ANSI/IEEE Std. C95.1-1999
In accordance with the requirements of
FCC Report and Order: ET Docket 93-62, and OET Bulletin 65 Supplement C

FCC SAR TEST REPORT

For

Product Name: Mobile Phone

Brand Name: Ulefone

Model No.: N9330

Series Model: N9588, N9589

Test Report Number:
C130315S01-SF

Issued for

SHENZHEN GOTRON ELECTRONIC CO.,LTD

Rm 24B,Block C of Electronic &Technology Building,2070 ShenNan Middle Road,Shenzhen China.

Issued by

Compliance Certification Services Inc.

Kun shan Laboratory

No.10 Weiye Rd., Innovation park, Eco&Tec,
Development Zone, Kunshan City, Jiangsu, China

TEL: 86-512-57355888

FAX: 86-512-57370818

TESTING CERT #2541.01

Revision History

Revision	REPORT NO.	Date	Page Revised	Contents
Original	C130315S01-SF	March 31, 2013	N/A	N/A

TABLE OF CONTENTS

1. CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

Product Name:	Mobile Phone
Brand Name:	Ulefone
Model Name.:	N9330
Series Model:	N9588, N9589
Devices supporting GPRS:	Class B
Description Test Modes(worst case):	SIM 1 and SIM2 is a chipset unit and tested as single chipset
Device Category:	PORTABLE DEVICES
Exposure Category:	GENERAL POPULATION/UNCONTROLLED EXPOSURE
Date of Test:	March 23, 2013 & March 24, 2013 & March 26, 2013
Applicant:	**SHENZHEN GOTRON ELECTRONIC CO.,LTD** Rm 24B,Block C of Electronic &Technology Building,2070 ShenNan Middle Road,Shenzhen China
Manufacturer:	**SHENZHEN GOTRON ELECTRONIC CO.,LTD** Rm 24B,Block C of Electronic &Technology Building,2070 ShenNan Middle Road,Shenzhen China
Application Type:	Certification

APPLICABLE STANDARDS AND TEST PROCEDURES

STANDARDS AND TEST PROCEDURES	TEST RESULT
FCC OET 65 Supplement C	No non-compliance noted

Deviation from Applicable Standard

None

The device was tested by Compliance Certification Services Inc. in accordance with the measurement methods and procedures specified in OET Bulletin 65 Supplement C(Edition 01-01). The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved by:

Hadiif Hoo
RF Manager
Compliance Certification Services Inc.

Tested by:

Jason Qiao
Test Engineer
Compliance Certification Services Inc.

2. EUT DESCRIPTION

Product Name:	Mobile Phone	
Brand Name:	Ulefone	
Model Name.:	N9330	
Series Model:	N9588, N9589	
Model Discrepancy:	The motherboard is consistent,only model name different	
FCC ID:	SDWN9330	
Power reduction:	NO	
DTM Description:	N/A	
Device Category:	Production unit	
Frequency Range:	GSM 850: 824.2 ~ 848.8 MHz GSM1900: 1850.2 ~ 1909.8MHz WCDMA/HSDPA BandV:826.4~846.60MHz 802.11b / g: 2412 ~ 2462 MHz n HT20: 2412 ~ 2462 MHz n HT40: 2422 ~2452 MHZ Bluetooth: 2402 ~ 2480 MHz	
Max. Transmit Power: (Conducted average power)	GSM 850: 32.42 dBm GPRS 850: 31.35 dBm EDGE 850:30.21 dBm GSM 1900: 29.44 dBm GPRS 1900: 28.52 dBm EDGE 1900:27.55 dBm WCDMA BandV: 22.54dBm	802.11b:16.23 dBm 802.11g:14.51 dBm 802.11n HT20:13.81 dBm 802.11n HT40:12.41 dBm Bluetooth:1.22 dBm
Max. SAR:	Head: GSM 850: 0.056 W/kg GSM 1900: 0.117 W/kg WCDMA Band V: 0.054 W/kg WI-FI IEEE 802.11b:0.020 W/kg	Body: GSM 850: 0.517 W/kg GSM 1900:0.268 W/kg WCDMA Band V: 0.238 W/kg 802.11b:0.201 W/kg
Modulation Technique:	GSM / DCS: GMSK WCDMA:QPSK IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: DSSS (CCK, DQPSK,DBPSK)+OFDM (QPSK, BPSK, 16-QAM, 64-QAM) WI-FI IEEE 802.11n: OFDM(MCS 0-7) Bluetooth : GFSK + π/4DQPSK+8DPSK	
Accessories:	Power supply and ADP(rating): Input:AC: 100-240V~50/60Hz 150mA Ouput:DC 5V 500mA Battery（rating）: Capacitance: 3000mAh Standard Voltage: 3.7V	
Antenna Specification:	GSM/WCDMA: PIFA antenna Bluetooth/Wifi: PIFA antenna	
Operating Mode:	Maximum continuous output	

3. REQUIREMENTS FOR COMPLIANCE TESTING DEFINED BY THE FCC

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g for an uncontrolled environment and 8.0 mW/g for an occupational/controlled environment as recommended by the ANSI/IEEE standard C95.1-1999. According to the Supplement C of OET Bulletin 65 "Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

4. TEST METHODOLOGY

The Specific Absorption Rate (SAR) testing specification, method and procedure for this Mobile Phone is in accordance with the following standards:

☒ FCC 47 CFR Part 2 (2.1093)
☒ IEEE C95.1-1999
☒ OET Bulletin 65 Supplement C (Edition 01-01)
☒ KDB 248227 D01v01r02 SAR Measurement Procedures for 802.11 a/b/g Transmitters
☒ KDB 447498 D01v05 Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Polices
☐ KDB 447498 D02v02 SAR Measurement Procedures for USB dongle Transmitters
☒ KDB 648474 D04v01 SAR Evaluation Considerations for Wireless Handsets
☒ KDB 865664 D01v01 SAR Measurement Requirements for 100 MHz to 6 GHz
☒ KDB 941225 D01v02 SAR Measurement Procedures for 3G Devices
☒ KDB 941225 D03v01 SAR Test Reduction Procedures GSM/GPRS/EDGE
☒ KDB 941225 D06v01 Hot Spot SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities

5. TEST CONFIGURATION

The device was controlled by using a base station emulator R&S CMU200. Communication between the device and the emulator was established by air link. The distance between the DUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of DUT. The DUT was set from the emulator to radiate maximum output power during all tests.

Measurements were performed on the lowest, middle, and highest channel for each testing position.

For SAR testing, EUT is in GSM/GPRS link mode. In GSM link mode, its crest factor is 8, In GPRS link mode, its crest factor is 2, because EUT is set in GPRS multi-slot class 12 with 4 uplink slots.

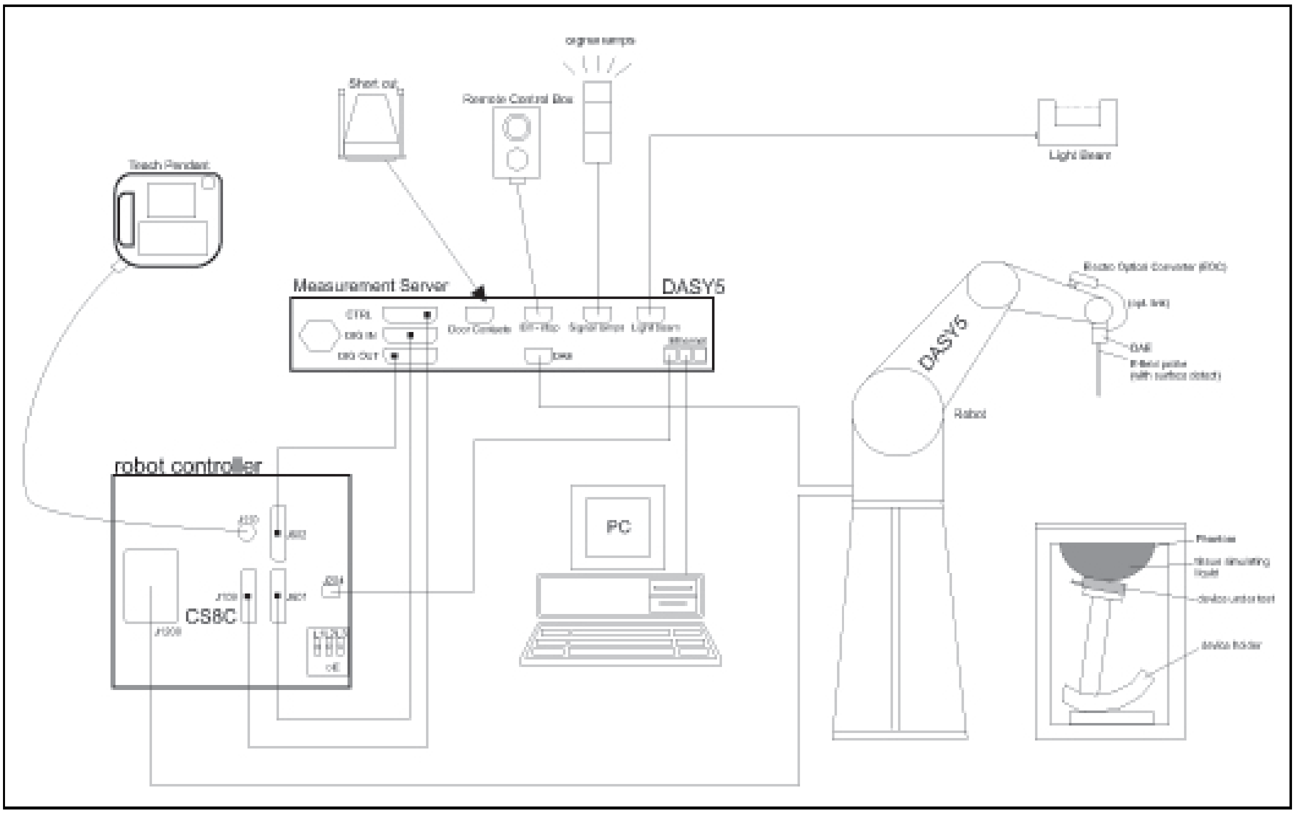
6. DOSIMETRIC ASSESSMENT SETUP

These measurements were performed with the automated near-field scanning system DASY 5 from ATTENNESSA. The system is based on a high precision robot (working range greater than 0.9 m), which positions the probes with a positional repeatability of better than ± 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the E-field PROBE EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [7] with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure described in [8] and found to be better than ±0.25 dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEE P1528 and CENELEC EN 62209.

The Tissue simulation liquid used for each test is in according with the FCC OET65 supplement C as listed below.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

6.1 MEASUREMENT SYSTEM DIAGRAM



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

- A standard high precision 6-axis robot (St¨aubli RX family) with controller, teach pendant 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 electronics (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.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASY5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing validating the proper functioning of the system.

6.2 SYSTEM COMPONENTS

	The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV celeron, 128MB chip-disk and 128 MB RAM. The necessary circuits for communication with either the DAE4(or DAE3) electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY5 I/O-board, which is directly connected to the PC/104 bus of the CPU board. The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation.
	The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.
Data Acquisition Electronics (DAE)	

The data acquisition electronics (DAE4) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE4 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

EX3DV4 Isotropic E-Field Probe for Dosimetric Measurements

Construction: Symmetrical design with triangular core
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

Calibration: Basic Broad Band Calibration in air: 10-3000 MHz.
Conversion Factors (CF) for HSL 900 and HSL 1800
CF-Calibration for other liquids and frequencies upon request.

Frequency: 10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)

Directivity: ± 0.3 dB in HSL (rotation around probe axis)
± 0.5 dB in HSL (rotation normal to probe axis)

Dynamic Range: 10 μW/g to > 100 mW/g; Linearity: ± 0.2 dB
(noise: typically < 1 μW/g)

Dimensions: Overall length: 337 mm (Tip: 9 mm)
Tip diameter: 2.5 mm (Body: 10 mm)
Distance from probe tip to dipole centers: 1 mm

Application: High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

Interior of probe

SAM Twin Phantom

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Construction:

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50360 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness: 2 ±0.2 mm

Filling Volume: Approx. 25 liters

Dimensions: Height: 850mm; Length: 1000mm; Width: 750mm

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SAM Phantom (ELI4 v4.0)

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Description Construction:

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is supported by software version DASY4/DASY5.5 and higher and is compatible with all SPEAG dosimetric probes and dipoles

Shell Thickness: 2.0 ± 0.2 mm (sagging: <1%)

Filling Volume: Approx. 25 liters

Dimensions: Major ellipse axis: 600 mm

Minor axis: 400 mm 500mm

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Device Holder for SAM Twin Phantom

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Construction: In combination with the Twin SAM Phantom, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, and flat phantom).

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System Validation Kits for SAM Twin Phantom

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Construction: Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

Frequency: 900,1800,2450,5800 MHz

Return loss: > 20 dB at specified validation position

Power capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

Dimensions:

D835V2: dipole length: 161 mm; overall height: 340 mm
D1800V2: dipole length: 72.5 mm; overall height: 300 mm
D1900V2: dipole length: 67.7 mm; overall height: 300 mm
D2450V2: dipole length: 51.5 mm; overall height: 290 mm
D5GHzV2: dipole length: 20.6 mm; overall height: 300mm

System Validation Kits for ELI4 phantom

Construction: Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

Frequency: 900, 1800, 2450, 5800 MHz

Return loss: > 20 dB at specified validation position

Power capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

Dimensions:

D835V2: dipole length: 161 mm; overall height: 340 mm
D1800V2: dipole length: 72.5 mm; overall height: 300 mm
D1900V2: dipole length: 67.7 mm; overall height: 300 mm
D2450V2: dipole length: 51.5 mm; overall height: 290 mm
D5GHzV2: dipole length: 20.6 mm; overall height: 300 mm

7. EVALUATION PROCEDURES

DATA EVALUATION

The DASY 5 post processing 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	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
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 be imported into the software from the configuration files issued for the DASY 5 components. In the direct measuring mode of the multi-meter 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 5 parameter)
dcp_i = Diode compression point (DASY 5 parameter)

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

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

H-field probes: $$H_i = \sqrt{Vi} \cdot \frac{a_{i10} + a_{i11} f + a_{i12} f^2}{f}$$

with V_i = Compensated signal of channel i (i = x, y, z)
$Norm_i$ = Sensor sensitivity of channel i (i = x, y, z)
$\mu V/(V/m)^2$ for E0field Probes
$ConvF$ = Sensitivity enhancement in solution
aij = Sensor sensitivity factors for H-field probes
f = Carrier frequency (GHz)
Ei = Electric field strength of channel i in V/m
Hi = Magnetic field strength of channel i in A/m

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

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

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/cm^3

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.

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

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with P_{pwe} = Equivalent power density of a plane wave in mW/cm^2
E_{tot} = total electric field strength in V/m
H_{tot} = total magnetic field strength in A/m

SAR EVALUATION PROCEDURES

The procedure for assessing the peak spatial-average SAR value consists of the following steps:

- **Power Reference Measurement**

  The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

- **Area Scan**

  The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY 5 software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan's property sheet is brought-up, grid was at to 15 mm by 15 mm and can be edited by a user.

- **Zoom Scan**

  Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures 5 x 5 x 7 points within a cube whose base faces are centered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more then one maximum, the number of Zoom Scans has to be enlarged accordingly (The default number inserted is 1).

- **Power Drift measurement**

  The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have DASY 5 software stop the measurements if this limit is exceeded.

SPATIAL PEAK SAR EVALUATION

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE1529 standard. It can be conducted for 1 g and 10 g.

The DASY 5 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 maximum 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

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 Cube 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 5x5x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1 g and 10 g cubes.

Boundary effect

For measurements in the immediate vicinity of a phantom surface, the field coupling effects between the probe and the boundary influence the probe characteristics. Boundary effect errors of different dosimetric probe types have been analyzed by measurements and using a numerical probe model. As expected, both methods showed an enhanced sensitivity in the immediate vicinity of the boundary. The effect strongly depends on the probe dimensions and disappears with increasing distance from the boundary. The sensitivity can be approximately given as:

$$S \approx S_o + S_b exp(-\frac{z}{a}) cos(\pi \frac{z}{\lambda})$$

Since the decay of the boundary effect dominates for small probes ($a \ll \lambda$), the cos-term can be omitted. Factors *Sb* (parameter Alpha in the DASY 5 software) and *a* (parameter Delta in the DASY 5 software) are assessed during probe calibration and used for numerical compensation of the boundary effect. Several simulations and measurements have confirmed that the compensation is valid for different field and boundary configurations.

This simple compensation procedure can largely reduce the probe uncertainty near boundaries. It works well as long as:

- the boundary curvature is small
- the probe axis is angled less than 30_ to the boundary normal
- the distance between probe and boundary is larger than 25% of the probe diameter
- the probe is symmetric (all sensors have the same offset from the probe tip)

Since all of these requirements are fulfilled in a DASY 5 system, the correction of the probe boundary effect in the vicinity of the phantom surface is performed in a fully automated manner via the measurement data extraction during post processing.

8. MEASUREMENT UNCERTAINTY

UNCERTAINTY BUDGE ACCORDING TO IEEE 1528-2003						
Error Description	**Uncertainty Value ±%**	**Probability distribution**	**Divisor**	**C_1 1g**	**Standard unc.(1g) ±%**	**V_1 or V_{eff}**
Measurement System						
Probe calibration	±5.5	normal	1	1	±5.5	∞
Axial isotropy of probe	±4.7	rectangular	√3	0.7	±1.9	∞
Hemispherical Isotropy of probe	±9.6	rectangular	√3	0.7	±3.9	∞
Probe linearity	±4.7	rectangular	√3	1	±2.7	∞
Detection Limit	±1.0	rectangular	√3	1	±0.6	∞
Boundary effects	±1.0	rectangular	√3	1	±0.6	∞
Readout electronics	±0.3	normal	1	1	±0.3	∞
Response time	±0.8	rectangular	√3	1	±0.5	∞
Integration time	±2.6	rectangular	√3	1	±1.5	∞
Probe positioning	±2.9	rectangular	√3	1	±1.7	∞
Probe positioner	±0.4	rectangular	√3	1	±0.2	∞
RF ambient Noise	±3.0	rectangular	√3	1	±1.7	∞
RF ambient Reflections	±3.0	rectangular	√3	1	±1.7	∞
Max.SAR Eval	±1.0	rectangular	√3	1	±0.6	∞
Test Sample Related						
Device positioning	±2.9	normal	1	1	±2.9	145
Device holder uncertainty	±3.6	normal	1	1	±3.6	5
Power drift	±5.0	rectangular	√3	1	±2.9	∞
Phantom and Set up						
Phantom uncertainty	±4.0	rectangular	√3	1	±2.3	∞
Liquid conductivity(target)	±5.0	rectangular	√3	0.64	±1.8	∞
Liquid conductivity(meas.)	±2.5	rectangular	1	0.64	±1.6	∞
Liquid permittivity(target)	±5.0	rectangular	√3	0.6	±1.7	∞
Liquid permittivity(meas.)	±2.5	rectangular	1	0.6	±1.5	∞
Combined Standard Uncertainty					±10.7	387
Coverage Factor for 95%		kp=2				
Expanded Standard Uncertainty					±21.4	

Table: Worst-case uncertainty for DASY5 assessed according to IEEE1528-2003.
The budge is valid for the frequency range 300 MHz to 6G Hz and represents a worst-case analysis.

9. EXPOSURE LIMIT

(A). Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

(B). Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Note: Whole-Body SAR is averaged over the entire body, **partial-body SAR** is averaged over any 10 gram of tissue defined as a tissue volume in the shape of a cube. **SAR for hands, wrists, feet and ankles** is averaged over any 1 grams of tissue defined as a tissue volume in the shape of a cube.

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

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

NOTE
GENERAL POPULATION/UNCONTROLLED EXPOSURE
PARTIAL BODY LIMIT
1.6 W/kg

10. EUT ARRANGEMENT

Please refer to IEEE1528-2003 illustration below.

10.1 ANTHROPOMORPHIC HEAD PHANTOM

Figure 7-1a shows the front, back and side views of SAM. The point "M" is the reference point for the center of mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERPs are 15 mm posterior to the entrance to ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 7-1b. The plane passing through the two ear reference points and M is defined as the Reference Plane. The line N-F (Neck-Front) perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 7-1c). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines should be marked on the external phantom shell to facilitate handset positioning. Posterior to the N-F line, the thickness of the phantom shell with the shape of an ear is a flat surface 6 mm thick at the ERPs. Anterior to the N-F line, the ear is truncated as illustrated in Figure 7-1b. The ear truncation is introduced to avoid the handset from touching the ear lobe, which can cause unstable handset positioning at the cheek.

Figure 7-1a
Front, back and side view of SAM (model for the phantom shell)

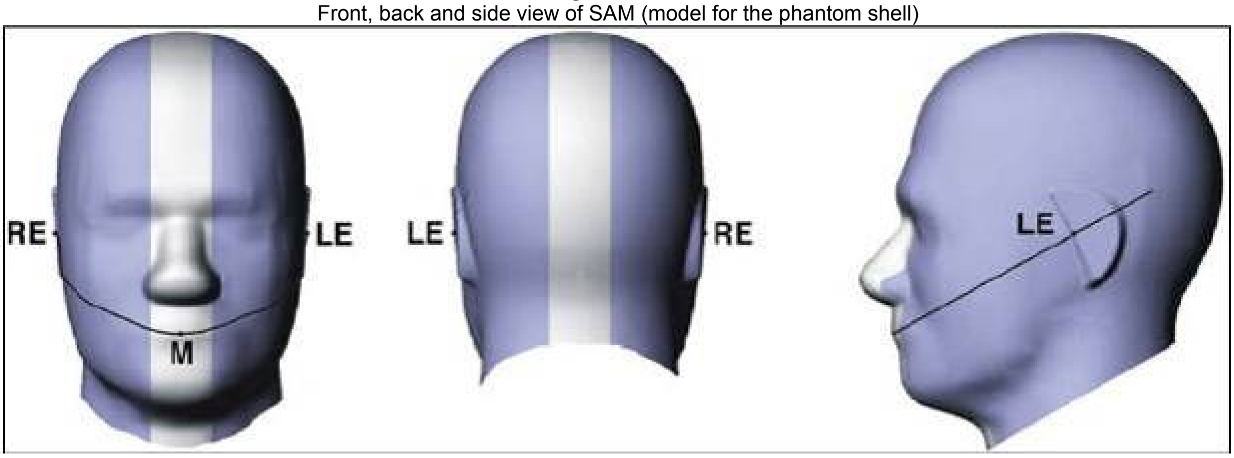


Figure 7-1b
Close up side view of phantom showing the ear region

Figure 7-1c
Side view of the phantom showing relevant markings and the 7 cross sectional plane locations

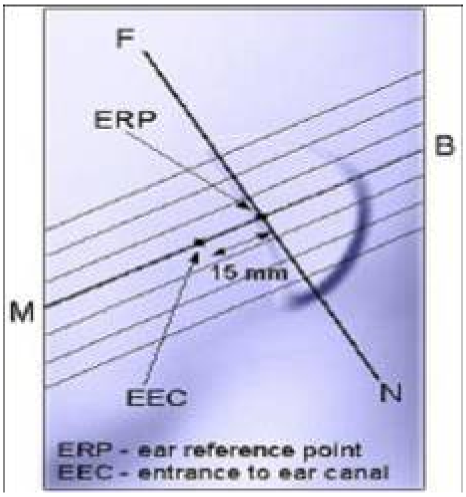


Figure 7-1b
Close up side view of phantom showing the ear region

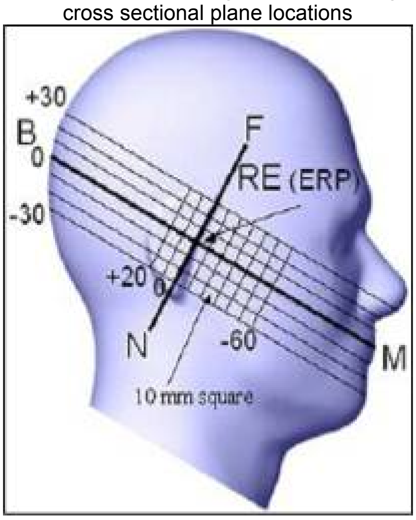


Figure 7-1c
Side view of the phantom showing relevant markings and the 7 cross sectional plane locations

10.2 DEFINITION OF THE "CHEEK/TOUCH" POSITION

The "cheek" or "touch" position is defined as follows:

a. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece, open the cover. (If the handset can also be used with the cover closed both configurations must be tested.)

b. Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width wt of the handset at the level of the acoustic output (point A on Figures 7-2a and 7-2b), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 7-2a). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 7-2b), especially for clamshell handsets, handsets with flip pieces, and other irregularly-shaped handsets.

c. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 7-2c), such that the plane defined by the vertical center line and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.

d. Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the pinna.

e. e) While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).

f. Rotate the handset around the vertical centerline until the handset (horizontal line) is symmetrical with respect to the line NF.

g. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE and maintaining the handset contact with the pinna, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the pinna (cheek). See Figure 7-2c. The physical angles of rotation should be noted.

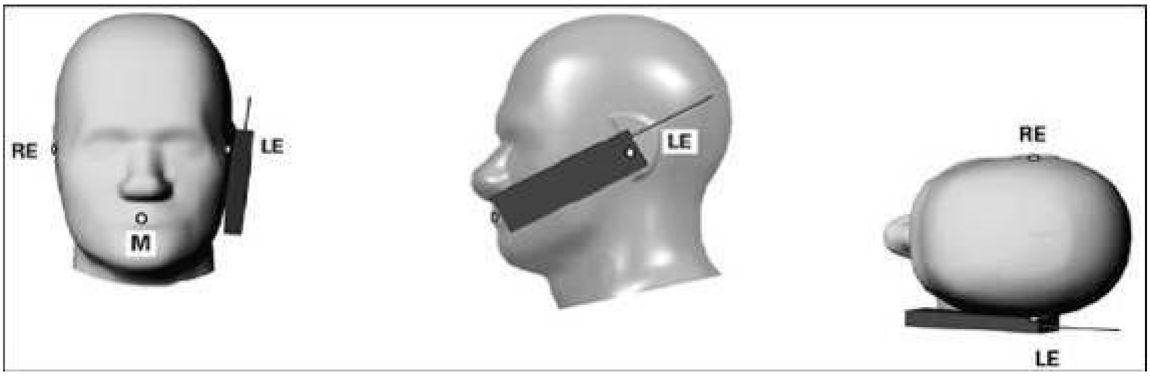


Figure 7.2c
Phone "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for handset positioning, are indicated.

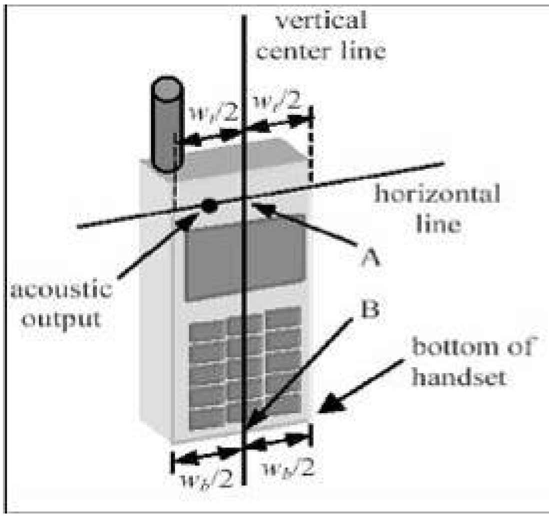


Figure 7.2a

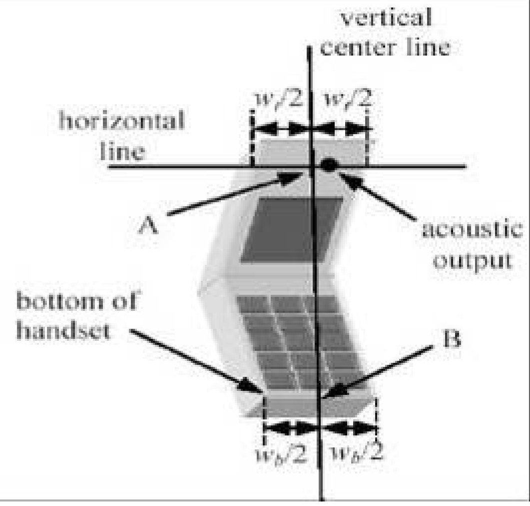


Figure 7.2b

10.3 DEFINITION OF THE “TILTED” POSITION

The “tilted” position is defined as follows:

a. Repeat steps (a) – (g) of 7.2 to place the device in the “cheek position.”

b. While maintaining the orientation of the handset move the handset away from the pinna along the line passing through RE and LE in order to enable a rotation of the handset by 15 degrees.

c. Rotate the handset around the horizontal line by 15 degrees.

d. While maintaining the orientation of the handset, move the handset towards the phantom on a line passing through RE and LE until any part of the handset touches the ear. The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna (e.g., the antenna with the back of the phantom head), the angle of the handset should be reduced. In this case, the tilted position is obtained if any part of the handset is in contact with the pinna as well as a second part of the handset is contact with the phantom (e.g., the antenna with the back of the head).

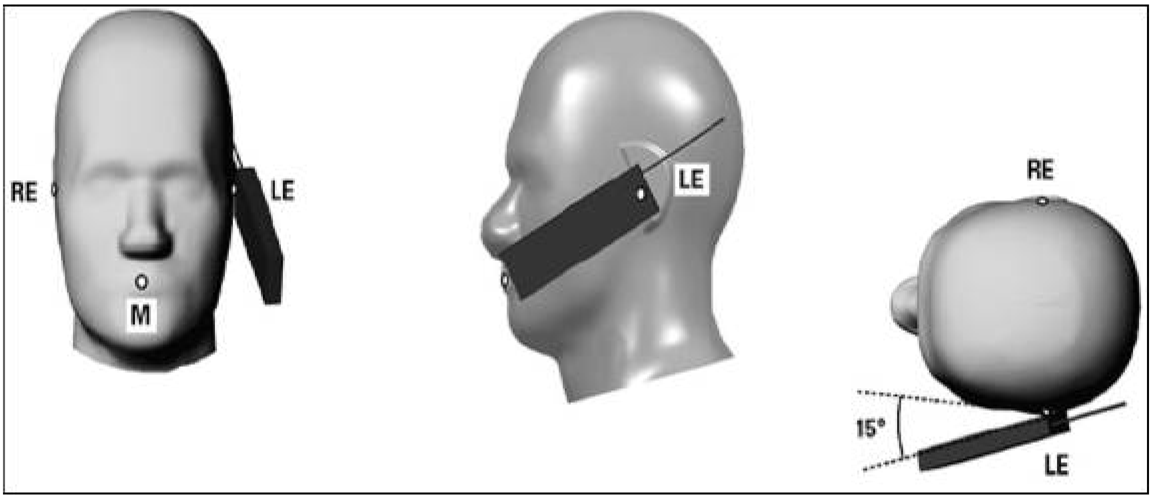


Figure 7-3

Phone “tilted” position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for handset positioning, are indicated.

11. MEASUREMENT RESULTS

11.1 TEST LIQUIDS CONFIRMATION

SIMULATED TISSUE LIQUID PARAMETER CONFIRMATION

The dielectric parameters were checked prior to assessment using the HP85070C dielectric probe kit. The dielectric parameters measured are reported in each correspondent section.

IEEE SCC-34/SC-2 P1528 RECOMMENDED TISSUE DIELECTRIC PARAMETERS

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in P1528

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	45.3	5.27	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

11.2 LIQUID MEASUREMENT RESULTS

The following table give the recipes for tissue simulating liquid:

For Head:

Frequency (MHz)	Water (%)	Sugar (%)	Salt (%)	Cellulose (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (ε_r)
835	41.07	47.31	1.15	0.23	0.24	0	0.90	41.50
1800,1900,2000	54.88	0	0.21	0	0	44.91	1.40	40.00
2450	55.00	0	0	0	0	45.00	1.80	39.20

For Body:

Frequency (MHz)	Water (%)	Sugar (%)	Salt (%)	Cellulose (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (ε_r)
835	51.5	45.4	1.12	0.21	0.25	0	0.97	55.20
1800,1900,2000	38.6	55.3	0.8	0	0	0	1.52	53.30
2450	65.33	0	0	0	0	23.54	1.95	52.70

The following table give the targets for tissue simulating liquid:

For Head:

Frequency (MHz)	Conductivity (σ)	+/- 5% Range	Permittivity (εr)	+/- 5% Range
835	0.90	0.86～0.95	41.50	39.40～43.60
1800,1900,2000	1.40	1.33～1.47	40.00	38.00～42.00
2450	1.80	1.71～1.89	39.20	37.24～41.16

For Body:

Frequency (MHz)	Conductivity (σ)	+/- 5% Range	Permittivity (εr)	+/- 5% Range
835	0.97	0.92～1.02	55.20	52.44～57.96
1800,1900,2000	1.52	1.44～1.60	53.30	50.64～55.96
2450	1.95	1.85～2.05	52.70	50.06～55.33

The following table show the measuring results for simulating liquid:

Ambient condition: Temperature: 21 °C Relative humidity: 58%

Liquid Type	Frequency	Temp. [°C]	Parameters	Target	Measured	Deviation[%]	Limited[%]	Measured Date
Head850	850 MHz	21	Permitivity	41.50	41.65	0.36	± 5	2013-3-24
		21	Conductivity	0.90	0.91	1.11	± 5	2013-3-24
Body850	850 MHz	21	Permitivity	55.20	55.39	0.34	± 5	2013-3-24
		21	Conductivity	0.97	0.98	1.03	± 5	2013-3-24
Head1900	1900 MHz	21	Permitivity	40.00	40.32	0.80	± 5	2013-3-26
		21	Conductivity	1.40	1.41	0.71	± 5	2013-3-26
Body1900	1900 MHz	21	Permitivity	53.30	52.81	-0.92	± 5	2013-3-26
		21	Conductivity	1.52	1.51	-0.66	± 5	2013-3-26
Head2450	2450 MHz	21	Permitivity	39.20	41.05	4.72	± 5	2013-3-23
		21	Conductivity	1.80	1.83	1.67	± 5	2013-3-23
Body2450	2450 MHz	21	Permitivity	52.70	53.25	1.04	± 5	2013-3-23
		21	Conductivity	1.95	1.98	1.54	± 5	2013-3-23

11.3 PROBE CALIBRATION PROCEDURE

For the calibration of E-field probes in lossy liquids, an electric field with an accurately known field strength must be produced within the measured liquid. For standardization purposes it would be desirable if all measurements which are necessary to assess the correct field strength would be traceable to standardized measurement procedures. In the following two different calibration techniques are summarized:

Transfer Calibration with Temperature Probes

In lossy liquids the specific absorption rate (SAR) is related both to the electric field (E) and the temperature gradient (dT/dt) in the liquid.

$$SAR = \frac{\sigma}{\rho}|E|^2 = c\frac{dT}{dt}$$

whereby σ is the conductivity, ρ the density and c the heat capacity of the liquid.

Hence, the electric field in lossy liquid can be measured indirectly by measuring the temperature gradient in the liquid. Non-disturbing temperature probes (optical probes or thermistor probes with resistive lines) with high spatial resolution (<1-2 mm) and fast reaction time (<1 s) are available and can be easily calibrated with high precision [2]. The setup and the exciting source have no influence on the calibration; only the relative positioning uncertainties of the standard temperature probe and the E-field probe to be calibrated must be considered. However, several problems limit the available accuracy of probe calibrations with temperature probes:

- The temperature gradient is not directly measurable but must be evaluated from temperature measurements at different time steps. Special precaution is necessary to avoid measurement errors caused by temperature gradients due to energy equalizing effects or convection currents in the liquid. Such effects cannot be completely avoided, as the measured field itself destroys the thermal equilibrium in the liquid. With a careful setup these errors can be kept small.
- The measured volume around the temperature probe is not well defined. It is difficult to calculate the energy transfer from a surrounding gradient temperature field into the probe. These effects must be considered, since temperature probes are calibrated in liquid with homogeneous temperatures. There is no traceable standard for temperature rise measurements.
- The calibration depends on the assessment of the specific density, the heat capacity and the conductivity of the medium. While the specific density and heat capacity can be measured accurately with standardized procedures ($\sim$ 2% for c; much better for ρ) , there is no standard for the measurement of the conductivity. Depending on the method and liquid, the error can well exceed ±5%.
- Temperature rise measurements are not very sensitive and therefore are often performed at a higher power level than the E-field measurements. The nonlinearities in the system (e.g., power measurements, different components, etc.) must be considered.

Considering these problems, the possible accuracy of the calibration of E-field probes with temperature gradient measurements in a carefully designed setup is about ±10% (RSS) [4]. Recently, a setup which is a combination of the waveguide techniques and the thermal measurements was presented in

[7]. The estimated uncertainty of the setup is ±5% (RSS) when the same liquid is used for the calibration and for actual measurements and ±7-9% (RSS) when not, which is in good agreement with the estimates given in [4].

Calibration with Analytical Fields

In this method a technical setup is used in which the field can be calculated analytically from measurements of other physical magnitudes (e.g., input power). This corresponds to the standard field method for probe calibration in air; however, there is no standard defined for fields in lossy liquids.

When using calculated fields in lossy liquids for probe calibration, several points must be considered in the assessment of the uncertainty:

- The setup must enable accurate determination of the incident power.
- The accuracy of the calculated field strength will depend on the assessment of the dielectric parameters of the liquid.
- Due to the small wavelength in liquids with high permittivity, even small setups might be above the resonant cutoff frequencies. The field distribution in the setup must be carefully checked for conformity with the theoretical field distribution.

In the following section a setup which allows the analytical calculation of the SAR will be introduced.

New Waveguide Setup for Probe Calibration

Rectangular waveguides are self-contained systems. In the frequency band in which only the dominant TE_{01} mode exists, highly accurate fields can be generated for calibration purposes if reflections can be minimized or compensated for. Considerable standing waves unavoidably occur if a lossy liquid is inserted in the waveguide. However, the cross sectional field distribution which is defined only by the geometry is not modified by these standing waves, a fact which can be utilized for generating well defined fields inside lossy liquid.

Three different standard waveguides (R9, R14 and R22) with overlapping frequency ranges were realized covering the frequency range of interest, i.e., from 800 up to 2500 MHz. In each waveguide, a planar, dielectric slab (ϵ_r = 3.3) was introduced to minimize reflections (return loss $<$ -10 dB). The lossy tissue simulating liquid in which the probe had to be calibrated was

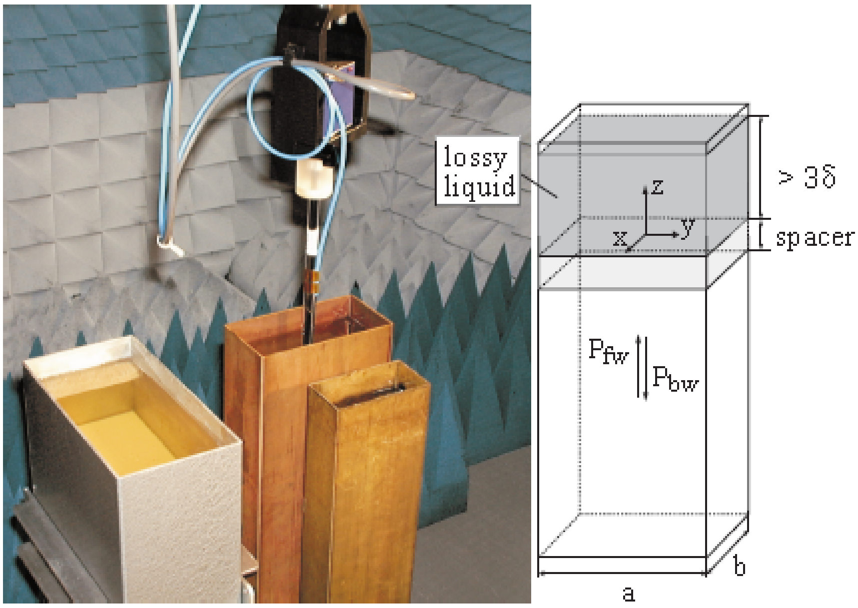


Figure 5.1: Experimental setup for assessment of the conversion factor when using a vertically rectangular waveguide.

The here presented waveguide system is a robust and easy-to-use setup enabling calibration of dosimetric E-field probes with high precision. Even more important is that the calibration of the setup can be reduced to power measurements which can be traced to a standard calibration procedure. The practical limitation given by the waveguide size to the frequency band between 800 and 2500 MHz is not severe in the context of compliance testing, since the most important operational frequencies of mobile communications systems are covered. The presented waveguide system is therefore well suited for implementation as a standard calibration technique for dosimetric probes in this frequency range. For frequencies below 800 MHz, transfer calibration with temperature probes remains the most practical way to achieve calibration with decent precision.

filled into the vertically standing waveguide. The medium depth had to be chosen such that the standing waves within the liquid were negligible, i.e., larger than three times the skin depth (< -50 dB at the interface liquid-slab). The attenuation of the waveguide adapters was determined to be 0.05 dB by the transmission method using two identical adapters. Table 5.1 gives an overview of some of the construction details.

	R9	R14	R22
WG cross section*	248 x 124	165 x 82.5	109 x 54.7
Spacer height*	50	30	25
Liquid height*	150	130	80

* all dimensions in mm

Table 5.1: Description of the waveguide systems.

With these setups, the total power absorbed by the lossy liquid can be accurately determined by measurement of the forward and reflected powers. Since all power entering the lossy liquid is absorbed by the liquid, the volume SAR can be determined as:

$$SAR^V = \frac{4\,(P_{fw} - P_{bw})}{ab\delta}\, cos^2(\pi \frac{y}{a})\, e^{(-2z/\delta)} \qquad (5.2)$$

The here presented waveguide system is a robust and easy-to-use setup enabling calibration of dosimetric E-field probes with high precision. Even more important is that the calibration of the setup can be reduced to power measurements which can be traced to a standard calibration procedure. The practical limitation given by the waveguide size to the frequency band between 800 and 2500 MHz is not severe in the context of compliance testing, since the most important operational frequencies of mobile communications systems are covered. The presented waveguide system is therefore well suited for implementation as a standard calibration technique for dosimetric probes in this frequency range. For frequencies below 800 MHz, transfer calibration with temperature probes remains the most practical way to achieve calibration with decent precision.

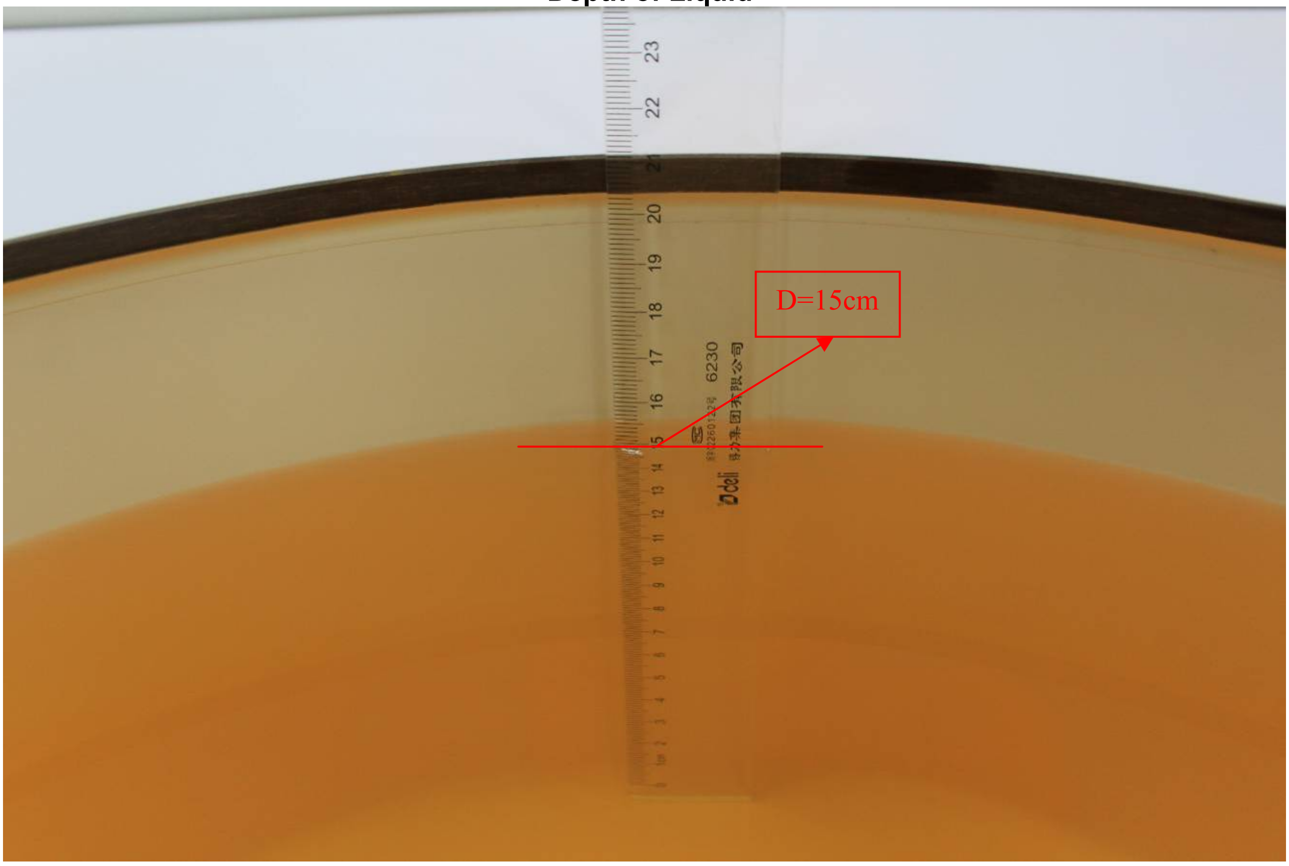
11.4 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of ±10%. The system performance check results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

SYSTEM PERFORMANCE CHECK MEASUREMENT CONDITIONS

- The measurements were performed in the flat section of the SAM twin phantom filled with head and body simulating liquid of the following parameters.
- The DASY5 system withan E-fileld probe EX3DV4 SN: 3798 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15 mm (below 1 GHz) and 10 mm (above 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 10mm was aligned with the dipole.
- Special 7x7x7 fine cube was chosen for cube integration (dx= 5 mm, dy= 5 mm, dz= 5 mm).
- Distance between probe sensors and phantom surface was set to 2 mm.
- The dipole input power was 1W±3%.
- The results are normalized to 1 W input power.

Depth of Liquid



- Note: For SAR testing, the depth is 15cm shown above

SYSTEM PERFORMANCE CHECK RESULTS

Ambient conduction

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D835V2-SN:4d114 **Date**: March 24, 2013

Head Simulatinf Liquid		Parameters	Target	Measured	Deviation[%]	Limited[%]
Frequency	Temp. [°C]					
850 MHz	20.30	1g SAR	9.35	9.24	-1.18	±10
		10g SAR	6.14	6.16	0.33	±10

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D835V2-SN:4d114 **Date**: March 24, 2013

Body Simulatinf Liquid		Parameters	Target	Measured	Deviation[%]	Limited[%]
Frequency	Temp. [°C]					
850 MHz	20.30	1g SAR	9.61	9.92	3.23	±10
		10g SAR	6.37	6.44	1.10	±10

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D1900V2-SN:5d136 **Date**: March 26, 2013

Head Simulatinf Liquid		Parameters	Target	Measured	Deviation[%]	Limited[%]
Frequency	Temp. [°C]					
1900 MHz	20.30	1g SAR	39.40	40.08	1.73	±10
		10g SAR	20.70	21.12	2.03	±10

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D1900V2-SN:5d136 **Date**: March 26, 2013

Body Simulatinf Liquid		Parameters	Target	Measured	Deviation[%]	Limited[%]
Frequency	Temp. [°C]					
1900 MHz	20.30	1g SAR	40.30	39.64	-1.64	±10
		10g SAR	21.10	20.48	-2.94	±10

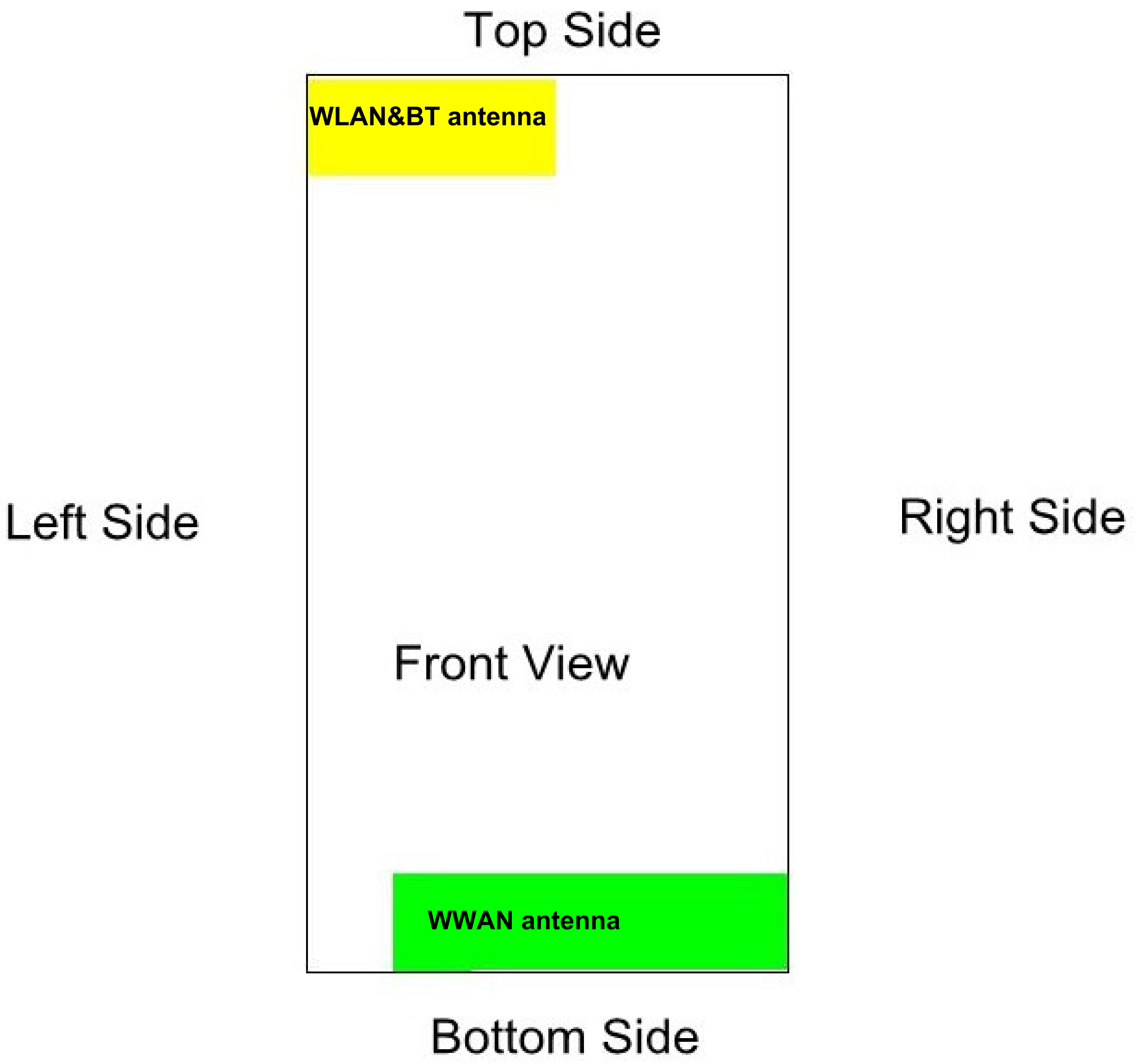
Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D2450V2-SN:817 **Date**: March 23, 2013

Head Simulatinf Liquid		Parameters	Target	Measured	Deviation[%]	Limited[%]
Frequency	Temp. [°C]					
2450 MHz	20.30	1g SAR	53.20	54.08	1.65	±10
		10g SAR	25.00	24.72	-1.12	±10

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D2450V2-SN:817 **Date**: March 23, 2013

Body Simulatinf Liquid		Parameters	Target	Measured	Deviation[%]	Limited[%]
Frequency	Temp. [°C]					
2450 MHz	20.30	1g SAR	51.40	52.88	2.88	±10
		10g SAR	24.00	24.44	1.83	±10

11.5 SAR TEST CONFIGURATIONS



Device dimensions (H x W x D): 150 x 78 x 10 mm

Antennas	Wireless Interface
WWAN antenna	GSM850 GSM1900 WCDMA Bnad V
WLAN&Bluetooth antenna	WLAN 2.4G Bluetooth

Test Mode

GSM 850/PCS1900	Data transmission mode(GPRS)/Voice mode(GSM)
WCDMA Band V	Data transmission mode(12.2kRMC)
WLAN	Data transmission mode(11b)

Head Exposure Condition for WWAN and WLAN

Test Configurations	SAR required	Note
Right Cheek	Yes	N/A
Right Tilted	Yes	N/A
Left Cheek	Yes	N/A
Left Tilted	Yes	N/A

Body Exposure Condition for WWAN

Test Configurations	Antenna-to-edge	SAR required	Note
Front	8 mm	Yes	
Rear	0.5 mm	Yes	
Left Side	10 mm	Yes	
Right Side	0.2 mm	Yes	
Top Side	125 mm	No	SAR is not required because the distance from the WLAN antenna to this edge is >25 mm as per KDB 941225 D06 Hot Sport SAR v01
Bottom Side	0.2mm	Yes	

Body Exposure Condition for WLAN

Test Configurations	Antenna-to-edge	SAR required	Note
Front	8 mm	Yes	
Rear	0.5 mm	Yes	
Left Side	0.2 mm	Yes	
Right Side	30 mm	No	SAR is not required because the distance from the WLAN antenna to this edge is >25 mm as per KDB 941225 D06 Hot Sport SAR v01
Top Side	0.2 mm	Yes	
Bottom Side	135 mm	No	SAR is not required because the distance from the WLAN antenna to this edge is >25 mm as per KDB 941225 D06 Hot Sport SAR v01

Note:

1. Per KDB 941225 D06, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10 mm.SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.
2. It is not necessary to test Body-worn SAR if the test separation distance(10mm) for hotspot mode is more conservative than Body-worn test(15mm),according to KDB 941225 D06 Hotspot SAR procedure.

3. If the test separation distance (antenna-user) is < 5mm, 5mm is used for estimated SAR calculation.
4. Per KDB 447498 D01v05, For minimum test separation distance ≤50mm, Bluetooth standalone SAR is excluded according to
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR

	Wireless Interface	Bluetooth
Tune-up Maximum power (dBm)		1.22
Tune-up Maximum rated power (mW)		1.32
Head	Antenna to user (mm)	5
	SAR exclusion threshold (mW)	9.68
	SAR testing required	NO
Body	Antenna to user (mm)	10
	SAR exclusion threshold (mW)	19.37
	SAR testing required	NO

11.6 EUT TUNE-UP PROCEDURES AND TEST MODE

The following procedure had been used to prepare the EUT for the SAR test.
To setup the desire channel frequency and the maximum output power. A Radio Communication Tester "CMU200 " was used to program the EUT.

GSM 850 / GPRS 850/ EDGE 850:

Network Support: GSM only / GPRS/EDGE
Main Service: Circuit Switched / Packet data
Power Setting: 33dBm / 33dBm

GSM 1900 / GPRS 1900/ EDGE1900:

Network Support: GSM only / GPRS/EDGE
Main Service: Circuit Switched / Packet data
Power Setting: 30dBm / 30dBm

GSM Conducted output power(dBm):

Band	GSM 850			GSM 1900		
Channel	128	190	251	512	661	810
Frequency(MHz)	824.2	836.6	848.8	1850.2	1880	1909.8
Maximum Burst-Averaged Output Power						
GSM(GMSK,1Uplink)	32.33	**32.42**	32.12	29.31	**29.44**	29.35
GPRS 8 (1 Uplink)	31.31	**31.35**	31.25	28.46	**28.52**	28.48
GPRS 10 (2 Uplink)	31.25	31.28	31.21	28.11	28.28	28.12
GPRS 11 (3 Uplink)	30.13	30.38	30.25	27.83	27.93	27.85
GPRS 12 (4 Uplink)	29.21	29.55	29.41	26.55	26.62	26.52
EDGE 8 (1 Uplink)	30.07	**30.21**	30.15	27.41	**27.55**	27.41
EDGE 10 (2 Uplink)	29.85	29.87	28.82	26.40	26.52	26.44
EDGE 11 (3 Uplink)	28.63	28.68	28.55	25.43	25.53	25.41
EDGE 12 (4 Uplink)	28.11	28.35	28.21	25.05	25.22	25.12
Maximum Frame-Averaged Output Power						
GSM(GMSK,1Uplink)	23.30	23.39	23.09	20.28	20.41	20.32
GPRS 8 (1 Uplink)	22.29	22.33	22.23	19.44	19.50	19.46
GPRS 10 (2 Uplink)	25.23	25.26	25.19	22.09	22.26	22.10
GPRS 11 (3 Uplink)	25.87	26.12	25.99	23.57	23.67	23.59
GPRS 12 (4 Uplink)	26.20	26.54	26.40	23.54	23.61	23.51
EDGE 8 (1 Uplink)	21.04	21.18	21.12	18.38	18.52	18.38
EDGE 10 (2 Uplink)	23.83	23.85	22.80	20.38	20.50	20.42
EDGE 11 (3 Uplink)	24.37	24.42	24.29	21.17	21.27	21.15
EDGE 12 (4 Uplink)	25.10	25.34	25.20	22.04	22.21	22.11

Remark: The frame-averaged power is linearly scaled the maximum burst-averaged power based on time slots. The calculated methods are shown as below:
Frame-averaged power = Burst-averaged power (1 Uplink) – 9.03 dBm
Frame-averaged power = Burst averaged power (2 Uplink) – 6.02 dBm
Frame-averaged power = Burst-averaged power (3 Uplink) – 4.26 dBm
Frame-averaged power = Burst averaged power (4 Uplink) – 3.01 dBm

Note: Per KDB 447498 D01v05, the maximum output power channel is used for SAR testing and for further SAR test reduction.

WCDMA Conducted output power(dBm):
As the SAR body tests for WCDMA **BandV**, we established the radio link through call processing. The maximum output power were verified on high, middle and low channels for each test band according to 3GPP TS 34.121 with the following configuration:a 12.2kbps RMC, 64,144,384 kbps RMC with TPC set to all "all '1's"b Test loop Mode 1
The following procedures had been used to prepare the EUT for the SAR test.

HSDPA Setup Configuration:

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	β_c	β_d	β_d *(SF)*	β_c/β_d	β_{HS} *(Note1, Note 2)*	CM (dB) *(Note 3)*	MPR (dB) *(Note 3)*
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 *(Note 4)*	15/15 *(Note 4)*	64	12/15 *(Note 4)*	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and Δ_{NACK} = 30/15 with $\beta_{hs} = 30/15 * \beta_c$, and Δ_{CQI} = 24/15 with $\beta_{hs} = 24/15 * \beta_c$.

Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

HSUPA Setup Configuration:

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	β_c	β_d	β_d *(SF)*	β_c/β_d	β_{HS} *(Note1)*	β_{ec}	β_{ed} *(Note 5) (Note 6)*	β_{ed} *(SF)*	β_{ed} *(Codes)*	CM *(dB) (Note 2)*	MPR *(dB) (Note 2)*	*AG Index (Note 6)*	*E-TFCI*
1	11/15 *(Note 3)*	15/15 *(Note 3)*	64	11/15 *(Note 3)*	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed}1: 47/15 β_{ed}2: 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 *(Note 4)*	15/15 *(Note 4)*	64	15/15 *(Note 4)*	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.

Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.

Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 6: β_{ed} can not be set directly, it is set by Absolute Grant Value.

Band	WCDMA Band V		
Channel	4132	4182	4233
Frequency(MHz)	826.4	836.4	846.6
AMR	22.61	22.21	22.83
RMC12.2K	22.45	**22.54**	22.35
HSDPA Subtest-1	21.31	21.35	21.28
HSDPA Subtest-2	21.18	21.25	21.65
HSDPA Subtest-3	21.55	21.42	21.87
HSDPA Subtest-4	21.48	21.41	21.88
HSUPA Subtest-1	20.65	20.56	21.05
HSUPA Subtest-2	20.37	20.53	20.98
HSUPA Subtest-3	20.42	20.61	20.94
HSUPA Subtest-4	20.51	20.33	20.92
HSUPA Subtest-5	20.45	20.35	20.89

Note:

Per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA output power is < 0.25dB higher than RMC, HSDPA/HSUPA SAR evaluation can be excluded.

WLAN Conducted output power(dBm):

Mode	Channel	Frequence	Average power(dBm) Date Rate(bps)			
			1M	2M	5.5M	11M
802.11 b	1	2412 MHZ	16.21	16.13	16.02	16.09
	6	2437 MHZ	**16.23**	16.18	16.11	15.98
	11	2462 MHZ	16.13	16.06	16.02	16.03

Mode	Channel	Frequence	Average power(dBm) Date Rate(bps)							
			6M	9M	12M	18M	24M	36M	48M	54M
802.11 g	1	2412 MHZ	14.42	14.21	14.22	14.11	14.21	14.09	14.12	14.09
	6	2437 MHZ	**14.51**	14.11	14.10	14.07	14.01	13.89	13.77	13.71
	11	2462 MHZ	14.32	14.33	14.22	14.32	14.45	14.23	14.34	14.21

Mode	Channel	Frequence	Average power(dBm) Date Rate(bps)							
			6.5	13	20	26	39	52	58	65
802.11 n HT20	1	2412 MHZ	13.43	13.24	13.43	13.45	13.09	13.19	13.32	13.51
	6	2437 MHZ	**13.81**	13.78	13.55	13.45	13.23	13.11	13.01	13.11
	11	2462 MHZ	13.31	13.28	13.27	13.17	13.13	13.11	13.21	13.21

Mode	Channel	Frequence	Average power(dBm) Date Rate(bps)							
			6.5	13	20	26	39	52	58	65
802.11 n HT40	3	2422 MHZ	12.25	12.28	12.22	12.28	12.13	12.12	12.03	12.08
	6	2437 MHZ	**12.41**	12.35	12.22	12.17	12.13	12.21	12.30	12.31
	9	2452 MHZ	12.31	12.11	12.17	12.07	12.11	12.22	12.13	12.28

Note:

1. Per KDB 248227, choose the highest output power channel to test SAR and determine further SAR exclusion
2. Per KDB 248227, 11g, 11n-HT20 and 11n-HT40 output power is less than 0.25dB higher than 11b mode, the SAR test can be excluded.

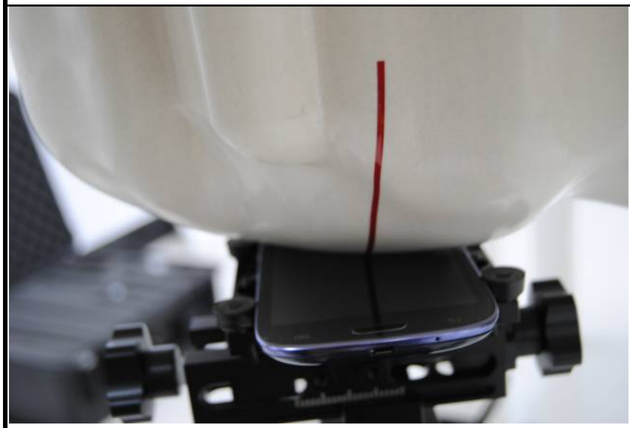
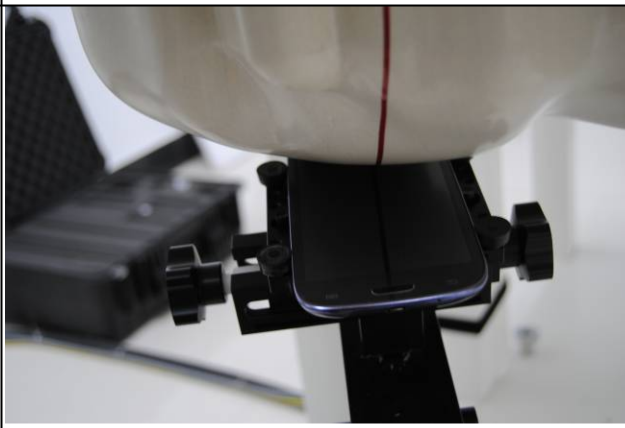
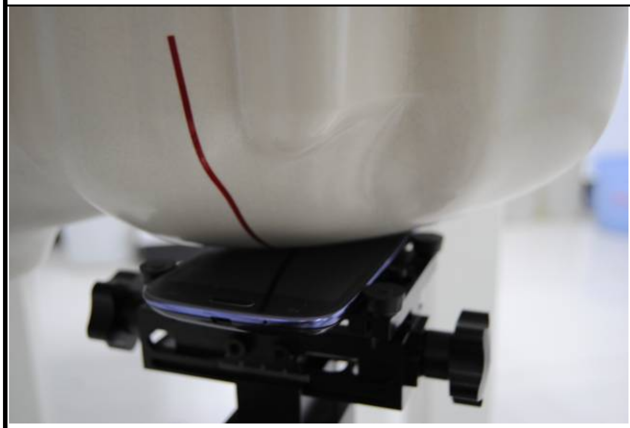
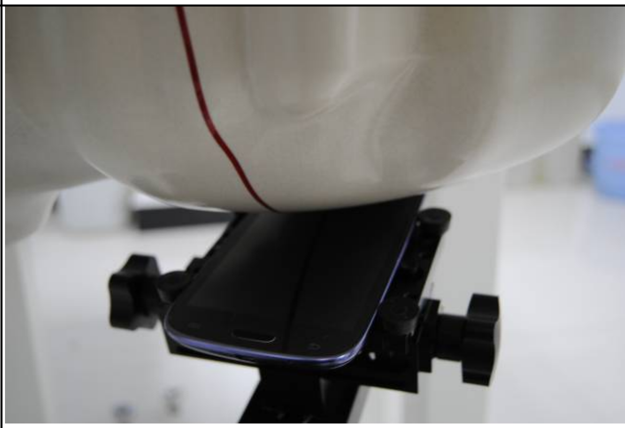
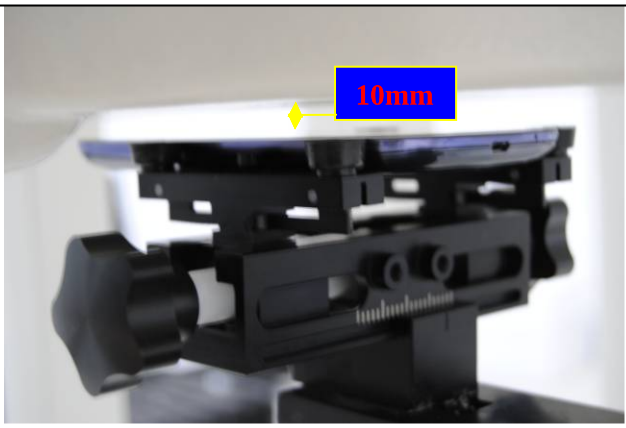
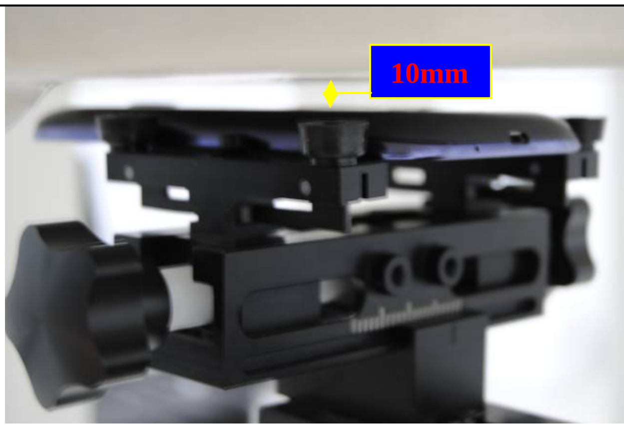
Bluetooth Conducted output power(dBm)

Mode	Frequence	Average power(dBm)								
		Date Rate								
		DH1	DH3	DH5	2DH1	2DH3	2DH5	3DH1	3DH3	3DH5
CH00	**2422MHZ**	1.02	0.98	0.92	0.88	0.85	0.81	0.78	0.73	0.71
CH39	**2437MHZ**	**1.22**	1.12	1.05	0.95	0.92	0.88	0.83	0.81	0.78
CH78	**2452MHZ**	0.98	0.92	0.89	0.82	0.79	0.73	0.71	0.68	0.65

Mode	The Turn-up Maximum Power(Customer Declared)(dBm)	Range	Measured Conduct Maximum Power(dBm)
GSM 850	32+/-1	31~33	32.42
GPRS 850-1TS	32+/-1	31~33	31.35
GPRS 850-2TS	31+/-1	30~32	31.28
GPRS 850-3TS	30+/-1	29~31	30.38
GPRS 850-4TS	29+/-1	28~30	29.55
EDGE 850-1TS	30+/-1	29~31	30.21
EDGE 850-2TS	29+/-1	28~30	29.87
EDGE 850-3TS	28+/-1	27~29	28.68
EDGE 850-4TS	28+/-1	27~29	28.35
GSM 1900	29+/-1	28~30	29.44
GPRS 1900-1TS	28+/-1	27~29	28.52
GPRS 1900-2TS	28+/-1	27~29	28.28
GPRS 1900-3TS	27+/-1	26~28	27.93
GPRS 1900-4TS	26+/-1	25~27	26.62
EDGE 1900-1TS	27+/-1	26~28	27.55
EDGE 1900-2TS	26+/-1	25~27	26.52
EDGE 1900-3TS	25+/-1	24~26	25.53
EDGE 1900-4TS	25+/-1	24~26	25.22
WCDMA Band V	22+/-1	21~23	22.54
HSDPA Band V	21+/-1	20~22	21.88
IEEE 802.11b	16+/-1	15~17	16.23
IEEE 802.11g	14+/-1	13~15	14.51
IEEE 802.11n(20M)	13+/-1	12~14	13.81
IEEE 802.11n(40M)	12+/-1	11~13	12.41

So, they are in tune-up range and complied.

11.7 EUT SETUP PHOTOS

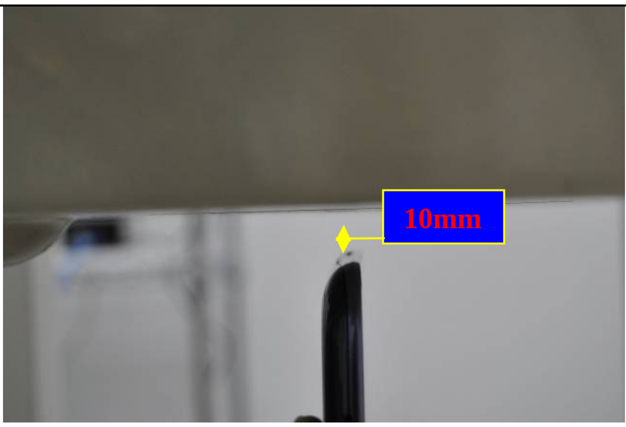
Cheek device with right head phantom.	Tilt device with right head phantom
	
EUT Setup Configuration 1	**EUT Setup Configuration 2**
Cheek device with left head phantom.	Tilt device with left head phantom
	
EUT Setup Configuration 3	**EUT Setup Configuration 4**
Up in body position	Down in body position
	
EUT Setup Configuration 5	**EUT Setup Configuration 6**
Top in body position	Bottom in body position

EUT Setup Configuration 7

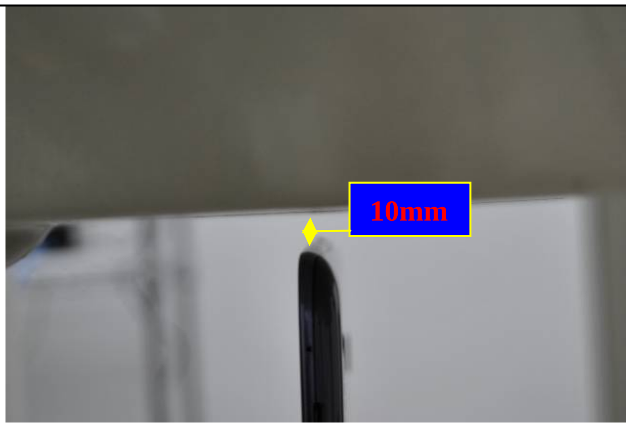
Left in body position

EUT Setup Configuration 8

Right in body position



EUT Setup Configuration 9



EUT Setup Configuration 10

11.8 SAR MEASUREMENT RESULTS

Head SAR Test Records

GSM SAR

Band	Mode	Test Position	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
GSM850	**GSM**	**Right Cheek**	**190**	**836.6**	**32.42**	**33**	**1.143**	**0.16**	**0.049**	**0.056**
GSM850	GSM	Right Tilted	190	836.6	32.42	33	1.143	0.07	0.024	0.027
GSM850	GSM	Left Cheek	190	836.6	32.42	33	1.143	0.06	0.041	0.049
GSM850	GSM	Left Tilted	190	836.6	32.42	33	1.143	0.19	0.024	0.027
GSM1900	GSM	Right Cheek	661	1880.0	29.44	30	1.138	0.16	0.089	0.101
GSM1900	GSM	Right Tilted	661	1880.0	29.44	30	1.138	0.12	0.065	0.074
GSM1900	**GSM**	**Left Cheek**	**661**	**1880.0**	**29.44**	**30**	**1.138**	**-0.17**	**0.103**	**0.117**
GSM1900	GSM	Left Tilted	661	1880.0	29.44	30	1.138	0.17	0.053	0.060

WCDMA SAR

Band	Mode	Test Position	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
WCDMA V	**RMC 12.2k**	**Right Cheek**	**4182**	**836.6**	**22.54**	**23**	**1.112**	**-0.03**	**0.049**	**0.054**
WCDMA V	RMC 12.2k	Right Tilted	4182	836.6	22.54	23	1.112	0.07	0.031	0.034
WCDMA V	RMC 12.2k	Left Cheek	4182	836.6	22.54	23	1.112	0.05	0.043	0.048
WCDMA V	RMC 12.2k	Left Tilted	4182	836.6	22.54	23	1.112	0.03	0.033	0.037

WLAN SAR

Band	Mode	Test Position	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
WLAN 2.4G	802.11b	Right Cheek	6	2437	16.23	17	1.194	0.11	0.013	0.016
WLAN 2.4G	**802.11b**	**Right Tilted**	**6**	**2437**	**16.23**	**17**	**1.194**	**0.04**	**0.017**	**0.020**
WLAN 2.4G	802.11b	Left Cheek	6	2437	16.23	17	1.194	-0.13	0.006	0.007
WLAN 2.4G	802.11b	Left Tilted	6	2437	16.23	17	1.194	0.06	0.010	0.012

Hotspot SAR Test Records

GSM SAR

Band	Mode	Test Position	Dist. (mm)	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
GSM850	GPRS 4slots	Front	10	190	836.6	29.55	30	1.109	0.02	0.052	0.058
GSM850	**GPRS 4slots**	**Rear**	**10**	**190**	**836.6**	**29.55**	**30**	**1.109**	**0.09**	**0.466**	**0.517**
GSM850	GPRS 4slots	Left Side	10	190	836.6	29.55	30	1.109	0.06	0.073	0.081
GSM850	GPRS 4slots	Right Side	10	190	836.6	29.55	30	1.109	-0.10	0.082	0.091
GSM850	GPRS 4slots	Bottom Side	10	190	836.6	29.55	30	1.109	-0.17	0.066	0.073
GSM850	GSM	Rear	10	190	836.6	32.42	33	1.143	-0.02	0.357	0.408
GSM1900	GPRS 4slots	Front	10	661	1880.0	26.62	27	1.091	-0.04	0.017	0.019
GSM1900	GPRS 4slots	Rear	10	661	1880.0	26.62	27	1.091	0.02	0.019	0.021
GSM1900	GPRS 4slots	Left Side	10	661	1880.0	26.62	27	1.091	-0.09	0.097	0.106
GSM1900	GPRS 4slots	Right Side	10	661	1880.0	26.62	27	1.091	0.17	0.089	0.097
GSM1900	**GPRS 4slots**	**Bottom Side**	**10**	**661**	**1880.0**	**26.62**	**27**	**1.091**	**0.19**	**0.246**	**0.268**
GSM1900	GSM	Bottom Side	10	661	1880.0	29.44	30	1.138	-0.05	0.235	0.267

WCDMA SAR

Band	Mode	Test Position	Dist. (mm)	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
WCDMA V	RMC 12.2k	Front	10	4182	836.6	22.54	23	1.112	0.06	0.056	0.062
WCDMA V	**RMC 12.2k**	**Rear**	**10**	**4182**	**836.6**	**22.54**	**23**	**1.112**	**0.03**	**0.214**	**0.238**
WCDMA V	RMC 12.2k	Left Side	10	4182	836.6	22.54	23	1.112	0.01	0.067	0.075
WCDMA V	RMC 12.2k	Right Side	10	4182	836.6	22.54	23	1.112	0.12	0.104	0.116
WCDMA V	RMC 12.2k	Bottom Side	10	4182	836.6	22.54	23	1.112	-0.04	0.033	0.037

WLAN SAR

Band	Mode	Test Position	Dist. (mm)	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
WLAN 2.4G	802.11b	Front	10	6	2437	16.23	17	1.194	0.07	0.022	0.026
WLAN 2.4G	802.11b	Rear	10	6	2437	16.23	17	1.194	0.13	0.158	0.189
WLAN 2.4G	802.11b	Left Side	10	6	2437	16.23	17	1.194	0.08	0.003	0.004
WLAN 2.4G	**802.11b**	**Top Side**	**10**	**6**	**2437**	**16.23**	**17**	**1.194**	**0.06**	**0.168**	**0.201**

Summary of Highest SAR Values

Band	Mode	Test Position	Dist. (mm)	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
GSM850	GSM	Right Cheek	-	190	836.6	32.42	33	1.143	0.16	0.049	0.056
GSM1900	GSM	Left Cheek	-	661	1880.0	29.44	30	1.138	-0.17	0.103	0.117
WCDMA V	RMC 12.2k	Right Cheek	-	4182	836.6	22.54	23	1.112	-0.03	0.049	0.054
WLAN 2.4G	802.11b	Right Tilted	-	6	2437	16.23	17	1.194	0.04	0.017	0.020
GSM850	GPRS 4slots	Rear	10	190	836.6	29.55	30	1.109	0.09	0.466	0.517
GSM1900	GPRS 4slots	Bottom Side	10	661	1880.0	26.62	27	1.091	0.19	0.246	0.268
WCDMA V	RMC 12.2k	Rear	10	4182	836.6	22.54	23	1.112	0.03	0.214	0.238
WLAN 2.4G	802.11b	Top Side	10	6	2437	16.23	17	1.194	0.06	0.168	0.201

11.9 SAR HANDSETS MULTI XMITER ASSESSMENT

	Position	Applicable Combination
Simultaneous Transmission	Head	WWAN (voice) + WLAN
		WWAN (voice) + BT
	Hotspot	WWAN (data) + WLAN
		WWAN (data) + BT
	Body-worn	WWAN (voice) + WLAN
		WWAN (voice) + BT

Note:
1. 2.4GHz WLAN and BT share the same antenna, and cannot transmit simultaneously.
2. The reported SAR summation is calculated based on the same configuration and test position.
3. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05 based on the formula below.
   (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√f(GHz)/x] W/kg for test separation distances ≤ 50 mm; where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
   0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

	Max power	Head (0cm distance)	Body (10mm distance)
Estimated SAR (W/kg)	1.22dBm	0.055 W/kg	0.028 W/kg

4. Per KDB 447498 D01v05, simultaneous transmission SAR is compliant if,
   1) Scalar SAR summation < 1.6W/kg.
   2) SPLSR = (SAR1 + SAR2)1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan
   If SPLSR ≤ 0.04, simultaneously transmission SAR is compliant
   3) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg

Result of SUM ∑SAR_{1g} of Head

SUM ∑SAR_{1g} (GSM850+WLAN(2.4G) or Bluetooth)						
Position	Distance	Stand alone SAR(1g) [W/kg]			SUM SAR(1g)[W/kg]	SUM SAR(1g)[W/kg]
	[mm]	GSM850	WLAN 2.4G	Bluetoooth	WWAN + WLAN(2.4G)	WWAN + Bluetooth
Right Cheek	0	0.056	0.016	0.055	0.072	0.111
Right Tilted	0	0.027	0.020	0.055	0.047	0.082
Left Cheek	0	0.049	0.007	0.055	0.056	0.104
Left Tilted	0	0.027	0.012	0.055	0.039	0.082

SUM ∑SAR_{1g} (PCS1900+WLAN(2.4G) or Bluetooth)						
Position	Distance	Stand alone SAR(1g) [W/kg]			SUM SAR(1g)[W/kg]	SUM SAR(1g)[W/kg]
	[mm]	PCS 1900	WLAN 2.4G	Bluetoooth	WWAN + WLAN(2.4G)	WWAN + Bluetooth
Right Cheek	0	0.101	0.016	0.055	0.117	0.156
Right Tilted	0	0.074	0.020	0.055	0.094	0.129
Left Cheek	0	0.117	0.007	0.055	0.124	0.172
Left Tilted	0	0.060	0.012	0.055	0.072	0.115

SUM ∑SAR_{1g} (WCDMA Band V+WLAN(2.4G) or Bluetooth)						
Position	Distance	Stand alone SAR(1g) [W/kg]			SUM SAR(1g)[W/kg]	SUM SAR(1g)[W/kg]
	[mm]	WCDMA V	WLAN 2.4G	Bluetoooth	WWAN + WLAN(2.4G)	WWAN + Bluetooth
Right Cheek	0	0.054	0.016	0.055	0.070	0.109
Right Tilted	0	0.034	0.020	0.055	0.054	0.089
Left Cheek	0	0.048	0.007	0.055	0.055	0.103
Left Tilted	0	0.037	0.012	0.055	0.049	0.086

Result of SUM ∑SAR1g of Hotspot

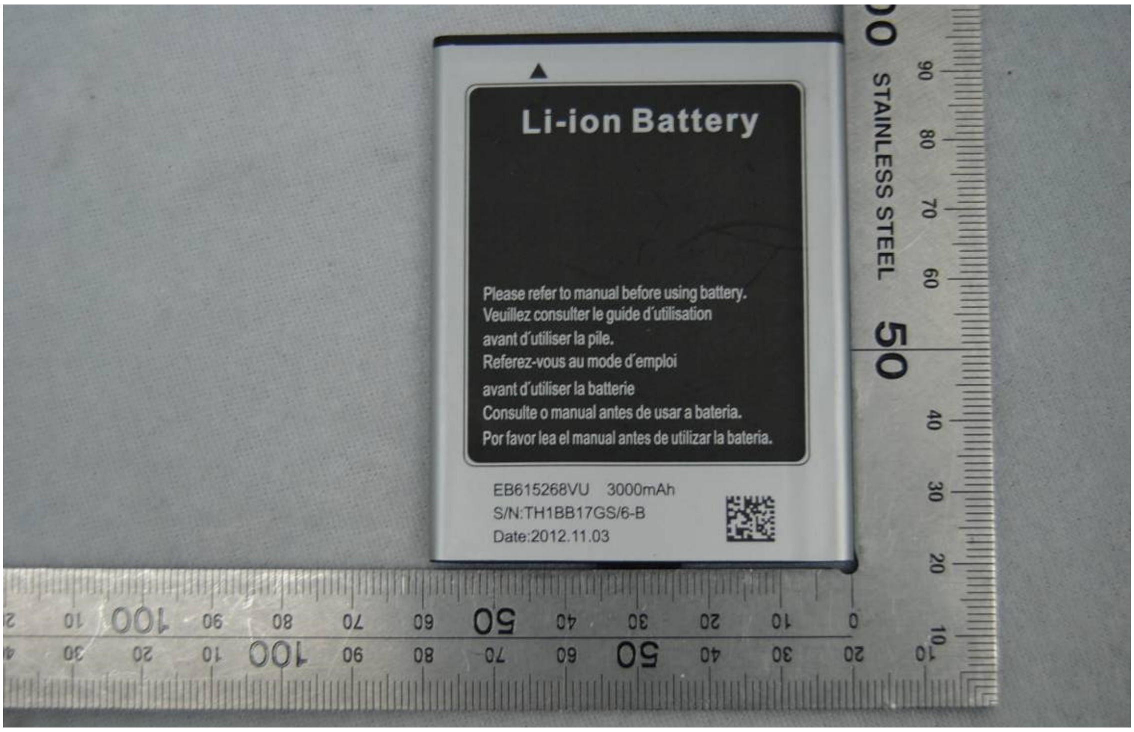
SUM ∑SAR1g (GSM850+WLAN(2.4G) or Bluetooth)						
Position	Distance	Stand alone SAR(1g) [W/kg]			SUM SAR(1g)[W/kg]	SUM SAR(1g)[W/kg]
	[mm]	GSM850	WLAN 2.4G	Bluetoooth	WWAN + WLAN(2.4G)	WWAN + Bluetooth
Front	10	0.058	0.026	0.028	0.084	0.086
Rear	10	0.517	0.189	0.028	0.706	0.545
Left Side	10	0.081	0.004	0.028	0.085	0.109
Right Side	10	0.091	-	0.028	-	0.119
Top Side	10	-	0.201	0.028	-	-
Bottom Side	10	0.073	-	0.028	-	0.101

SUM ∑SAR1g (PCS1900+WLAN(2.4G) or Bluetooth)						
Position	Distance	Stand alone SAR(1g) [W/kg]			SUM SAR(1g)[W/kg]	SUM SAR(1g)[W/kg]
	[mm]	PCS 1900	WLAN 2.4G	Bluetoooth	WWAN + WLAN(2.4G)	WWAN + Bluetooth
Front	10	0.019	0.026	0.028	0.045	0.047
Rear	10	0.021	0.189	0.028	0.210	0.049
Left Side	10	0.106	0.004	0.028	0.110	0.134
Right Side	10	0.097	-	0.028	-	0.125
Top Side	10	-	0.201	0.028	-	-
Bottom Side	10	0.268	-	0.028	-	0.296

SUM ∑SAR1g (WCDMA Band V+WLAN(2.4G) or Bluetooth)						
Position	Distance	Stand alone SAR(1g) [W/kg]			SUM SAR(1g)[W/kg]	SUM SAR(1g)[W/kg]
	[mm]	WCDMA V	WLAN 2.4G	Bluetoooth	WWAN + WLAN(2.4G)	WWAN + Bluetooth
Front	10	0.062	0.026	0.028	0.090	0.090
Rear	10	0.238	0.189	0.028	0.427	0.266
Left Side	10	0.075	0.004	0.028	0.079	0.103
Right Side	10	0.116	-	0.028	-	0.144
Top Side	10	-	0.201	0.028	-	-
Bottom Side	10	0.037	-	0.028	-	0.065

12. EUT PHOTO


Li-ion Battery
FABRIQUÉ AU JAPONFINITION EN CORÉE
ENSAMBLADO EN COREEAMONTADO NA CORÉIA
Standard: GB/T18287-2000 Voltage: 3.7V
3.7V Li-ion BATTERY 3.7V Li-ion BATTERIE 11.1Wh
3.7V Li-ion BATERÍA 3.7V Li-ion BATERIA 11.1Wh
STAINLESS STEEL


Li-ion Battery
Please refer to manual before using battery.
Veuillez consulter le guide d´utilisation
avant d´utiliser la pile.
Referez-vous au mode d´emploi
avant d´utiliser la batterie
Consulte o manual antes de usar a bateria.
Por favor lea el manual antes de utilizar la batería.
EB615268VU 3000mAh
S/N:TH1BB17GS/6-B
Date:2012.11.03
STAINLESS STEEL

13. EQUIPMENT LIST & CALIBRATION STATUS

Name of Equipment	Manufacturer	Type/Model	Serial Number	Calibration Due
P C	HP	Core(rm)3.16G	CZCO48171H	N/A
Signal Generator	Agilent	E8257C	MY43321570	05/12/2013
S-Parameter Network Analyzer	Agilent	E5071B	MY42301382	03/10/2014
Wireless Communication Test Set	R&S	CMU200	SN:B23-03291	05/12/2013
Power Meter	Agilent	E4416A	QB41292714	03/15/2014
Peak & Average sensor	Agilent	E9327A	CF0001	03/15/2014
E-field PROBE	SPEAG	EX3DV4	3798	07/24/2013
DIPOLE 835MHZ ANTENNA	SPEAG	D835V2	4d114	07/24/2013
DIPOLE 1900MHZ ANTENNA	SPEAG	D1900V2	5d136	07/19/2013
DIPOLE 2450MHZ ANTENNA	SPEAG	D2450V2	817	07/23/2013
DUMMY PROBE	SPEAG	DP_2	SPDP2001AA	N/A
SAM PHANTOM (ELI4 v4.0)	SPEAG	QDOVA001BB	1102	N/A
Twin SAM Phantom	SPEAG	QD000P40CD	1609	N/A
ROBOT	SPEAG	TX60	F10/5E6AA1/A101	N/A
ROBOT KRC	SPEAG	CS8C	F10/5E6AA1/C101	N/A
LIQUID CALIBRATION KIT	ANTENNESSA	41/05 OCP9	00425167	N/A
DAE	SD000D04BJ	DEA4	1245	07/19/2013

14. FACILITIES

All measurement facilities used to collect the measurement data are located at

☒ No.10, Weiye Rd., Innovation Park, Eco & Tec. Development Part, Kunshan City, Jiangsu Province, China.

15. REFERENCES

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16. ATTACHMENTS

Exhibit	Content
1	System Performance Check Plots
2	SAR Test Plots
3	Probe calibration report EX3DV4 SN3798
4	Dipole calibration report D835V2 SN:4d114
5	Dipole calibration report D1900V2-SN:5d136
6	Dipole calibration report D2450V2 SN: 817
7	DAE calibration report DEA4 SD000D04BJ SN: 1245

APPENDIX A: PLOTS OF PERFORMANCE CHECK

The plots are showing as followings.

Test Laboratory: Compliance Certification Services Inc.

System Performance Head Check-D850_2013.03.24

DUT: Dipole 850 MHz D835V2; Type: D835V2; SN:4d114

Communication System: CW; Frequency: 850 MHz

Medium parameters used: f = 850 MHz; σ = 0.91 mho/m; ε_r = 41.65; ρ = 1000 kg/m^3

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3798; ConvF(9.03, 9.03, 9.03); Calibrated: 7/25/2012
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2012
- Phantom: Twin SAM Phantom; Type: QD 000 P40 CD; Serial: 1609
- Measurement SW: DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

System Performance Check at Frequencies below 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Area Scan (7x12x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 3.362mW/g

System Performance Check at Frequencies below 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Zoom Scan (7x7x7) /Cube 0:

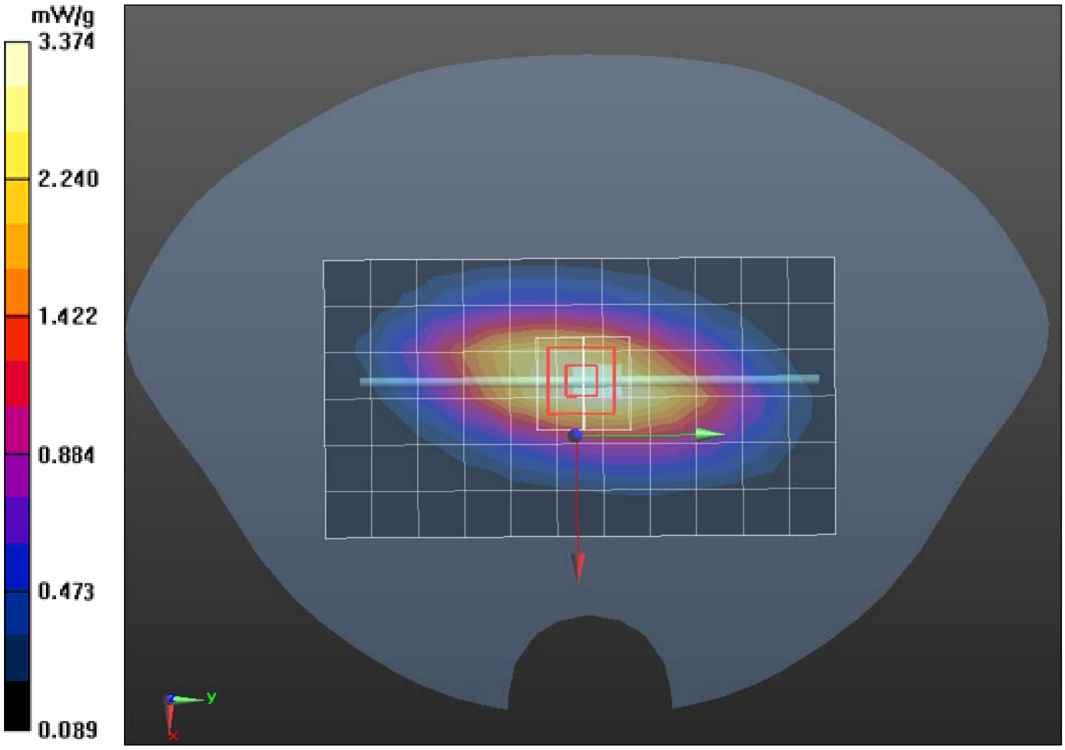
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.952 V/m; Power Drift = 0.00052 dB

Peak SAR (extrapolated) = 3.625W/kg

SAR(1 g) = 2.31mW/g; SAR(10 g) = 1.54 mW/g

Maximum value of SAR (measured) =3.374 mW/g



Test Laboratory: Compliance Certification Services Inc.

System Performance Body Check-D850_2013.03.24

DUT: Dipole 850 MHz D835V2; Type: D835V2; SN:4d114

Communication System: CW; Frequency: 850 MHz

Medium parameters used: f = 850 MHz; σ = 0.98 mho/m; ε_r = 55.39; ρ = 1000 kg/m^3

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3798; ConvF(9.12, 9.12, 9.12); Calibrated: 7/25/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2012
- Phantom: Twin SAM Phantom; Type: QD 000 P40 CD; Serial: 1609

  Measurement SW: DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

System Performance Check at Frequencies below 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Area Scan (7x12x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 3.127mW/g

System Performance Check at Frequencies below 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0:

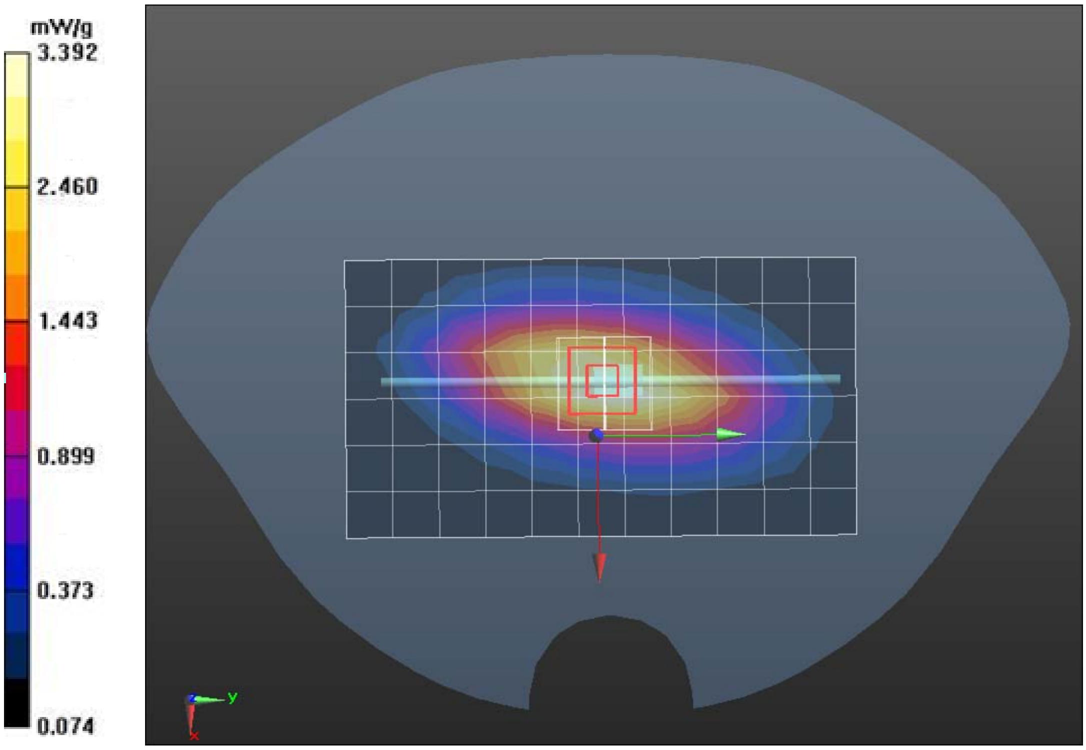
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.83 V/m; Power Drift = 0.0021 dB

Peak SAR (extrapolated) = 3.624 W/kg

SAR(1 g) = 2.52 mW/g; SAR(10 g) = 1.61 mW/g

Maximum value of SAR (measured) = 3.392 mW/g



Test Laboratory: Compliance Certification Services Inc.

System Performance Head Check-D1900_2013.03.26

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:5d136

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz; σ = 1.41 mho/m; ε_r = 40.32; ρ = 1000 kg/m^3

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3798; ConvF(7.64, 7.64, 7.64); Calibrated: 7/25/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2012
- Phantom: SAM1; Type: SAM; Serial: 1609
- Measurement SW: DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=3.0mm (EX-Probe) 2/Area Scan (7x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 11.897 mW/g

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=3.0mm (EX-Probe) 2/Zoom Scan (7x7x7) /Cube 0:

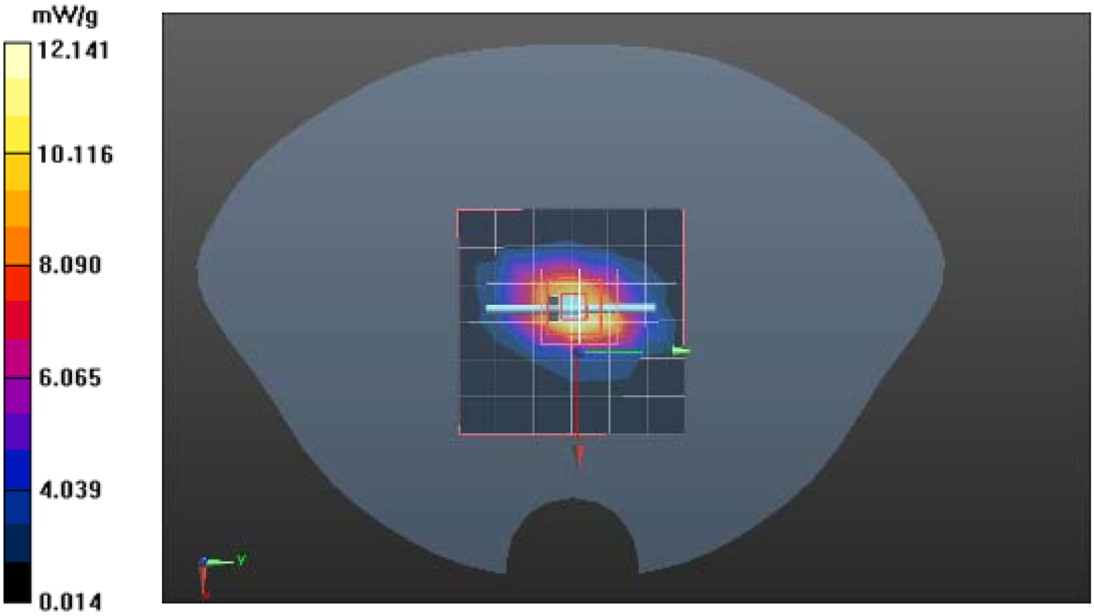
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.57 V/m; Power Drift = 0.0032 dB

Peak SAR (extrapolated) = 16.572 W/kg

SAR(1 g) = 10.02 mW/g; SAR(10 g) = 5.28 mW/g

Maximum value of SAR (measured) = 12.141 mW/g



Test Laboratory: Compliance Certification Services Inc.

System Performance Body Check-D1900_2013.03.26

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:5d136

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz; σ = 1.51 mho/m; ε_r = 52.81; ρ = 1000 kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3798; ConvF(7.29, 7.29, 7.29); Calibrated: 7/25/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2012
- Phantom: SAM1; Type: SAM; Serial: 1609
- Measurement SW: DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=3.0mm (EX-Probe) 2/Area Scan (7x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 12.533mW/g

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=xx mW, dist=3.0mm (EX-Probe) 2/Zoom Scan (7x7x7) /Cube 0:

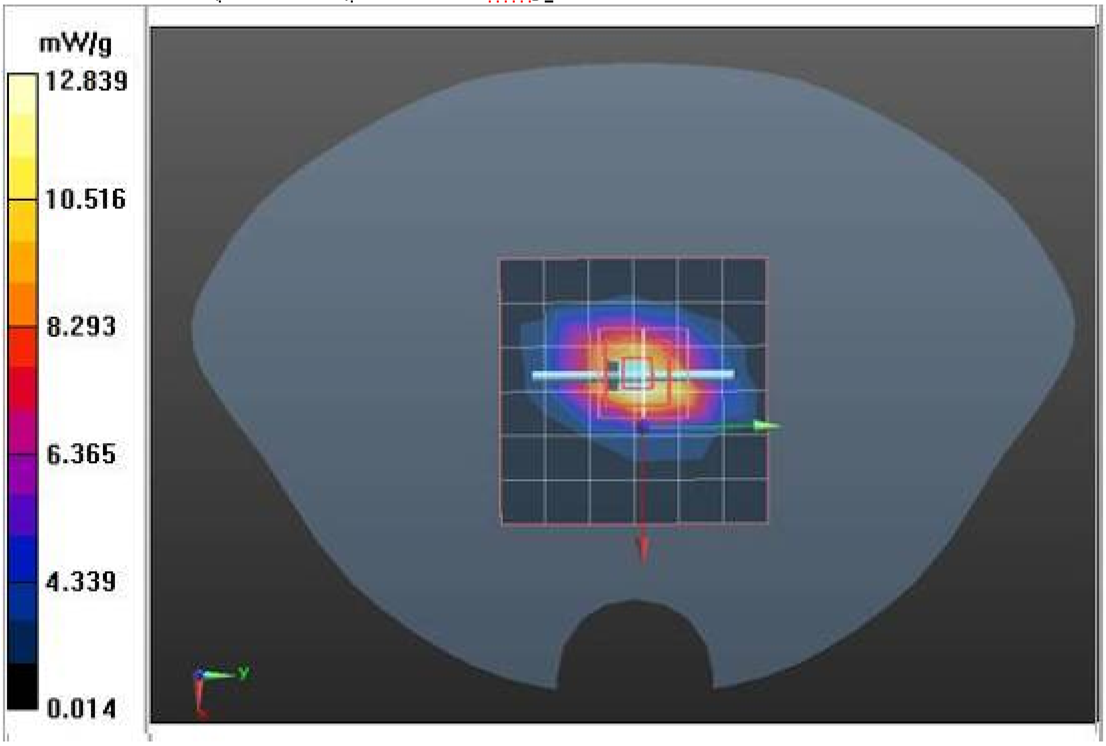
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.5V/m; Power Drift = 0.0001 dB

Peak SAR (extrapolated) = 16.529 W/kg

SAR(1 g) = 9.91 mW/g; SAR(10 g) = 5.12 mW/g

Maximum value of SAR (measured) = 12.839mW/g



Test Laboratory: Compliance Certification Services Inc.

SystemPerformanceHeadCheck-D2450-2013.03.23

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; SN:817

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.83 mho/m; ε_r = 41.05; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5 Configuration:

- Probe: EX3DV4 - SN3798; ConvF(6.87, 6.87, 6.87); Calibrated: 7/25/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2012
- Phantom: Twin SAM Phantom; Type: QD 000 P40 CD; Serial: 1609
- Measurement SW: DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Area Scan(7x7x1)):

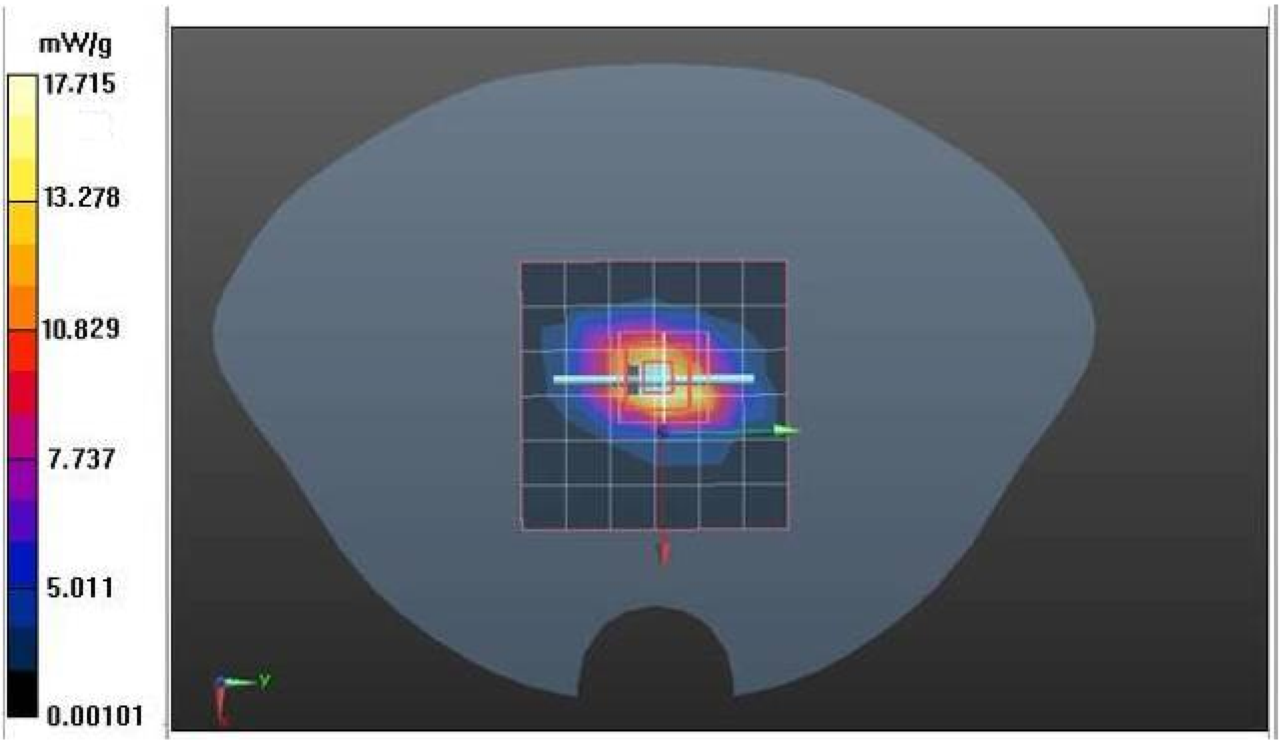
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 17.715mW/g

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Zoom Scan (7x7x7) /Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.55 V/m; Power Drift = 0.007 dB
Peak SAR (extrapolated) = 26.475 W/kg

SAR(1 g) = 13.52 mW/g; SAR(10 g) = 6.18 mW/g

Maximum value of SAR (measured) = 16.954 mW/g



Test Laboratory: Compliance Certification Services Inc.

SystemPerformanceBodyCheck-D2450-2013.03.23

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; SN:817

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.98 mho/m; ε_r = 53.25; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5 Configuration:

- Probe: EX3DV4 - SN3798; ConvF(6.92, 6.92, 6.92); Calibrated: 7/25/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1245; Calibrated: 7/20/2012
- Phantom: SAM1; Type: SAM; Serial: 1609
- Measurement SW: DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=3.0mm (EX-Probe) 2/Area Scan (7x7x1):

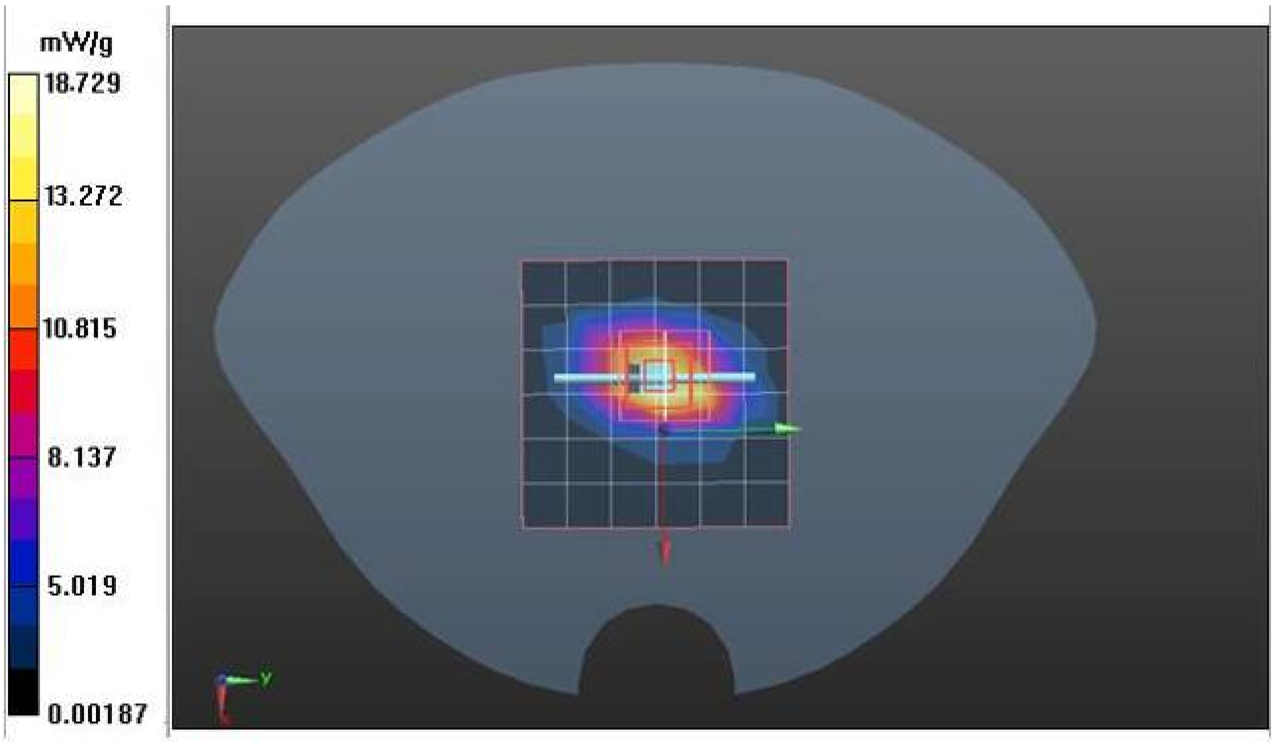
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 18.729mW/g

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=3.0mm (EX-Probe) 2/Zoom Scan (7x7x7) /Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.55 V/m; Power Drift = 0.003 dB
Peak SAR (extrapolated) = 27.671 W/kg

SAR(1 g) = 13.22 mW/g; SAR(10 g) = 6.11 mW/g

Maximum value of SAR (measured) = 17.409 mW/g



APPENDIX B: DASY CALIBRATION CERTIFICATE

The DASY Calibration Certificates are showing as followings .

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

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

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

Accreditation No.: **SCS 108**

Client **CCS-CN (Auden)**

Certificate No: **D835V2-4d114_Jul12**

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d114

Calibration procedure(s): QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 25, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 25, 2012

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

Certificate No: D835V2-4d114_Jul12 Page 1 of 8

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

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

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D835V2-4d114_Jul12 Page 2 of 8

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.5 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**9.35 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**6.14 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.3 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**9.61 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**6.37 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.2 Ω - 2.5 jΩ
Return Loss	- 29.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω - 4.3 jΩ
Return Loss	- 26.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.397 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 25.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

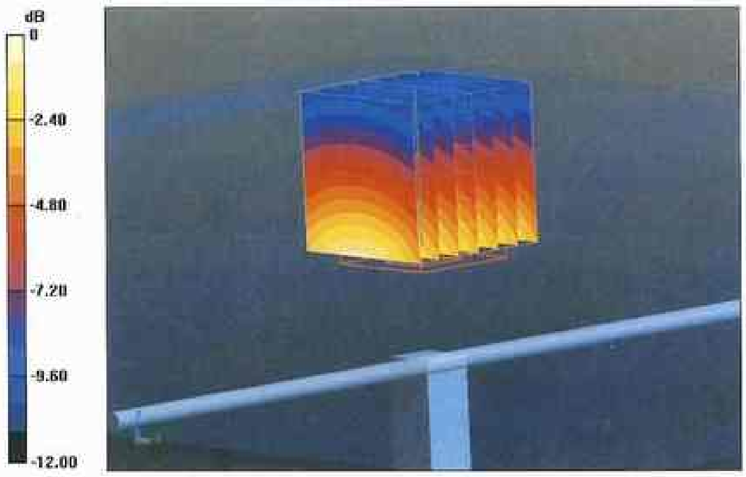
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d114

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.89 mho/m; ε_r = 40.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

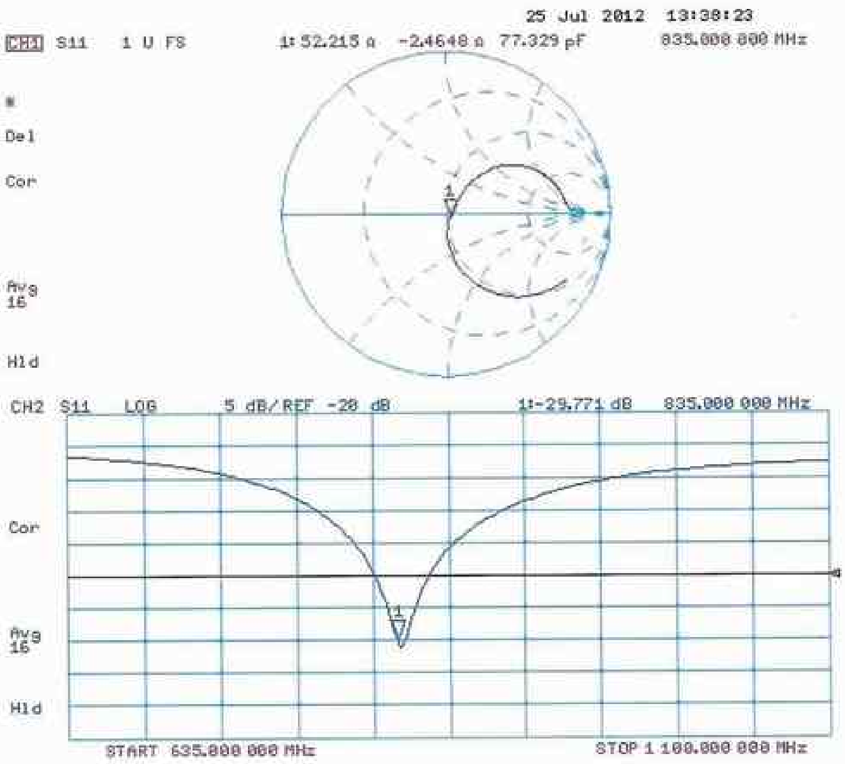
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.017 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.454 mW/g
SAR(1 g) = 2.33 mW/g; SAR(10 g) = 1.53 mW/g
Maximum value of SAR (measured) = 2.71 mW/g



0 dB = 2.71 mW/g = 8.66 dB mW/g

Certificate No: D835V2-4d114_Jul12 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d114_Jul12 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 25.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

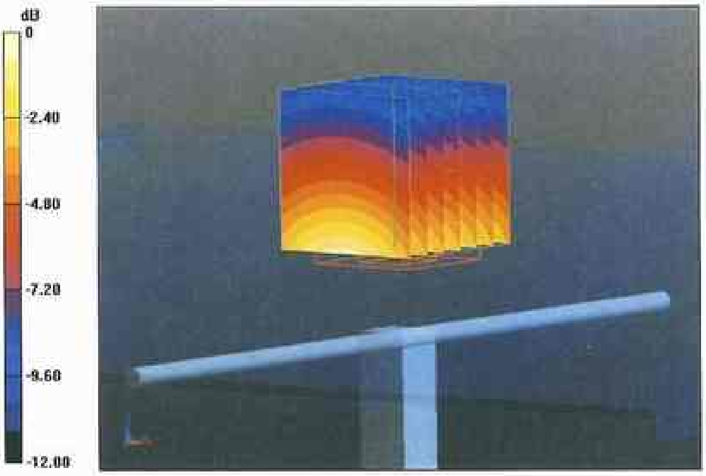
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d114

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma = 0.99$ mho/m; $\varepsilon_r = 53.3$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

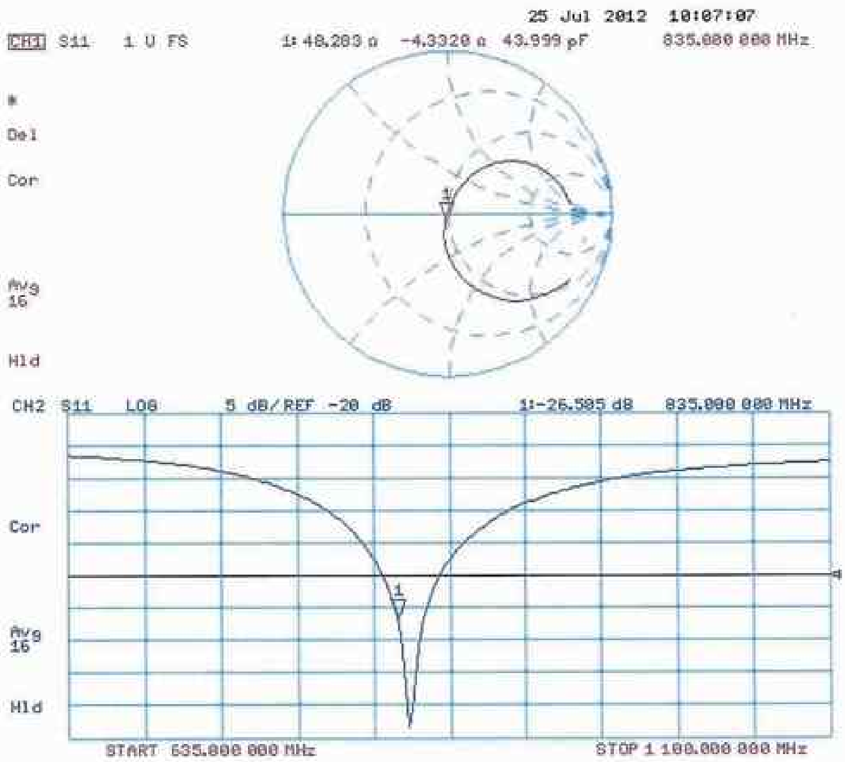
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.673 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.598 mW/g
SAR(1 g) = 2.46 mW/g; SAR(10 g) = 1.62 mW/g
Maximum value of SAR (measured) = 2.86 mW/g



0 dB = 2.86 mW/g = 9.13 dB mW/g

Certificate No: D835V2-4d114_Jul12 Page 7 of 8

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **CCS-CN (Auden)**

Certificate No: **D1900V2-5d136_Jul12**

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d136

Calibration procedure(s): QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 20, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	D. Iliev
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 20, 2012

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Certificate No: D1900V2-5d136_Jul12 Page 1 of 8

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.76 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**39.4 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.14 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.7 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.6 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**40.3 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.36 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.4 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 Ω + 6.5 jΩ
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.0 Ω + 6.8 jΩ
Return Loss	- 22.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	April 14, 2010

DASY5 Validation Report for Head TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

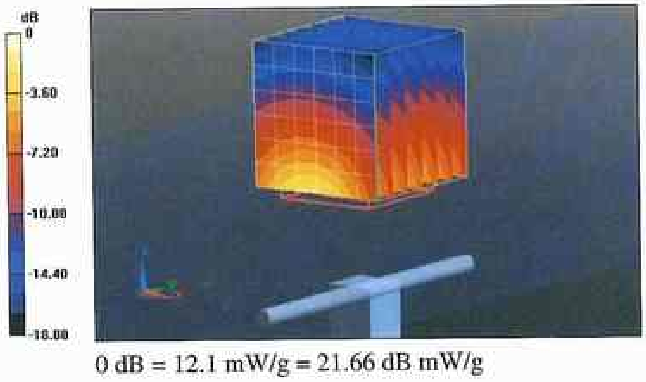
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d136

Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 mho/m; ε_r = 39.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

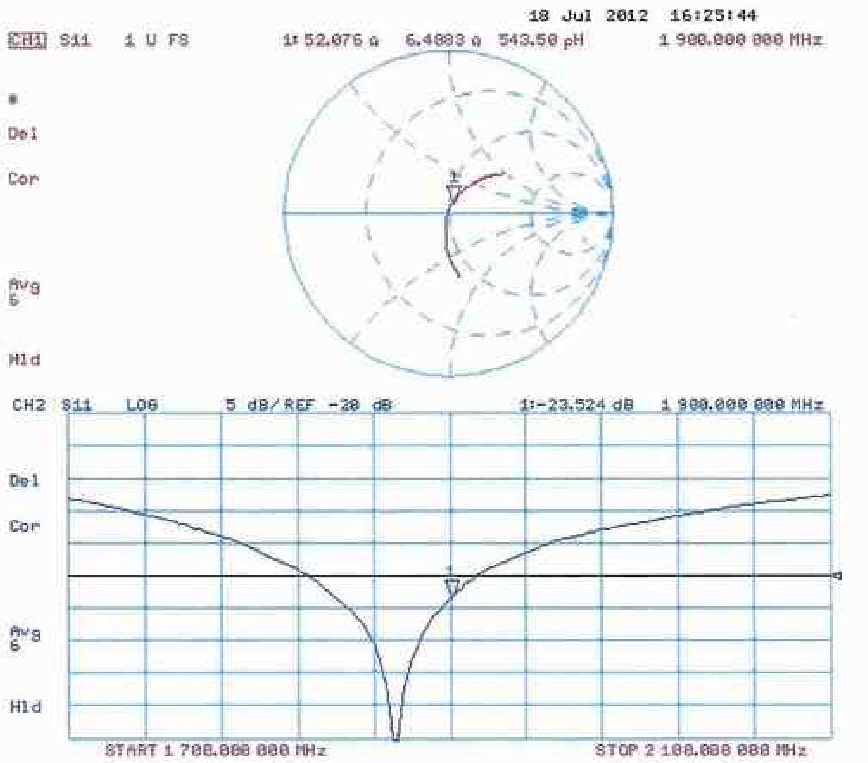
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.700 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 17.403 mW/g
SAR(1 g) = 9.76 mW/g; SAR(10 g) = 5.14 mW/g
Maximum value of SAR (measured) = 12.1 mW/g



0 dB = 12.1 mW/g = 21.66 dB mW/g

Certificate No: D1900V2-5d136_Jul12 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d136_Jul12 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

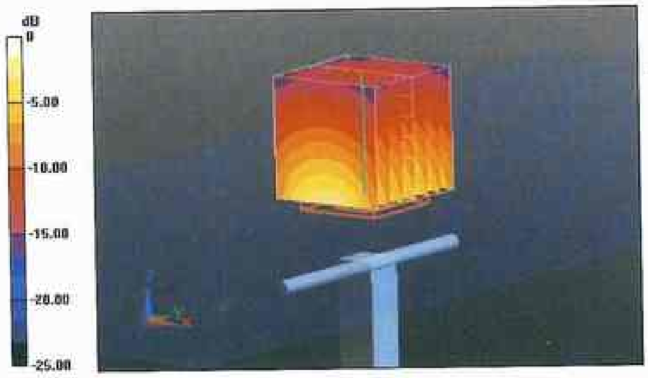
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d136

Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.52 mho/m; ε_r = 52.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

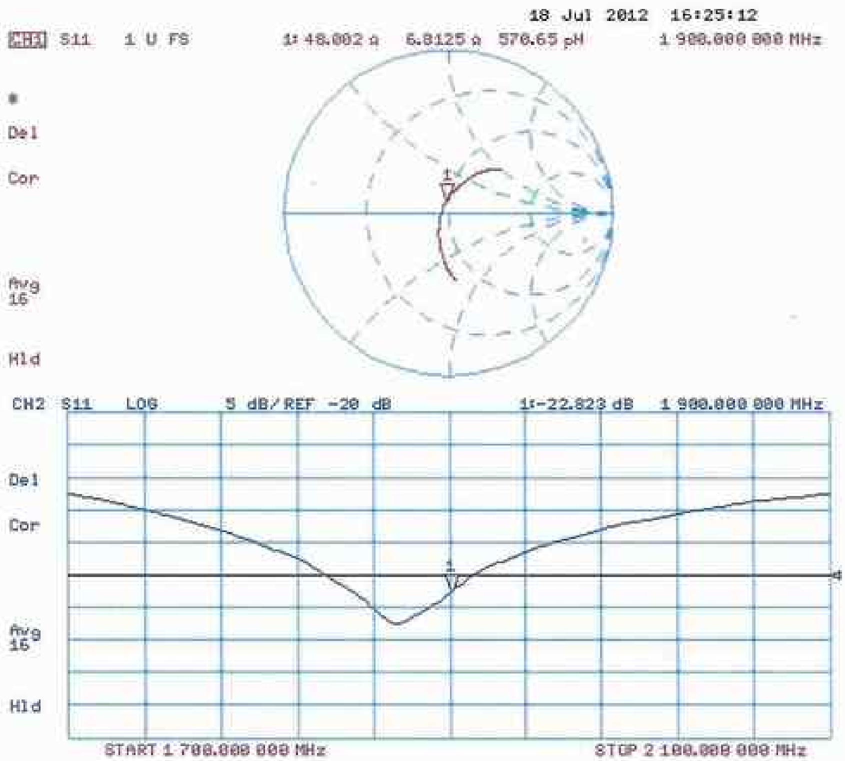
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.632 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 17.606 mW/g
SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.36 mW/g
Maximum value of SAR (measured) = 12.8 mW/g



0 dB = 12.8 mW/g = 22.14 dB mW/g

Certificate No: D1900V2-5d136_Jul12 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d136_Jul12 Page 8 of 8

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Accreditation No.: SCS 108

Client **CCS-CN (Auden)**

Certificate No: **D2450V2-817_Jul12**

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 817

Calibration procedure(s): QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 24, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: July 24, 2012

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Certificate No: D2450V2-817_Jul12 Page 1 of 8

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**53.2 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.29 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**25.0 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.4 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**51.4 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.08 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.3 Ω + 2.7 jΩ
Return Loss	- 27.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.4 Ω + 4.3 jΩ
Return Loss	- 27.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 23, 2007

DASY5 Validation Report for Head TSL

Date: 24.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

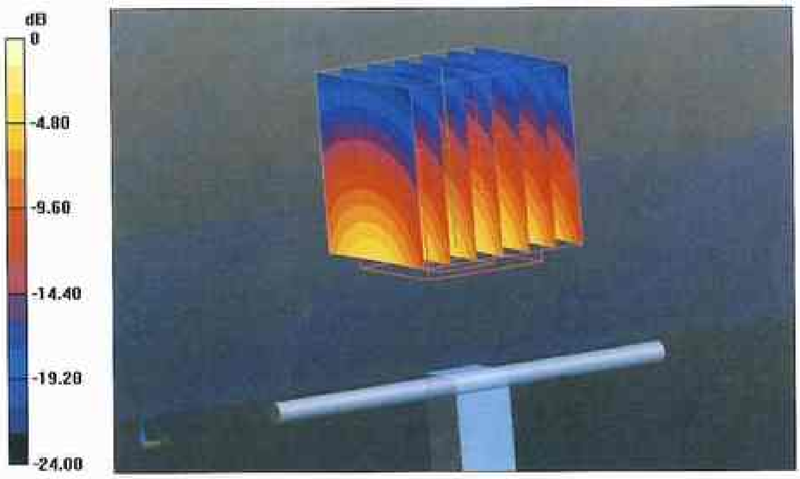
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 817

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 mho/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

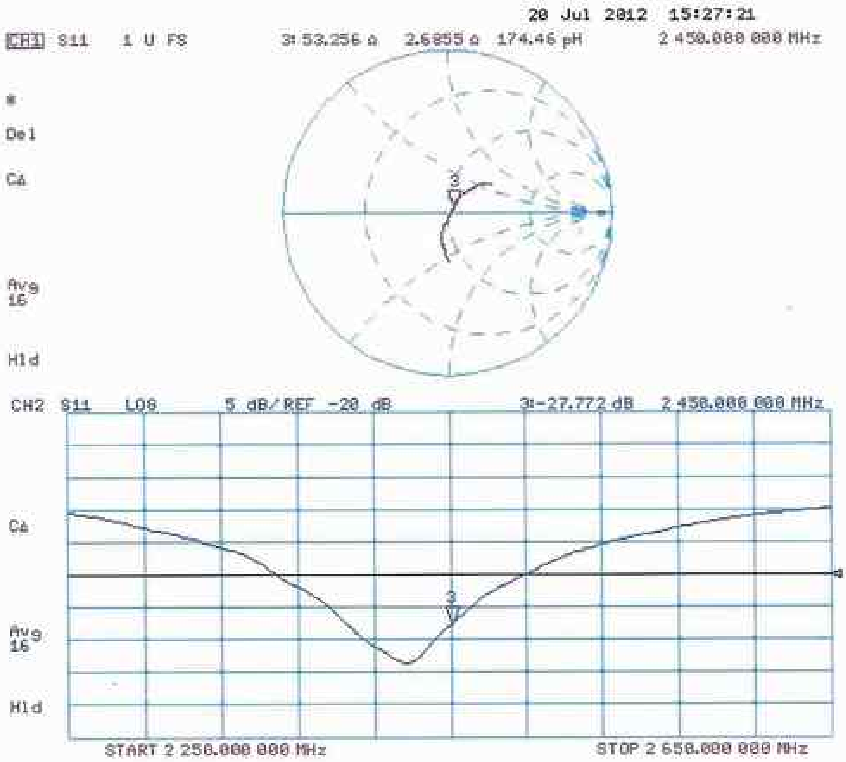
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.5 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 28.137 mW/g
SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.29 mW/g
Maximum value of SAR (measured) = 17.4 mW/g



0 dB = 17.4 mW/g = 24.81 dB mW/g

Certificate No: D2450V2-817_Jul12 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-817_Jul12 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 23.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

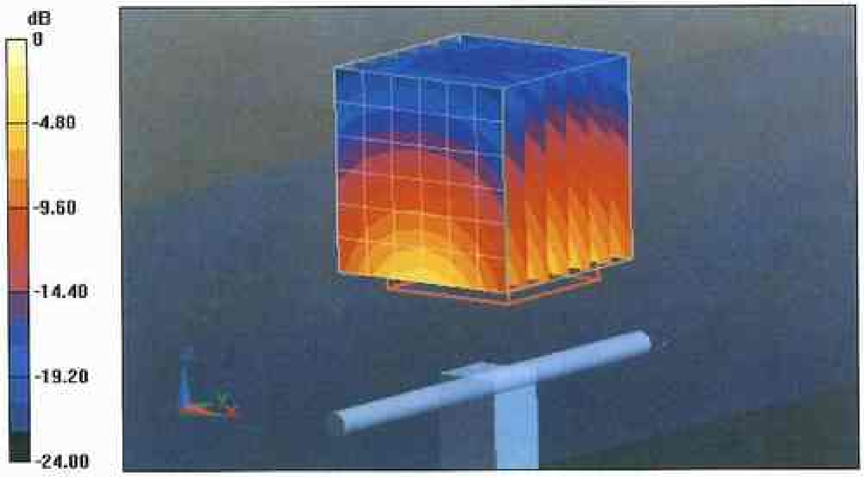
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 817

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.01 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

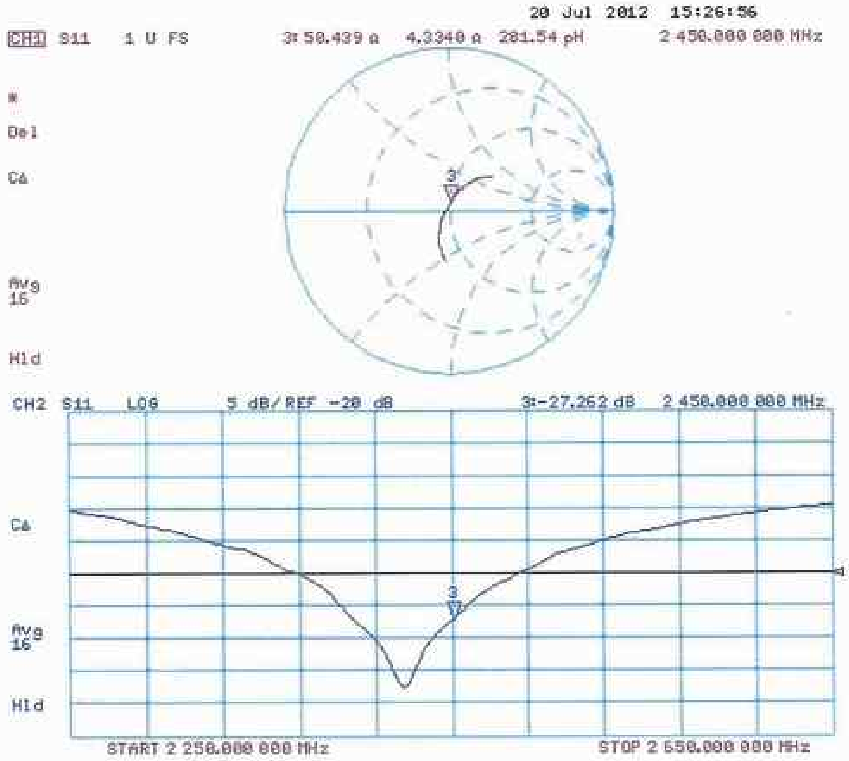
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.751 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 26.861 mW/g
SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.08 mW/g
Maximum value of SAR (measured) = 17.1 mW/g



0 dB = 17.1 mW/g = 24.66 dB mW/g

Certificate No: D2450V2-817_Jul12 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-817_Jul12 Page 8 of 8

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Accreditation No.: SCS 108

Client **CCS-CN (Auden)**

Certificate No: **EX3-3798_Jul12**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3798
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	July 25, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: July 25, 2012

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

Certificate No: EX3-3798_Jul12 Page 1 of 11

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Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3798

Manufactured: April 5, 2011
Calibrated: July 25, 2012

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3798

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	0.54	0.51	0.59	± 10.1 %
DCP (mV)[B]	97.9	98.4	99.0	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	126.1	±4.1 %
			Y	0.00	0.00	1.00	126.5	
			Z	0.00	0.00	1.00	140.3	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3798

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	41.5	0.90	9.03	9.03	9.03	0.32	0.97	± 12.0 %
900	41.5	0.97	8.88	8.88	8.88	0.28	1.06	± 12.0 %
1810	40.0	1.40	7.77	7.77	7.77	0.55	0.74	± 12.0 %
1900	40.0	1.40	7.64	7.64	7.64	0.44	0.85	± 12.0 %
2000	40.0	1.40	7.64	7.64	7.64	0.51	0.77	± 12.0 %
2450	39.2	1.80	6.87	6.87	6.87	0.46	0.81	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3798

Calibration Parameter Determined in Body Tissue Simulating Media

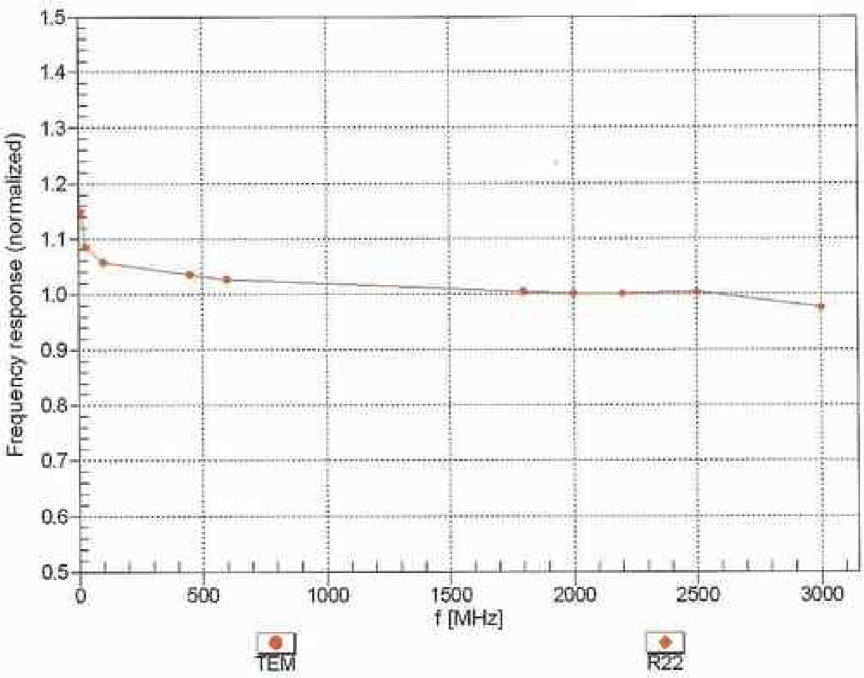
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	9.12	9.12	9.12	0.69	0.66	± 12.0 %
900	55.0	1.05	8.97	8.97	8.97	0.29	1.13	± 12.0 %
1810	53.3	1.52	7.64	7.64	7.64	0.61	0.71	± 12.0 %
1900	53.3	1.52	7.29	7.29	7.29	0.55	0.73	± 12.0 %
2000	53.3	1.52	7.45	7.45	7.45	0.80	0.62	± 12.0 %
2450	52.7	1.95	6.92	6.92	6.92	0.80	0.59	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

EX3DV4– SN:3798 July 25, 2012

Frequency Response of E-Field

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



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

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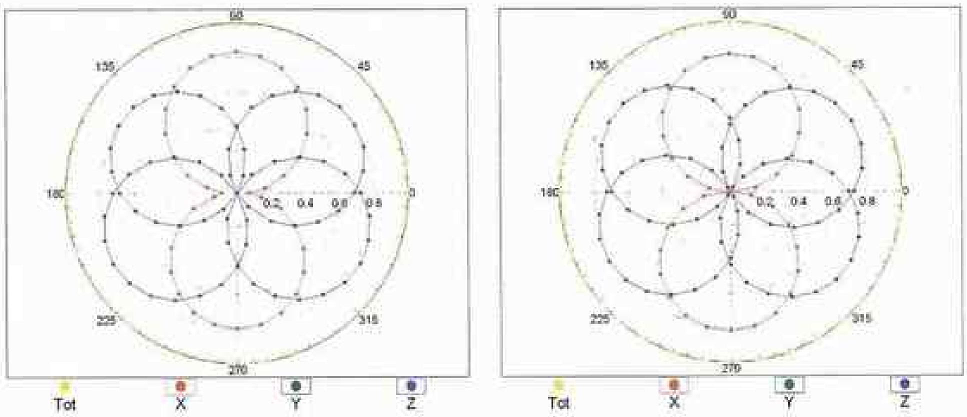
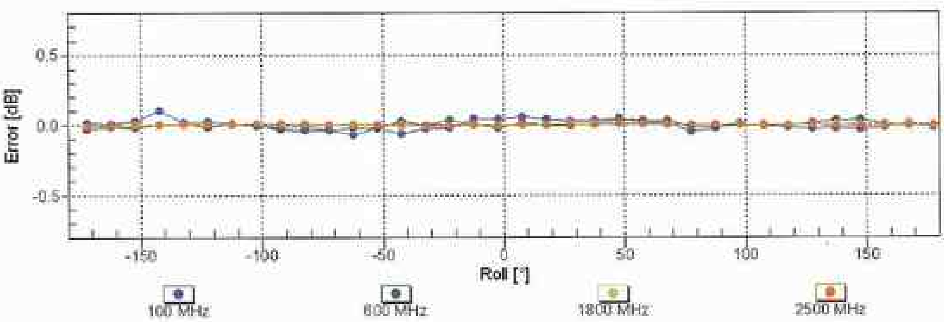
EX3DV4– SN:3798 July 25, 2012

Receiving Pattern (ϕ), ϑ = 0°

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





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

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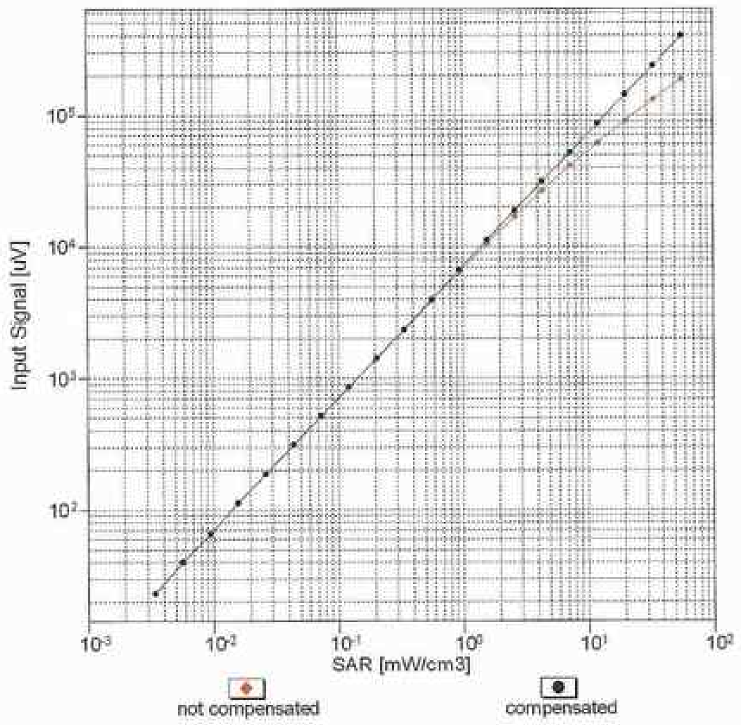
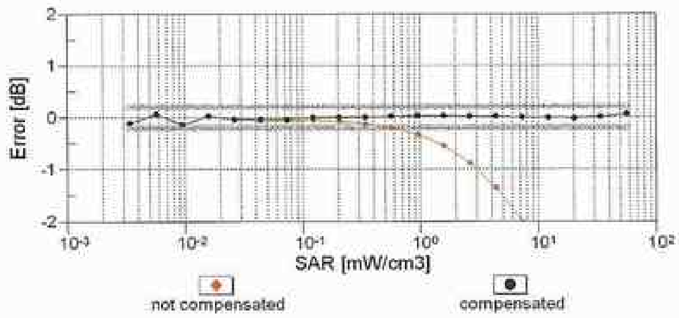
EX3DV4– SN:3798 July 25, 2012

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

(TEM cell , f = 900 MHz)





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

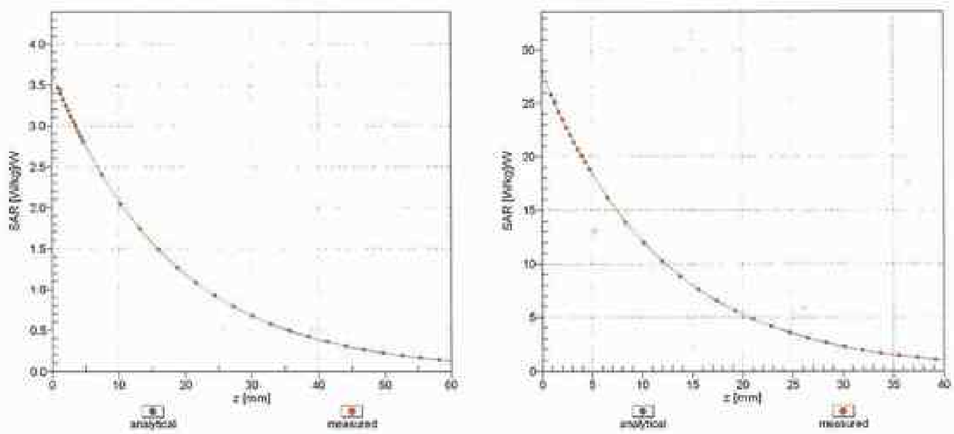
Certificate No: EX3-3798_Jul12 Page 9 of 11

EX3DV4– SN:3798 July 25, 2012

Conversion Factor Assessment

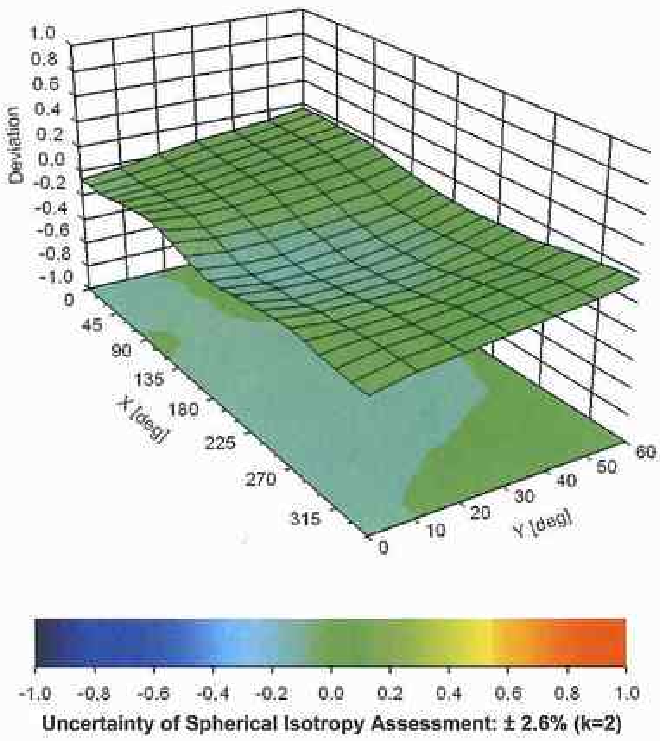
f = 900 MHz,WGLS R9 (H_convF)

f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: EX3-3798_Jul12 Page 10 of 11

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3798

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	137.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

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Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

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Accreditation No.: SCS 108

Client CCS-CN (Auden)

Certificate No: DAE4-1245_Jul12

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BJ - SN: 1245
Calibration procedure(s)	QA CAL-06.v24 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	July 20, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V2.1	SE UWS 053 AA 1001	05-Jan-12 (in house check)	In house check: Jan-13

	Name	Function	Signature
Calibrated by:	R.Mayoraz	Technician	R. Mayoraz
Approved by:	Fin Bomholt	R&D Director	i.V. [signature]

Issued: July 20, 2012

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Certificate No: DAE4-1245_Jul12 Page 1 of 5

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Accreditation No.: **SCS 108**

Glossary

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

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal
High Range: 1LSB = 6.1μV , full range = -100…+300 mV
Low Range: 1LSB = 61nV , full range = -1…….+3mV
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	405.959 ± 0.1% (k=2)	404.685 ± 0.1% (k=2)	405.830 ± 0.1% (k=2)
Low Range	3.99395 ± 0.7% (k=2)	3.99771 ± 0.7% (k=2)	4.01925 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	30.5 ° ± 1 °

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Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200000.30	1.60	0.00
Channel X	+ Input	20004.61	3.49	0.02
Channel X	- Input	-19997.91	2.27	-0.01
Channel Y	+ Input	199998.08	-0.09	-0.00
Channel Y	+ Input	20000.67	-0.38	-0.00
Channel Y	- Input	-20000.36	0.04	-0.00
Channel Z	+ Input	200003.86	5.32	0.00
Channel Z	+ Input	20001.36	0.34	0.00
Channel Z	- Input	-20002.18	-1.86	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.90	0.56	0.03
Channel X	+ Input	202.54	0.73	0.36
Channel X	- Input	-197.89	0.20	-0.10
Channel Y	+ Input	2001.79	0.59	0.03
Channel Y	+ Input	201.58	-0.12	-0.06
Channel Y	- Input	-198.84	-0.74	0.37
Channel Z	+ Input	2000.85	-0.28	-0.01
Channel Z	+ Input	200.56	-1.05	-0.52
Channel Z	- Input	-199.22	-0.93	0.47

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-7.69	-8.65
	- 200	10.63	8.87
Channel Y	200	-7.55	-7.91
	- 200	6.43	6.31
Channel Z	200	-6.53	-6.42
	- 200	4.11	3.97

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	4.67	-3.38
Channel Y	200	9.20	-	3.62
Channel Z	200	10.31	7.37	-

4. AD-Converter Values with inputs shorted
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15867	16300
Channel Y	16438	17857
Channel Z	15918	15927

5. Input Offset Measurement
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.76	-0.48	2.20	0.56
Channel Y	-0.11	-1.42	0.98	0.47
Channel Z	-0.80	-1.88	0.45	0.49

6. Input Offset Current
Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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APPENDIX C: PLOTS OF SAR TEST RESULT

The plots are showing in the file named Appendix C Plots of SAR Test Result

END REPORT