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: plum
Model No.: Wicked
Series Model: Z100, Z101
Test Report Number:
KS120710A21-SF

Issued for

CLC Hong Kong Limited

2209, Concordia Plaza, North Tower, No.1 Science Museum Road, Tsim Sha Tsui East, Kowloon, Hong Kong

Issued by

Compliance Certification Services Inc.

Kun shan Laboratory

No.10 Weiye Rd., Innovation park, Eco&Tec,
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TESTING CERT #2541.01

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1. CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

Product Name:	Mobile Phone
Trade Name:	plum
Model Name.:	Wicked
Series Model:	Z100,Z101
Applicant Discrepancy:	Initial
Devices supporting GPRS :	Class B
Description Test Modes(worst case):	SIM CARD
Device Category:	PORTABLE DEVICES
Exposure Category:	GENERAL POPULATION/UNCONTROLLED EXPOSURE
Date of Test:	July 24, 2012 & July 25, 2012 & July 26, 2012
Applicant:	**CLC Hong Kong Limited** 2209, Concordia Plaza, North Tower, No.1 Science Museum Road, Tsim Sha Tsui East, Kowloon, Hong Kong
Manufacturer:	**CLC Technology Co. Ltd** Room 303, Block 31, Longtang Industrial Zone, Longtang Community Minzhi Street, Bao'an District , 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	
Model Name:	Wicked	
Series Model:	Z100, Z101	
Model Discrepancy:	The main board is the same, but the series model Z101 only support one SIM card.	
Brand Name:	plum	
FCC ID:	Y7WPLUMWICKED	
GPRS Level:	Multi-Class 12	
Multi-slot Class:	4 Uplink +1 Downlink	
Total timeslots per frame for GPRS/EDGE:	only 5 timeslots are used for GPRS/EDGE	
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 GPRS/ EDGE 850: 824.2 ~ 848.8 MHz GPRS/ EDGE 1900: 1850.2 ~ 1909.8 MHz WCDMA Band II /HSDPA:1852.4~1907.6MHz WCDMA Band V /HSDPA:826.4~846.60MHz	802.11b / g: 2412 ~ 2462 MHz n HT20: 2412 ~ 2462 MHz Bluetooth: 2402 ~ 2480 MHz
Transmit Power(Average):	GSM 850:32.81 dBm GPRS 850:31.23 dBm EDGE 850:32.22 dBm GSM 1900:30.01 dBm GPRS 1900: 28.78 dBm EDGE 1900: 29.88 dBm WCDMA BandII:22.12 dBm WCDMA BandV:23.37 dBm	WI-FI IEEE 802.11b:16.98 dBm WI-FI IEEE 802.11g:15.01 dBm WI-FI IEEE 802.11n20MHz: 14.18 dBm WI-FI IEEE 802.11n40MHz: 13.61 dBm Bluetooth:0.55 dBm BandII HSDPA: 21.82 dBm BandV HSDPA: 23.12 dBm
Max. SAR:	GSM 850 Head: 0.293 W/kg Body: 0.258 W/kg GSM 1900 Head: 0.195 W/kg Body: 0.221 W/kg	WI-FI IEEE 802.11b:0.441 W/kg GPRS 850: 0.217 W/kg GPRS 1900: 0.233 W/kg EDGE 850: 0. 168 W/kg EDGE 1900: 0. 228 W/kg WCDMA BandII:0. 579 W/kg WCDMA BandV:0.691 W/kg
Modulation Technique:	GSM / GPRS : GMSK WCDMA: QPSK EGPRS : GMSK,8PSK WI-FI 802.11b / 802.11g: WI-FI IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) WI-FI 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 + /4DQPSK+8DPSK	

Accessories:	Power supply and ADP (rating) : Brand Name: plum Model No.: PMC03 Input: AC100-240V, 0.15 A, 50/60 Hz Output: DC5V,0.5 A	Battery (rating) : Brand Name: plum Model No.: PMB24 Capacitance: 1000mAh Rated Voltage: 3.7V Charge Limit: 4.2V
Antenna Specification:	GSM: PIFA antenna WCDMA: PIFA antenna	WIFI: PIFA antenna Bluetooth : PIFA antenna
Operating Mode:	Maximum continuous output	

This device supports voice/data wireless communication technology in GSM/GPRS/EDGE /WCDMA Band II /Band V,WLAN and Bluetooth. The data mode of GPRS/EDGE and WLAN didn't support VOIP capacity
The details are listed as below:

Mode	Technology Support	Modulation	Frequency Band
Voice	GSM	GMSK	850MHz/1900 MHz
Voice	WCDMA	QPSK	Band V
Data	GPRS/EDGE	GMSK	850MHz/1900 MHz
Data	HSDPA/HSUPA	QPSK	Band V
Data	WI-FI 802.11b / 802.11g/n-20MHz	OFDM	2.4GHz
Data	Bluetooth	GFSK	2.4GHz

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:

☒ 47 CFR Part 2 (2.1093)
☒ IEEE C95.1-1999
☒ KDB 248227 D01 SAR measurement procedures for 802.11 b/g transmitters
☒ KDB 648474 D01 SAR evaluation considerations for handsets with multiple transmitters and antennas
☐KDB 447498 D01 Mobile Portable RF Exposure
☒ KDB 941225 D04 Evaluating SAR for GSM/(E)GPRS Dual Transfer Mode OET
☒Bulletin 65 Supplement C (Edition 01-01)
☒KDB941225 D01 v02 SAR measurement procedures for 3G Devices -CDMA 200/EV-DO-WCDMA/HSDPA/HSPA-

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.

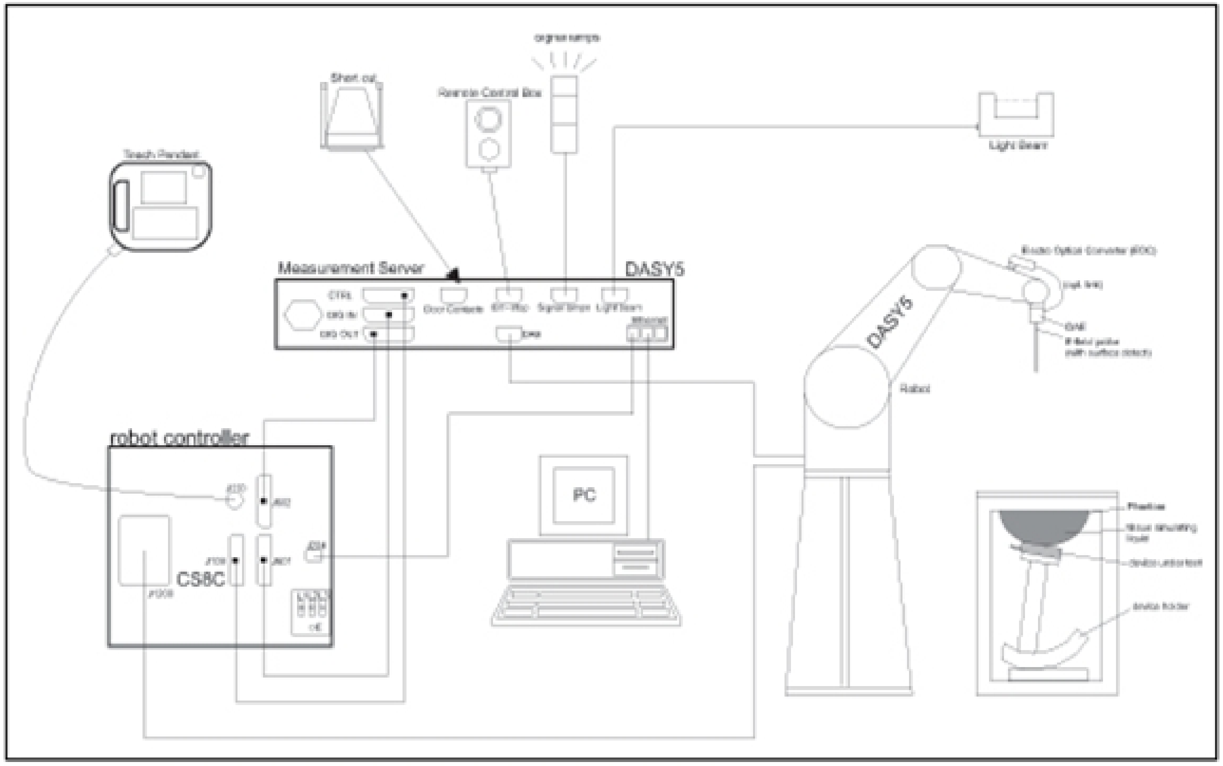
6. DOSIMETRIC ASSESSMENT SETUP

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)

<table>
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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%.

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Interior of probe

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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	
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).	
System Validation Kits for SAM Twin 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: 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:

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

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:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

H-field probes:

$$H_i = \sqrt{V_i} \times \frac{a_{i10} + a_{i11} f + a_{i12} f^2}{f}$$

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.

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

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.

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

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<<λ), 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)

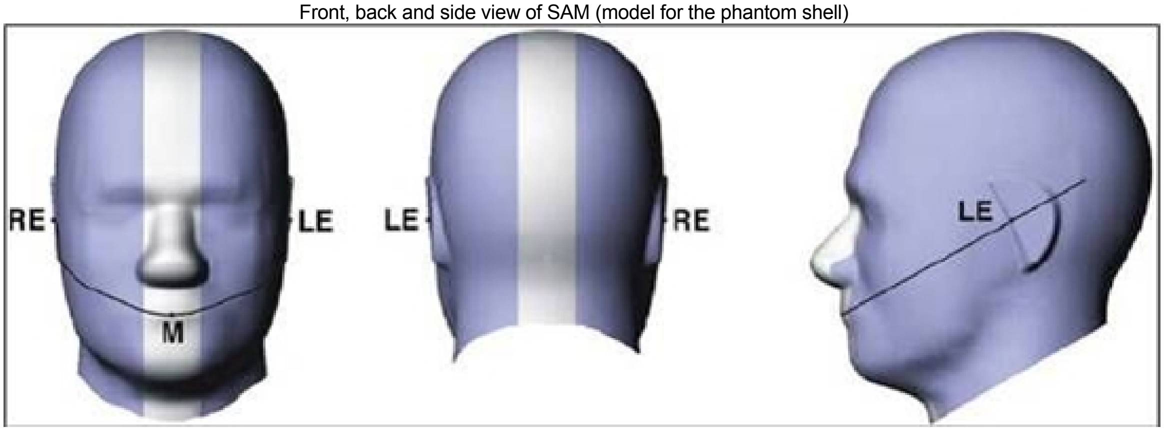
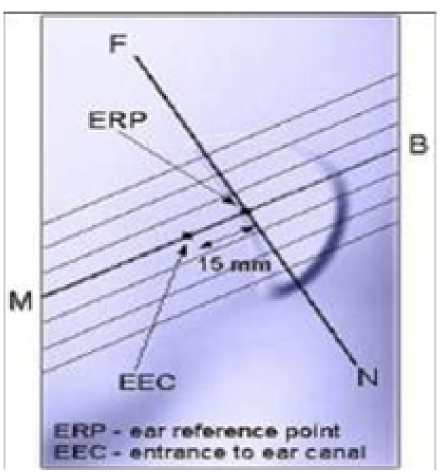


Figure 7-1b
Close up side view of phantom showing the ear region

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



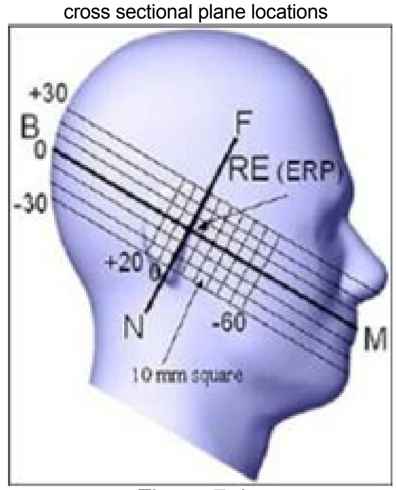


Figure 7-1b
Close up side view of phantom showing the ear region

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.

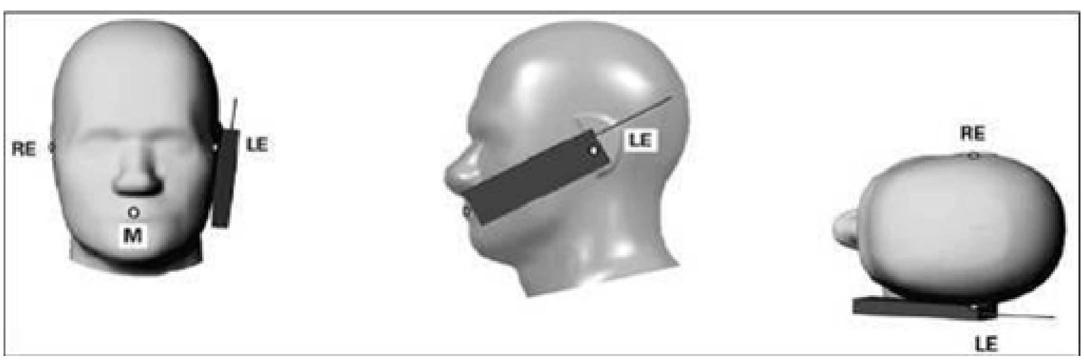


Figure 7.2c

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.

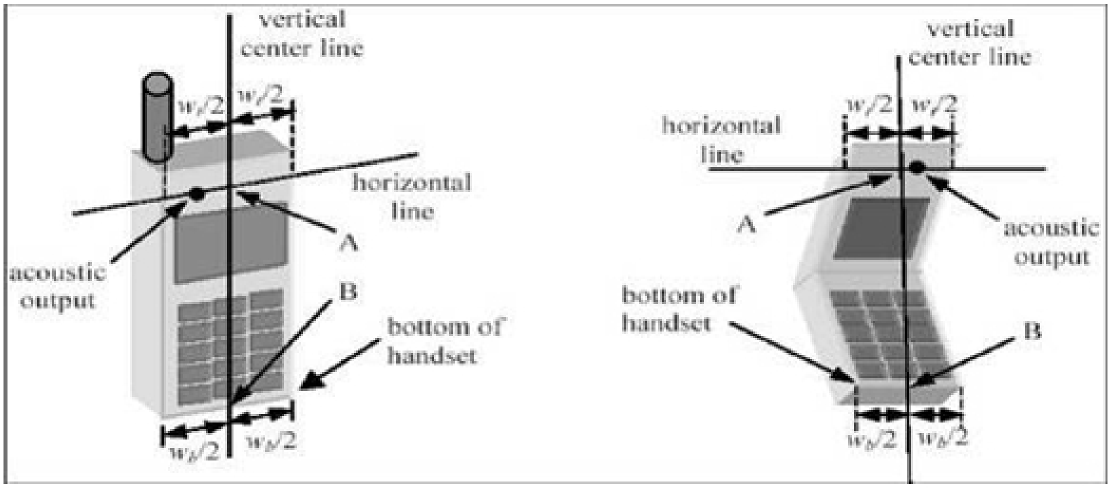


Figure 7.2a Figure 7.2b

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).

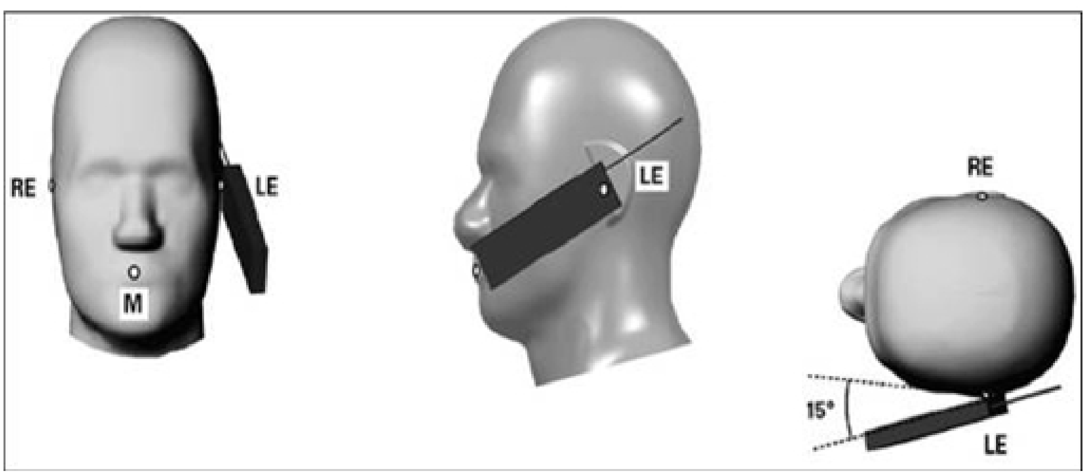


Figure 7-3
Phone "tilted" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for handset positioning, are indicated.

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
1900	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
1900	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
1900	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
1900	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	41.57	0.17	± 5	2012-7-24
		21	Conductivity	0.90	0.91	1.11	± 5	2012-7-24
Body850	850 MHz	21	Permitivity	55.20	55.84	1.16	± 5	2012-7-24
		21	Conductivity	0.97	0.98	1.03	± 5	2012-7-24
Head1900	1900 MHz	21	Permitivity	40.00	40.2	0.50	± 5	2012-7-25
		21	Conductivity	1.40	1.41	0.71	± 5	2012-7-25
Body1900	1900 MHz	21	Permitivity	53.30	54.31	1.89	± 5	2012-7-25
		21	Conductivity	1.52	1.53	0.66	± 5	2012-7-25
Head2450	2450 MHz	20	Permitivity	39.20	41.23	5.18	± 5	2012-7-26
		20	Conductivity	1.80	1.79	-0.56	± 5	2012-7-26
Body2450	2450 MHz	21	Permitivity	52.70	53.23	1.01	± 5	2012-7-26
		21	Conductivity	1.95	1.96	0.51	± 5	2012-7-26

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

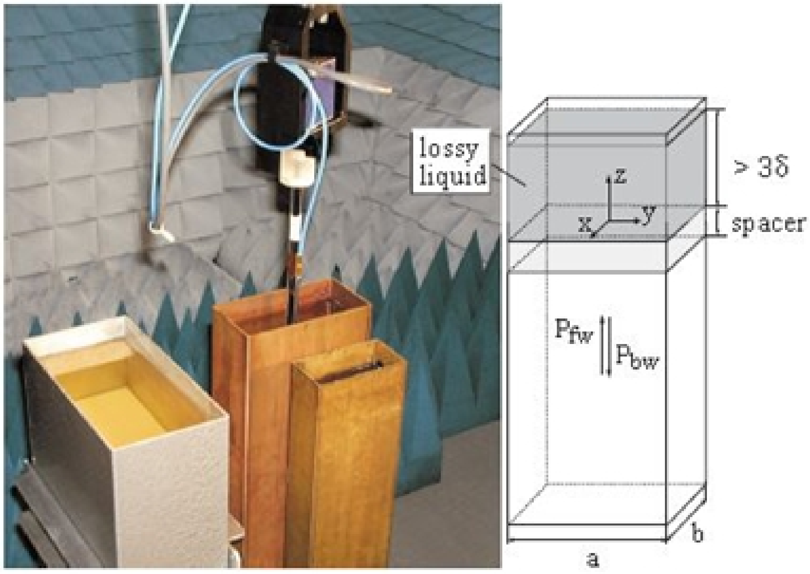


Figure 5.1: Experimental setup for assessment of the conversion factor when using a vertically rectangular waveguide.

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: 3755 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.

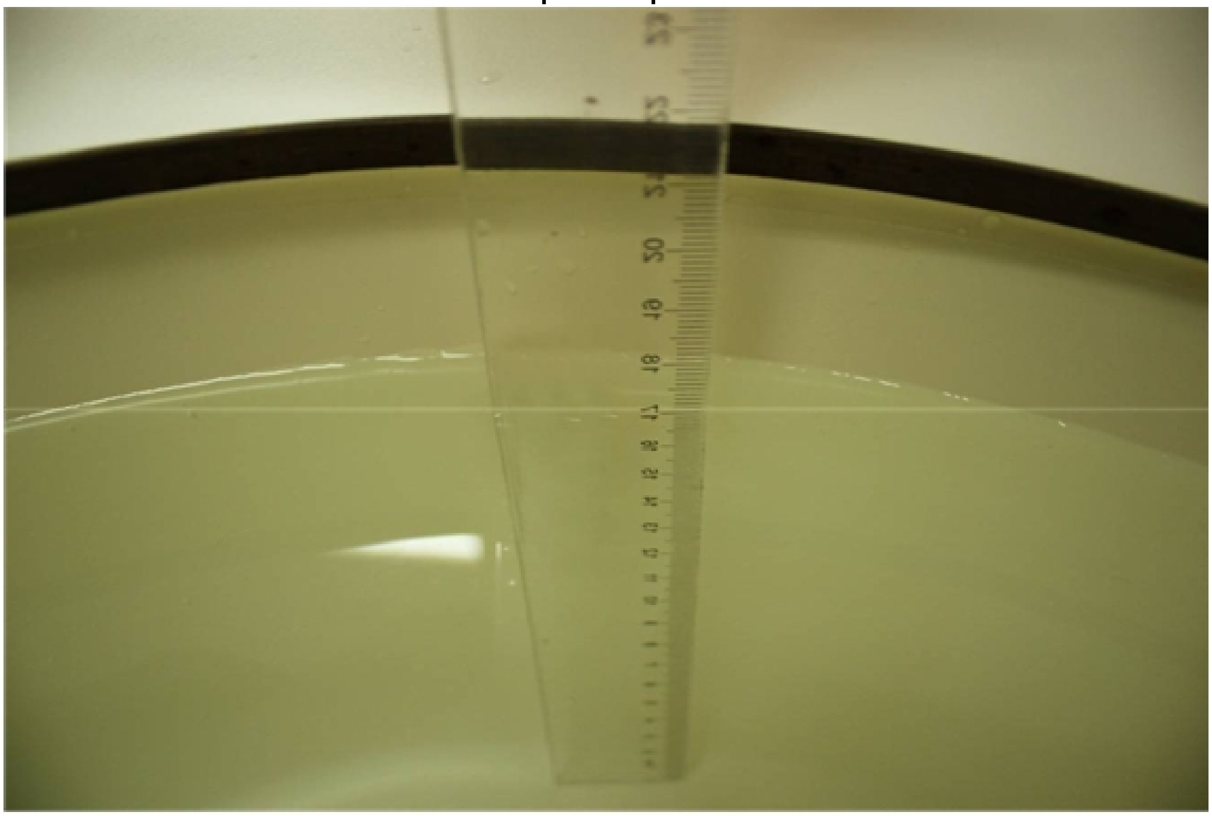
· The coarse grid with a grid spacing of 10mm was aligned with the dipole.

· 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 2.5 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 larger than 15cm shown above

Reference SAR values

The reference SAR values were using measurement results indicated in the dipole calibration document (see table below)

Frequency (MHz)	1g SAR	10g SAR	Local SAR at Surface (Above Feed Point)	Local SAR at Surface (y = 2cm offset from feed point)
850 Head	9.57	6.23	14.1	4.9
850 Body	9.92	6.55		
1900 Head	40.50	21.10	67.6	6.6
1900 Body	39.70	21.10		
2450 Head	54.80	25.30	104.2	7.7
2450 Body	52.90	24.50		

SYSTEM PERFORMANCE CHECK RESULTS

Ambient conduction

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D835V2-SN:4d114 **Date**: July 24, 2012

Head Simulatinf Liquid		Parameters	Target	Measured	Deviation[%]	Limited[%]
Frequency	Temp . [°C]					
850 MHz	20.30	1g SA R	9.57	9.68	1.15	±10
		10g SA R	6.23	6.36	2.09	±10

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D835V2-SN:4d114 **Date**: July 24, 2012

Body Simulatinf Liquid		Parameters	Target	Meas ured	Dev iation [%]	Limited [%]
Frequenc y	Temp . [°C]					
850 MHz	20 .30	1 g SA R	9 .92	10 .08	1 .61	± 1 0
		10 g SA R	6 .55	6 .44	- 1 .68	± 1 0

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D1900V2-SN:5d136 **Date**: July 25, 2012

Head Simulatinf Liquid		Parameters	Target	Meas ured	Dev iation [%]	Limited [%]
Frequenc y	Temp . [°C]					
1900 MHz	20 .30	1 g SA R	40 .50	40 .08	- 1 .04	± 1 0
		10 g SA R	21 .10	21 .36	1 .23	± 1 0

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D1900V2-SN:5d136 **Date**: July 25, 2012

Head Simulatinf Liquid		Parameters	Target	Measured	Deviation[%]	Limited[%]
Frequency	Temp. [°C]					
1900 MHz	20.30	1g SA R	39.70	39.96	0.65	± 10
		10g SA R	21.10	20.68	- 1.99	± 10

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D2450V2-SN:817 **Date**: July 26, 2012

Head Simulatinf Liquid		Parameters	Target	Meas ured	Dev iation [%]	Limited [%]
Frequenc y	Temp . [°C]					
2450 MHz	20 .30	1 g SA R	54 .80	54 .52	- 0 .51	± 1 0
		10 g SA R	25 .30	25 .28	- 0 .08	± 1 0

Temperature: 21 °C Relative humidity: 58%
System Validation Dipole: D2450V2-SN:817 **Date**: July 26, 2012

Body Simulatinf Liquid		Parameters	Target	Meas ured	Deviation[%]	Limited [%]
Frequency	Temp. [°C]					
2450 MHz	20.30	1g SA R	52.90	52 .32	- 1.10	± 1 0
		10g SA R	24.50	24 .60	0.41	± 1 0

11.5 EUT TUNE-UP PROCEDURES AND TEST MODE

The following procedure had been used to prepare the EUT for the SAR test.

To set up the desire channel frequency and the maximum output power. A Radio Communication Tester "CMU200 " was used to program the EUT.

GSM 850 / GPRS850/EDGE850:

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

According to the customer declared tune-up power:

Mode Po	The tune-up maximum wer(customer declared) (dBm)	Range
GSM 850	32.36+/-0.5	31.86~32.86
GPRS 850	30.80+/-0.5	30.30~31.30
EDGE 850	31.82+/-0.5	31.32~32.32
GSM 1900	29.57+/-0.5	29.07~30.07
GPRS 1900	28.43+/-0.5	27.93~28.93
EDGE 1900	29.43+/-0.5	28.93~29.93
WCDMA Band II	21.72+/-0.5	21.22~22.22
WCDMA Band V	22.93+/-0.5	22.43~23.43
IEEE 802.11b	16.49+/-0.5	15.99~16.99
IEEE 802.11g	14.55+/-0.5	14.05~15.05
IEEE 802.1120Mhz	13.78+/-0.5	13.28~14.28
IEEE 802.11 40Mhz	13.15+/-0.5	12.65~13.65

We measured conduct maximum power:

Mode	Measurement conducted Power (dBm)
GSM 850	32.81
GPRS 850	31.23
EDGE 850	32.22
GSM 1900	30.01
GPRS 1900	28.78
EDGE 1900	29.88
WCDMA Band II	22.12

WCDMA Band V	23.37
IEEE 802.11b	16.98
IEEE 802.11g	15.01
IEEE 802.1120Mhz	14.18
IEEE 802.1140Mhz	13.61

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

Maximum conducted power was measured by replacing the antenna with an adapter for conductive measurement.

Conducted output power (Average) For GSM 850/GSM1900:

GSM	Frequency		GSM mode	
	Channel	MHz	before	after
GSM850	128	824.2	32.72	32.63
	190	836.6	**32.81**	32.79
	251	848.8	32.70	32.69
GSM	Frequency		GSM mode	
	Channel	MHz	before	after
GSM1900	512	1850.2	29.88	29.83
	661	1880.0	**30.01**	29.92
	810	1909.8	29.73	29.63

Conducted output power (Average) For GPRS 850/ GPRS 1900:

GPRS	Frequency		GPRS mode	
	Channel	MHz	before	after
GPRS 850	128	824.2	31.05	30.92
	190	836.6	**31.23**	31.12
	251	848.8	31.18	31.11
GPRS	Frequency		GPRS mode	
	Channel	MHz	before	after
GPRS 1900	512	1850.2	28.68	28.67
	661	1880.0	**28.78**	28.74
	810	1909.8	28.65	28.62

Conducted output power (Average) For EDGE 850/ EDGE 1900:

EDGE	Frequency		GPRS mode	
	Channel	MHz	before	after
EDGE 850	128	824.2	31.96	31.90
	190	836.6	**32.22**	31.95
	251	848.8	31.94	31.88

EDGE	Frequency		GPRS mode	
	Channel	**MHz**	before	after
EDGE 1900	512	1850.2	29.69	29.56
	661	1880.0	**29.88**	29.79
	810	1909.8	29.72	29.59

It support GPRS Class 12:

System and Channel	Power values (dbm)	Average factor (db)	Time average (dbm) (before)	Time average (dbm) (after)
GSM850 CH190(1TS)	---	---	---	---
GPRS850 CH190				
1TS	31.21	-9.03	22.18	---
2TS	31.19	-6.02	25.17	---
3TS	31.15	-4.26	26.89	---
4TS	31.08	**-3.01**	**28.07**	**27.79**
GSM1900 Ch 661(1TS)	---	---	---	---
GPRS1900 Ch 661				
1TS	28.81	-9.03	19.78	---
2TS	28.72	-6.02	22.70	---
3TS	28.65	-4.26	24.39	---
4TS	28.46	**-3.01**	**25.45**	**25.21**

NOTE: 1)For GSM ,complete set of tests are performed ,For GPRS ,only the modes with maximum time average power values need to be tested respectively, So GPRS 850 only 4timeslot mode and GPRS 1900 only 4timeslot mode are tested.
2)For GPRS ,the test modes are the worst case of GSM modes
3)GSM has 8 timeslot
Average factor: when 1TS : 10*LOG1/8=-9.03
2TS: 10*LOG2/8=-6.02
3TS: 10*LOG3/8=-4.26
4TS: 10*LOG4/8=-3.01
Time average power: when 1TS=Power value+ Average factor=31.21+(-9.03)=22.18dbm
2TS,3TS and 4TS in a similar way

GSM Multi-slot classes supported by the devices:

Multislot Class	Max Slot Allocation			Allowable Configuration	Max Data Rate
	Downlink	Uplink	Active		
12	4	4	5	1 up; 4 down	8-12K bps Send 32-48K bps Receive
				2 up; 3 down	16-24K bps Send 24-36K bps Receive
				3 up; 2 down	24-36K bps Send 16-24K bps Receive
				4 up; 1 down	32-48K bps Send 8-12K bps Receive

It support EDGE Class 12:

System and Channel	Power values (dbm)	Average factor (db)	Time average (dbm) (before)	Time average (dbm) (after)
GSM850 CH190(1TS)	---	---	---	---
GPRS850 CH190				
1TS	31.97	-9.03	22.94	---
2TS	31.85	-6.02	25.83	---
3TS	31.74	-4.26	27.48	---
4TS	31.88	**-3.01**	**28.87**	**28.72**
GSM1900 Ch 661(1TS)	---	---	---	---

GPRS1900 Ch 661				
1TS	26.68	-9.03	17.65	---
2TS	26.70	-6.02	20.68	---
3TS	26.60	-4.26	22.34	---
4TS	26.22	**-3.01**	**23.21**	**23.11**

NOTE: 1)For GPRS ,complete set of tests are performed ,For DEGE ,only the modes with maximum time average power values need to be tested respectively, So EDGE 850 only 4timeslot mode and EDGE1900 only 4timeslot mode are tested.

2)For EDGE ,the test modes are the worst case of GPRS modes

3)GPRS has 8 timeslot

Average factor: when 1TS : 10*LOG1/8=-9.03

2TS: 10*LOG2/8=-6.02

3TS: 10*LOG3/8=-4.26

4TS: 10*LOG4/8=-3.01

Time average power: when 1TS=Power value+ Average factor=30.97+(-9.03)=21.94dbm

2TS,3TS and 4TS in a similar way

WCDMA:

As the SAR body tests for WCDMA **Band II/ Band V,** 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.

WCDMA Band II		**Conducted Power (dBm)**					
		Ch 9262 (1852.4MHz)		**Ch 9400 (1880.0MHz)**		**Ch 9538 (1907.6MHz)**	
RMC		**before**	**after**	**before**	**after**	**before**	**after**
		22.02	N/A	**22.12**	22.11	22.10	N/A
HSDPA	**Sub-test 1**	21.77	N/A	21.88	N/A	21.81	N/A
	Sub-test 2	21.76	N/A	21.86	N/A	21.82	N/A
	Sub-test 3	21.53	N/A	21.68	N/A	21.62	N/A
	Sub-test 4	21.58	N/A	**21.69**	N/A	21.66	N/A

WCDMA Band V		Conducted Power (dBm)					
		Ch 4132 (826.40MHz)		Ch 4175 (835.00MHz)		Ch 4233 (846.60MHz)	
RMC		before	after	before	after	before	after
		23.34	N/A	23.36	N/A	**23.37**	23.33
HSDPA	Sub-test 1	23.09	N/A	23.02	N/A	**23.12**	N/A
	Sub-test 2	23.08	N/A	23.02	N/A	23.14	N/A
	Sub-test 3	22.79	N/A	22.87	N/A	22.98	N/A
	Sub-test 4	22.85	N/A	22.92	N/A	22.96	N/A

Bluetooth & WIFI (IEEE802.11b/g/n)

a. The client supplied a special driver to program the EUT, allowing it to continually transmit the specified maximum power and change the channel frequency.

b. Maximum conducted power was measured by replacing the antenna with an adapter for conductive measurement.

c. The conducted power was measured at the high, middle and low channel frequency before and after the SAR measurement.

d. During SAR test, the highest output channel per band measured first, and then if necessary, the other channels were measured according to the normal procedures.

802.11b/g/n Conducted output power (Average)(dBm)
Before:

Mode / Frequency	802.11b 1M	802.11g 6M	802.11n(20MHz)	802.11n (40MHz)
Low	16.84	14.81	13.96	13.18
Mid	**16.98**	**15.01**	**14.18**	**13.61**
High	16.90	14.69	13.93	13.43

After:

Mode / Frequency	802.11b 1M	802.11g 6M	802.11n(20MHz)	802.11n (40MHz)
Low	16.78	N/A	N/A	N/A
Mid	**16.95**	N/A	N/A	N/A
High	16.87	N/A	N/A	N/A

Ps :
WIFI 802.11b Mode Max output power 16.98 dBm(=49.49mW) ≥PRef and antenna is ≥ 2.5 cm < 5.0 cm
from BT antenna, so **802.11b stand-alone SAR is required**.
According to the KDB248227,g mode and n-20MHz maximum average power 1/4dB < b mode test channels power
So **802.11g and n-20MHz and n-40MHz stand-alone SAR is not required**.

Bluetooth output power (Average)(dBm)

Mode / Frequency	DATA1 1M	DATA3 3M
2402 MHz	0.35	0.25
2441 MHz	**0.55**	0.45
2480 MHz	0.21	0.09

Ps.
GSM and BT Antenna distance≤ 2.5 cm, BT power 0.55 dBm(=1.135mW) ≤Pref ,so BT stand-alone SAR is not required
0.55dBm(=1.135mW) ≤PRef
(1)Antenna(BT) is ≥ 2.5 cm < 5.0 cm from other antennas(WIFI), so **BT stand-alone SAR is not required**.

11.6 SAR HANDSETS MULTI XMITER ASSESSMENT

Simultaneous SAR for Actually tested SAR value :

SAR For Head and Body-Worn:

	GSM 850 head	GSM 850 body worn	GPRS 850 body worn
GSM 850 SAR(worst)	0.293	0.258	0.199
802.11b SAR(worst)	0.441	0.394	0.394
Σ1g-SAR	0.734	0.652	0.593
remark	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)

	EDGE 850 body worn
GSM 850 SAR(worst)	0.168
802.11b SAR(worst)	0.394
Σ1g-SAR	0.562
remark	Less than 1.6W/kg(limit)

	GSM 1900 head	GSM 1900 body worn	GPRS 1900 body worn
GSM 1900 SAR(worst)	0.195	0.221	0.181
802.11b SAR(worst)	0.441	0.394	0.394
Σ1g-SAR	0.636	0.615	0.575
remark	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)

	EDGE 1900 body worn
GSM 1900 SAR(worst)	0.166
802.11b SAR(worst)	0.394
Σ1g-SAR	0560
remark	Less than 1.6W/kg(limit)

	head	body worn
Bluetooth SAR(worst)	0	0
802.11b SAR(worst)	0.441	0.394
Σ1g-SAR	0.441	0.394
remark	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)

	head	body worn
Bluetooth SAR(worst)	0	0
GSM SAR(worst)	0.293	0.258
Σ1g-SAR	0.293	0.258
remark	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)

SAR For Head and Body(Hotspot):

	GSM 850 body Hotspot	GPRS 850 body Hotspot	EDGE 850 body Hotspot
GSM 850 SAR(worst)	0.192	0.217	0.116
802.11b SAR(worst)	0.385	0.385	0.385
Σ1g-SAR	0.577	0.602	0.501
remark	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)

	BandII body Hotspot	BandV body Hotspot
WCDMA SAR(worst)	0.415	0.421
802.11b SAR(worst)	0.385	0.385
Σ1g-SAR	0.800	0.806
remark	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)

	GSM 1900 body Hotspot	GPRS 1900 body Hotspot	EDGE 1900 body Hotspot
GSM 1900 SAR(worst)	0.214	0.233	0.228
802.11b SAR(worst)	0.385	0.385	0.385
Σ1g-SAR	0.599	0.618	0.613
remark	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)	Less than 1.6W/kg(limit)

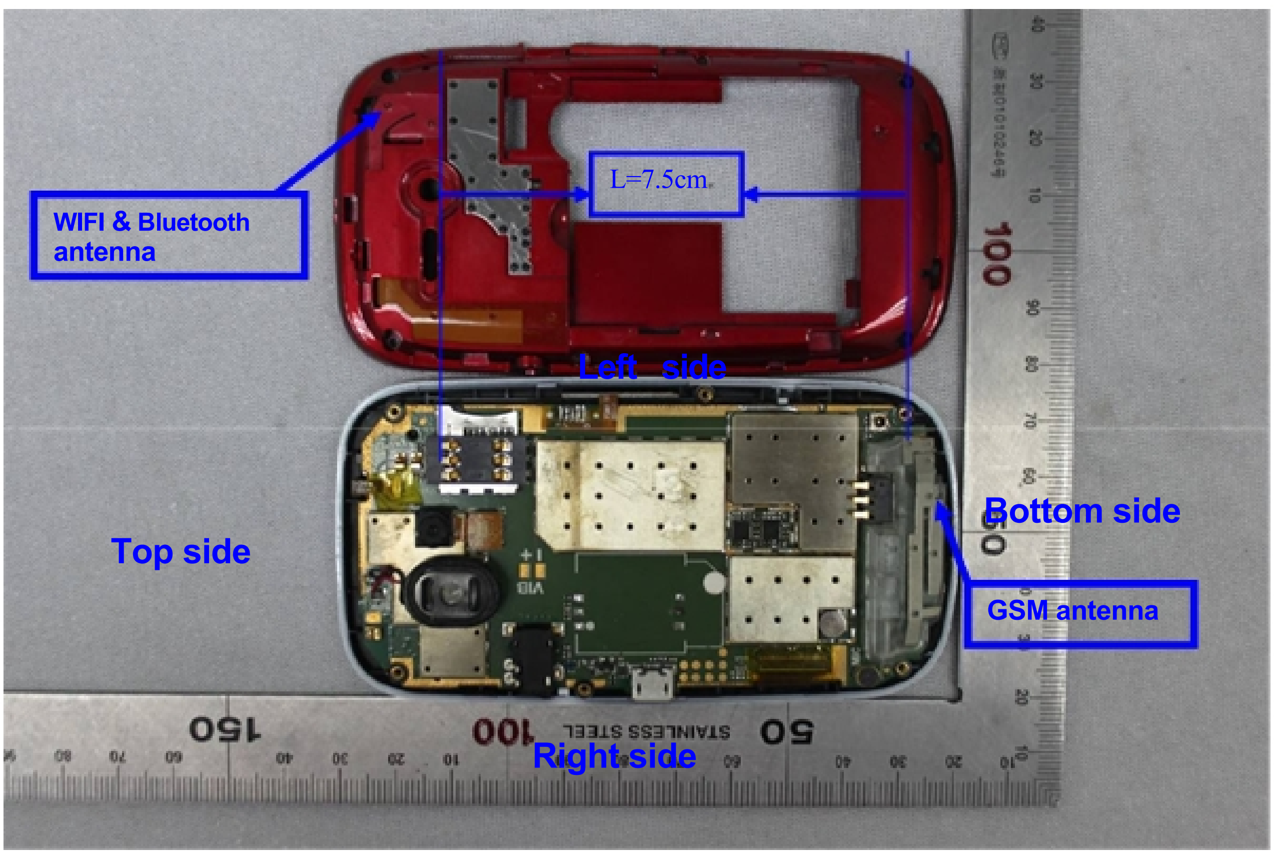
	body Hotspot
Bluetooth SAR(worst)	0
802.11b SAR(worst)	0.385
Σ1g-SAR	0.385
remark	Less than 1.6W/kg(limit)
	body Hotspot
Bluetooth SAR(worst)	0
GSM SAR(worst)	0.233
Σ1g-SAR	0.233
remark	Less than 1.6W/kg(limit)

KDB 648474 simultaneous SAR evaluation:

Antenna Location:

antenna1	antenna2	antenna3	GSM to WIFI antenna distance(cm)	GSM to Bluetooth antenna distance(cm)	Bluetooth to WIFI antenna distance(cm)	remark
GSM	Bluetooth	WIFI	7.5cm	7.5cm	0cm	Please refer to page 37

(x,y)	d_{xy}, cm	simultaneous Tx SAR	remarks
WIFI to GSM antenna distance(cm)	7.5 cm	No	GSM/WIFI , Antenna distance is more than 5cm ,the sum of WIFI and GSM SAR is less than 1.6 W/kg. so no Simultaneous SAR needed.
GSM to Bluetooth antenna distance(cm)	7.5 cm	No	GSM/BT , Antenna distance is more than 5cm , and BT Power is less than 2*Pref. so no Simultaneous SAR needed.
Bluetooth to WIFI antenna distance(cm)	0 cm	No	WIFI/BT , Antenna distance is less than 2.5cm , WIFI Max SAR is less than 1.2 W/kg, so no Simultaneous SAR needed.



SAR Data for **Body(Hotspot)** :

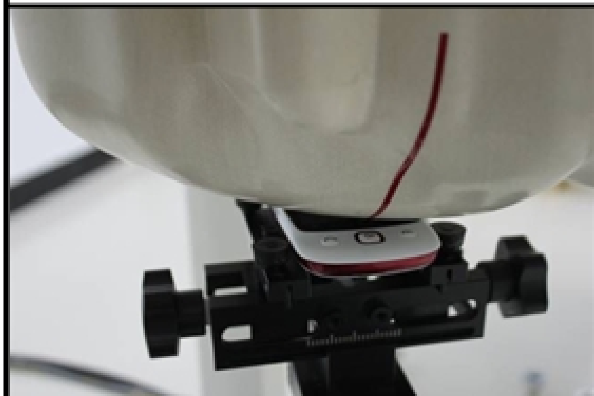
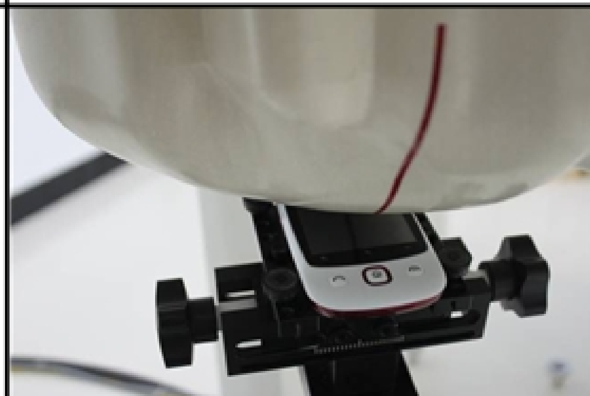
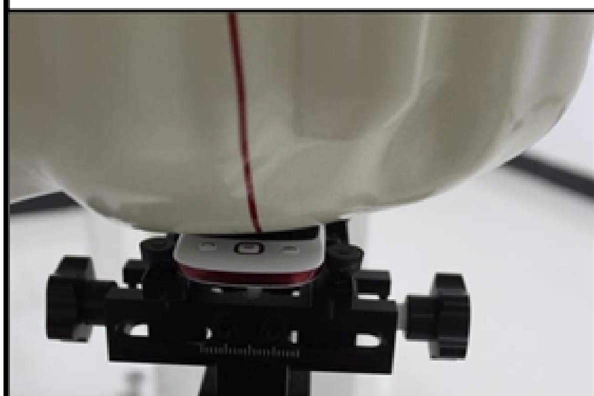
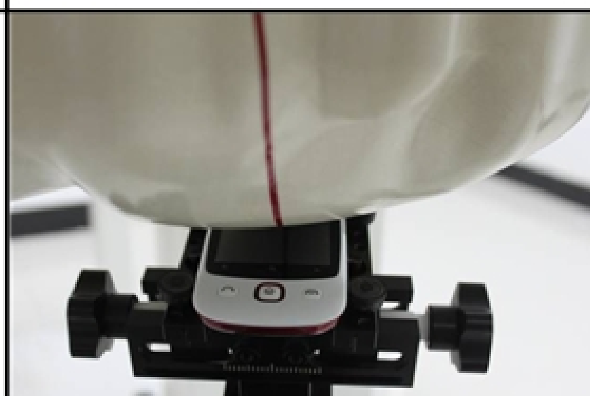
Mode	Test Position	Distance
For GSM/GPRS	up face, down face , Bottom side , right side ,left side	Flat(1.0cm)
For WCDMA	up face, down face , Bottom side , right side ,left side	Flat(1.0cm)
For WIFI	up face, down face , Top side , right side ,left side	Flat(1.0cm)

SAR Data for **Body Worn** :

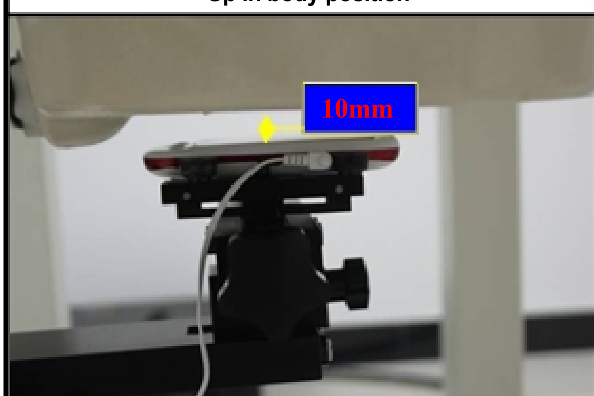
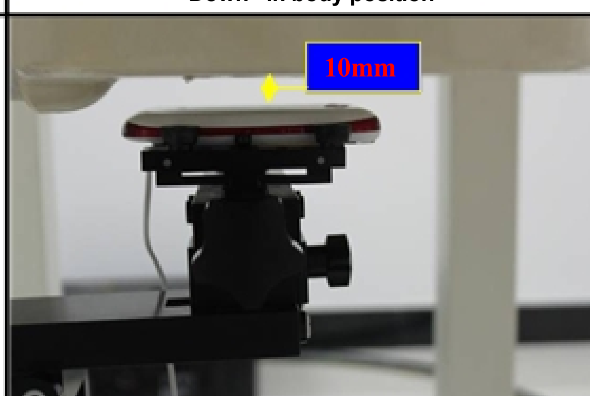
Mode	Test Position	Distance
For GSM/GPRS	up face, down face	Flat(1.0cm)
For WCDMA	up face, down face	Flat(1.0cm)
For WIFI	up face, down face	Flat(1.0cm)

11.7 EUT SETUP PHOTOS

SAR Tested for Head:

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**
	

SAR Tested for Body-Worn:

UT Setup Configuration 3	**EUT Setup Configuration 4**
Up in body position	**Down in body position**
	
EUT Setup Configuration 5	**EUT Setup Configuration 6**