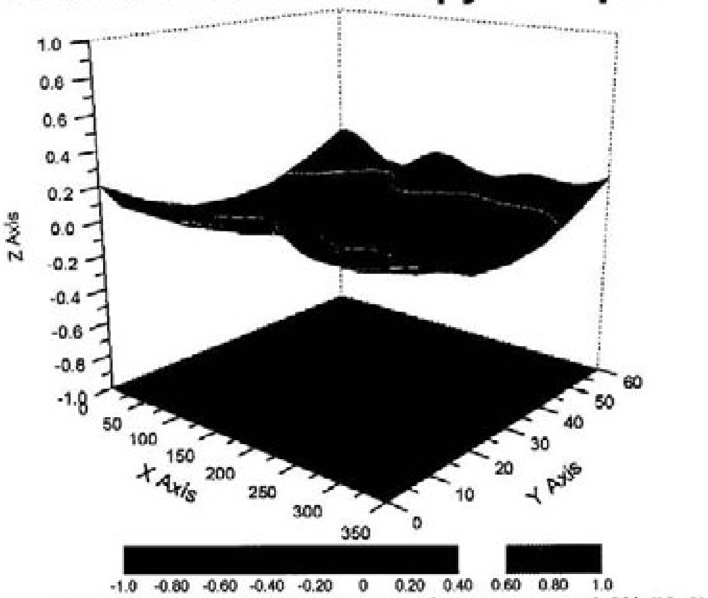
f=900 MHz, WGLS R9(H_convF)



f=2450 MHz, WGLS R26(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

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DASY - Parameters of Probe: ES3DV3 - SN: 3109

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	161.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	10mm
Tip Diameter	4mm
Probe Tip to Sensor X Calibration Point	2mm
Probe Tip to Sensor Y Calibration Point	2mm
Probe Tip to Sensor Z Calibration Point	2mm
Recommended Measurement Distance from Surface	3mm

6.2. D835V2 Dipole Calibration Ceriticate

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ilac-MRA CNAS 校准 CNAS L0442

Client CIQ SZ (Auden) Certificate No: J13-2-3049

CALIBRATION CERTIFICATE

Object D835V2 - SN: 4d134

Calibration Procedure(s) TMC-OS-E-02-194
Calibration procedure for dipole validation kits

Calibration date: December 13, 2013

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	11-Sep-13 (TMC, No.JZ13-443)	Sep-14
Power sensor NRV-Z5	100595	11-Sep-13 (TMC, No. JZ13-443)	Sep -14
Reference Probe ES3DV3	SN 3149	5- Sep-13 (SPEAG, No.ES3-3149_Sep13)	Sep-14
DAE4	SN 777	22-Feb-13 (SPEAG, DAE4-777_Feb13)	Feb -14
Signal Generator E4438C	MY49070393	13-Nov-13 (TMC, No.JZ13-394)	Nov-14
Network Analyzer E8362B	MY43021135	19-Oct-13 (TMC, No.JZ13-278)	Oct-14

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: December 17, 2013

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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 300MHz to 3GHz)", February 2005

c) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.8.7.1137
Extrapolation	Advanced Extrapolation	
Phantom	Twin 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	41.7 ± 6 %	0.88 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	2.38 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**9.66 mW /g ± 20.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.55 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**6.27 mW /g ± 20.4 % (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	56.3 ± 6 %	0.97 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	2.32 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**9.36 mW /g ± 20.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.54 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**6.20 mW /g ± 20.4 % (k=2)**

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5Ω + 3.14jΩ
Return Loss	- 28.1dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.2Ω + 2.90jΩ
Return Loss	- 30.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.241 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

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DASY5 Validation Report for Head TSL Date: 12.11.2013

Test Laboratory: TMC, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d134

Communication System: CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz; σ = 0.884 mho/m; εr = 41.65; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(6.21,6.21,6.21); Calibrated: 2013/9/5
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 22/2/2013
- Phantom: SAM 1186;Type: QD000P40CC;
- Measurement SW: DASY52 52.8.7(1137); SEMCAD X Version 14.6.10 (7164)

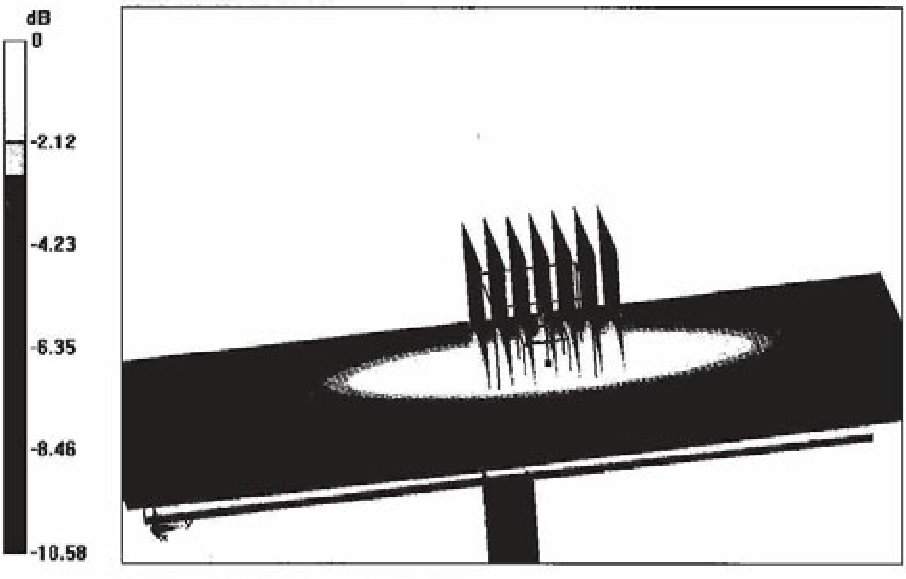
Dipole Calibration for Head Tissue/Pin=250mW, d=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 48.581 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.57 W/kg

SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.55 W/kg

Maximum value of SAR (measured) = 2.80 W/kg



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

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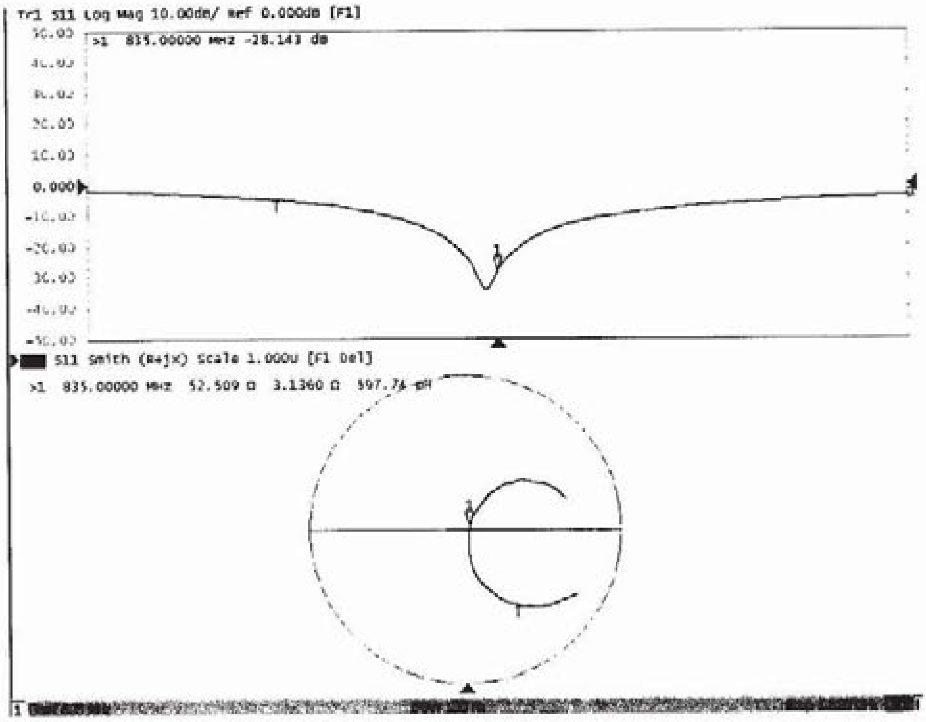
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 12.13.2013

Test Laboratory: TMC, Beijing, China

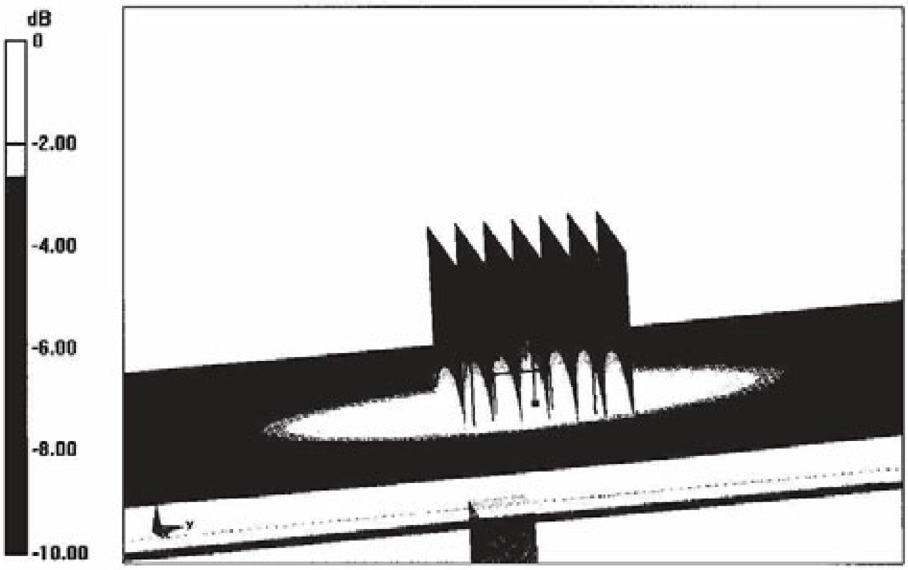
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d134

Communication System: CW; Frequency: 835 MHz;
Medium parameters used: f = 835 MHz; σ = 0.965 mho/m; εr = 56.32; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(5.98,5.98,5.98) ; Calibrated: 2013/9/5
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 22/2/2013
- Phantom: SAM 1186;Type: QD000P40CC;
- Measurement SW: DASY52 52.8.7(1137); SEMCAD X Version 14.6.10 (7164)

Dipole Calibration for Body Tissue/Pin=250mW, d=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.271 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.38 W/kg
SAR(1 g) = 2.32 W/kg; SAR(10 g) = 1.54 W/kg
Maximum value of SAR (measured) = 2.69 W/kg



0 dB = 2.69 W/kg = 4.30 dBW/kg

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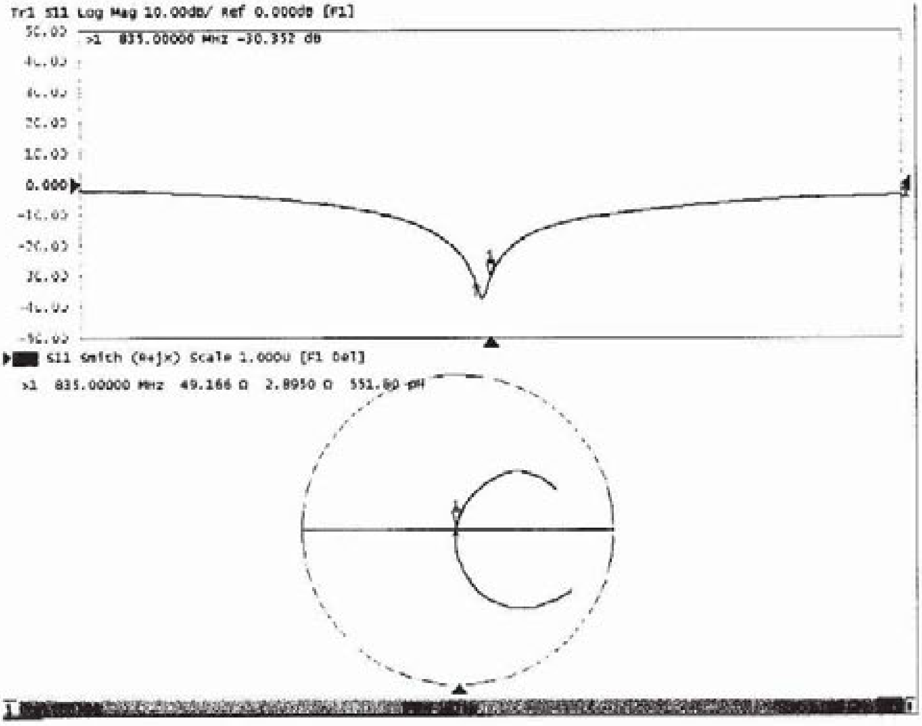
Impedance Measurement Plot for Body TSL



6.3. D1900V2 Dipole Calibration Ceriticate

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ilac-MRA CNAS 校准 CNAS L0442

Client CIQ SZ (Auden) Certificate No: J13-2-3052

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d150
Calibration Procedure(s)	TMC-OS-E-02-194 Calibration procedure for dipole validation kits
Calibration date:	December 12, 2013

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	11-Sep-13 (TMC, No.JZ13-443)	Sep-14
Power sensor NRV-Z5	100595	11-Sep-13 (TMC, No. JZ13-443)	Sep -14
Reference Probe ES3DV3	SN 3149	5- Sep-13 (SPEAG, No.ES3-3149_Sep13)	Sep-14
DAE4	SN 777	22-Feb-13 (SPEAG, DAE4-777_Feb13)	Feb -14
Signal Generator E4438C	MY49070393	13-Nov-13 (TMC, No.JZ13-394)	Nov-14
Network Analyzer E8362B	MY43021135	19-Oct-13 (TMC, No.JZ13-278)	Oct-14

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: December 17, 2013

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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 300MHz to 3GHz)", February 2005

c) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.8.7.1137
Extrapolation	Advanced Extrapolation	
Phantom	Twin 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 %	1.42 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	9.71 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**38.3 mW /g ± 20.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.08 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.2 mW /g ± 20.4 % (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	53.7 ± 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	9.98 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**39.9 mW /g ± 20.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.26 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 mW /g ± 20.4 % (k=2)**

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.3Ω+ 3.17jΩ
Return Loss	- 30.0dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8Ω+ 3.92jΩ
Return Loss	- 27.7dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.048 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

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DASY5 Validation Report for Head TSL Date: 12.12.2013

Test Laboratory: TMC, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d150

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz; σ = 1.416 mho/m; εr = 38.91; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(5.06,5.06,5.06); Calibrated: 2013/9/5
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 22/2/2013
- Phantom: SAM 1186; Type: QD000P40CC;
- DASY52 52.8.7(1137); SEMCAD X Version 14.6.10 (7164)

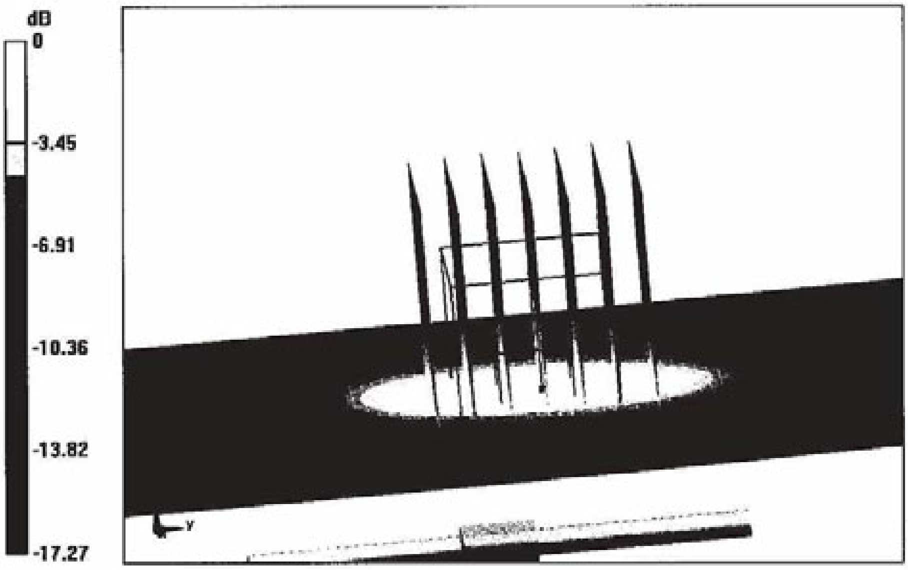
Dipole Calibration for Head Tissue/Pin=250mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 90.054 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.9 W/kg

SAR(1 g) = 9.71 W/kg; SAR(10 g) = 5.08 W/kg

Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 11.8 W/kg = 10.72 dBW/kg

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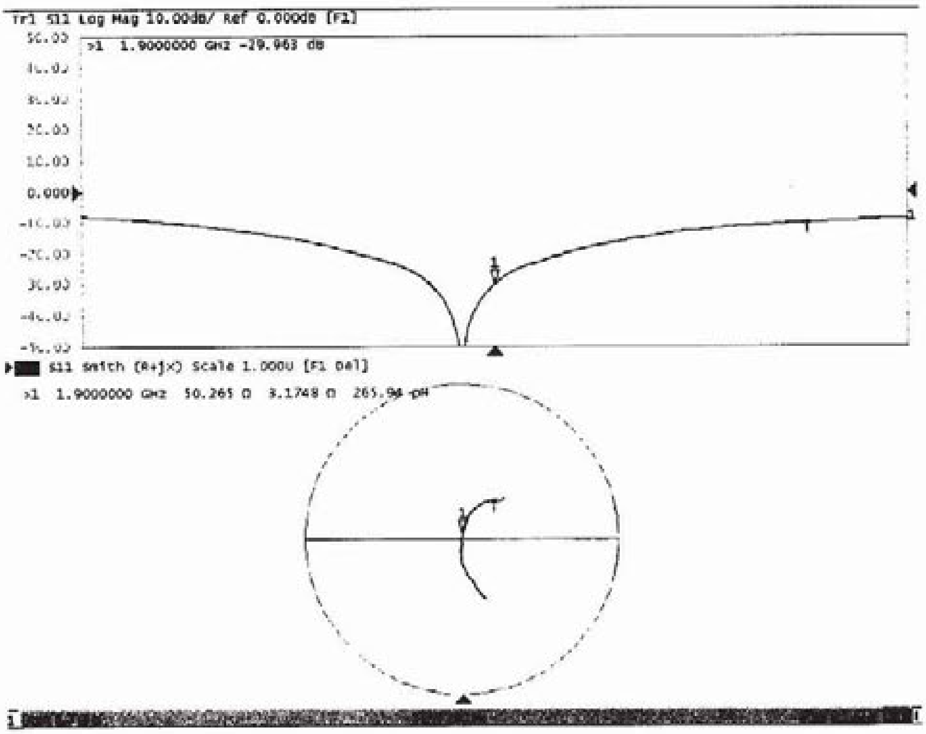
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 12.10.2013

Test Laboratory: TMC, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d150

Communication System: CW; Frequency: 1900 MHz;

Medium parameters used: f = 1900 MHz; σ = 1.528 mho/m; εr = 53.74; ρ = 1000 kg/m^3

Phantom section: Flat Phantom

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.72,4.72,4.72) ; Calibrated: 2013/9/5
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 22/2/2013
- Phantom: SAM1186; Type: QD000P40CC;
- DASY52 52.8.7(1137); SEMCAD X Version 14.6.10 (7164)

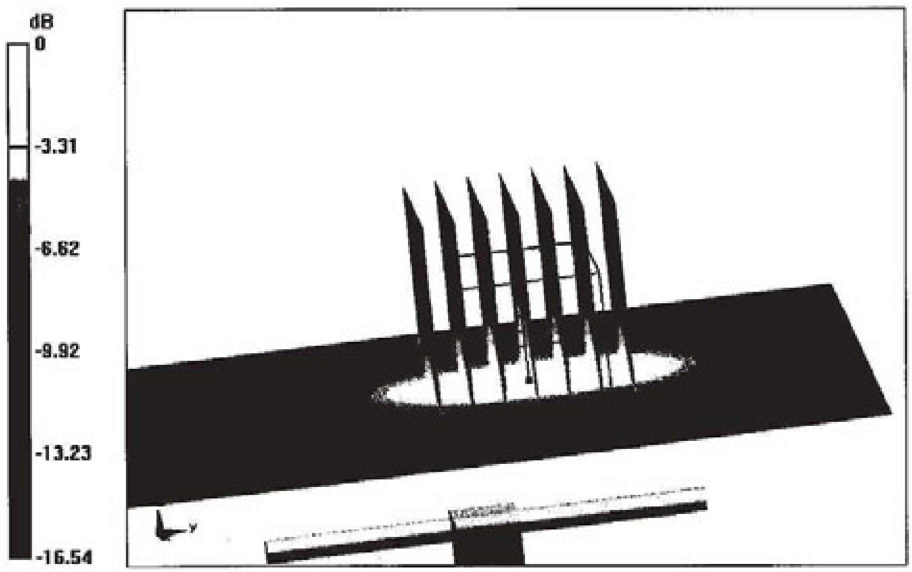
Dipole Calibration for Body Tissue/Pin=250mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 83.606 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 17.7 W/kg

SAR(1 g) = 9.98 W/kg; SAR(10 g) = 5.26 W/kg

Maximum value of SAR (measured) = 12.1 W/kg



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

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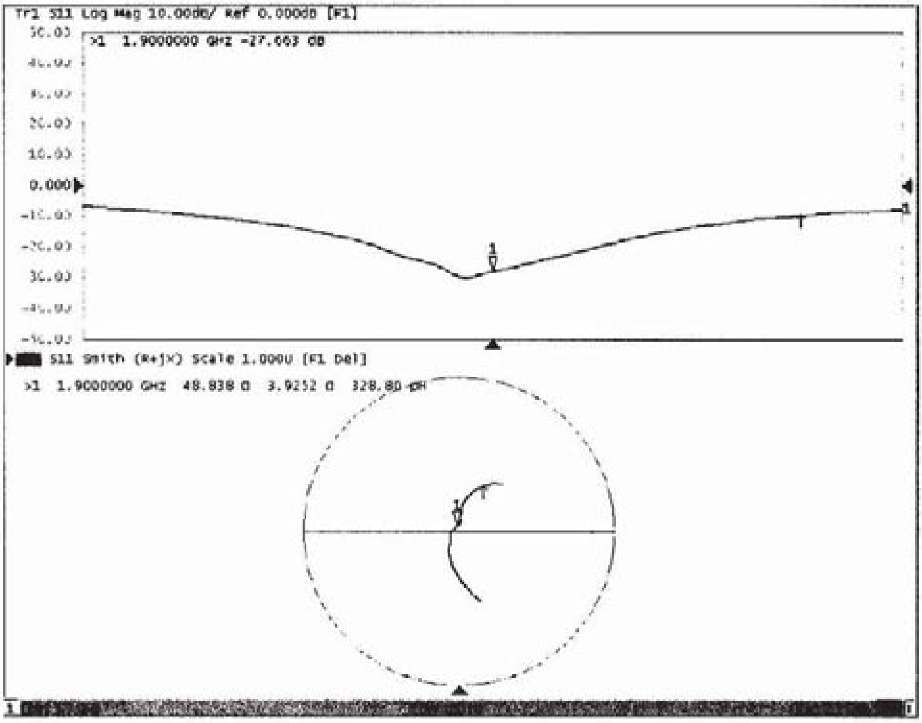
Impedance Measurement Plot for Body TSL



1.1. D2450V2 Dipole Calibration Ceriticate

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CNAS L0442

Client CIQ SZ (Auden) **Certificate No: J13-2-3053**

CALIBRATION CERTIFICATE

Object D2450V2 - SN: 884

Calibration Procedure(s) TMC-OS-E-02-194
Calibration procedure for dipole validation kits

Calibration date: December 11, 2013

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	11-Sep-13 (TMC, No.JZ13-443)	Sep-14
Power sensor NRV-Z5	100595	11-Sep-13 (TMC, No. JZ13-443)	Sep -14
Reference Probe ES3DV3	SN 3149	5- Sep-13 (SPEAG, No.ES3-3149_Sep13)	Sep-14
DAE4	SN 777	22-Feb-13 (SPEAG, DAE4-777_Feb13)	Feb -14
Signal Generator E4438C	MY49070393	13-Nov-13 (TMC, No.JZ13-394)	Nov-14
Network Analyzer E8362B	MY43021135	19-Oct-13 (TMC, No.JZ13-278)	Oct-14

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: December 17, 2013

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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 300MHz to 3GHz)", February 2005
c) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.8.7.1137
Extrapolation	Advanced Extrapolation	
Phantom	Twin 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	39.0 ± 6 %	1.82 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	13.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**51.7 mW /g ± 20.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.05 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.1 mW /g ± 20.4 % (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	52.8 ± 6 %	1.94 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	12.9 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**51.8 mW /g ± 20.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.98 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 mW /g ± 20.4 % (k=2)**

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.8Ω+ 3.76jΩ
Return Loss	- 25.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	55.2Ω+ 2.38jΩ
Return Loss	- 25.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 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

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DASY5 Validation Report for Head TSL Date: 12.10.2013

Test Laboratory: TMC, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 884

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz; σ = 1.817 mho/m; εr = 38.96; ρ = 1000 kg/m^3

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.48,4.48,4.48); Calibrated: 2013/9/5
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 22/2/2013
- Phantom: SAM 1593; Type: QD000P40CC;
- DASY52 52.8.7(1137); SEMCAD X Version 14.6.10 (7164)

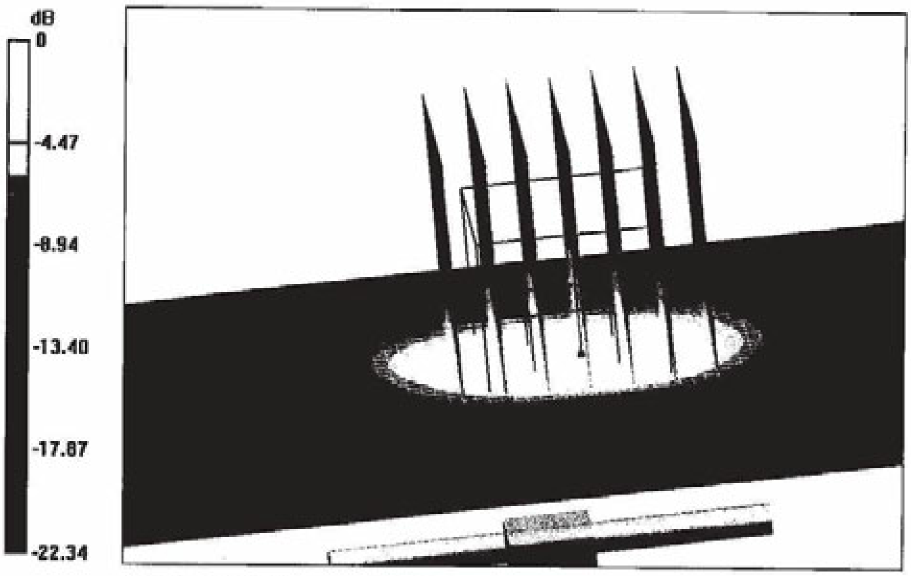
Dipole Calibration for Head Tissue/Pin=250mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 86.529 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 27.0 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.05 W/kg

Maximum value of SAR (measured) = 16.2 W/kg



0 dB = 16.2 W/kg = 12.10 dBW/kg

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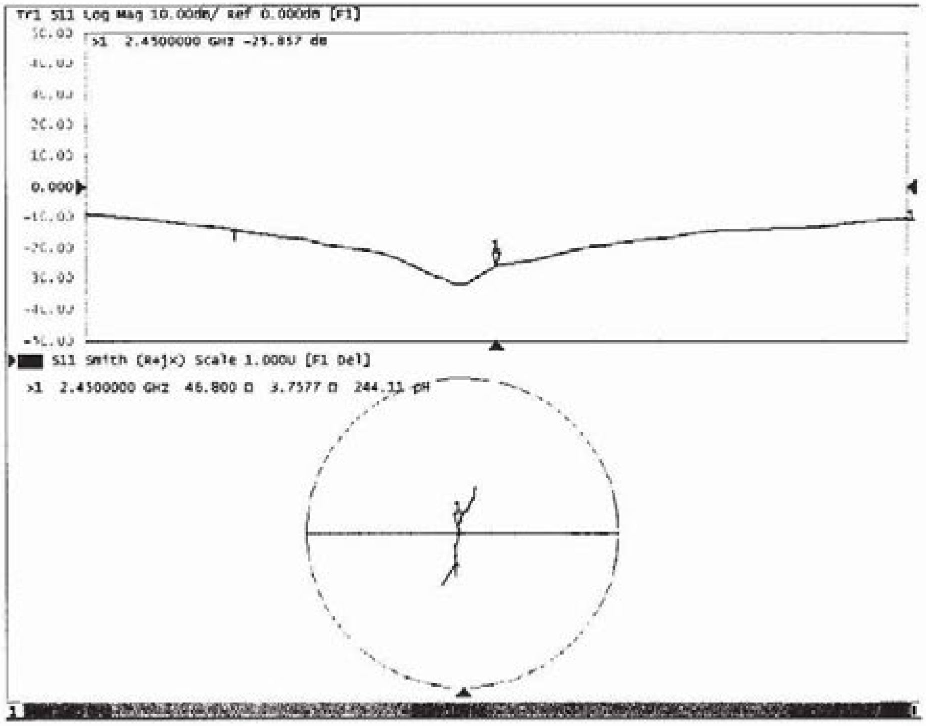
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 12.11.2013

Test Laboratory: TMC, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 884

Communication System: CW; Frequency: 2450 MHz;

Medium parameters used: f = 2450 MHz; σ = 1.939 mho/m; εr = 52.97; ρ = 1000 kg/m^3

Phantom section: Flat Phantom

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DVS - SN3149; ConvF(4.21,4.21,4.21) ; Calibrated: 2013/9/5
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 22/2/2013
- Phantom: SAM1186; Type: QD000P40CC;
- DASY52 52.8.7(1137); SEMCAD X Version 14.6.10 (7164)

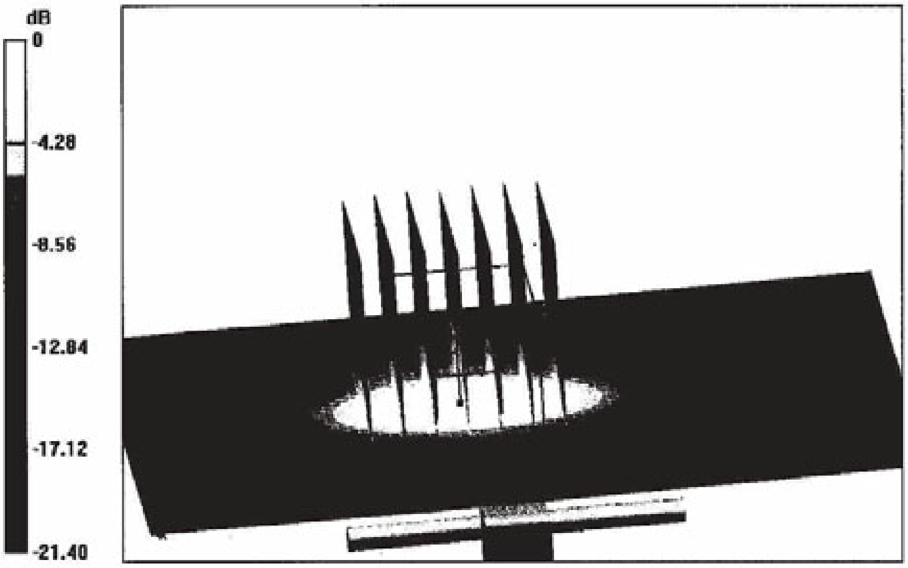
Dipole Calibration for Body Tissue/Pin=250mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 84.687 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 27.1 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.98 W/kg

Maximum value of SAR (measured) = 16.0 W/kg



0 dB = 16.0 W/kg = 12.04 dBW/kg

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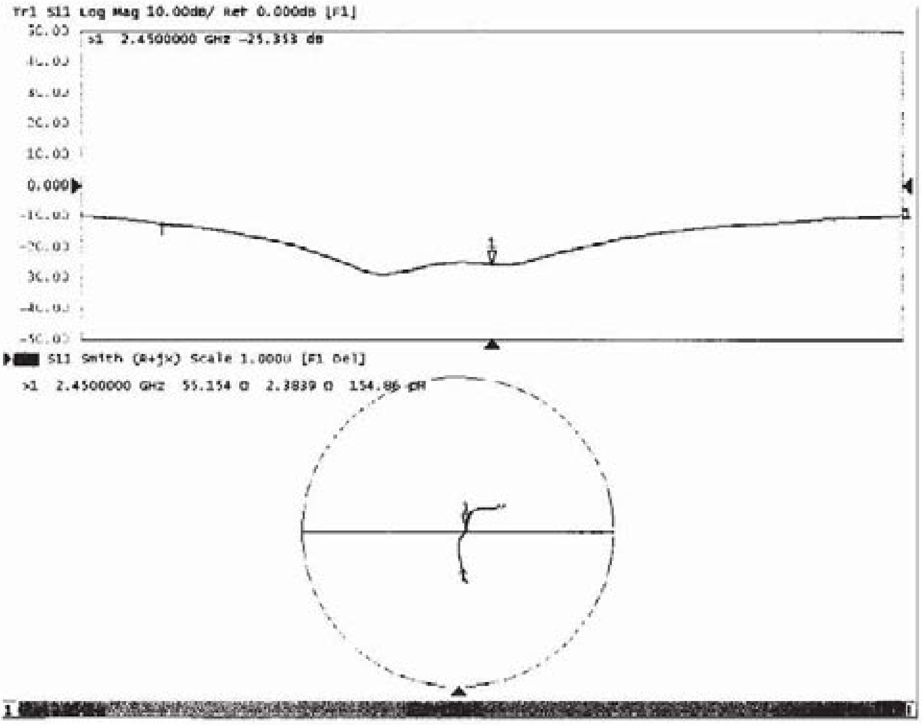
Impedance Measurement Plot for Body TSL



6.4. DAE4 Calibration Ceriticate

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ilac-MRA CNAS 校准 CNAS L0442

Client : CIQ SZ (Auden) Certificate No: J13-2-3048

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 1315
Calibration Procedure(s)	TMC-OS-E-01-198 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	November 25, 2013

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Documenting Process Calibrator 753	1971018	01-July-13 (TMC, No:JW13-049)	July-14

	Name	Function	Signature
Calibrated by:	Yu zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 25, 2013

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Glossary:

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.

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DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV
Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

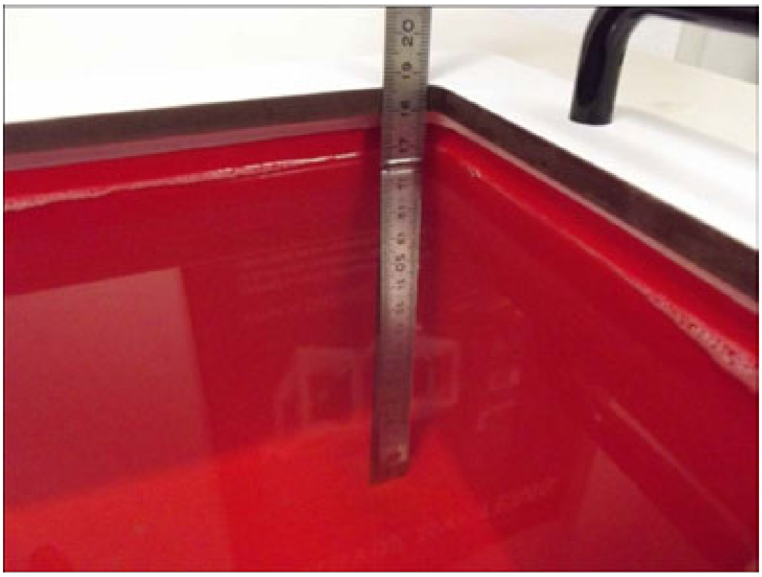
Calibration Factors	X	Y	Z
High Range	403.915 ± 0.15% (k=2)	405.171 ± 0.15% (k=2)	404.667 ± 0.15% (k=2)
Low Range	3.98903 ± 0.7% (k=2)	3.94180 ± 0.7% (k=2)	3.93862 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	162.5° ± 1 °

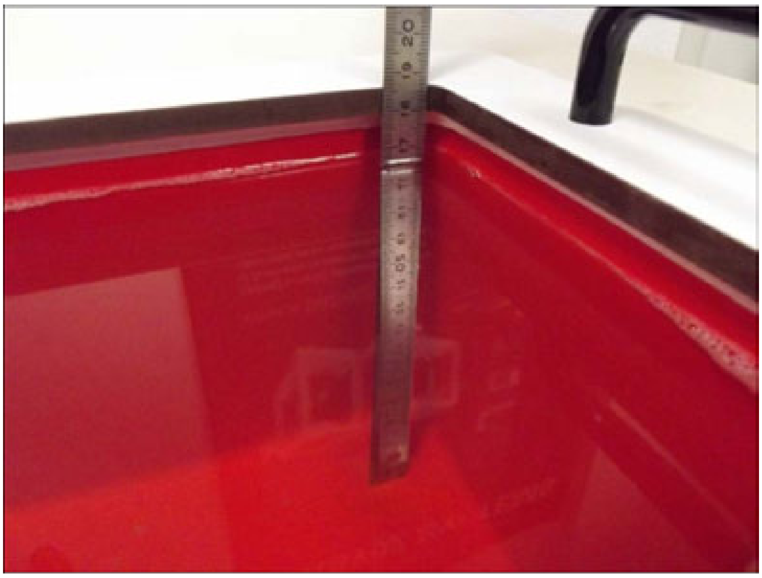
7. Test Setup Photos

Photograph of the depth in the Head Phantom (850MHz)



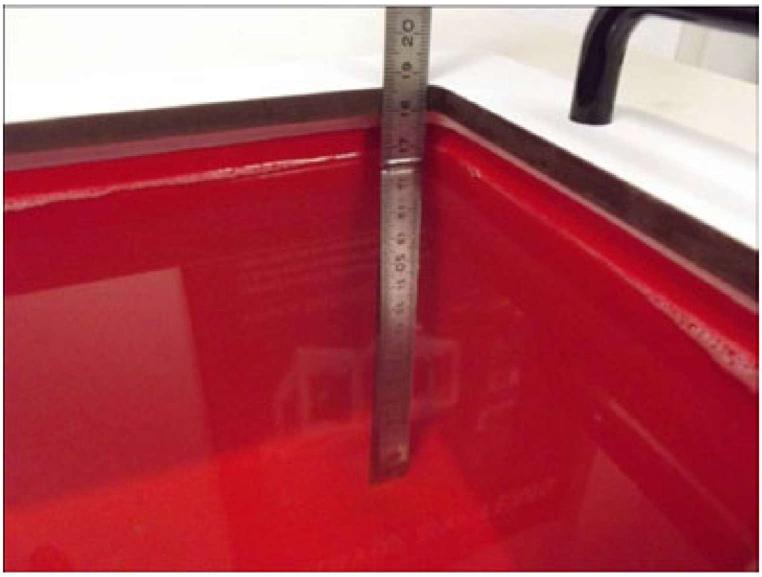
Photograph of the depth in the Body Phantom (850MHz)

Photograph of the depth in the Head Phantom (1900MHz)

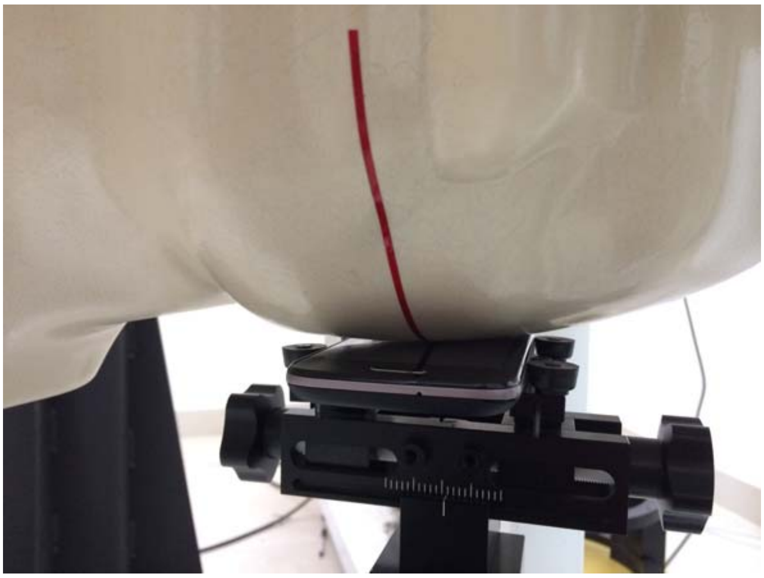


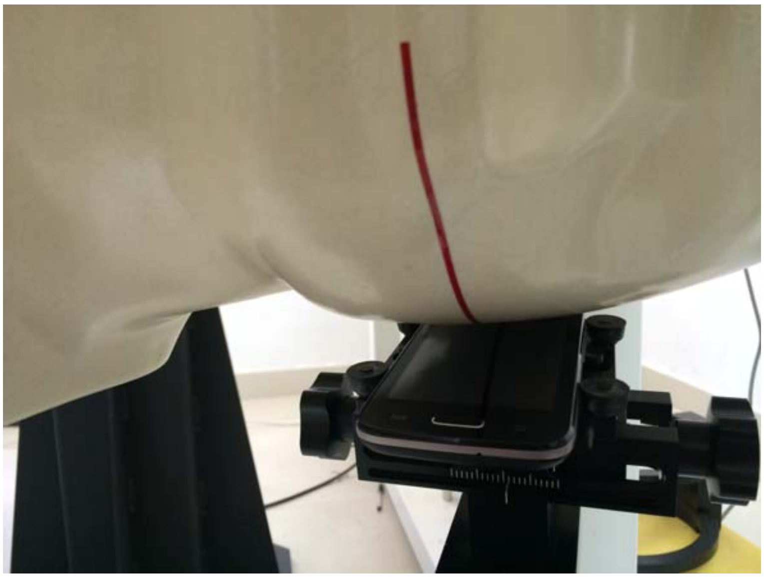
Photograph of the depth in the Body Phantom (1900MHz)

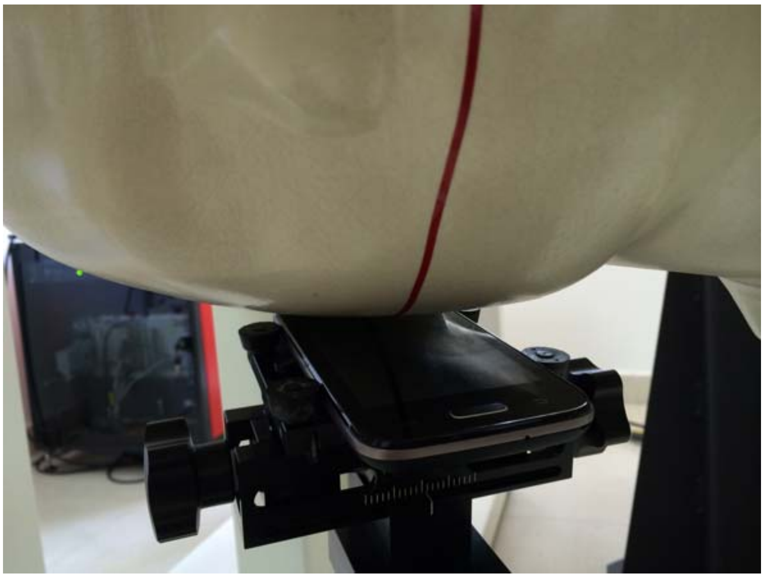
Photograph of the depth in the Head Phantom (2450MHz)

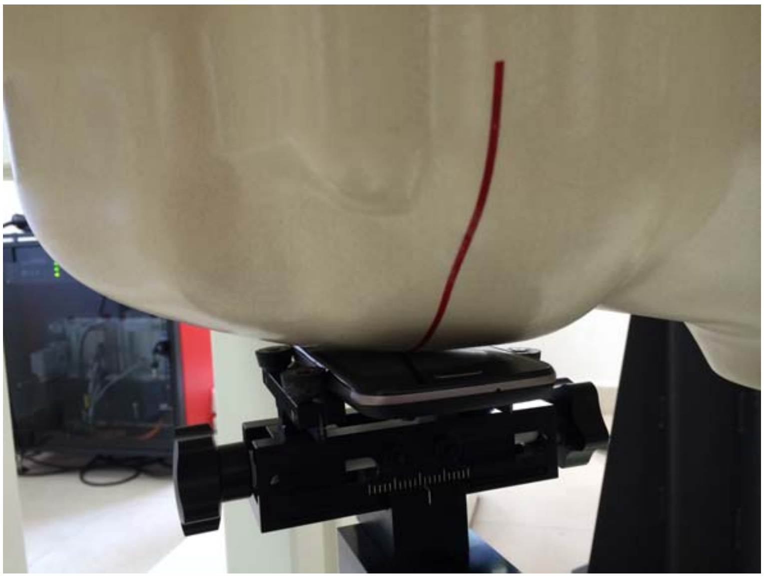


Photograph of the depth in the Body Phantom (2450MHz)


Right Head Tilt Setup Photo


Right Head Touch Setup Photo

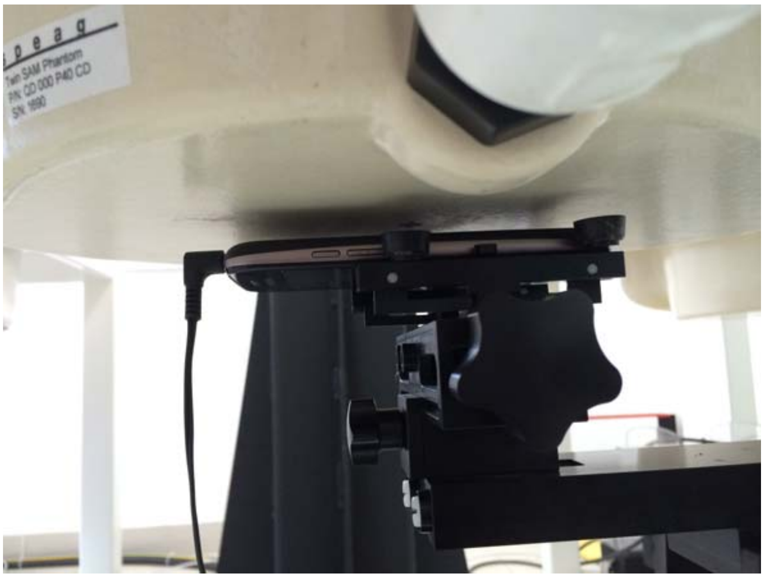

Left Head Tilt Setup Photo



Left Head Touch Setup Photo

10mm Body-worn Rear Side Setup Photo

10mm Body-worn Front Side Setup Photo

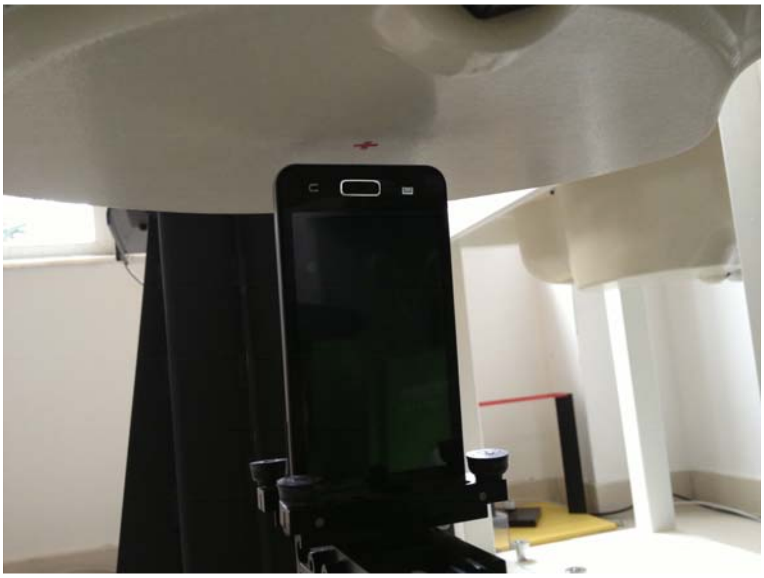


10mm Body-worn Rear Side (With Headset)Setup Photo

10mm Body-worn Left SideSetup Photo

10mm Body-worn Right Side Setup Photo

10mm Body-worn Top Side Setup Photo


10mm Body-worn Bottom Side Setup Photo

8. External Photos of the EUT

External Photos

.....................End of Report.........................