

TEST REPORT

EN62209-2:2010

EN50566:2017 EN62479:2010

Report Reference No.....: TZ190100535-SAR

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Date of issue.....: 2019/1/25

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Testing Laboratory Name: The Testing and Technology Center for Industrial Products of Shenzhen Entry-Exit Inspection and Quarantine Bureau

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Applicant's name.....: SHENZHEN DIBET TECHNOLOGY CO., LTD.

Address.....: Floor 1,Research Building,Tsinghua Hi-tech park,Nanshan district, Shenzhen,Guangdong,China

Test specification:

Standard: EN62209-2:2010
EN50566:2017
EN62479:2010

Test item description: Smart Watch

Trade Mark: N/A

Manufacturer: SHENZHEN DIBET TECHNOLOGY CO., LTD.

Model/Type reference.....: CGTW1

Listed Models: CGTW1,CGTW2,CGTW3,CGTW4,CGTW7,CGTW7PLUS,CGTW15,CGTW15PLUS,CGTW16,CGTW16PLUS,CGTW17, CGTW18,CGTW19,CGTW20,GTW5,GTW6,GTW7,GTW8,GTW9

Hardware version: G72S-MB-V2.6

Software version.....: G72F_V1

Ratings.....: DC 3.7V

Operation Frequency.....: GSM900/GSM1800/WiFi

Result.....: PASS

TEST REPORT

Test Report No. : TZ190100525-SAR	2019/1/25
	Date of issue

Equipment under Test : Smart Watch

Model /Type : CGTW1

Listed Models : Refer to page1

Applicant : SHENZHEN DIBET TECHNOLOGY CO., LTD.

Address : Floor 1,Research Building,Tsinghua Hi-tech park,Nanshan district,
Shenzhen,Guangdong,China

Manufacturer : SHENZHEN DIBET TECHNOLOGY CO., LTD.

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Shenzhen,Guangdong,China

Test Result	PASS
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Note:The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

**** Modified History ****

Revision	Description	Issued Data	Remark
Revision 1.0	Initial Test Report Release	2019/1/25	Andy Zhang

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1 TEST STANDARDS

Test Standard	Version	Test Standard Description
EN 50566	2017	Product standard to demonstrate compliance of radio frequency fields from handheld and body-mounted wireless communication devices used by the general public (30 MHz — 6 GHz) (applying the standard update)
EN 62209-2	2010	Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)
EN 62479	2010	Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields
1999/519/EC	1999-07	Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal L 197 of 30 July 1999)

2 SUMMARY

2.1 General ReMarks

Date of receipt of test sample	2019/1/12
Testing commenced on	2019/1/12
Testing concluded on	2019/1/25

2.2 Maximum Results of SAR

The maximum results of Specific Absorption Rate (SAR) found during testing for **TD-02** are as follows (with expanded uncertainty 20.4%)

Table 1:Max. SAR Measured(10g)

Exposure Configuration	Technolohy Band	Highest Measured SAR 10g(W/Kg)
Body-worn (Separation Distance 5mm)	GSM900	0.943
	GSM1800	0.569
	WiFi	0.096

Note: This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure (Localized 10-gram SAR for head and trunk, limit: 2.0W/kg) specified in Council Recommendation 1999/519/EC, and ICNIRP Guidelines, and R&TTE Directive - 1999/5/EC, and had been tested in accordance with the measurement methods and procedures specified in EN50566:2017, EN 62479:2010 and EN 62209-2:2010.

2.3 Product Description

The **SHENZHEN DIBET TECHNOLOGY CO., LTD.** 's Model: **CGTW** 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.

Product Feature & Specification	
Equipment Name	Smart Watch
Trade Mark	N/A
Model Name	CGTW1
Listed Models	Refer to page 1
Wireless Technology and Frequency Range	NON-EU BAND: GSM850: 824-849MHz (TX), 869-894MHz (RX); DCS1900: 1850-1910 MHz (TX), 1930-1990 MHz (RX) EU-BAND: E-GSM900: 880-915MHz (TX), 925-960MHz (RX); DCS1800: 1710-1785 MHz (TX), 1805-1880 MHz (RX) WiFi: 2412 MHz ~ 2472 MHz(TX/RX)
Antenna Type	Integral Antenna
HW Version	G72S-MB-V2.6
SW Version	G72F_V1
Mode	GSM 802.11b/g/n HT20
EUT Stage	Identical Prototype

2.4 Equipment under Test

Power supply system utilised

Power supply voltage	:	<input type="radio"/>	120V/ 60 Hz	<input type="radio"/>	115V/60Hz
		<input type="radio"/>	12 V DC	<input type="radio"/>	24 V DC
		<input checked="" type="radio"/>	Other (specified in blank below)		

DC 3.7V

2.5 Short description of the Equipment under Test (EUT)

Smart Watch (Model:CGTW).

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

2.6 EUT operation mode

The EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

2.7 EUT configuration

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

● - supplied by the manufacturer

○ - supplied by the lab

<input type="radio"/>	/	M/N:	/
		Manufacturer:	/

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.149,Gongye 7th Rd. Nanshan District, Shenzhen, China

3.2 Environmental conditions

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

Temperature:	20-23 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

3.3 SAR Limits

according to the European Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal L 197 of 30 July 1999):

Human Exposure	Uncontrolled Environment/ General Population
Spatial Peak SAR (Brain/Body)	2.00 W/kg
Spatial Average SAR (Whole Body)	0.08 W/kg
Spatial Peak SAR (Limbs)	4.00 W/kg

The limit applied in this test report is shown in bold letters

Notes:

* The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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

3.4 Equipments Used during the Test

Used	Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
					Last Calibration	Calibration Interval
<input checked="" type="checkbox"/>	Data Acquisition Electronics DAEx	SPEAG	DAE4	1373	2018-03-22	1
<input checked="" type="checkbox"/>	E-field Probe	SPEAG	EX3DV4	3924	2018-07-19	1
<input checked="" type="checkbox"/>	System Validation Dipole D900V2	SPEAG	D900V2	1d086	2016-07-01	3
<input checked="" type="checkbox"/>	System Validation Dipole 1750V2	SPEAG	D1750V2	1021	2016-07-01	3
<input checked="" type="checkbox"/>	System Validation Dipole D1900V2	SPEAG	D1900V2	5d175	2016-06-15	3
<input checked="" type="checkbox"/>	System Validation Dipole 2450V2	SPEAG	D2450V2	898	2016-10-12	3
<input checked="" type="checkbox"/>	Network analyzer	Agilent	E5071B	MY42404001	2018-12-12	1
<input checked="" type="checkbox"/>	Communication Tester	R&S	CMW500	116581	2018-12-12	1
<input checked="" type="checkbox"/>	Dielectric Probe Kit	Agilent	85070E	NA#F-EP-00777	/	/
<input checked="" type="checkbox"/>	Power meter	Agilent	NRVD	835843/014	2018-12-12	1
<input checked="" type="checkbox"/>	Power meter	Agilent	NRVD	835843/018	2018-12-12	1
<input checked="" type="checkbox"/>	Power meter	Agilent	NRVD	835843/021	2018-12-12	1
<input checked="" type="checkbox"/>	Power sensor	Agilent	NRV-Z2	100211	2018-12-12	1
<input checked="" type="checkbox"/>	Power sensor	Agilent	NRV-Z2	100215	2018-12-12	1
<input checked="" type="checkbox"/>	Power sensor	Agilent	NRV-Z2	100219	2018-12-12	1
<input checked="" type="checkbox"/>	Signal generator	ROHDE & SCHWARZ	SME03	100029	2018-12-12	1
<input checked="" type="checkbox"/>	Amplifier	AR	2HL-42W-S	100206	/	/

4 SAR Measurements System configuration

4.1 SAR Measurement Set-up

The DASY4 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 DASY4 measurement server.

The DASY4 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.

DASY4 software and SEMCAD data evaluation software.

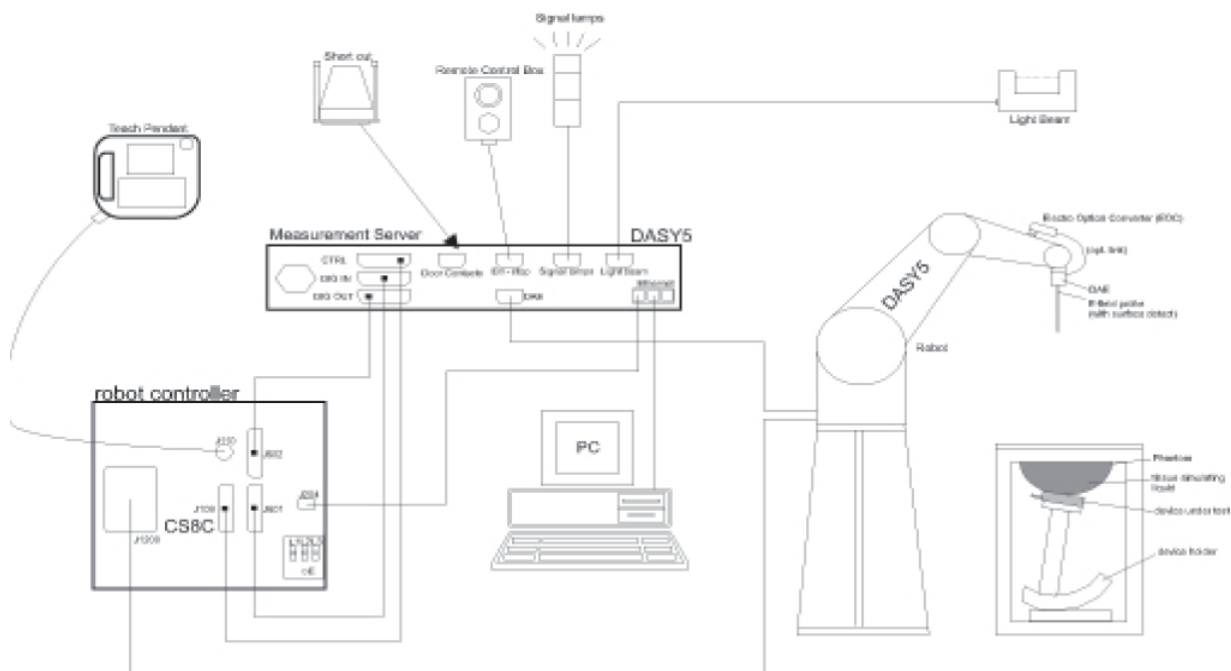
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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

The device holder for handheld Smart Watches.

Tissue simulating liquid mixed according to the given recipes.

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



4.2 DASY4 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.

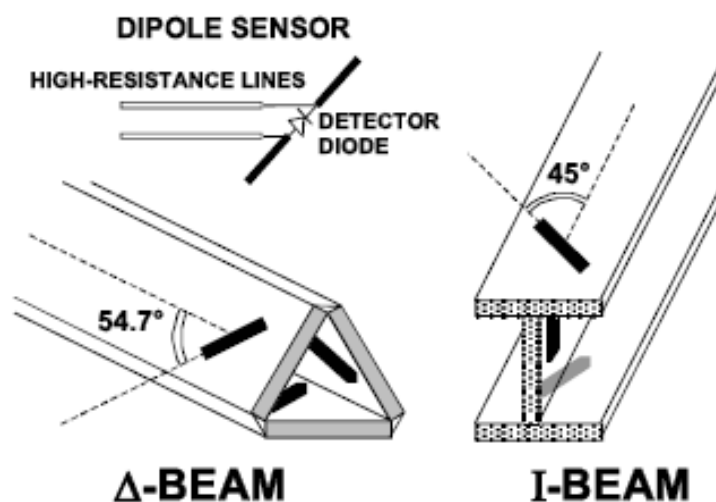
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 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 Smart Watches
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI



Isotropic E-Field Probe

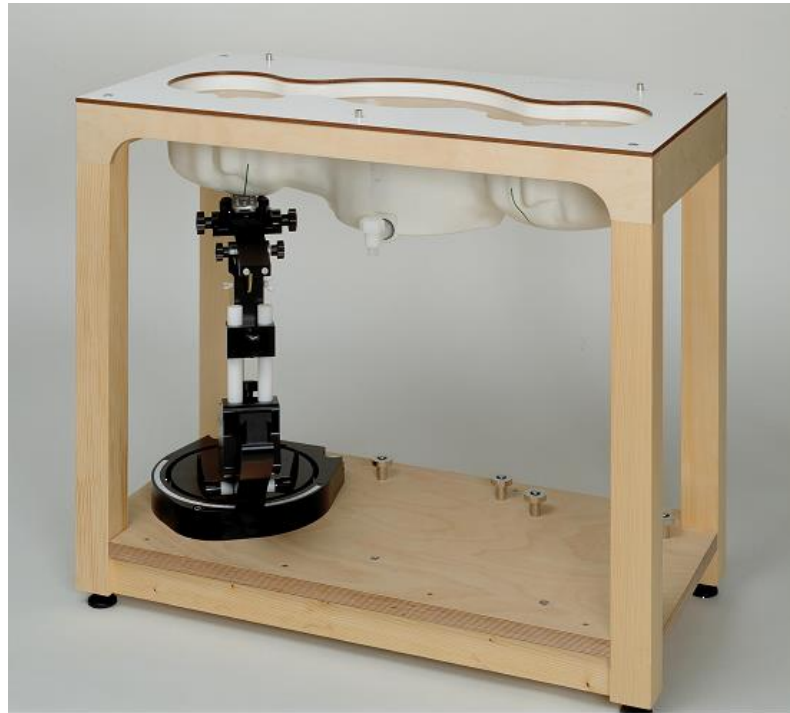
The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

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 DASY4 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. $\pm 5\%$.

The “surface check” measurement tests the optical surface detection system of the DASY4 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 $\pm 0.1\text{mm}$). 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 $\pm 30^\circ$.)

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 DASY4 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 DASY4 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 DASY4 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 V_i = compensated signal of channel i ($i = x, y, z$)
 U_i = input signal of channel i ($i = x, y, z$)
 cf = crest factor of exciting field (DASY parameter)
 dcp_i = diode compression point (DASY parameter)

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

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

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

With V_i = compensated signal of channel i ($i = x, y, z$)
 $Norm_i$ = sensor sensitivity of channel i ($i = x, y, z$)
[mV/(V/m)²] for E-field Probes
 $ConvF$ = sensitivity enhancement in solution
 a_{ij} = sensor sensitivity factors for H-field probes
 f = carrier frequency [GHz]
 E_i = electric field strength of channel i in V/m
 H_i = 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 priMayy field data are used to calculate the derived field units.

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

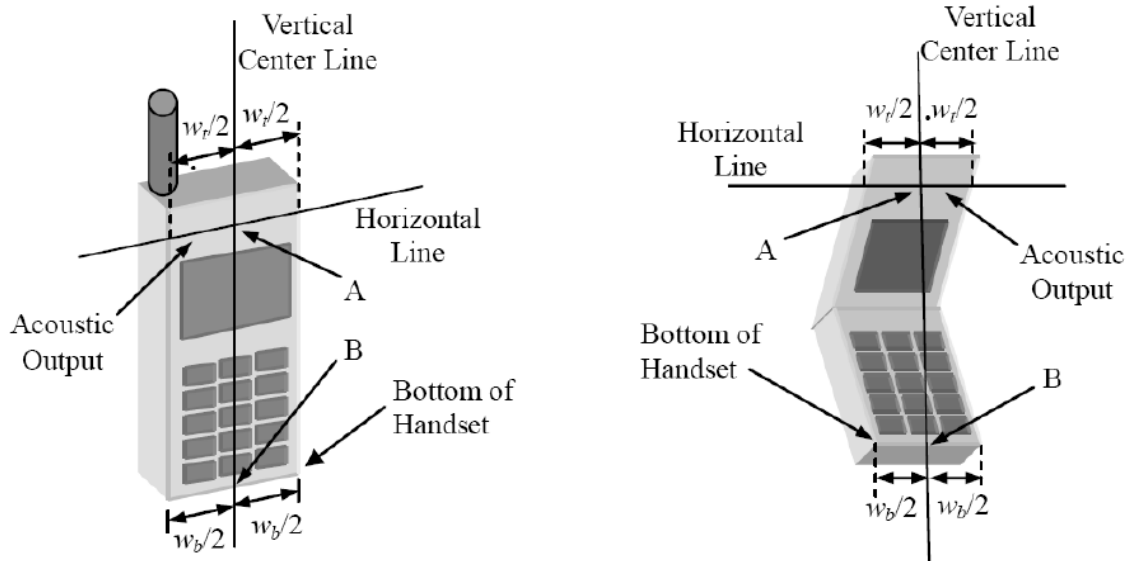
with SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm³

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 Position of the wireless device in relation to the phantom

General considerations

This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.



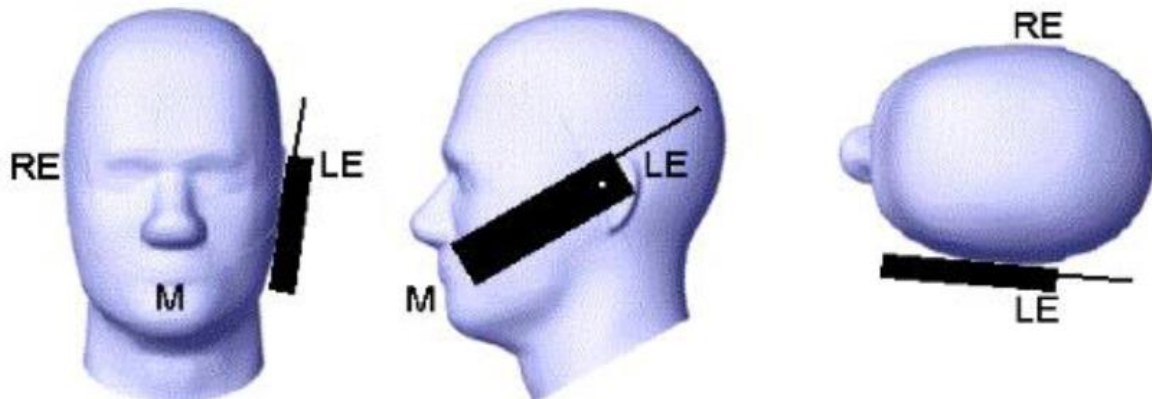
W_t Width of the handset at the level of the acoustic

W_b Width of the bottom of the handset

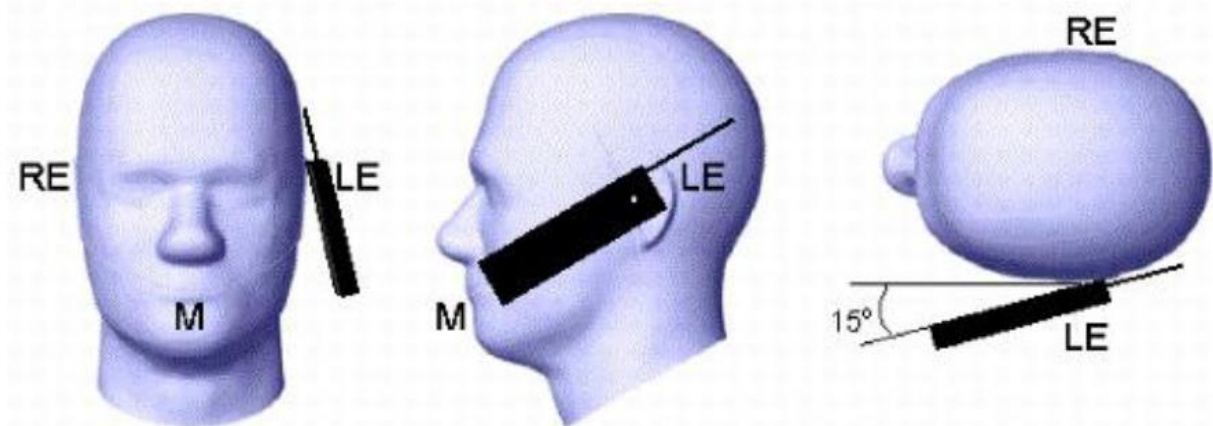
A Midpoint of the width w_t of the handset at the level of the acoustic output

B Midpoint of the width w_b of the bottom of the handset

Picture 1-a Typical “fixed” case handset Picture 1-b Typical “clam-shell” case handset



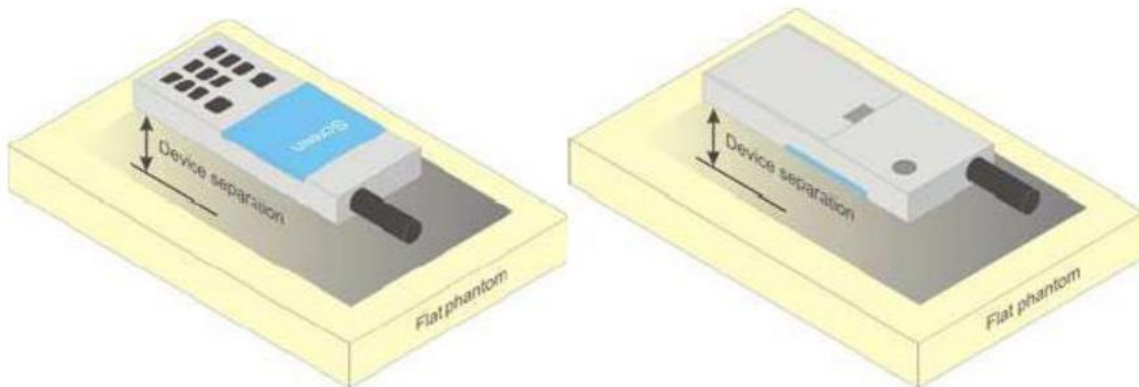
Picture 2 Cheek position of the wireless device on the left side of SAM



Picture 3 Tilt position of the wireless device on the left side of SAM

Body-worn device

A typical example of a body-worn device is a Mobile Phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer.



Picture 4 Test positions for body-worn devices

4.8 Tissue Dielectric Parameters for Head and Body Phantoms

The liquid used for the frequency range of 400-3000 MHz consisted of water, sugar, salt and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table 3 and 4 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

Table 2. Composition of the Head Tissue Equivalent Matter

Ingredients (% by weight)	Frequency (MHz)				
	835	900	1800	1950	2450
Water	41.45	40.92	16.33	54.89	46.70
Sugar	56.0	56.5	/	/	/
Salt	4.45	1.48	0.41	0.18	/
Preventol	0.19	0.1	/	/	/
Cellulose	0.1	0.4	/	/	/
Clycol Monobutyl	/	/	65.3	44.93	53.3
Dielectric Parameters Target Value	f=835MHz $\varepsilon = 41.5$ $\sigma = 0.90$	f=900MHz $\varepsilon = 41.5$ $\sigma = 0.97$	f=1800MHz $\varepsilon = 40.0$ $\sigma = 1.40$	f=1950 MHz $\varepsilon = 40.0$ $\sigma = 1.40$	f=2450 MHz $\varepsilon = 39.2$ $\sigma = 1.80$

Table 3. Targets for tissue simulating liquid

Frequency (MHz)	Liquid Type	Liquid Type (σ)	$\pm 5\%$ Range	Permittivity (ε)	$\pm 5\%$ Range
300	Head	0.87	0.83~0.91	45.30	40.04~47.57
450	Head	0.87	0.83~0.91	43.50	41.33~45.68
835	Head	0.90	0.86~0.95	41.50	39.43~43.58
900	Head	0.97	0.92~1.02	41.50	39.43~43.58
1450	Head	1.20	1.14~1.26	40.50	38.48~42.53
1800	Head	1.40	1.33~1.47	40.00	38.00~42.00
1900	Head	1.40	1.33~1.47	40.00	38.00~42.00
1950	Head	1.40	1.33~1.47	40.00	38.00~42.00
2000	Head	1.40	1.33~1.47	40.00	38.00~42.00
2450	Head	1.80	1.71~1.89	39.20	37.24~41.16
3000	Head	2.40	2.28~2.52	38.50	36.58~40.43
300	Body	0.87	0.83~0.91	45.30	40.04~47.57
450	Body	0.87	0.83~0.91	43.50	41.33~45.68
835	Body	0.90	0.86~0.95	41.50	39.43~43.58
900	Body	0.97	0.92~1.02	41.50	39.43~43.58
1450	Body	1.20	1.14~1.26	40.50	38.48~42.53
1800	Body	1.40	1.33~1.47	40.00	38.00~42.00
1900	Body	1.40	1.33~1.47	40.00	38.00~42.00
1950	Body	1.40	1.33~1.47	40.00	38.00~42.00
2000	Body	1.40	1.33~1.47	40.00	38.00~42.00
2100	Body	1.49	1.42~1.56	39.80	37.81~41.79
2450	Body	1.80	1.71~1.89	39.20	37.24~41.16
2600	Body	1.96	1.86~2.06	39.00	37.05~40.95
3000	Body	2.40	2.28~2.52	38.50	36.58~40.43
3500	Body	2.91	2.77~3.06	37.90	36.01~39.80
4000	Body	3.43	3.26~3.61	37.40	35.53~39.27
4500	Body	3.94	3.74~4.14	36.80	34.96~38.64
5000	Body	4.45	4.23~4.67	36.20	34.39~38.01
5200	Body	4.66	4.23~4.89	36.00	34.20~37.80
5400	Body	4.86	4.62~5.10	35.80	34.01~37.59
5600	Body	5.07	4.82~5.32	35.50	33.73~37.28
5800	Body	5.27	5.01~5.53	35.30	33.54~37.07
6000	Body	5.48	5.21~5.75	35.10	33.35~36.86

4.9 Dielectric Performance

Dielectric Performance of Head Tissue Simulating Liquid

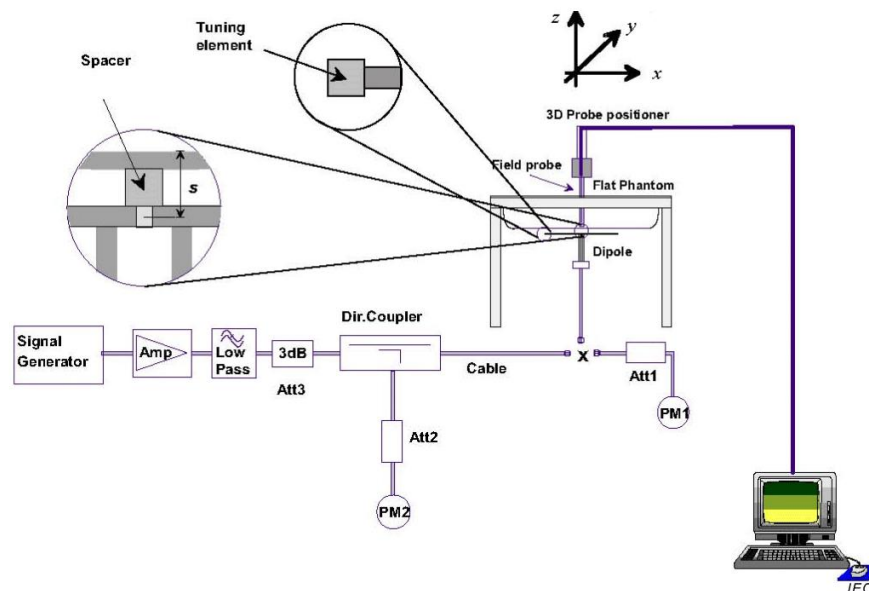
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Data
		ϵ_r	σ	ϵ_r	Dev. (%)	σ	Dev. (%)		
900H	900	41.5	0.97	41.7	0.48	0.97	0.00	22.4	1/12/2019
1750H	1750	40.1	1.37	39.5	-1.50	1.34	-2.19	22.3	1/13/2019
2450H	2450	39.2	1.8	39.3	0.26	1.85	2.78	22.4	1/14/2019

4.10 System Check

The purpose of the system check is to verify that the system operates within its specifications at the device 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 ($\pm 10\%$).

System check is performed regularly on all frequency bands where tests are performed with the DASY4 system.



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

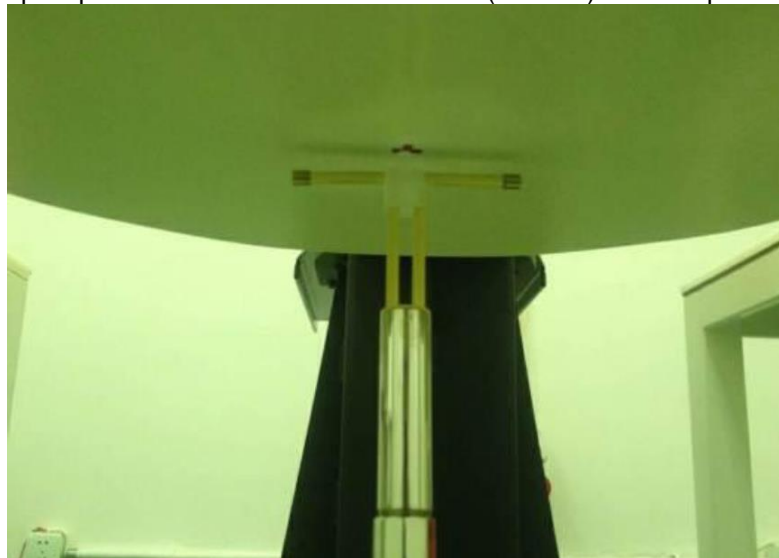


Photo of Dipole Setup

System Validation of Head

Frequency (MHz)	Description	SAR(1g) W/Kg	SAR(10g) W/Kg	Tissue Temp. (°C)	Date
900 (Head)	Reference	10.7±10% (9.63~11.77)	6.88±10% (6.19~7.57)	NA	1/12/2019
	Measurement	10.5	6.81	22.1	
1750 (Head)	Reference	36.9±10% (33.21~40.59)	19.8±10% (17.82~23.76)	NA	1/13/2019
	Measurement	35.12	18.71	22.3	
2450 (Head)	Reference	52.4±10% (47.16~57.64)	24.4±10% (21.96~26.84)	NA	1/14/2019
	Measurement	53.2	25.76	22.3	

4.11 Measurement Procedures

Tests to be performed

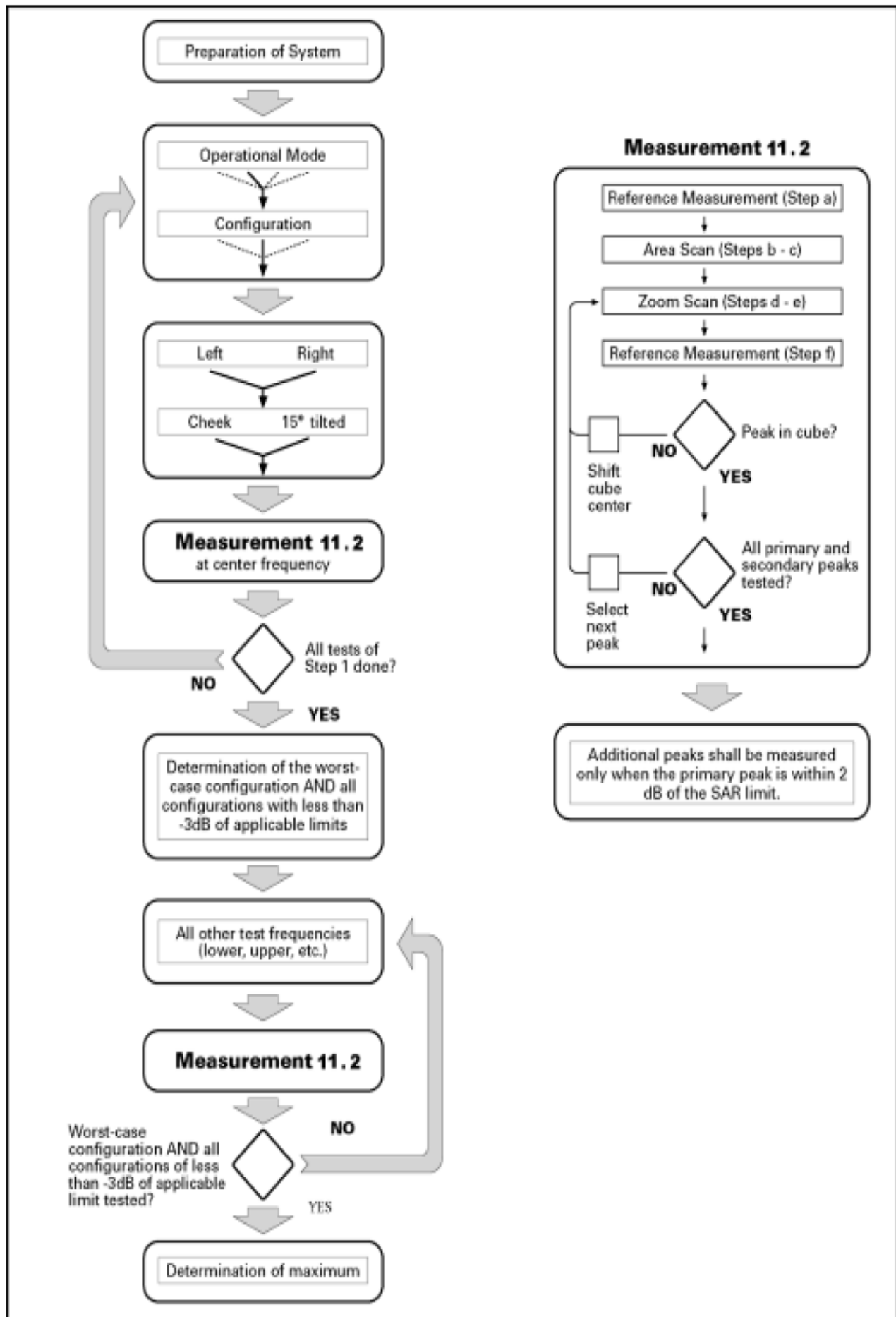
In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in Picture 5

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.
- d) 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 5 Block diagram of the tests to be performed

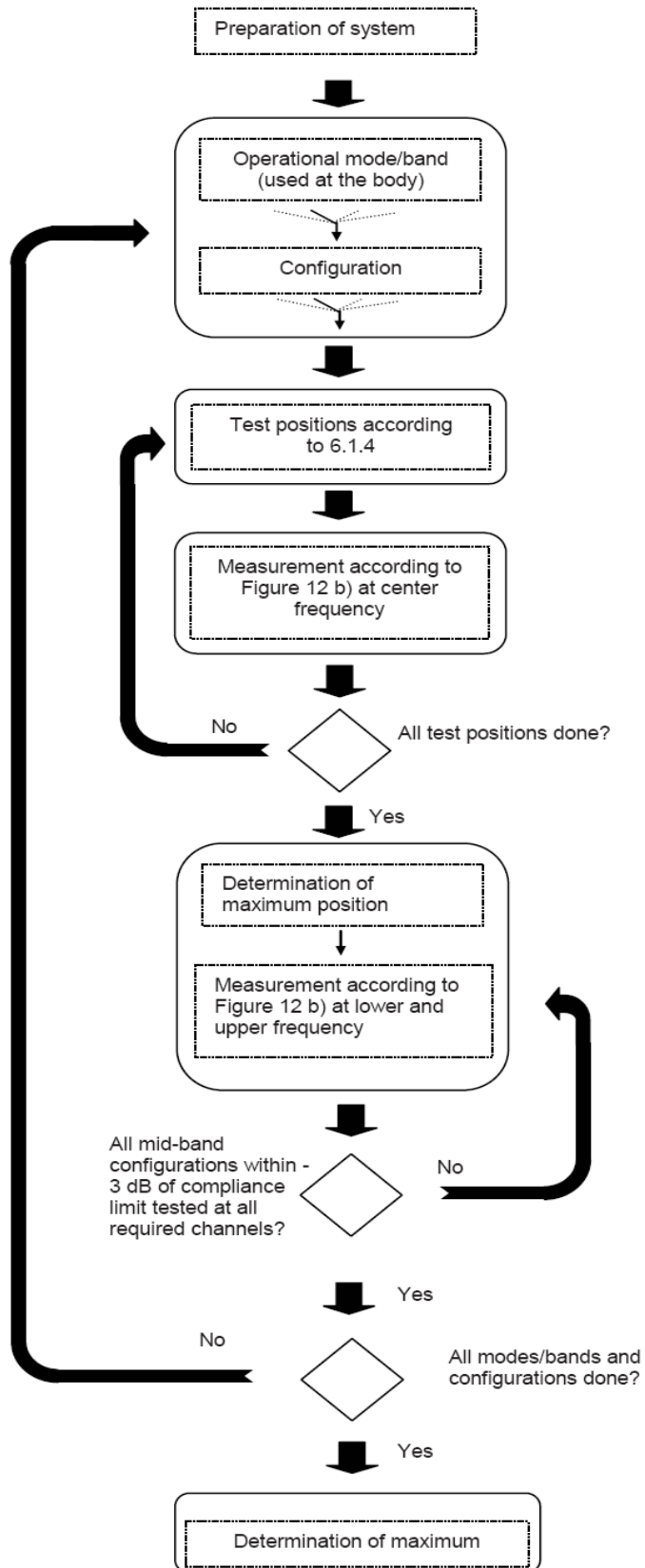


Figure 12a – Tests to be performed

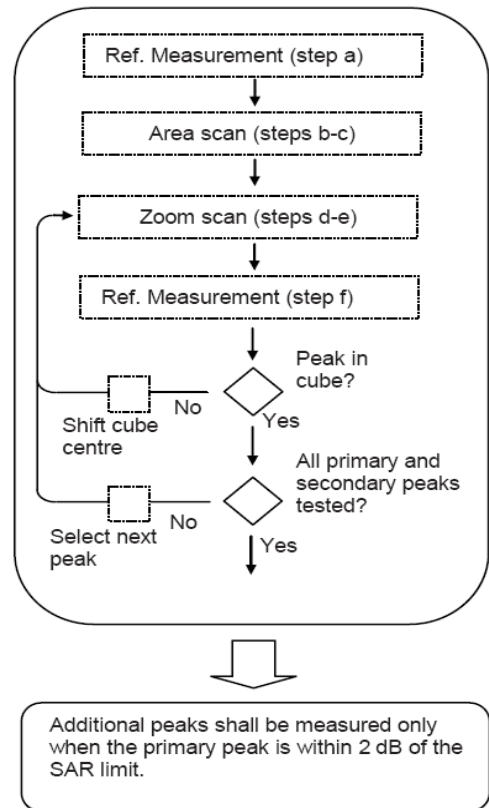


Figure 12b – General procedure

Picture 6 Block diagram of the tests to be performed

Measurement procedure

The following procedure shall be performed for each of the test conditions (see Picture 5) described in 11.1:

- a) Measure the local SAR at a test point within 8 mm or less in the normal direction from the inner surface of the phantom.
- b) Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grid spacing of 20 mm for frequencies below 3 GHz and $(60/f \text{ [GHz]})$ mm for frequencies of 3 GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and $\delta \ln(2)/2$ mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and $\ln(x)$ is the natural logarithm. The maximum variation of the sensor-phantom surface shall be ± 1 mm for frequencies below 3 GHz and ± 0.5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5° . If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional measurement distance to the phantom inner surface shorter than the probe diameter, additional
- c) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;
- d) Measure the three-dimensional SAR distribution at the local maxima locations identified in step
- e) The horizontal grid step shall be $(24 / f \text{ [GHz]})$ mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grid step in the vertical direction shall be $(8/f \text{ [GHz]})$ mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be $(12 / f \text{ [GHz]})$ mm or less but not more than 4 mm, and the spacing between further points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and $\delta \ln(2)/2$ mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and $\ln(x)$ is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved is the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5° . If this cannot be achieved an additional uncertainty evaluation is needed.
- f) Use post processing (e.g. interpolation and extrapolation) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

Power Drift

To control the output power stability during the SAR test, DASY4 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 2 to Table 6 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

5 TEST CONDITIONS AND RESULTS

5.1 Conducted Power Results

During the process of testing, the EUT was controlled via Rhode & Schwarz Digital Radio Communication tester (CMW500) to ensure the maximum power transmission and proper modulation. This result contains conducted output power for the EUT. In all cases, the measured peak output power should be greater and within 5% than EMI measurement.

<GSMConducted Power>

Band GSM900	Burst Average Power (dBm)			Frame-Average Power (dBm)		
TX Channel	975	37	124	975	37	124
Frequency (MHz)	880.2	897.4	914.8	880.2	897.4	914.8
GSM (GMSK, 1 Tx slot)	31.31	32.42	31.55	22.31	23.42	22.55
GPRS (GMSK, 1 Tx slot) – CS1	31.73	31.54	32.00	22.73	22.54	23
GPRS (GMSK, 2 Tx slots) – CS1	30.85	30.82	30.52	24.85	24.82	24.52
GPRS (GMSK, 3 Tx slots) – CS1	28.8	28.7	29.16	24.54	24.44	24.9
GPRS (GMSK, 4 Tx slots) – CS1	28.46	28.64	28.43	25.46	25.64	25.43
EDGE (8PSK, 1 Tx slot) – MCS1	26.95	27.13	26.98	17.95	18.13	17.98
EDGE (8PSK, 2 Tx slots) – MCS1	25.43	25.69	25.22	19.43	19.69	19.22
EDGE (8PSK, 3 Tx slots) – MCS1	24.25	24.36	24.97	19.99	20.1	20.71
EDGE (8PSK, 4 Tx slots) – MCS1	23.86	23.78	23.64	20.86	20.78	20.64

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

The calculated method are shown as below:

Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB

Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB

Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

Band GSM1800	Burst Average Power (dBm)			Frame-Average Power (dBm)		
TX Channel	512	699	885	512	699	885
Frequency (MHz)	1710.2	1747.6	1784.8	1710.2	1747.6	1784.8
GSM (GMSK, 1 Tx slot)	30.17	30.91	30.38	21.17	21.91	21.38
GPRS (GMSK, 1 Tx slot) – CS1	29.72	30.57	29.41	20.72	21.57	20.41
GPRS (GMSK, 2 Tx slots) – CS1	28.24	29.1	28.96	22.24	23.1	22.96
GPRS (GMSK, 3 Tx slots) – CS1	26.36	26.46	26.62	22.1	22.2	22.36
GPRS (GMSK, 4 Tx slots) – CS1	25.65	25.73	25.93	22.65	22.73	22.93
EDGE (8PSK, 1 Tx slot) – MCS1	26.84	26.48	26.27	17.84	17.48	17.27
EDGE (8PSK, 2 Tx slots) – MCS1	26.04	26.53	26.16	20.04	20.53	20.16
EDGE (8PSK, 3 Tx slots) – MCS1	24.72	25.33	24.51	20.46	21.07	20.25
EDGE (8PSK, 4 Tx slots) – MCS1	23.83	23.3	23.81	20.83	20.3	20.81

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

The calculated method are shown as below:

Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB

Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB

Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

Note:

1. For Head SAR testing for voice call operation GSM should be evaluated and the mode of highest source-based time-average power is selected to be tested. Therefore GSM900 and GSM1800 band GSM Voice is selected.
2. For Body-worn SAR testing, the mode of highest source-based time-average power among GSM, GPRS is selected to be tested; therefore GSM900 and GSM1800 band GPRS 4 Tx slots and GSM Voice are selected.
3. Start tests at middle channel and determine the worst configuration for further high/low channel tests

<WLAN2.4G Conducted Power>

Mode	Channel	Frequency (MHz)	Average power(dBm)	Test Rate Data
802.11b	1	2412	14.51	1 Mbps
	7	2442	15.19	1 Mbps
	13	2472	14.51	1 Mbps
802.11g	1	2412	12.65	6 Mbps
	7	2442	12.86	6 Mbps
	13	2472	12.38	6 Mbps
802.11n(20MHz)	1	2412	12.22	6.5 Mbps
	7	2442	12.43	6.5 Mbps
	13	2472	12.62	6.5 Mbps

5.2 SAR Measurement Results

<Body SAR>

Band	Mode	TestPosition	Gap (cm)	Ch.	Power Drift (dB)	SAR _{10g} (W/kg)	Plot
GSM900	GPRS(4 Tx slots)	Front	0.5	37	-0.07	0.726	
GSM900	GPRS(4 Tx slots)	Back	0.5	37	-0.09	0.943	#1
GSM900	GSM Voice	Back	0.5	37	-0.08	0.800	
GSM900	GPRS(4 Tx slots)	Back	0.5	975	0.00	0.909	
GSM900	GPRS(4 Tx slots)	Back	0.5	124	-0.06	0.905	
GSM1800	GPRS(4 Tx slots)	Front	0.5	699	-0.03	0.357	
GSM1800	GPRS(4 Tx slots)	Back	0.5	699	-0.01	0.532	
GSM1800	GSM Voice	Back	0.5	699	-0.03	0.497	
GSM1800	GPRS(4 Tx slots)	Back	0.5	512	-0.10	0.536	
GSM1800	GPRS(4 Tx slots)	Back	0.5	885	-0.04	0.569	#2

<WLAN2.4G>

Band	Mode	TestPosition	Gap (cm)	Ch.	Power Drift (dB)	SAR _{10g} (W/kg)	Plot
WLAN2.4G	802.11b	Front	0.5	7	-0.04	0.092	
WLAN2.4G	802.11b	Back	0.5	7	-0.01	0.074	
WLAN2.4G	802.11b	Back	0.5	1	-0.01	0.096	#3
WLAN2.4G	802.11b	Back	0.5	13	-0.07	0.055	

5.3 Simultaneous Transmission analysis

According to EN62209-2 Annex K:

Method 1:

The maximum power level, $P_{\max,m}$, that can be transmitted by a device before the SAR averaged over a mass, m , exceeds a given limit, SAR_{\lim} , can be defined. Any device transmitting at power levels below $P_{\max,m}$ can then be excluded from SAR testing. The lowest possible value for $P_{\max,m}$ is:

$$P_{\max,m} = SAR_{\lim} \times m$$

($SAR_{\lim} = 2 \text{ W/kg}$, an averaging mass of $m = 10 \text{ g}$, $P_{\max,m} = 20 \text{ mW}$;
 $SAR_{\lim} = 1,6 \text{ W/kg}$, an averaging mass of $m = 1 \text{ g}$, $P_{\max,m} = 1,6 \text{ mW}$)

Method 2:

Simultaneous multi-band transmission means that the device can transmit multiple transmission modes at the same time

In some cases, the secondary transmitter can be excluded from SAR testing when used alone (e.g., using Method 1). However, when the primary and secondary transmitters are used together, the SAR limit may still be exceeded. A means of determining the threshold power for the secondary transmitter that allows it to be excluded from SAR testing is needed.

One way of determining the threshold power level available to the secondary transmitter ($P_{\text{available}}$) is to calculate it from the measured peak spatial-average SAR of the primary transmitter (SAR_1) according to the equation:

$$P_{\text{available}} = P_{\text{th},m} \times (SAR_{\lim} - SAR_1) / SAR_{\lim}$$

where $P_{\text{th},m}$ is the threshold exclusion power level taken from Annex B of IEC 62479 for the frequency of the secondary transmitter at the separation distance used in the testing.

If the output power of the secondary transmitter is less than $P_{\text{available}}$, SAR measurement for the secondary transmitter is not necessary. The above formula can be easily generalized to the case where more than two transmitters are communicating simultaneously. If there are N simultaneous transmitters and the peak spatial-average SAR of the first $N - 1$ transmitters are known (SAR_i), then the threshold power level available to the N th transmitter can be found from

$$P_{\text{available}} = P_{\max,m} \times (SAR_{\lim} - \sum_{i=1}^{N-1} SAR_i) / SAR_{\lim}$$

Alternatively, $P_{\text{th},m}$ can be replaced by $P_{\max,m}$, which is an easier approach but leads to more restrictive power threshold.

EN62479 Annex B:

f GHz	BW %	Example air interface	P_{\max}' mW			
			$s = 5 \text{ mm}$		$s = 25 \text{ mm}$	
			$m = 1 \text{ g}$	$m = 10 \text{ g}$	$m = 1 \text{ g}$	$m = 10 \text{ g}$
2,442	3,4	802.11b	7,3	32	130	328

Test result:

No.	Simultaneous Transmission Configurations	Head	Body-worn	Note
1	GSM (data) + WIFI (data)	No	YES	
2	GSM (Voice) + WIFI (data)	No	YES	

GSM are single standby single-pass, So they can not transmit simultaneously

$$P_{\text{available}} = P_{\text{th},m} \times (\text{SAR}_{\text{lim}} - \text{SAR}_1) / \text{SAR}_{\text{lim}}$$

$P_{\text{th}, m} = 20 \text{ mW}$, $\text{SAR}_{\text{lim}} = 2 \text{ W/Kg}$;

Body position: 0.346 W/Kg

So:

$$\text{Body position: } P_{\text{available}} = 20 \times (2 - 0.346) / 2 = 16.54 \text{ mW}$$

$$P_{\text{max}}(\text{Bluetooth}) = 6.88 \text{ dBm} = 4.88 \text{ mW} < P_{\text{available}}$$

So We can not consider transmitting simultaneously of the LTE and BT

For GSM and WIFI.

For Body

$$\text{SAR}(\text{GSM MAX}) + \text{SAR}(\text{WIFI MAX}) = 0.943 \text{ W/Kg} + 0.096 \text{ W/Kg} = 1.039 \text{ W/Kg} < 2 \text{ W/Kg};$$

So For GSM and WIFI. transmit simultaneously conforms the standards.

5.4 Measurement Uncertainty (300-3GHz)

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 evaluation	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	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	∞

	(meas.)									
21	Liquid permittivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
22	Liquid permittivity (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%	∞

5.5 System Check Results

Date: 1/12/2019

DUT: Dipole 900MHz; Type: D900V2; Serial: D900V2 - SN: 1d086
Program Name: System Performance Check Head at 900 MHz

Communication System: CW; Frequency: 900 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.97 \text{ mho/m}$; $\epsilon_r = 41.7$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3924; ConvF(9.63, 9.63, 9.63); Calibrated: 7/19/2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1373; Calibrated: 3/22/2018
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

d=15mm, Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
 Maximum value of SAR (interpolated) = 2.87 mW/g

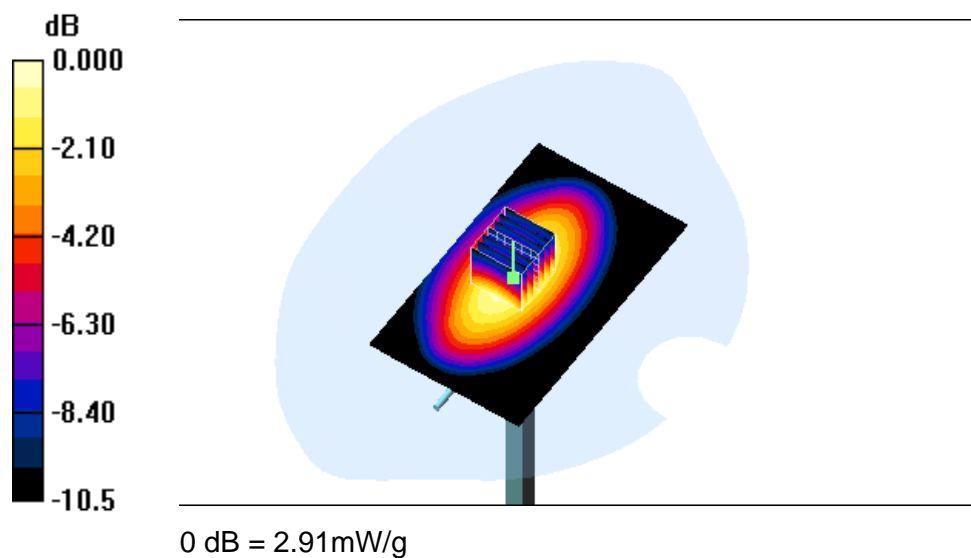
d=15mm, Pin=250mW/Zoom Scan (5x5x7) (7x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 54.523 V/m; Power Drift = -0.01dB

Peak SAR (extrapolated) = 4.068 W/kg

SAR(1 g) = 2.625 mW/g; SAR(10 g) = 1.70 mW/g

Maximum value of SAR (measured) = 2.91 mW/g



Date: 1/13/2019

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1021
Program Name: System Performance Check Head at 1750 MHz

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.34$ mho/m; $\epsilon_r = 39.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3924; ConvF(8.30, 8.30, 8.30); Calibrated: 7/19/2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1373; Calibrated: 3/22/2018
- Phantom: SAM 1; Type: SAM; Serial: TP-1360
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

d=10mm, Pin=250mW/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm
 Maximum value of SAR (interpolated) = 9.12 mW/g

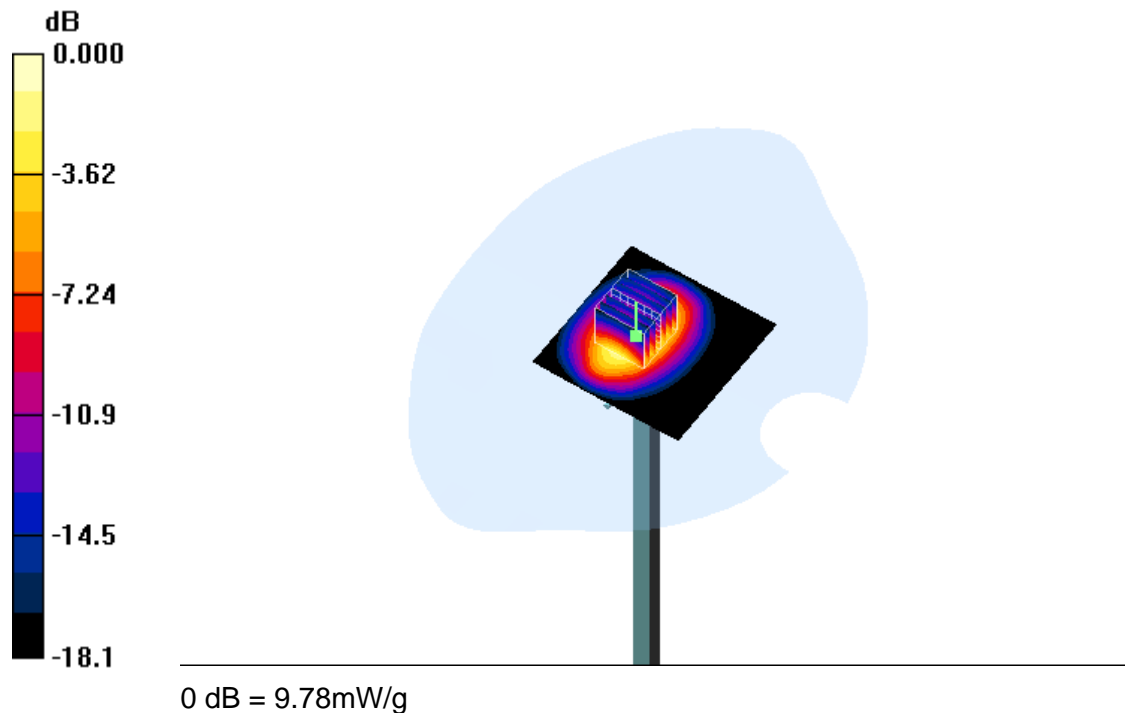
d=10mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 83.712 V/m; Power Drift = 0.02dB

Peak SAR (extrapolated) = 16.718 W/kg

SAR(1 g) = 8.78 mW/g; SAR(10 g) = 4.68 mW/g

Maximum value of SAR (measured) = 9.78 mW/g



Date: 1/14/2019

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 955
Program Name: System Performance Check Head at 2450 MHz

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ mho/m; $\epsilon_r = 39.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3924; ConvF(7.51, 7.51, 7.51); Calibrated: 7/19/2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1373; Calibrated: 3/22/2018
- Phantom: SAM 1; Type: SAM; Serial: TP-1360
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

d=10mm, Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=12mm, dy=12mm
 Maximum value of SAR (interpolated) = 15.6 mW/g

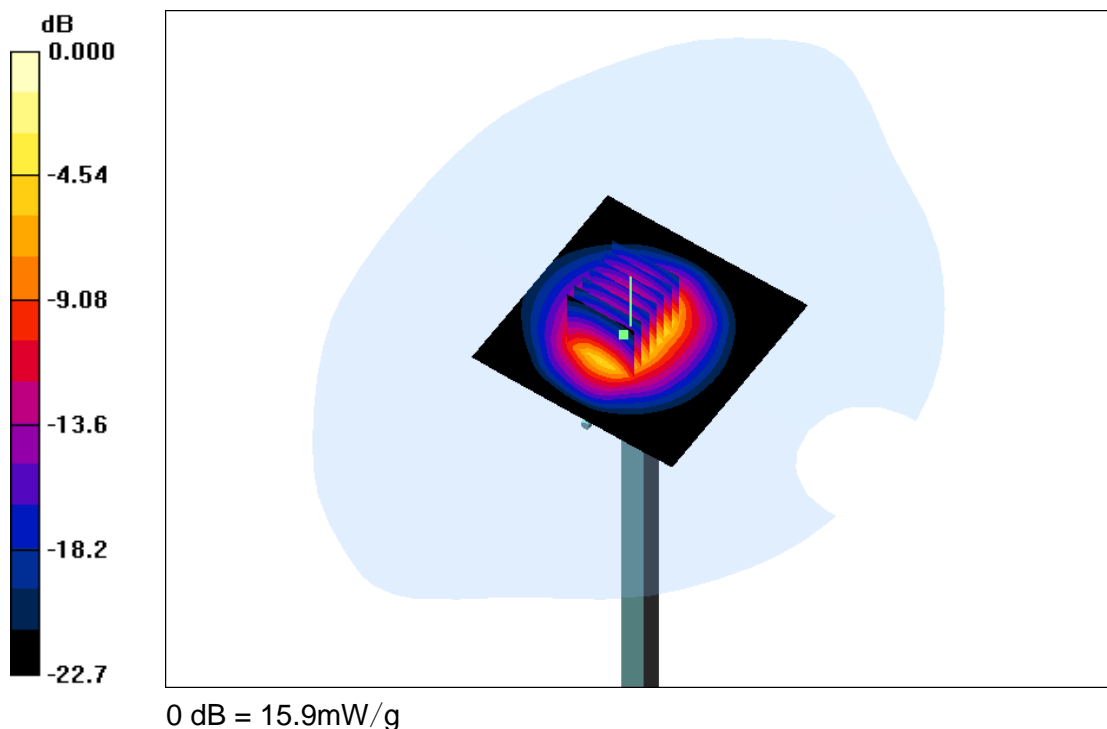
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 86.4 V/m; Power Drift = 0.006 dB

Peak SAR (extrapolated) = 30.2 W/kg

SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.44 mW/g

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



5.6 SAR Test Graph Results

#1

Date: 1/12/2019

GSM900_GPRS(4 Tx slots)_Back_Ch37

Communication System: GSM 900; Frequency: 897.4 MHz; Duty Cycle: 1:2

Medium parameters used: $f = 898$ MHz; $\sigma = 0.973$ mho/m; $\epsilon_r = 42.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3924; ConvF(9.63, 9.63, 9.63); Calibrated: 7/19/2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1373; Calibrated: 3/22/2018
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Body/Back/Area Scan (61x101x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 1.23 mW/g

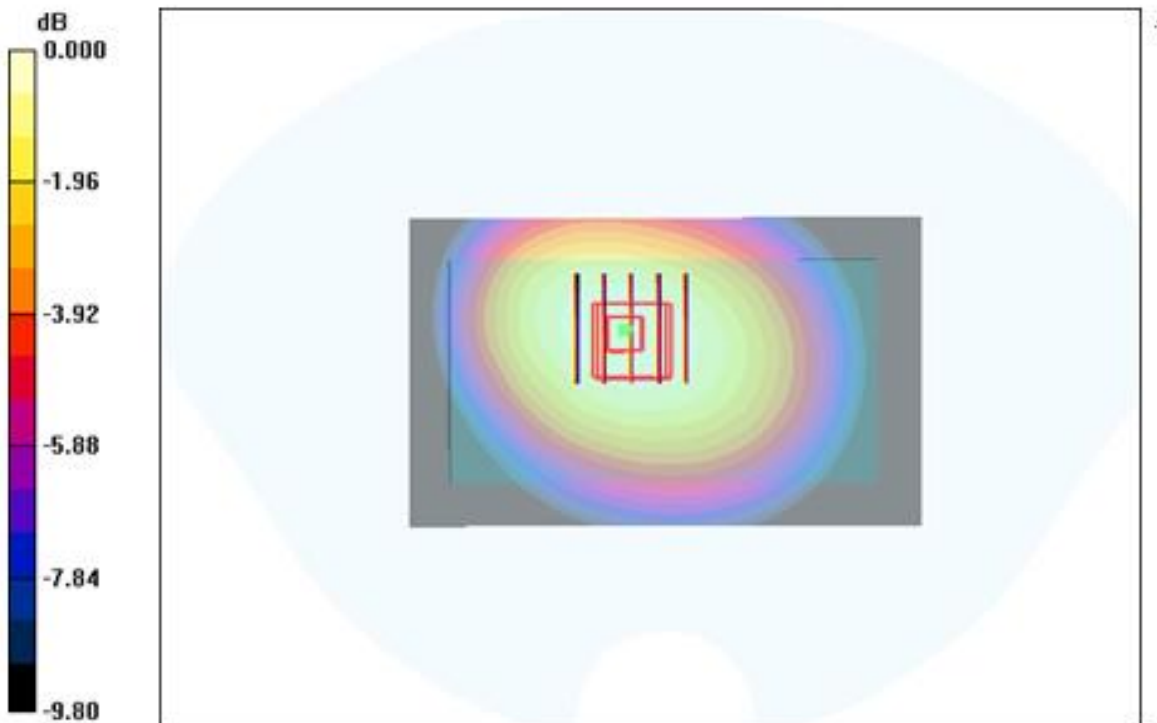
Body/Back/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8$ mm, $dy=8$ mm, $dz=5$ mm

Reference Value = 44.2 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 1.84 W/kg

SAR(1 g) = 1.23 mW/g; SAR(10 g) = 0.943 mW/g

Maximum value of SAR (measured) = 1.37 mW/g



#2

Date: 1/13/2018

GSM1800_GPRS(4 Tx slots) _ Back_Ch885

Communication System: GPRS 1800; Frequency: 1784.8 MHz; Duty Cycle: 1:2

Medium parameters used (interpolated): $f = 1784.8$ MHz; $\sigma = 1.37$ mho/m; $\epsilon_r = 41.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3924; ConvF(8.30, 8.30, 8.30); Calibrated: 7/19/2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1373; Calibrated: 3/22/2018
- Phantom: SAM 1; Type: SAM; Serial: TP-1360
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Body/Back 2/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm.

Maximum value of SAR (interpolated) = 1.33 mW/g

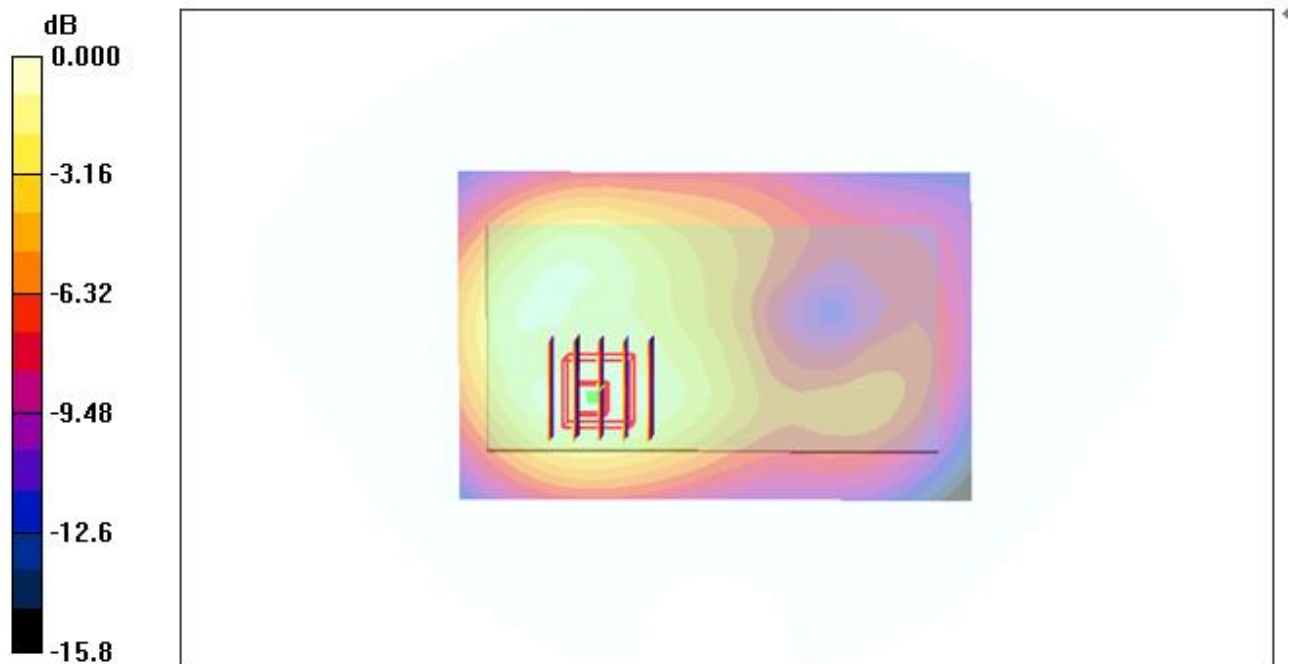
Body/Back 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 36.5 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 1.66 W/kg

SAR(1 g) = 1.29 mW/g; SAR(10 g) = 0.569 mW/g

Maximum value of SAR (measured) = 1.35 mW/g



#3

Date: 1/14/2019

WLAN2.4G_802.11b_Back_Ch13

Communication System: 802.11; Frequency: 2472 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2472$ MHz; $\sigma = 1.88$ mho/m; $\epsilon_r = 37.5$; $\rho = 1000$ kg/m³

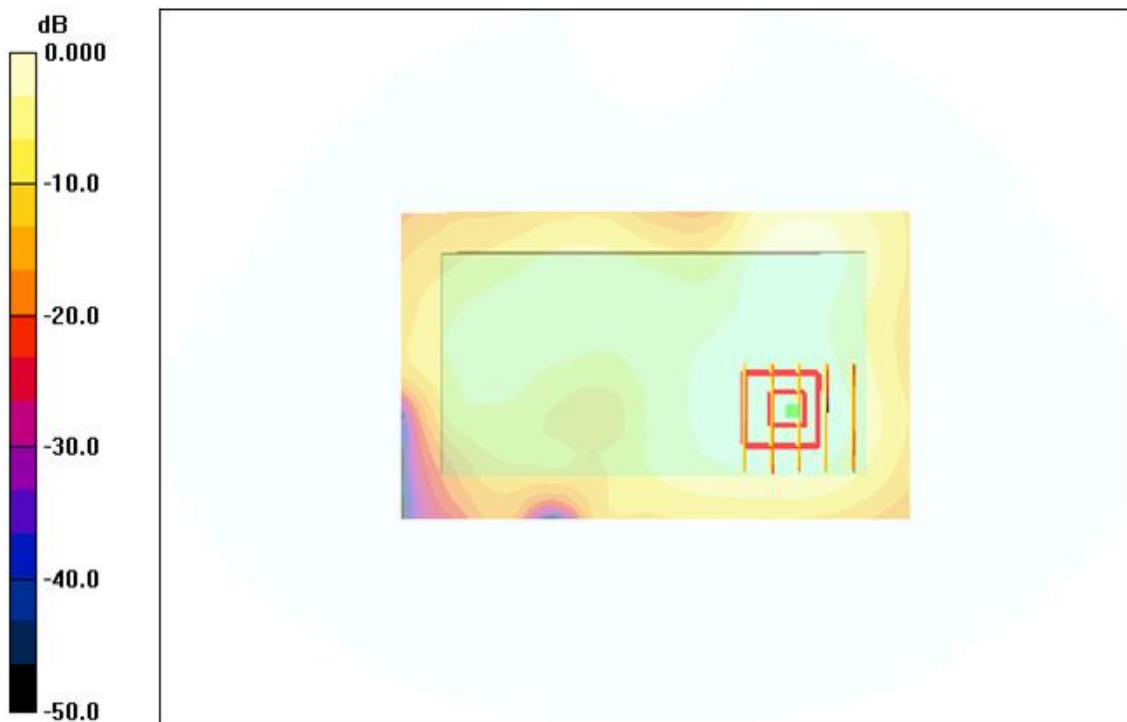
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3924; ConvF(7.51, 7.51, 7.51); Calibrated: 7/19/2018;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1373; Calibrated: 3/22/2018
- Phantom: SAM 1; Type: SAM; Serial: TP-1360
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Body/Back/Area Scan (61x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.189 mW/g

Body/Back/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.71 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.492 W/kg
SAR(1 g) = 0.187 mW/g; SAR(10 g) = 0.096 mW/g
Maximum value of SAR (measured) = 0.193mW/g



6 Calibration Certificate

6.1 Probe Calibration Certificate

6.1.1. Probe: EX3DV4



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校准
CALIBRATION
CNAS L0570

Client

CCIS

Certificate No: Z18-60226

CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3924

Calibration Procedure(s) FF-Z11-004-01
Calibration Procedures for Dosimetric E-field Probes

Calibration date: July 19, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101547	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101548	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Reference10dBAAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01132)	Feb-20
Reference Probe EX3DV4	SN 3846	25-Jan-18(SPEAG, No.EX3-3846_Jan18)	Jan-19
DAE4	SN 777	15-Dec-17(SPEAG, No.DAE4-777_Dec17)	Dec -18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	21-Jun-18 (CTTL, No.J18X05033)	Jun-19
Network Analyzer E5071C	MY46110673	14-Jan-18 (CTTL, No.J18X00561)	Jan -19

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: July 20, 2018

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



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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), $\theta=0$ is normal to probe axis

Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta=0$ ($f \leq 900\text{MHz}$ in TEM-cell; $f > 1800\text{MHz}$: waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,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 $f \leq 800\text{MHz}$) and inside waveguide using analytical field distributions based on power measurements for $f > 800\text{MHz}$. 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 NORM_{x,y,z} ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from $\pm 50\text{MHz}$ to $\pm 100\text{MHz}$.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).



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Probe EX3DV4

SN: 3924

Calibrated: July 19, 2018

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3924

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.50	0.42	0.68	±10.0%
DCP(mV) ^B	101.1	100.2	99.9	

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	172.2	±2.2%
		Y	0.0	0.0	1.0		153.7	
		Z	0.0	0.0	1.0		202.8	

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

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

^B Numerical linearization parameter: uncertainty not required.

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



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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3924

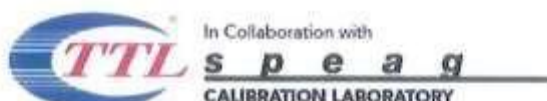
Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz] ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	10.06	10.06	10.06	0.40	0.80	± 12.1%
835	41.5	0.90	9.66	9.66	9.66	0.17	1.33	± 12.1%
900	41.5	0.97	9.63	9.63	9.63	0.16	1.37	± 12.1%
1750	40.1	1.37	8.30	8.30	8.30	0.17	1.26	± 12.1%
1900	40.0	1.40	8.03	8.03	8.03	0.24	1.05	± 12.1%
2300	39.5	1.67	7.86	7.86	7.86	0.52	0.73	± 12.1%
2450	39.2	1.80	7.51	7.51	7.51	0.55	0.73	± 12.1%
2600	39.0	1.96	7.27	7.27	7.27	0.65	0.69	± 12.1%

^C Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At 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.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3924

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz] ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	10.23	10.23	10.23	0.40	0.80	± 12.1%
835	55.2	0.97	9.86	9.86	9.86	0.17	1.44	± 12.1%
900	55.0	1.05	9.83	9.83	9.83	0.24	1.18	± 12.1%
1750	53.4	1.49	8.02	8.02	8.02	0.21	1.13	± 12.1%
1900	53.3	1.52	7.72	7.72	7.72	0.21	1.15	± 12.1%
2300	52.9	1.81	7.75	7.75	7.75	0.55	0.81	± 12.1%
2450	52.7	1.95	7.49	7.49	7.49	0.50	0.89	± 12.1%
2600	52.5	2.16	7.12	7.12	7.12	0.60	0.74	± 12.1%

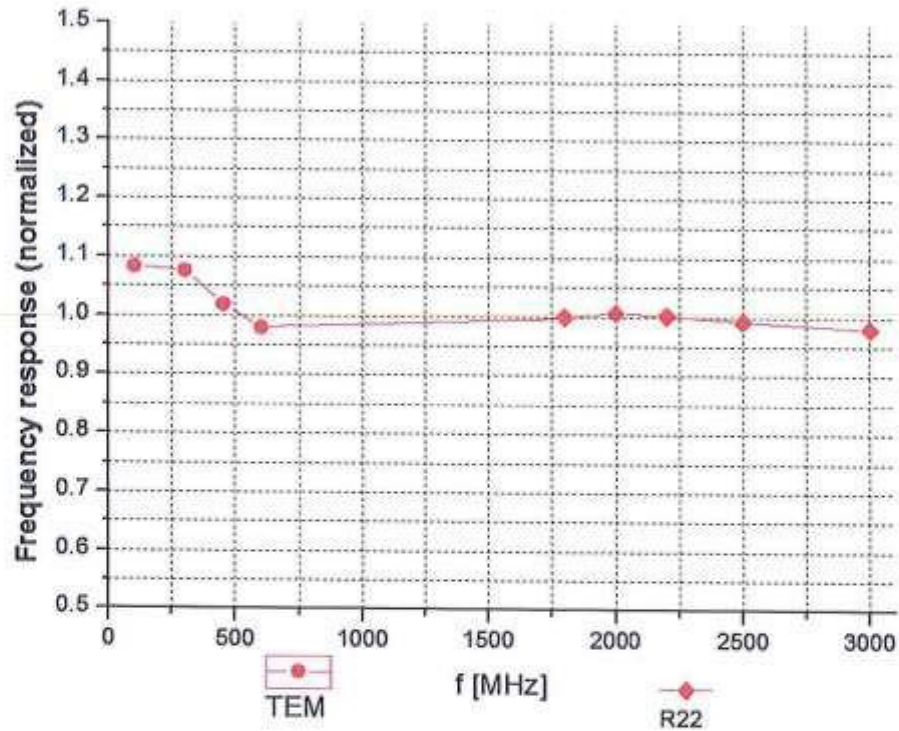
^C Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25,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

^F At 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.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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



Uncertainty of Frequency Response of E-field: $\pm 7.4\%$ ($k=2$)

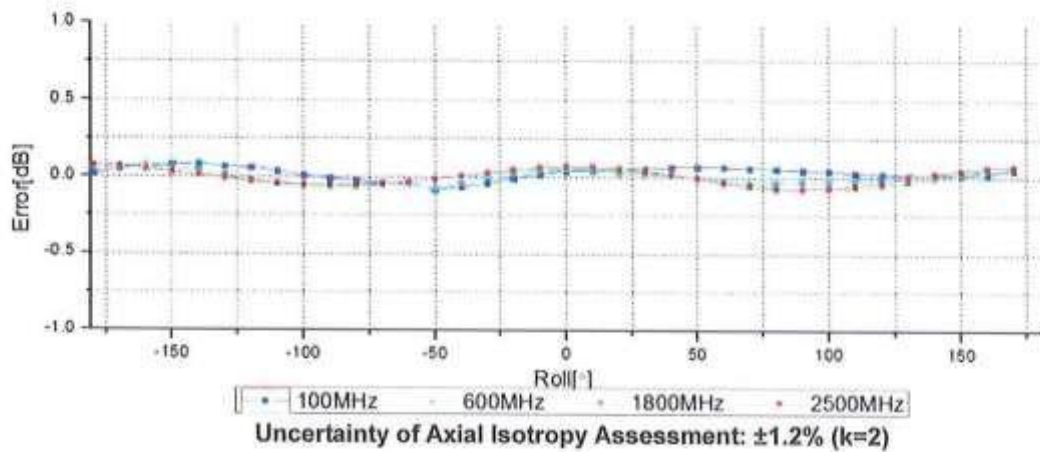
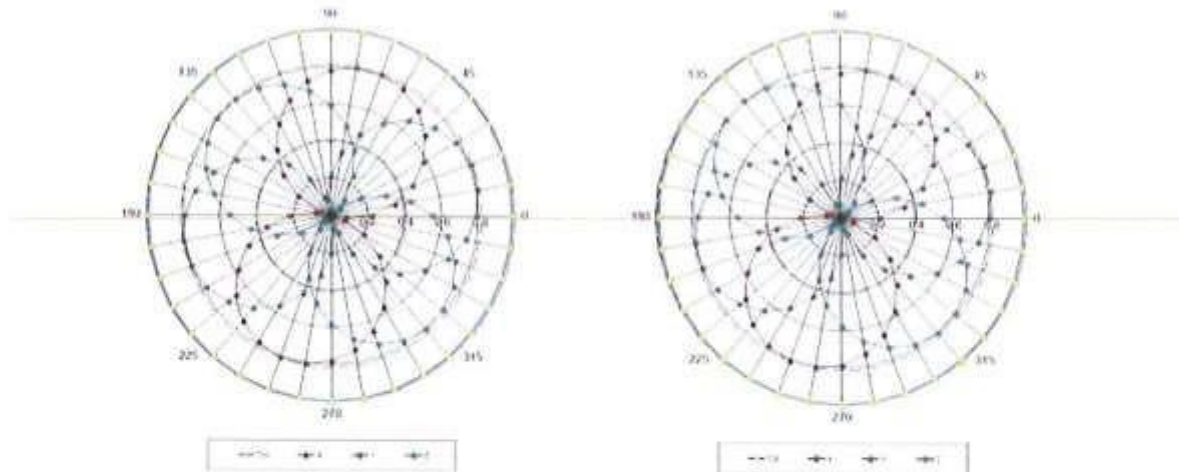


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Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM

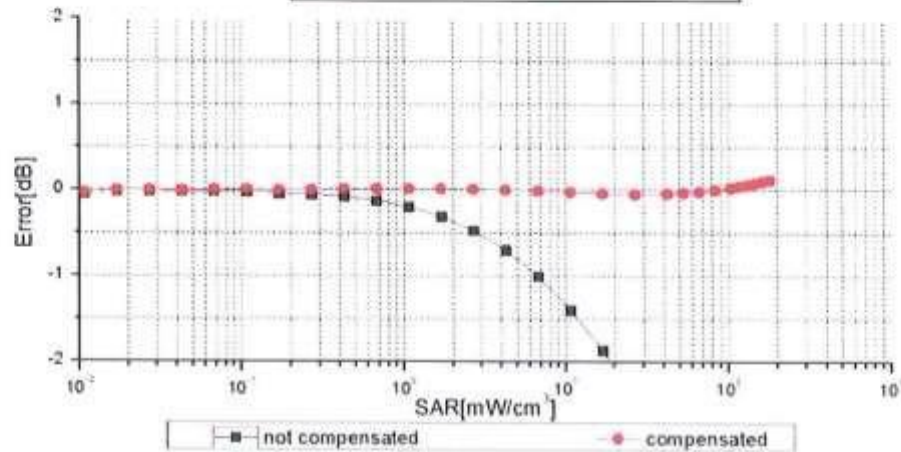
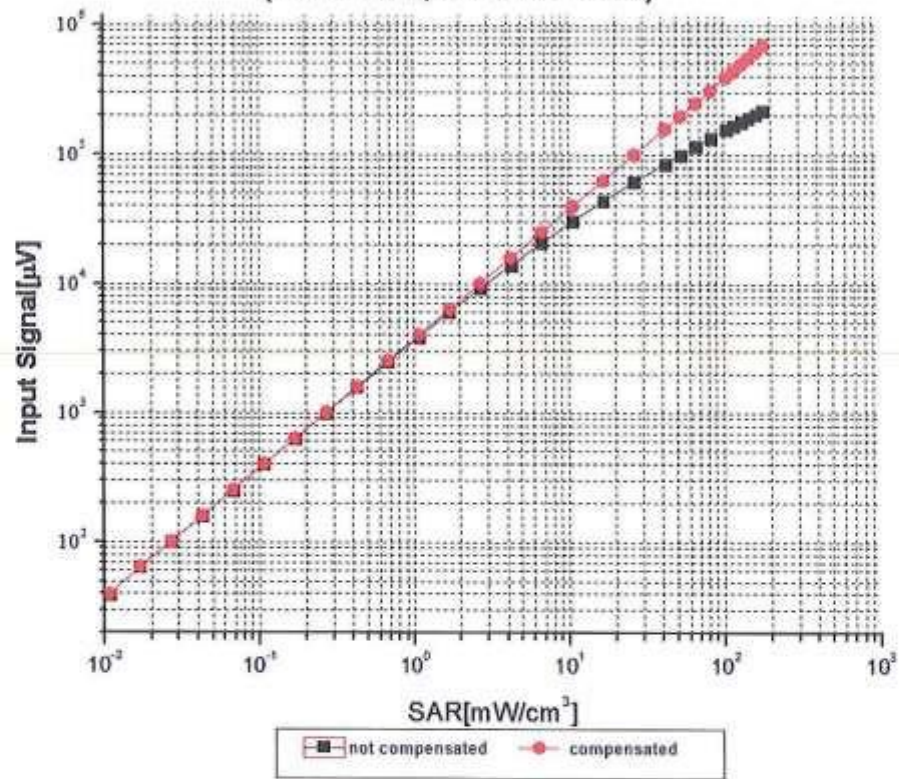
f=1800 MHz, R22





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



Uncertainty of Linearity Assessment: $\pm 0.9\%$ ($k=2$)

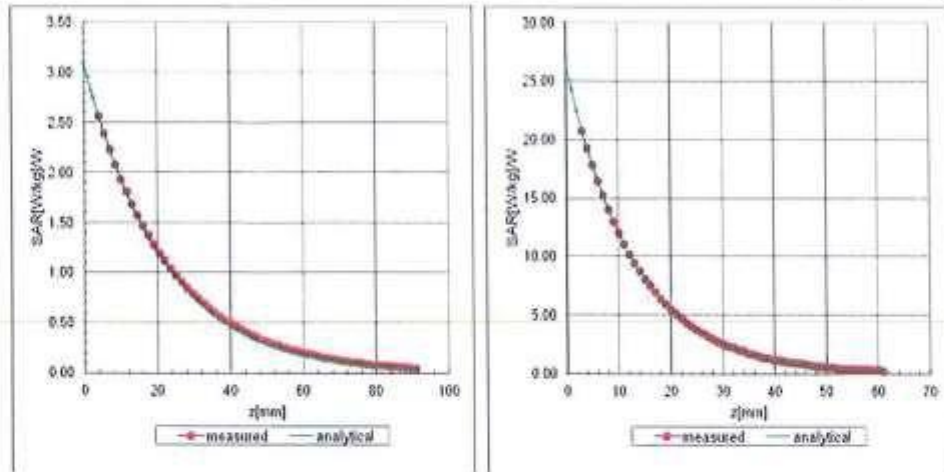


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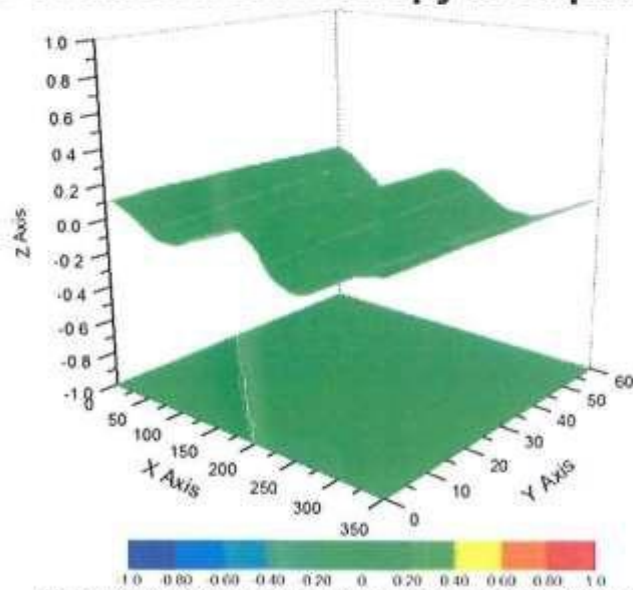
Conversion Factor Assessment

f=750 MHz, WGLS R9(H_convF)

f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: $\pm 3.2\%$ (K=2)



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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3924

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	159.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

6.2 D900V2 Dipole Calibration Certificate



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Client: **Sunway**Certificate No: **Z16-97102****CALIBRATION CERTIFICATE**Object: **D900V2 - SN: 1d086**

Calibration Procedure(s): **FD-Z11-2-003-01**
Calibration Procedures for dipole validation kits

Calibration date: **July 1, 2016**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe EX3DV4	SN 7307	19-Feb-16(SPEAG, No.EX3-7307_Feb16)	Feb-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG, No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

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

Issued: July 4, 2016

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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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



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Measurement Conditions

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

DASY Version	DASY52	52.8.8.1258
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.97 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	41.2 \pm 6 %	0.99 mho/m \pm 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.72 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	10.7 mW / g \pm 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.74 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.88 mW / g \pm 20.4 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.0	1.05 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	55.1 \pm 6 %	1.07 mho/m \pm 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.74 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	10.9 mW / g \pm 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.80 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	7.14 mW / g \pm 20.4 % (k=2)



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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.9Ω- 7.86jΩ
Return Loss	- 22.1dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.9Ω- 8.14jΩ
Return Loss	- 20.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.514 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

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DASY5 Validation Report for Head TSL

Date: 07.01.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d086

Communication System: UID 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.988 \text{ S/m}$; $\epsilon_r = 41.16$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(9.82, 9.82, 9.82); Calibrated: 2/19/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2016-02-02
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

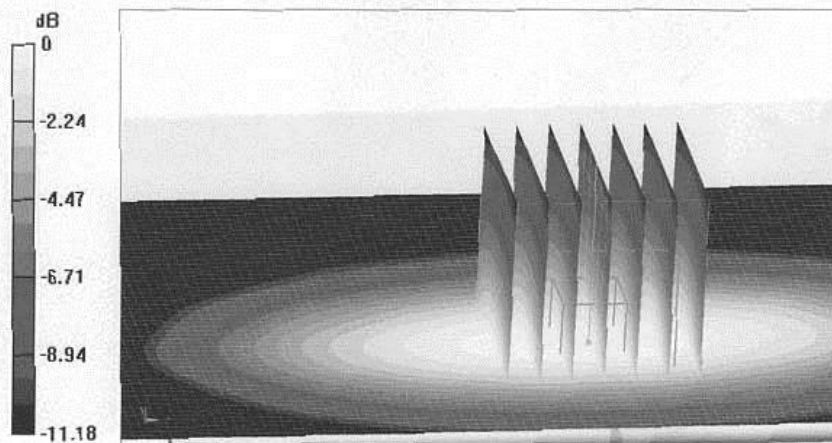
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 48.86 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 4.13 W/kg

SAR(1 g) = 2.72 W/kg; SAR(10 g) = 1.74 W/kg

Maximum value of SAR (measured) = 3.49 W/kg



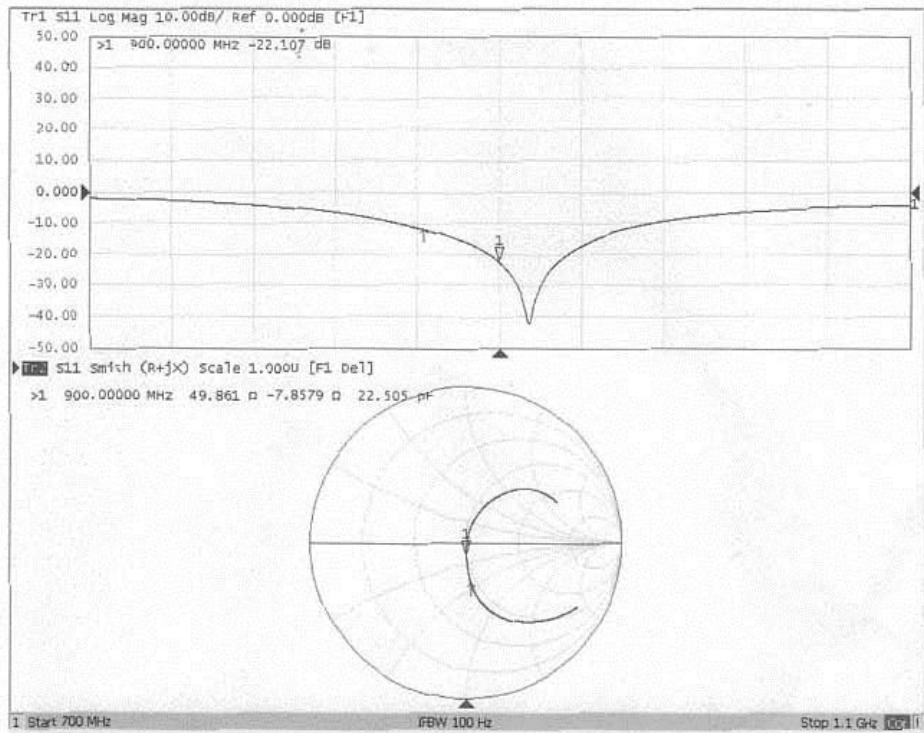
0 dB = 3.49 W/kg = 5.43 dBW/kg



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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 07.01.2016

Test Laboratory: CCTL, Beijing, China

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d086

Communication System: UID 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 900$ MHz; $\sigma = 1.065$ S/m; $\epsilon_r = 55.08$; $\rho = 1000$ kg/m³

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(9.9,9.9, 9.9); Calibrated: 2/19/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2016-02-02
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

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

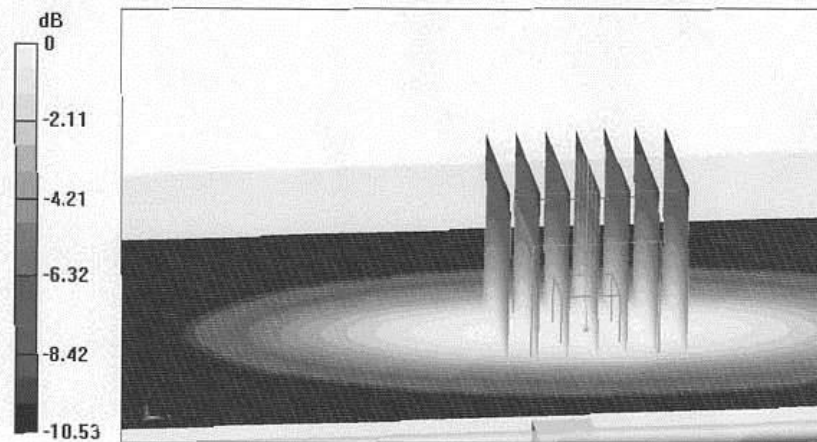
dy=5mm, dz=5mm

Reference Value = 55.76 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 4.05 W/kg

SAR(1 g) = 2.74 W/kg; SAR(10 g) = 1.8 W/kg

Maximum value of SAR (measured) = 3.45 W/kg



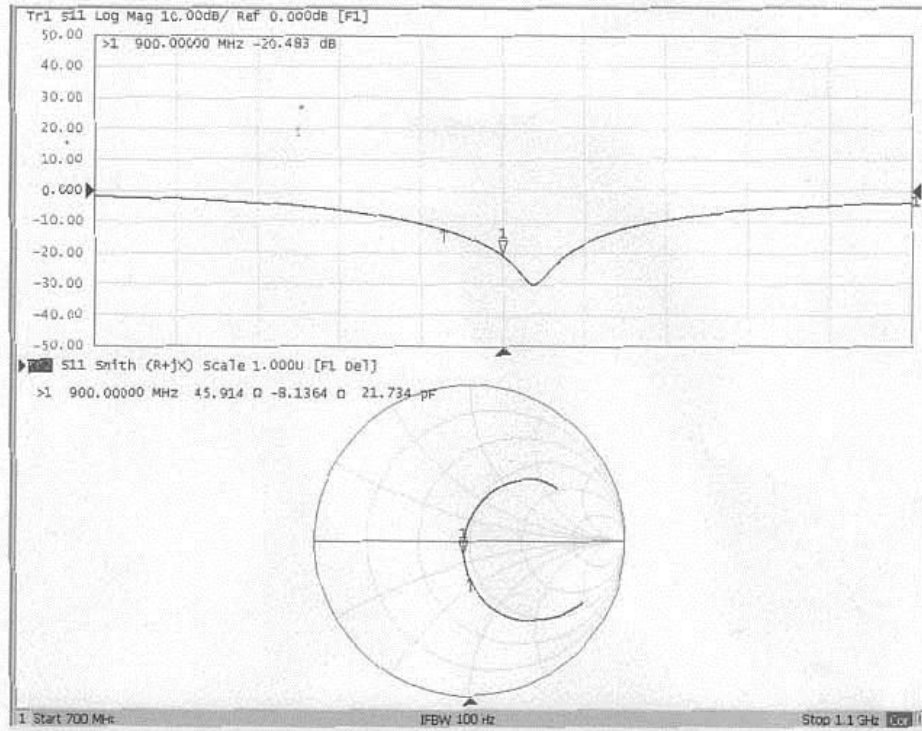
0 dB = 3.45 W/kg = 5.38 dBW/kg



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Impedance Measurement Plot for Body TSL




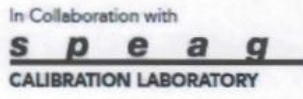


Justification of the extended calibration of Dipole D900V2 SN: 1d086

Per KDB 865664, we have Measured the Impedance and Return Loss as below, and the return loss is $< -20\text{dB}$, with 20% of prior calibration; the real or imaginary parts of the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Head						
Date of measurement	Return-loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary impedance (ohm)	Delta (ohm)
2016-07-01	-22.1		49.9		-7.86	
2017-06-29	-22.7	2.71	49.3	-0.6	-7.61	0.25
2018-06-28	-23.0	4.07	49.5	-0.4	-7.67	0.19

Body						
Date of measurement	Return-loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary impedance (ohm)	Delta (ohm)
2016-07-01	-20.5		45.9		-8.14	
2017-06-29	-21.3	3.90	46.8	0.9	-7.83	0.31
2018-06-28	-21.7	5.85	47.5	1.6	-7.79	0.35

6.3 D1750V2 Dipole Calibration Certificate

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 校准
 CALIBRATION
 CNAS L0570

Client: **Sunway** Certificate No: **Z16-97103**

CALIBRATION CERTIFICATE

Object: **D1750V2 - SN: 1021**

Calibration Procedure(s): **FD-Z11-2-003-01**
 Calibration Procedures for dipole validation kits

Calibration date: **July 1, 2016**


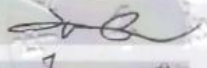
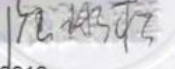
This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ 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	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe EX3DV4	SN 7307	19-Feb-16(SPEAG,No.EX3-7307_Feb16)	Feb-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	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: July 4, 2016

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

Certificate No: Z16-97103
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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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



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Measurement Conditions

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

DASY Version	DASY52	52.8.8.1258
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	40.5 \pm 6 %	1.36 mho/m \pm 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	36.9 mW / g \pm 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.94 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	19.8 mW / g \pm 20.4 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	53.1 \pm 6 %	1.51 mho/m \pm 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.25 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	36.7 mW / g \pm 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	4.94 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	19.7 mW / g \pm 20.4 % (k=2)



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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.6Ω- 1.40jΩ
Return Loss	- 33.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.0Ω+ 0.61jΩ
Return Loss	- 27.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.318 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

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DASY5 Validation Report for Head TSL

Date: 07.01.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1021

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.362$ S/m; $\epsilon_r = 40.49$; $\rho = 1000$ kg/m³

Phantom section: Center Section

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

DASY5.Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.37, 8.37, 8.37); Calibrated: 2/19/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

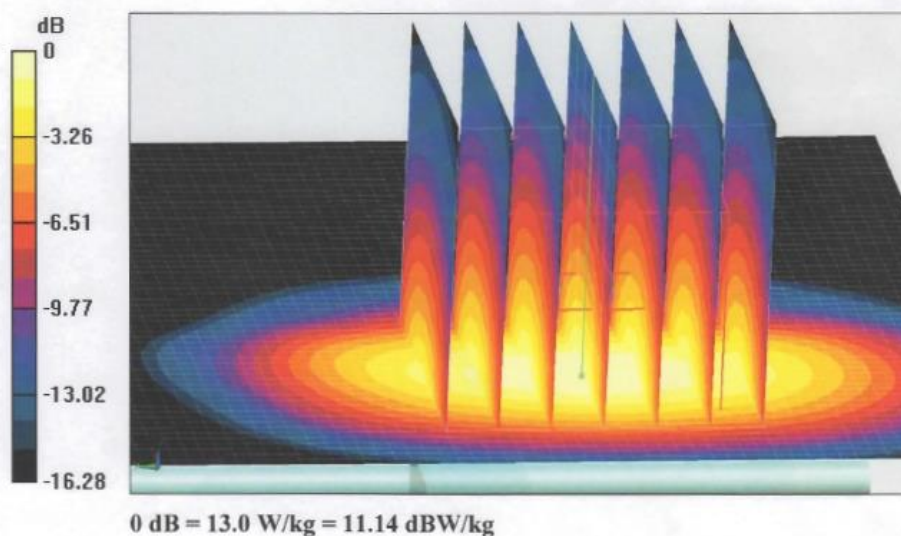
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 47.11V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 16.4W/kg

SAR(1 g) = 9.17 W/kg; SAR(10 g) = 4.94 W/kg

Maximum value of SAR (measured) = 13.0 W/kg

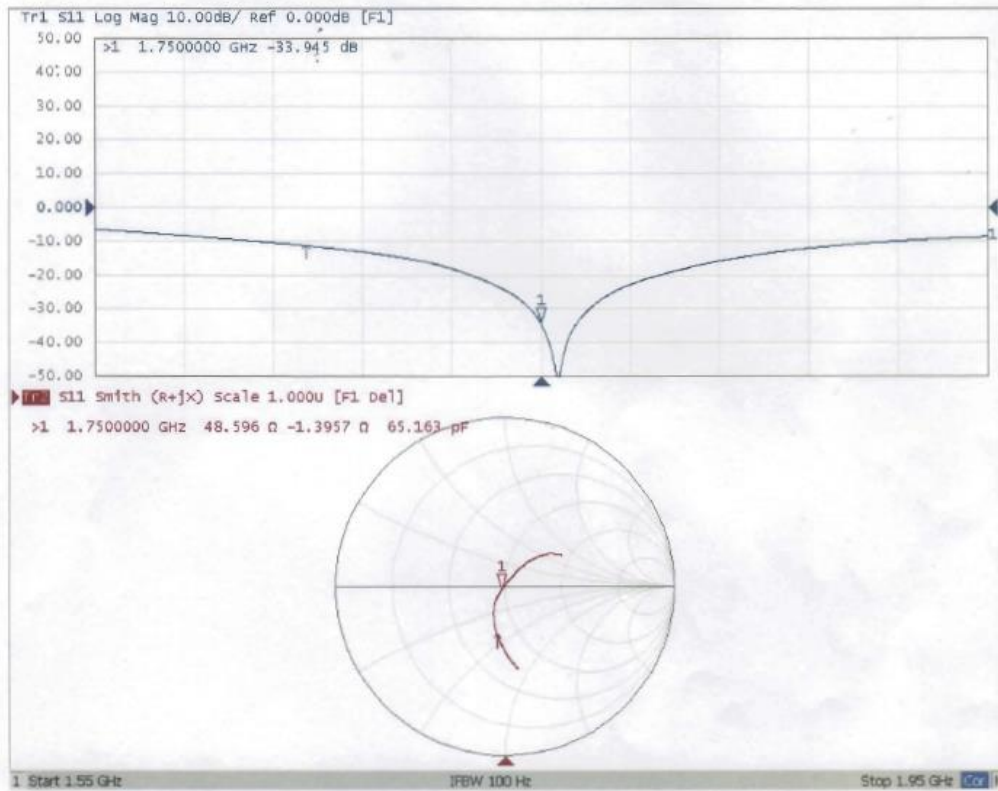




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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 07.01.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1021

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.505$ S/m; $\epsilon_r = 53.06$; $\rho = 1000$ kg/m³

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.18, 8.18, 8.18); Calibrated: 2/19/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:

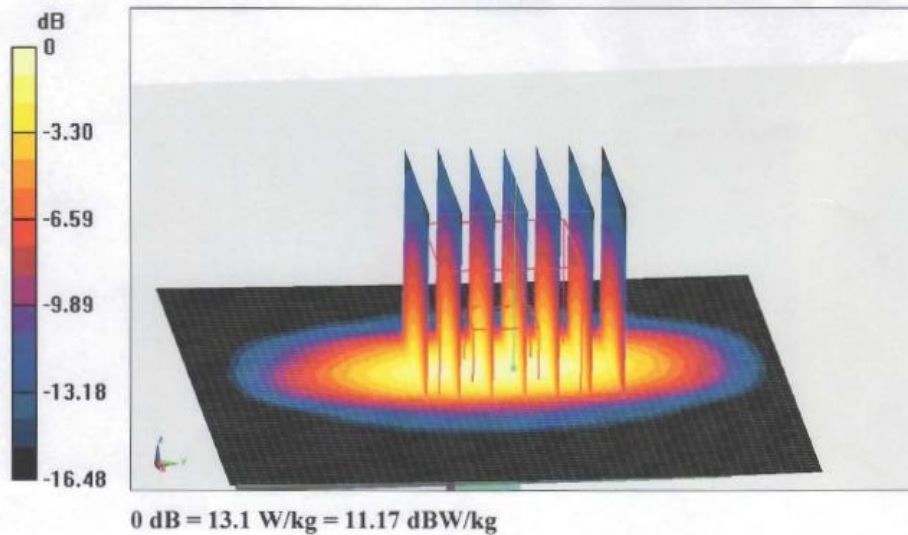
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 94.11 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 16.4 W/kg

SAR(1 g) = 9.25 W/kg; SAR(10 g) = 4.94 W/kg

Maximum value of SAR (measured) = 13.1 W/kg

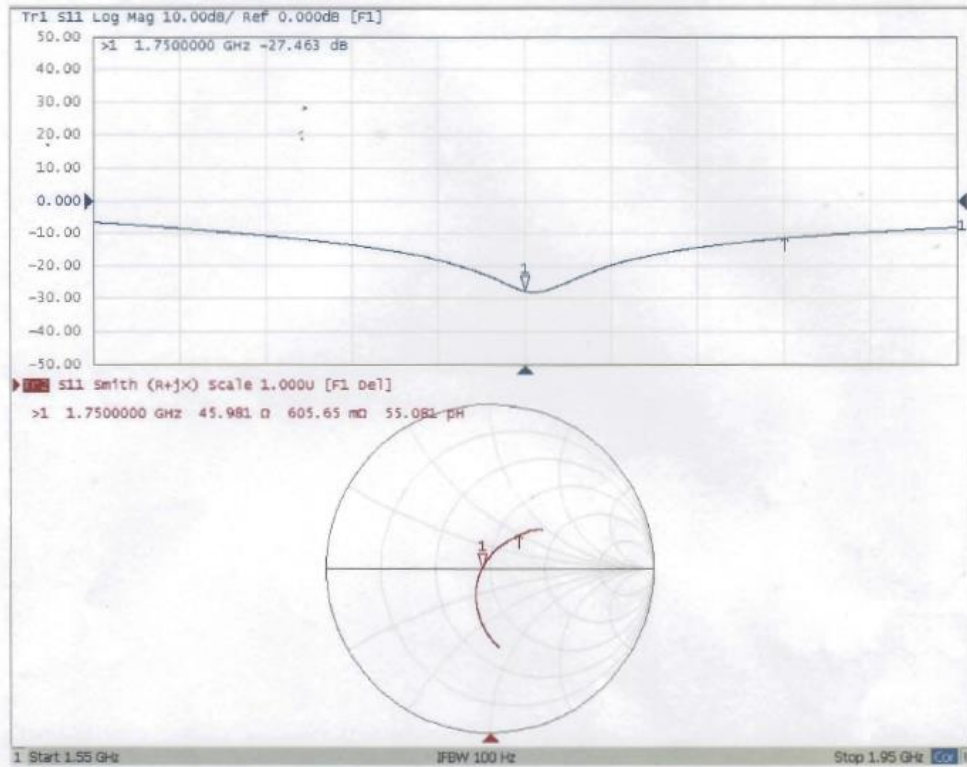




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Impedance Measurement Plot for Body TSL



Justification of the extended calibration of Dipole D1750V2 SN: 1021

Per KDB 865664, we have Measured the Impedance and Return Loss as below, and the return loss is $< -20\text{dB}$, with 20% of prior calibration; the real or imaginary parts of the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Head						
Date of measurement	Return-loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary impedance (ohm)	Delta (ohm)
2016-07-01	-33.90		48.60		-1.40	
2017-06-29	-34.90	2.94	48.50	-0.21	7.06	0.12
2018-06-28	-34.90	6.54	48.56	-0.08	3.54	0.49

Body						
Date of measurement	Return-loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary impedance (ohm)	Delta (ohm)
2016-07-01	-27.50		46.00		0.61	
2017-06-29	-28.87	4.97	45.99	-0.03	1.45	0.24
2018-06-28	-29.54	7.41	46.07	0.14	7.93	-0.40

6.4 D2450V2 Dipole Calibration Certificate



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E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Client

NTI

Certificate No: Z16-97158

CALIBRATION CERTIFICATE

Object

D2450V2 - SN: 898

Calibration Procedure(s)

FD-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

October 12, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe ES3DV3	SN 3149	15-Apr-16(CTTL-SPEAG,No.J16-97035)	Apr-17
DAE4	SN 777	22-Aug-16(CTTL-SPEAG,No.Z16-97138)	Aug-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Liu Wei	Deputy Director of SEM Department	

Issued: October 14, 2016

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

Certificate No: Z16-97158

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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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



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Measurement Conditions

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

DASY Version	DASY52	52.8.8.1258
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz \pm 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 \pm 0.2) °C	39.0 \pm 6 %	1.78 mho/m \pm 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	51.9 mW / g \pm 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.08 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.4 mW / g \pm 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 \pm 0.2) °C	52.9 \pm 6 %	1.92 mho/m \pm 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.6 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.8 mW / g \pm 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.96 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.9 mW / g \pm 20.4 % (k=2)



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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5Ω+ 4.52jΩ
Return Loss	- 25.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.1Ω+ 5.39jΩ
Return Loss	- 25.3dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.263 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: 10.12.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 898

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.777$ S/m; $\epsilon_r = 39.03$; $\rho = 1000$ kg/m³

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.51, 4.51, 4.51); Calibrated: 4/15/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

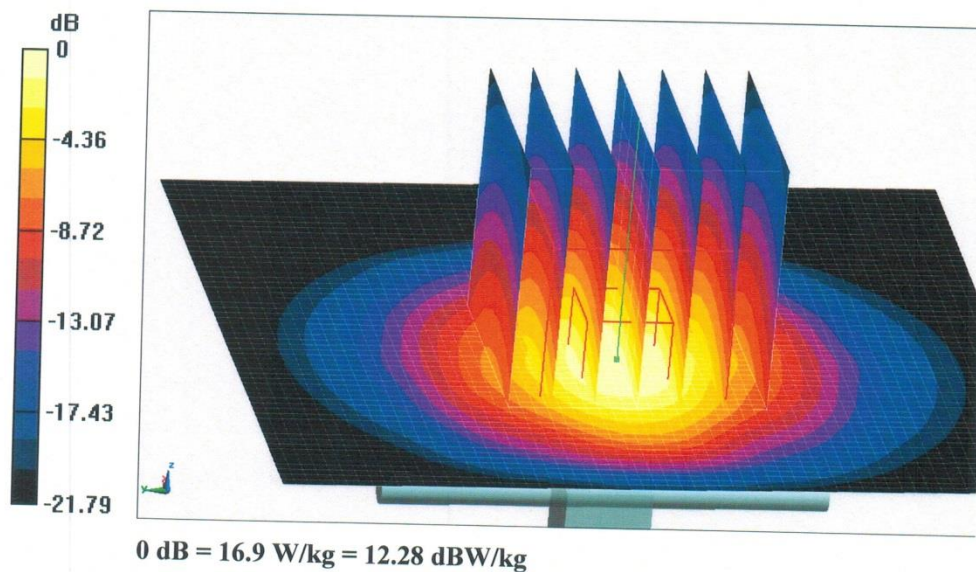
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 100.2 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.4 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.08 W/kg

Maximum value of SAR (measured) = 16.9 W/kg

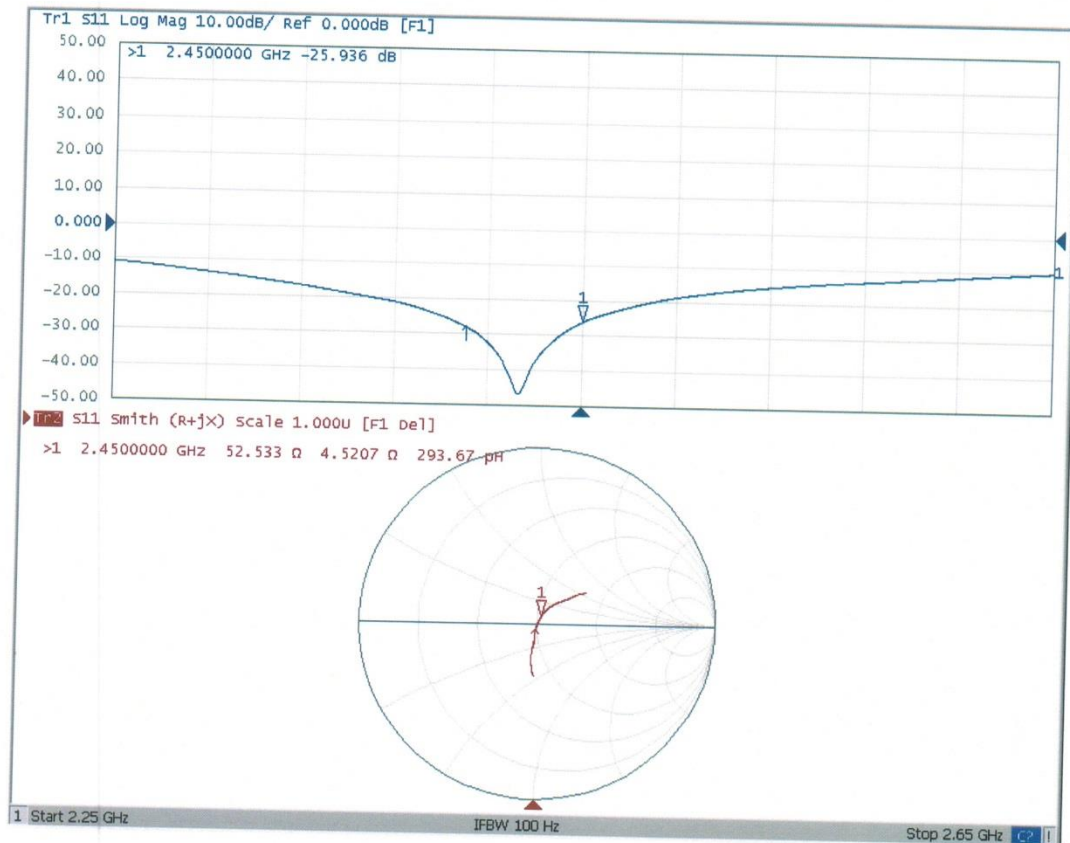




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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 10.12.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 898

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.923$ S/m; $\epsilon_r = 52.91$; $\rho = 1000$ kg/m³

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.23, 4.23, 4.23); Calibrated: 4/15/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

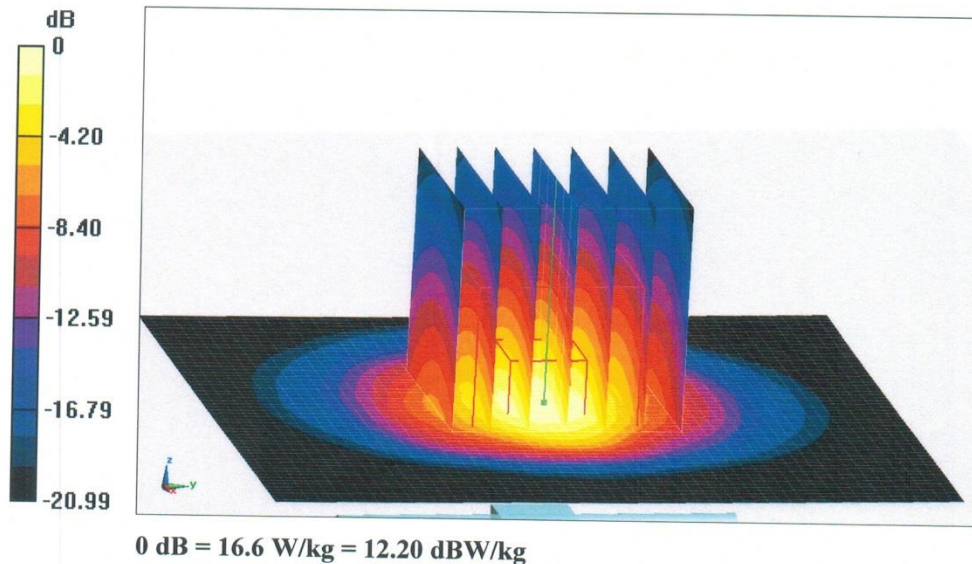
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.26 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 24.6 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.96 W/kg

Maximum value of SAR (measured) = 16.6 W/kg

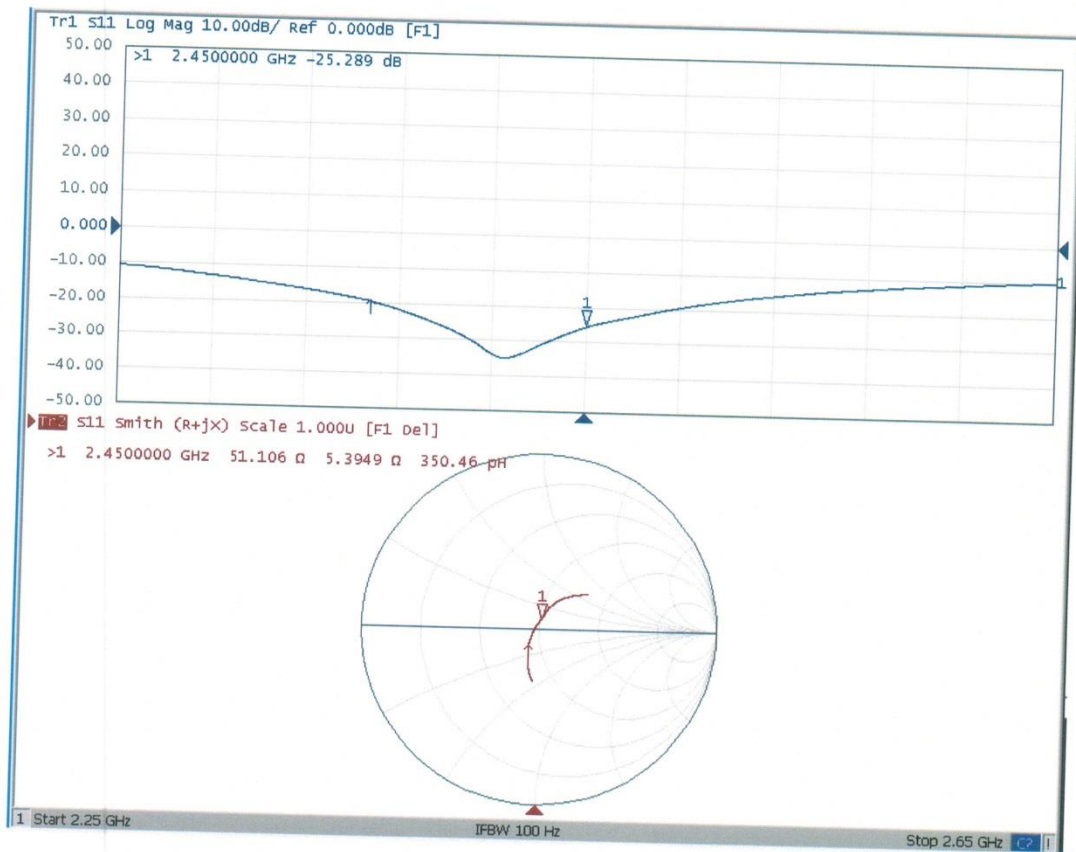




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Impedance Measurement Plot for Body TSL



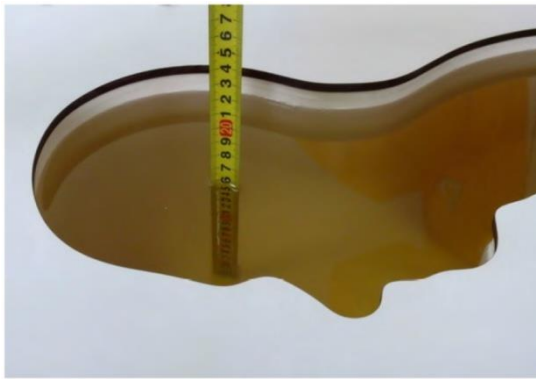
Justification of the extended calibration of Dipole D2450V2 SN: 898

Per KDB 865664, we have Measured the Impedance and Return Loss as below, and the return loss is $< -20\text{dB}$, with 20% of prior calibration; the real or imaginary parts of the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Head						
Date of measurement	Return-loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary impedance (ohm)	Delta (ohm)
2016/10/12	-25.90		52.50		4.52	
2017/10/11	-26.58	2.64	52.59	0.18	0.42	-0.27
2018/10/10	-25.96	0.23	52.32	-0.34	0.72	0.11

Body						
Date of measurement	Return-loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary impedance (ohm)	Delta (ohm)
2016/10/12	-25.30		51.10		5.39	
2017/10/11	-25.72	1.65	51.12	0.05	4.67	0.21
2018/10/10	-26.61	5.18	51.09	-0.02	7.66	0.12

7 Test Setup Photos



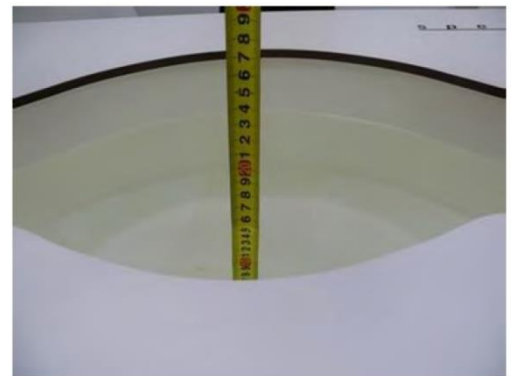
Liquid depth in the head phantom (900MHz)



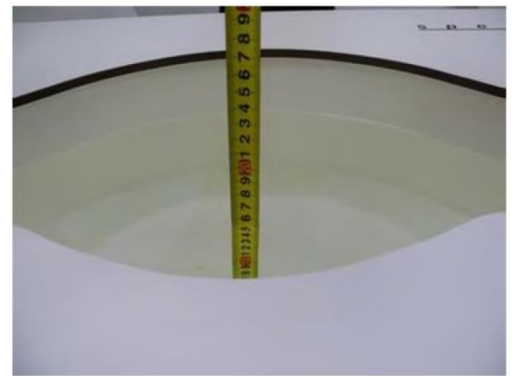
Liquid depth in the body phantom (900MHz)



Liquid depth in the head phantom (1800MHz)

Liquid depth in the body phantom
(1800MHz)

Liquid depth in the head phantom (2450MHz)

Liquid depth in the body phantom
(2450MHz)

8 External and Internal Photos of the EUT

Reference to the test report No. TZ190100535-RE

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