FCC SAR Compliance Test Report

Project Name: HSDPA/UMTS/GPRS/GSM /EDGE Mobile Phone with Bluetooth

Model : HUAWEI U8350-3/U8350-3

FCC ID : QISU8350-3

IC : 6369A-U83503

Report No. : SYBH (Z-SAR)004082011-2

	APPROVED	CHECKED	PREPARED
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DATE	2011-09-07	2011-09-07	2011-09-07

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※ ※ Modified History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev. 1.0	Initial Test Report Release	2011-09-07	Mi Wenping

1 General Information

1.1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for HUAWEI U8350-3 are as below Table 1.

Band	Position	Test Mode	Measured MAX SAR_{1g} (W/kg)	MAX Conducted Power (dBm)	Turn-up Power (dBm)	Extrapolated Result (W/kg)
GSM850	Head	GSM	0.263	32.19	33.00	0.317
	Body(10mm)	GPRS 2TS	0.764	31.07	32.00	0.946
	hotspot(10mm)	GPRS 2TS	0.764	31.07	32.00	0.946
GSM1900	Head	GSM	0.500	30.24	31.00	0.596
	Body(10mm)	GPRS 2TS	0.936	29.37	29.7	1.010
	hotspot(10mm)	EDGE 2TS	1.030	29.19	29.70	1.158
Band IV	Head	RMC	0.837	23.22	24.00	1.002
	Body(10mm)	HSDPA	**1.210**	23.22	24.00	1.448
	hotspot(10mm)	HSDPA	**1.210**	23.22	24.00	1.448
WiFi 2450	Head	802.11b	0.064	/	/	/
	Body(10mm)	802.11b	0.069	/	/	/

Table 1: Summary of test result

The device is in compliance with Specific Absorption Rate（SAR）for general population/uncontraolled exposure limits of 1.6 W/Kg as averaged over any 1 g tissue according to the FCC rule §2.1093, the ANSI/IEEE C 95.1:1999, the NCRP Report Number 86 for uncontrolled environment, according to the Health Canada's Safety Code 6 and the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003 and FCC OET Bulletin 65 Supplement.

1.2 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain)	**1.60 mW/g**	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

Table 2: RF exposure limits

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

Notes:

* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

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

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

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

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

1.3 EUT Description

Device Information:			
DUT Name:	HSDPA/UMTS/GPRS/GSM/EDGE Mobile Phone with Bluetooth		
Type Identification:	HUAWEI U8350-3/U8350-3		
FCC ID :	QISU8350-3		
IC :	6369A-U83503		
IMEI No:	868080000000292		
Device Type :	portable device		
Exposure Category:	uncontrolled environment / general population		
Hardware Version :	HD1U835M		
Software Version :	U8350-3V100R001C00B620		
Antenna Type :	Integrated		
Battery Options :	Huawei Technologies Co., Ltd. Rechargeable Li-ion Battery Model: HB5I1H ; Rated capacity: 1200mAh Nominal Voltage: ⎓ +3.7V; Charging Voltage: ⎓ +4.2V S/N: UNDB226XF0904155		
Others Accessories	Headset		
Device Operating Configurations:			
Supporting Mode(s)	GSM850/1900,WCDMA 1700,WiFi（Tested）; Bluetooth,		
Test Modulation	GSM(GMSK), WCDMA(QPSK)		
Device Class	B		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM 1900	1850-1910	1930-1990
	GSM850	824 – 849	869 – 894
	WCDMA Band IV	1713- 1753	2113-2153
	Bluetooth	2400-2483.5	
GPRS Multislot Class (10)	Max Number of Timeslots in Uplink:	2	
	Max Number of Timeslots inDownlink:	4	
	Max Total Timeslot:	5	
EGPRS Multislot Class (10)	Max Number of Timeslots in Uplink:	2	
	Max Number of Timeslots inDownlink:	4	
	Max Total Timeslot:	5	
HSDPA UE Category	8		
Power Class :	1,tested with power level 0 (GSM 1900)		
	4,tested with power level 5 (GSM 850)		
	3, tested with power control “all 1”(WCDMA Band IV)		
Test Channels (low-mid-high) :	512-661-810 (GSM 1900)		
	128-190-251(GSM 850)		
	1312-1413-1513WCDMA Band IV)		

Table 3: Device information and operating configuration

1.3.1 General Description

HSDPA/UMTS/GPRS/GSM/EDGE Mobile Phone with Bluetooth- HUAWEI U8350-3/U8350-3 is subscriber equipment in the WCDMA/GSM system. The HSDPA/UMTS frequency band is Band I and Band IV, but only Band IV test data included in this report. The GSM/GPRS/EDGE frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900, but only GSM850 and PCS1900MHz band test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, HSDPA/UMTS and GSM/GPRS/EDGE protocol processing, voice, video, MMS service, GPS, AGPS and WIFI etc. Externally it provides micro SD card interface, earphone port(to provide voice service) and USIM card interface. It also provides Bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other Bluetooth devices

1.4 Test specification(s)

IEEE Std C95.1 – 1999	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.
IEEE 1528-2003	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
OET Bulletin No. 65, Supplement C– 2001	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
Canada's Safety Code 6	Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz (99-EHD-237)
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 4 of March 2010)
KDB941225 D01	SAR test for 3G devices v02 ,Published on Nov 13 2009
KDB941225 D03	SAR Test Reduction GSM GPRS EDGE vo1 ,Published on Nov 13 2009
KDB941225 D06	Hot Spot SAR v01
KDB648474 D01	SAR Handsets Multi Xmiter and Ant v01r05

1.5 Testing laboratory

Test Site	Reliability Laboratory of Huawei Technologies Co., Ltd.
Test Location	Section K3,Bantian, Longgang District, Shenzhen, P.R.China
Telephone	+86-755-28785513
Fax	+86-755-36834474
State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. CNAS Registration number: L0310

1.6 Applicant and Manufacturer

Company Name	HUAWEI TECHNOLOGIES CO., LTD
Address	Huawei Base, Bantian, Longgang District, Shenzhen, P.R.China

1.7 Application details

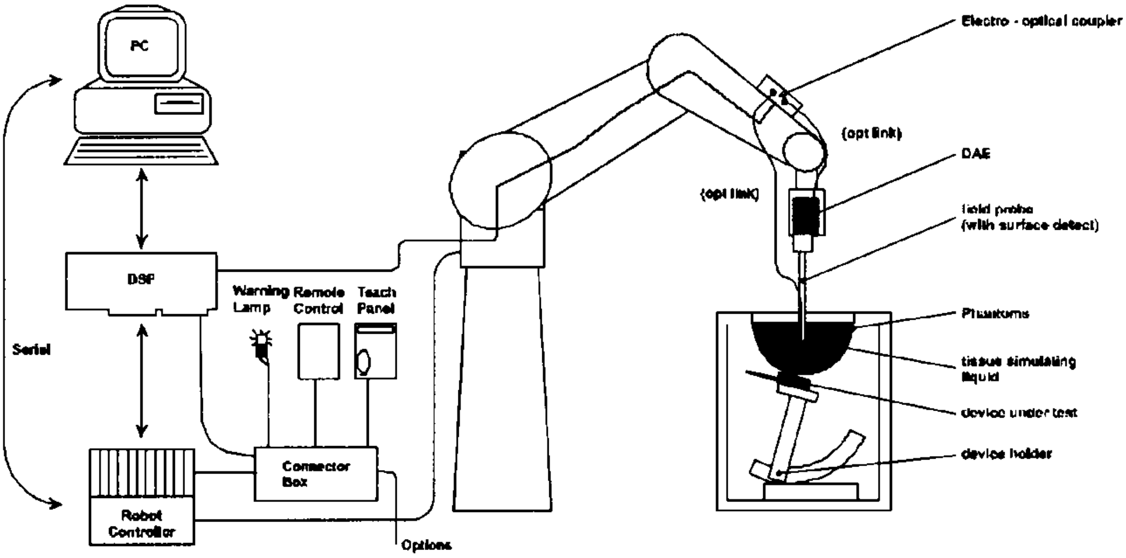
Start Date of test	2011-08-05
End Date of test	2011-08-30

1.8 Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

2 SAR Measurement System

2.1 SAR Measurement Set-up



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

- A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- A unit to operate the optical surface detector which is connected to the EOC.
- The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
- The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows XP.
- DASY5 software and SEMCAD data evaluation software.
- Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- System validation dipoles allowing to validate the proper functioning of the system.

2.2 Test environment

The DASY4 measurement system is placed at the head end of a room with dimensions:
5 x 2.5 x 3 m³, the SAM phantom is placed in a distance of 75 cm from the side walls and 1.1m from the rear wall. Above the test system a 1.5 x 1.5 m² array of pyramid absorbers is installed to reduce reflections from the ceiling.
Picture 1 of the photo documentation shows a complete view of the test environment.
The system allows the measurement of SAR values larger than 0.005 mW/g.

2.3 Data Acquisition Electronics description

The data acquisition electronics (DAE) consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converte and a command decoder with a 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.

DAE4

Input Impedance	200MOhm	
The Inputs	symmetrical and floating	
Common mode rejection	above 80 dB	

2.4 Probe description

These probes are specially designed and calibrated for use in liquids with high permittivities. They should not be used in air, since the spherical isotropy in air is poor (±2 dB). The dosimetric probes have special calibrations in various liquids at different frequencies.

Isotropic E-Field Probe ES3DV3 for Dosimetric Measurements

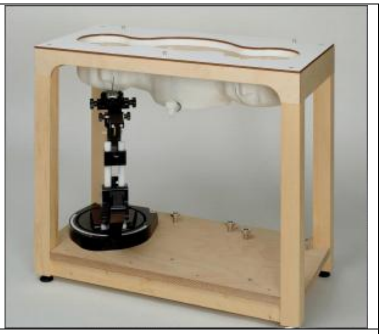
Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Calibration	ISO/IEC 17025 calibration service available.	
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)	
Dynamic range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones	

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

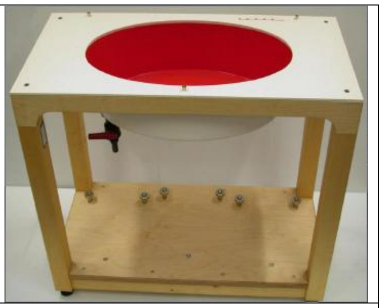
Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycolether)	
Calibration	In air from 10 MHz to 2.5 GHz In head tissue simulating liquid (HSL) at 900 (800-1000) MHz and 1.8 GHz (1700-1910 MHz) (accuracy ± 11%; k=2) Calibration for other liquids and frequencies upon request	
Frequency	10 MHz to 3 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 3 GHz)	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)	
Dynamic range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB	
Optical Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces (EX3DV4 only)	
Dimensions	Overall length: 337 mm Tip length: 9 mm Body diameter: 10 mm Tip diameter:2.5 mm Distance from probe tip to dipole centers: 1.0 mm	
Application	General dosimetry up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms (EX3DV4)	

2.5 Phantom description

SAM Twin Phantom

Shell Thickness	2mm +/- 0.2 mm; The ear region: 6mm	
Filling Volume	Approximately 30 liters	
Dimensions	Length:1000mm; Width:500mm; Height: adjustable feet	
Measurement Areas	Left hand Right hand Flat phantom	
The bottom plate contains three pairs of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to cover the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on top of this phantom cover are possible. Three reference marks are provided on the phantom counter. These reference marks are used to teach the absolute phantom position relative to the robot.		

ELI4 Phantom

Shell Thickness	2mm +/- 0.2 mm	
Filling Volume	Approximately 30 liters	
Dimensions	Length:1000mm; Width:500mm; Height: adjustable feet	
Measurement Areas	Flat phantom	
The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209-2 and all known tissue simulating liquids.		

2.6 Device holder description

The DASY5 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. This device holder is used for standard mobile phones or PDA's only. If necessary an additional support of polystyrene material is used.

Larger DUT's (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values.
Therefore those devices are normally only tested at the flat part of the SAM.

2.7 Test Equipment List

This table gives a complete overview of the SAR measurement equipment
Devices used during the test described are marked ☒

	Manufacturer	Device	Type	Serial number	Date of last calibration)*
☐	SPEAG	Dosimetric E-Field Probe	ES3DV3	3168	2010-12-23
☒	SPEAG	Dosimetric E-Field Probe	EX3DV4	3753	2010-12-13
☐	SPEAG	Dosimetric E-Field Probe	EX3DV4	3744	2010-11-26
☐	SPEAG	835 MHz Validation Dipole	D835V2	4d095	2011-02-23
☒	SPEAG	900 MHz Validation Dipole	D900V2	1d112	2011-03-09
☒	SPEAG	1800 MHz Validation Dipole	D1800V2	2d184	2011-03-08
☒	SPEAG	1900 MHz Validation Dipole	D1900V2	5d018	2011-06-16
☐	SPEAG	2000 MHz Validation Dipole	D2000V2	1036	2011-02-23
☐	SPEAG	2300 MHz Validation Dipole	D2300V2	1016	2011-04-13
☒	SPEAG	2450 MHz Validation Dipole	D2450V2	860	2011-03-08
☐	SPEAG	2600 MHz Validation Dipole	D2600V2	1021	2011-04-13
☐	SPEAG	Data acquisition electronics	DAE4	851	2010-06-30
☐	SPEAG	Data acquisition electronics	DAE4	852	2010-12-24
☒	SPEAG	Data acquisition electronics	DAE4	1235	2010-10-22
☒	SPEAG	Software	DASY 5	N/A	N/A
☒	SPEAG	Twin Phantom	SAM1	TP-1475	N/A
☒	SPEAG	Twin Phantom	SAM2	TP-1474	N/A
☒	SPEAG	Twin Phantom	SAM3	TP-1597	N/A
☒	SPEAG	Twin Phantom	SAM4	TP-1620	N/A
☐	SPEAG	Flat Phantom	ELI 4.0	TP-1038	N/A
☐	SPEAG	Flat Phantom	ELI 4.0	TP-1111	N/A
☐	R & S	Universal Radio Communication Tester	CMU 200	111379	2011-08-06
☒	R & S	Universal Radio Communication Tester	CMU 200	113989	2011-06-02
☒	Agilent)*	Network Analyser	E5071B	MY42404956	2011-02-22
☒	Agilent	Dielectric Probe Kit	85070E	2484	N/A
☒	Agilent	Signal Generator	N5181A	MY47420989	2011-02-22
☒	MINI-CIRCUITS	Amplifier	ZHL-42W	QA0746001	N/A
☒	Agilent	Power Meter	E4417A	MY45101339	2011-02-22
☒	Agilent	Power Meter Sensor	E9321A	MY44420359	2011-02-22

Note: The calibration interval of validation dipoles is 3 years.

1) Per KDB 450824 D02 requirements for dipole calibration, Huawei SAR lab has adopted three years calibration interval. But each measured dipole is expected to evaluate with the following criteria at least on annual interval.

a) There is no physical damage on the dipole;
b) System validation with specific dipole is within 10% of calibrated value;
c) Return-loss is within 10% of calibrated measurement;
d) Impedance is within 5Ω from the previous measurement.

2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

3) 900 MHz probe/dipole calibration is valid +/-100 MHz and fully covers the 850 MHz band

3 SAR Measurement Procedure

3.1 Scanning procedure

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

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

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

- The „area scan “measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement. Standard grid spacing for head measurements is 15 mm in x- and y- dimension. If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.
  Results of this coarse scan are shown in annex 2.

- A „7x7x7 zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous „coarse“ scan. This is a fine 7x7 grid where the robot additionally moves the probe in 7 steps along the z-axis away from the bottom of the Phantom. Grid spacing for the cube measurement is 5 mm in x and y-direction and 5 mm in z-direction. DASY5 is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in annex 2. Test results relevant for the specified standard (see chapter 1.6.) are shown in table form in chapter 2.5.

- A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2mm steps. This measurement shows the continuity of the liquid and can - depending in the field strength – also show the liquid depth. A z-axis scan of the measurement with maximum SAR value is shown in annex 2.

3.2 Spatial Peak SAR Evaluation

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of 7 x 7 x 7 points. The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.

- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.

- All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.

Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

Advanced Extrapolation

DASY5 uses the advanced extrapolation option which is able to compansate boundary effects on E-field probes.

3.3 Data Storage and Evaluation

Data Storage

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

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

Data Evaluation by SEMCAD

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

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

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

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf/dcp_i$$

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

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

E-field probes: $E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$

H-field probes: $H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1}f + a_{i2}f^2)/f$

with
- V_i = compensated signal of channel i (i = x, y, z)
- $Norm_i$ = sensor sensitivity of channel i (i = x, y, z) $[mV/(V/m)^2]$ for E-field Probes
- ConvF = sensitivity enhancement in solution
- a_{ij} = sensor sensitivity factors for H-field probes
- f = carrier frequency [GHz]
- E_i = electric field strength of channel i in V/m
- H_i = magnetic field strength of channel i in A/m

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

$$E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}$$

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

$$SAR = (E_{tot}^2 \cdot \sigma) / (\rho \cdot 1000)$$

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 to be a free space field.

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

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

4 System Verification Procedure

4.1 Tissue Verification

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectic parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within ± 5% of the target values.

The following materials are used for producing the tissue-equivalent materials.

Ingredients (% of weight)	Head Tissue					
Frequency Band (MHz)	450	835	900	1800	1950	2450
Water	38.56	41.45	40.92	52.64	55.242	62.7
Salt (NaCl)	3.95	1.45	1.48	0.36	0.306	0.5
Sugar	56.32	56.0	56.5	0.0	0.0	0.0
HEC	0.98	1.0	1.0	0.0	0.0	0.0
Bactericide	0.19	0.1	0.1	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	36.8
DGBE	0.0	0.0	0.0	47.0	44.542	0.0
Ingredients (% of weight)	Body Tissue					
Frequency Band (MHz)	450	835	900	1800	1950	2450
Water	51.16	52.4	56.0	69.91	69.91	73.2
Salt (NaCl)	1.49	1.40	0.76	0.13	0.13	0.04
Sugar	46.78	45.0	41.76	0.0	0.0	0.0
HEC	0.52	1.0	1.21	0.0	0.0	0.0
Bactericide	0.05	0.1	0.27	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	0.0	29.96	29.96	26.7

Table 4: Tissue Dielectric Properties

Salt: 99+% Pure Sodium Chloride; Sugar: 98+% Pure Sucrose; Water: De-ionized, 16MΩ+ resistivity
HEC: Hydroxyethyl Cellulose; DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

Used Target Frequency	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
	ε_r (+/-5%)	σ (S/m) (+/-5%)	ε_r	σ (S/m)		
825MHz Head	41.6 (39.52~43.68)	0.90 (0.86~0.95)	40.36	0.88	21.4°C	2011-8-5
835MHz Head	41.5 (39.43~43.58)	0.90 (0.86~0.95)	40.19	0.89		
850MHz Head	41.5 (39.43~43.58)	0.92 (0.87~0.96)	39.99	0.89		
900MHz Head	41.5 (39.43~43.58)	0.97 (0.92~1.02)	39.50	0.94		
1710MHz Head	40.1 (38.10~42.10)	1.35 (1.28~1.42)	39.25	1.37	21.4°C	2011-8-8
1730MHz Head	40.1 (38.10~42.10)	1.36 (1.29~1.43)	39.24	1.40		
1750MHz Head	40.1 (38.10~42.10)	1.37 (1.31~1.43)	39.05	1.40		
1800MHz Head	40.0 (38.00~42.00)	1.40 (1.33~1.47)	38.96	1.43		
1850MHz Head	40.0 (38.00~42.00)	1.40 (1.33~1.47)	39.76	1.38	21.5°C	2011-8-6
1880MHz Head	40.0 (38.00~42.00)	1.40 (1.33~1.47)	39.82	1.41		

1910MHz Head	40.0 (38.00~42.00)	1.40 (1.33~1.47)	39.69	1.41		
1900MHz Head	40.0 (38.00~42.00)	1.40 (1.33~1.47)	39.70	1.41		
2410MHz Head	39.3 (37.34~41.26)	1.76 (1.67~1.85)	39.05	1.73	21.5°C	2011-8-30
2435MHz Head	39.2 (37.24~41.16)	1.79 (1.70~1.88)	38.97	1.76		
2460MHz Head	39.2 (37.24~41.16)	1.81 (1.72~1.90)	38.90	1.79		
2450MHz Head	39.2 (37.24~41.16)	1.80 (1.71~1.89)	38.93	1.77		
825MHz Body	55.2 (52.44~57.96)	0.97 (0.92~1.02)	53.73	0.95	21.0°C	2011-8-6
835MHz Body	55.2 (52.44~57.96)	0.97 (0.92~1.02)	53.69	0.97		
850MHz Body	55.2 (52.44~57.96)	0.99 (0.94~1.04)	53.30	0.97		
900MHz Body	55.0 (52.25~57.75)	1.05 (1.00~1.10)	53.27	1.01		
1710MHz Body	53.5 (50.83~56.18)	1.46 (1.39~1.53)	51.35	1.50	21.0°C	2011-8-8
1730MHz Body	53.5 (50.83~56.18)	1.48 (1.41~1.55)	51.28	1.53		
1750MHz Body	53.4 (50.73~56.07)	1.49 (1.42~1.56)	51.16	1.54		
1800MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.07	1.56		
1850MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.39	1.47	21.6°C	2011-8-7
1880MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.32	1.50		
1910MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.26	1.54		
1900MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.28	1.53		
1850MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.39	1.47	21.6°C	2011-8-8
1880MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.32	1.50		
1910MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.26	1.54		
1900MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	51.28	1.53		
2410MHz Body	52.8 (50.16~55.44)	1.91 (1.81~2.00)	51.68	1.90	21.4°C	2011-8-29
2435MHz Body	52.7 (50.07~55.34)	1.94 (1.84~2.04)	51.47	1.92		
2460MHz Body	52.7 (50.07~55.34)	1.96 (1.86~2.06)	51.50	1.96		
2450MHz Body	52.7 (50.07~55.34)	1.95 (1.85~2.05)	51.45	1.96		
ε_r= Relative permittivity, σ= Conductivity						

Table 5: Measured Tissue Parameter

The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 °C of the conditions expected during the SAR evaluation to satisfy protocol requirements.

Note: 1) KDB 450824 was ensured to be applied for probe calibration frequencies greater than or equal to 50MHz of the EUT frequencies.

2)The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies. The SAR test plots may slightly differ from the table above since the DASY rounds to three significant digits.

3) For GSM measurement in 850 band and for 900 MHz system verification the same TSL and 835 MHz SAR probe calibration point have been used.

4) For WCDMA measurement in AWS band and for 1800MHz system verification the same TSL and 1750MHz SAR probe calibration point have been used.

4.2 System Check

The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system validation is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows validation results for all frequency bands and tissue liquids used during the tests (Graphic Plot(s) see Appendix A).

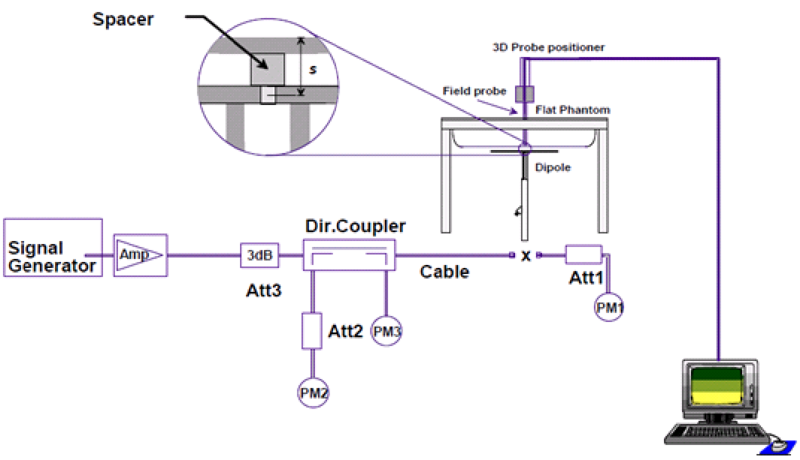
System Check	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (mW/g)	10-g (mW/g)	1-g (mW/g)	10-g (mW/g)		
D900V2 Head	11.2 (10.08~12.32)	7.13 (6.417~7.84)	10.88	7.00	21.0°C	2011-08-05
D1800V2 Head	39.1 (35.19~43.01)	20.3 (18.27~22.33)	38.28	19.92	21.0°C	2011-08-08
D1900V2 Head	39.8 (35.82~43.78)	20.8 (18.72~22.88)	38.56	20.00	21.5°C	2011-08-06
D2450V2 Head	53.7 (48.33~59.07)	24.9 (22.41~27.39)	51.60	23.80	21.5°C	2011-08-30
D900V2 Body	11.3 (10.17~12.43)	7.30 (6.57~8.03)	10.68	6.88	21.0°C	2011-08-06
D1800V2 Body	38.8 (34.92~42.68)	20.4 (18.36~22.44)	40.80	21.84	21.0°C	2011-08-08
D1900V2 Body	40.5 (36.45~44.55)	21.1 (18.99~23.21)	41.20	21.40	21.6°C	2011-08-07
D1900V2 Body	40.5 (36.45~44.55)	21.1 (18.99~23.21)	41.60	21.36	21.6°C	2011-08-08
D2450V2 Body	52.8 (47.52~58.08)	24.5 (22.05~26.95)	50.40	23.76	21.4°C	2011-08-29

Table 6: System Check Results

4.3 Validation Procedure

The validation is performed by using a validation dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a plexiglass spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 250 mW. To adjust this power a power meter is used. The power sensor is connected to the cable before the validation to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).

Validation results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



5 Measurement Uncertainty Evaluation

5.1 Measurement uncertainty evaluation for SAR test

The overall combined measurement uncertainty of the measurement system is ± 10.9% (K=1).
The expanded uncertainty (k=2) is assessed to be ± 21.9%
This measurement uncertainty budget is suggested by IEEE P1528 and determined by Schmid & Partner Engineering AG. The breakdown of the individual uncertainties is as follows:

Error Sources	Uncertainty Value	Probability Distribution	Divisor	c_i 1g	c_i 10g	Standard Uncertainty 1g	Standard Uncertaint y10g	v_i^2 or v_{eff}
Measurement System								
Probe calibration	± 6.0%	Normal	1	1	1	± 6.0%	± 6.0%	∞
Axial isotropy	± 4.7%	Rectangular	√3	0.7	0.7	± 1.9%	± 1.9%	∞
Hemispherical isotropy	± 9.6%	Rectangular	√3	0.7	0.7	± 3.9%	± 3.9%	∞
Spatial resolution	± 0.0%	Rectangular	√3	1	1	± 0.0%	± 0.0%	∞
Boundary effects	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Probe linearity	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%	∞
System detection limits	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Readout electronics	± 0.3%	Normal	1	1	1	± 0.3%	± 0.3%	∞
Response time	± 0.8%	Rectangular	√3	1	1	± 0.5%	± 0.5%	∞
Integration time	± 2.6%	Rectangular	√3	1	1	± 1.5%	± 1.5%	∞
RF ambient conditions	± 3.0%	Rectangular	√3	1	1	± 1.7%	± 1.7%	∞
Probe positioner	± 0.4%	Rectangular	√3	1	1	± 0.2%	± 0.2%	∞
Probe positioning	± 2.9%	Rectangular	√3	1	1	± 1.7%	± 1.7%	∞
Max. SAR evaluation	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Test Sample Related								
Device positioning	± 2.9%	Normal	1	1	1	± 2.9%	± 2.9%	145
Device holder uncertainty	± 3.6%	Normal	1	1	1	± 3.6%	± 3.6%	5
Power drift	± 5.0%	Rectangular	√3	1	1	± 2.9%	± 2.9%	∞
Phantom and Set-up								
Phantom uncertainty	± 4.0%	Rectangular	√3	1	1	± 2.3%	± 2.3%	∞
Liquid conductivity (target)	± 5.0%	Rectangular	√3	0.64	0.43	± 1.8%	± 1.2%	∞
Liquid conductivity (meas.)	± 2.5%	Normal	1	0.64	0.43	± 1.6%	± 1.1%	∞
Liquid permittivity (target)	± 5.0%	Rectangular	√3	0.6	0.49	± 1.7%	± 1.4%	∞
Liquid permittivity (meas.)	± 2.5%	Normal	1	0.6	0.49	± 1.5%	± 1.2%	∞
Combined Uncertainty						± 10.9%	± 10.7%	387
Expanded Std. Uncertainty						**± 21.9%**	**± 21.4%**	

Table 7:Measurement uncertainties

5.2 Measurement uncertainty evaluation for system validation

The overall combined measurement uncertainty of the measurement system is ± 9.5% (K=1).
The expanded uncertainty (k=2) is assessed to be ± 18.9%
This measurement uncertainty budget is suggested by IEEE P1528 and determined by Schmid & Partner Engineering AG. The breakdown of the individual uncertainties is as follows:

Error Sources	Uncertainty Value	Probability Distribution	Divi-sor	c_i 1g	c_i 10g	Standard Uncertainty 1g	Standard Uncertainty 10g	v_i^2 or v_{eff}
Measurement System								
Probe calibration	± 6.0%	Normal	1	1	1	± 6.0%	± 6.0%	∞
Axial isotropy	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%	∞
Hemispherical isotropy	± 9.6%	Rectangular	√3	0.7	0.7	± 0.0%	± 0.0%	∞
Boundary effects	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Probe linearity	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%	∞
System detection limits	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Readout electronics	± 0.3%	Normal	1	1	1	± 0.3%	± 0.3%	∞
Response time	± 0.0%	Rectangular	√3	1	1	± 0.0%	± 0.0%	∞
Integration time	± 0.0%	Rectangular	√3	1	1	± 0.0%	± 0.0%	∞
RF ambient conditions	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Probe positioner	± 0.4%	Rectangular	√3	1	1	± 0.2%	± 0.2%	∞
Probe positioning	± 2.9%	Rectangular	√3	1	1	± 1.7%	± 1.7%	∞
Max. SAR evaluation	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Dipole								
Deviation of experimental dipole	± 5.5%	Rectangular	√3	1	1	± 3.2%	± 3.2%	∞
Dipole axis to liquid distance	± 2.0%	Rectangular	1	1	1	± 1.2%	± 1.2%	∞
Power drift	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%	∞
Phantom and Set-up								
Phantom uncertainty	± 4.0%	Rectangular	√3	1	1	± 2.3%	± 2.3%	∞
Liquid conductivity (target)	± 5.0%	Rectangular	√3	0.64	0.43	± 1.8%	± 1.2%	∞
Liquid conductivity (meas.)	± 2.5%	Normal	1	0.64	0.43	± 1.6%	± 1.1%	∞
Liquid permittivity (target)	± 5.0%	Rectangular	√3	0.6	0.49	± 1.7%	± 1.4%	∞
Liquid permittivity (meas.)	± 2.5%	Normal	1	0.6	0.49	± 1.5%	± 1.2%	∞
Combined Uncertainty						**± 9.5%**	**± 9.2%**	
Expanded Std. Uncertainty						**± 18.9%**	**± 18.4%**	

Table 8: Measurement uncertainties

6 SAR Test Configuration

6.1 GSM Test Configuration

SAR tests for GSM 850 and GSM 1900, a communication link is set up with a base station by air link. Using CMU200 the power lever is set to “5”and “0” in SAR of GSM 850 and GSM 1900. The tests in the band of GSM 850 and GSM 1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 10 for this EUT, it has at most 2 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5. The EGPRS class is 10 for this EUT, it has at most 2 timeslots in uplink, and at most 4 timeslots in downlink, the maximum total timeslot is 5.

When SAR tests for EGPRS mode is necessary, GMSK modulation should be used to minimize SAR measurement error due to higher peak-to-average power (PAR) ratios inherent in 8-PSK.

According to specification 3GPP TS 51.010, the maximum power of the GSM can do the power reduction for the multi-slot.

The allowed power reduction in the multi-slot configuration is as following:

Number of timeslots in uplink assignment		Reduction of maximum output power, (dB)		
Band	Time Slots	GPRS (GMSK）	EGPRS (GMSK)	EGPRS (8PSK)
GSM850	1 TX slot	0	0	0
	2 TX slots	1	1	0
GSM1900	1 TX slot	0	0	0
	2 TX slots	1	1	0

Table 9: The allowed power reduction in the multi-slot configuration of GSM

6.2 WCDMA Test Configuration

1) RMC

As the SAR body tests for WCDMA Band IV，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:

1) 12.2kbps RMC, 64,144,384 kbps RMC with TPC set to 'all 1'.
2) Test loop Mode 1.

For the output power, the configurations for the DPCCH and $DPDCH_1$ are as followed (EUT do not support the $DPDCH_{2-n}$)

	Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	Spreading Factor	Spreading Code Number	Bits/Slot
DPCCH	15	15	256	0	10
$DPDCH_1$	15	15	256	64	10
	30	30	128	32	20
	60	60	64	16	40
	120	120	32	8	80
	240	240	16	4	160
	480	480	8	2	320
	960	960	4	1	640
$DPDCH_n$	960	960	4	1, 2, 3	640

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits configured to all "1s". SAR for other spreading codes and multiple DPDCHn, when supported by the EUT, are not required when the maximum average outputs of each RF channel, for each spreading code and DPDCHn configuration, are less than ¼ dB higher than those measured in 12.2 kbps RMC.

2) HSDPA

SAR for body exposure configurations is measured according to the ''Body SAR Measurements'' procedures of 3G device. In addition, body SAR is also measured for HSDPA when the maximum average outputs of each RF channel with HSDPA active is at ¼ dB higher than that measured without HSDPA using 12.2kbps RMC or the maximum SAR 12.2kbps RMC is above 75% of the SAR limit. Body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA.

HSDPA should be configured according to UE category of a test device. The number of HS-DSCH/ HS-PDSCHs, HAPRQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission condition, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. The β_c and β_d gain factors for DPCCH and DPDCH were set according to the values in the below table, β_{hs} for HS-DPCCH is set automatically to the correct value when ΔACK, ΔNACK, ΔCQI = 8. The variation of the β_c /β_d ratio causes a power reduction at sub-tests 2 - 4.

Sub-test	β_c	β_d	β_d (SF)	β_c /β_d	β_{hs} (1)	CM(dB)(2)	MPR (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0
2	12/15(3)	15/15(3)	64	12/15(3)	24/15	1.0	0
3	15/15	8/15	64	15/8	30/15	1.5	1
4	15/15	4/15	64	15/4	30/15	1.5	1

Note 1: Δ ACK, Δ NACK and Δ CQI = 8 . $A_{hs} = \beta_{hs}/\beta_c = 30/15$. $\beta_{hs} = 30/15 * \beta_c$
Note 2 : CM=1 for $\beta_c/\beta_{d}= 12/15$, $\beta_{hs}/\beta_c = 24/15$. 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 3 : 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 $\beta_c = 11/15$ and $\beta_d = 15/15$

Table 10: Sub-tests for UMTS Release 5 HSDPA

The measurements were performed with a Fixed Reference Channel (FRC) and H-Set 1 QPSK.

Parameter	Value
Nominal average inf. bit rate	534 kbit/s
Inter-TTI Distance	3 TTI's
Number of HARQ Processes	2 Processes
Information Bit Payload	3202 Bits
MAC-d PDU size	336 Bits
Number Code Blocks	1 Block
Binary Channel Bits Per TTI	4800 Bits
Total Available SMLs in UE	19200 SMLs
Number of SMLs per HARQ Process	9600 SMLs
Coding Rate	0.67
Number of Physical Channel Codes	5

Table 11: settings of required H-Set 1 QPSK acc. to 3GPP 34.121

HS-DSCH Category	Maximum HS-DSCH Codes Received	Minimum Inter-TTI Interval	Maximum HS-DSCH Transport Block Bits/HS-DSCH TTI	Total Soft Channel Bits
1	5	3	7298	19200
2	5	3	7298	28800
3	5	2	7298	28800
4	5	2	7298	38400
5	5	1	7298	57600
6	5	1	7298	67200
7	10	1	14411	115200
8	10	1	14411	134400
9	15	1	25251	172800
10	15	1	27952	172800
11	5	2	3630	14400
12	5	1	3630	28800
13	15	1	34800	259200
14	15	1	42196	259200
15	15	1	23370	345600
16	15	1	27952	345600

Table 12: HSDPA UE category

6.3 WiFi Test Configuration

For the 802.11b/g SAR tests, a communication link is set up with the test mode software for WiFi mode test. The Absolute Radio Frequency Channel Number(ARFCN) is allocated to 1,6and 11 respectively in the case of 2450 MHz.During the test,at the each test frequency channel, theEUT is operated at the RF continuous emission mode.Each channel should be tested at the lowest data rate.

802.11b/g operating modes are tested independently according to the service requirements in each frquency band.802.11b/g/n modes are tested on channel 1,6,11;however,if output power reduction is necessary for channels 1 and/or 11 to meet restricted band requirements the highest output channel closest to each of these channels must be tested instead.

SAR is not required for 802.11g channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

7 SAR Measurement Results

7.1 Conducted power measurements

For the measurements a Rohde & Schwarz Radio Communication Tester CMU 200 was used.
The output power was measured using an integrated RF connector and attached RF cable.
The conducted output power was also checked before and after each SAR measurement. The resulting power values were within a 0.2 dB tolerance of the values shown below.

Note: CMU200 measures GSM peak and average output power for active timeslots.
For SAR the timebased average power is relevant. The difference in between depends on the duty cycle of the TDMA signal :

No. of timeslots	**1**	**2**	**3**	**4**
Duty Cycle	1 : 8	1: 4	1 : 2.66	1 : 2
timebased avg. power compared to slotted avg. power	- 9 dB	- 6 dB	- 4.25 dB	- 3 dB

The signalling modes differ as follows:

mode	**coding scheme**	**modulation**
GPRS	CS1 to CS4	GMSK
EDGE	MCS1 to MCS4	GMSK
EDGE	MCS5 to MCS9	8PSK

Apart from modulation change (GMSK/8PSK) coding schemes differ in code rate without influence on the RF signal. Therefore one coding scheme per mode was selected for conducted power measurements.

7.1.1 Conducted power measurements GSM 850 MHz

GSM850		Conducted Power (dBm)			Division Factors	Average Power (dBm)		
		128CH	190CH	251CH		128CH	190CH	251CH
GSM (CS)		32.19	32.3	32.27	-9	23.19	23.3	23.27
GPRS (GMSK)	1 Tx Slot	32.16	32.31	32.26	-9	23.16	23.31	23.26
	2 Tx Slot	31.01	31.1	31.07	-6	25.01	25.1	25.07
EDGE (GMSK)	1 Tx Slot	32.19	32.28	32.26	-9	23.19	23.28	23.26
	2 Tx Slot	31.02	31.07	31.02	-6	25.02	25.07	25.02
EDGE (8PSK)	1 Tx Slot	26.79	26.88	26.92	-9	17.79	17.88	17.92
	2 Tx Slot	26.71	26.79	26.82	-6	20.71	20.79	20.82

Table 13: Test results conducted power measurement GSM 850 MHz

7.1.2 Conducted power measurements GSM 1900 MHz

GSM1900		Conducted Power (dBm)			Division Factors	Average Power (dBm)		
		512CH	661CH	810CH		512CH	661CH	810CH
GSM (CS)		30.24	30.24	30.03	-9	21.24	21.24	21.03
GPRS (GMSK)	1 Tx Slot	30.18	30.23	29.99	-9	21.18	21.23	20.99
	2 Tx Slot	29.36	29.37	29.16	-6	23.36	23.37	23.16
EDGE (GMSK)	1 Tx Slot	30.24	30.26	30.05	-9	21.24	21.26	21.05
	2 Tx Slot	29.36	29.37	29.19	-6	23.36	23.37	23.19
EDGE (8PSK)	1 Tx Slot	26.79	26.81	26.62	-9	17.79	17.81	17.62
	2 Tx Slot	26.75	26.73	26.56	-6	20.75	20.73	20.56

Table 14: Test results conducted power measurement GSM 1900 MHz

Remark : SAR measurements were performed in GPRS mode with 2 active timeslots because highest time based averaged output power was calculated for that configuration.

For comparison an additional delta measurement was performed with 1 timeslot in speech mode. In EDGE mode no delta measurement was performed.

7.1.3 Conducted power measurements WCDMA FDD IV (1700 MHz)

UMTS1700 (Band IV)		Conducted Power (dBm)		
		1312CH	1413CH	1513CH
WCDMA	12.2kbps RMC	23.14	23.1	23.22
	64kbps RMC	23.07	23.07	23.15
	144kbps RMC	23.06	23.03	22.15
	384kbps RMC	23.02	23.04	23.17
HSDPA	Subtest 1	23.07	22.89	23.09
	Subtest 2	22.84	22.85	22.89
	Subtest 3	22.2	22.21	22.23
	Subtest 4	22.19	22.18	22.23

Table 15: Test results conducted power measurement WCDMA 1700

7.2 SAR measurement Result

7.2.1 SAR measurement Result of GSM 850

Test Position of Head	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Left Hand Touched	GSM	190/836.6	0.256	0.185	0.152	1.6	21°C
Left Hand Tilted 15°	GSM	190/836.6	0.212	0.161	0.022	1.6	21°C
Right Hand Touched	GSM	190/836.6	0.238	0.178	0.068	1.6	21°C
Right Hand Tilted 15°	GSM	190/836.6	0.207	0.157	0.016	1.6	21°C
Left Hand Touched	GSM	251/848.8	0.246	0.177	0.136	1.6	21°C
Left Hand Touched	GSM	128/824.2	**0.263**	0.194	0.047	1.6	21°C

Table 16: Test results head SAR GSM 850 MHz

Test Position of Body with 10mm	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Towards Phantom	GPRS 1TS	190/836.6	0.388	0.293	0.029	1.6	21°C
Towards Phantom	GPRS 2TS	190/836.6	0.576	0.435	0.022	1.6	21°C
Towards Ground	GPRS 2TS	190/836.6	0.755	0.560	-0.093	1.6	21°C
Left edge	GPRS 2TS	190/836.6	0.452	0.309	-0.103	1.6	21°C
Right edge	GPRS 2TS	190/836.6	0.410	0.281	0.071	1.6	21°C
Bottom edge	GPRS 2TS	190/836.6	0.079	0.046	-0.088	1.6	21°C
Towards Ground	GPRS 2TS	251/848.8	**0.764**	0.566	-0.005	1.6	21°C
Towards Ground	GPRS 2TS	128/824.2	0.742	0.551	-0.073	1.6	21°C
Towards Ground	EDGE 1TS	190/836.6	0.517	0.383	0.074	1.6	21°C
Towards Ground	EDGE 2TS	190/836.6	0.763	0.565	-0.064	1.6	21°C
Towards Ground	EDGE 2TS	251/848.8	0.757	0.559	-0.100	1.6	21°C
Towards Ground	EDGE 2TS	128/824.2	0.746	0.551	-0.005	1.6	21°C
Towards Ground with Headset	GSM	251/848.8	0.413	0.304	0.075	1.6	21°C

Table 17: Test results body SAR GSM 850 MHz

Note: 1) The value with bold colour is the maximum SAR value of each test band.

2) The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

3) Tests in body position were performed with 10 mm air gap between DUT and SAM to simulate the use of a non-metallic belt-clip or holster.

4) The addition body test was performed at Body-worn worst case.

5) For the antenna-to-edge distance is greater than 2.5 cm,so the top edge side does not need to be tested

7.2.2 SAR measurement Result of GSM 1900

Test Position of Head	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Left Hand Touched	GSM	661/1880	**0.500**	0.301	-0.021	1.6	21.5°C
Left Hand Tilted 15°	GSM	661/1880	0.183	0.112	0.021	1.6	21.5°C
Right Hand Touched	GSM	661/1880	0.353	0.227	-0.110	1.6	21.5°C
Right Hand Tilted 15°	GSM	661/1880	0.206	0.118	-0.064	1.6	21.5°C
Left Hand Touched	GSM	810/1909.8	0.378	0.228	-0.026	1.6	21.5°C
Left Hand Touched	GSM	512/1850.2	0.419	0.257	-0.011	1.6	21.5°C

Table 18: Test results head SAR GSM 1900 MHz

Test Position of Body with 10mm	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Towards Phantom	GPRS 1TS	661/1880	0.418	0.252	-0.095	1.6	21.6°C
Towards Phantom	GPRS 2TS	661/1880	0.627	0.378	-0.139	1.6	21.6°C
Towards Ground	GPRS 2TS	661/1880	0.936	0.525	0.125	1.6	21.6°C
Left edge	GPRS 2TS	661/1880	0.181	0.106	0.021	1.6	21.6°C
Right edge	GPRS 2TS	661/1880	0.198	0.117	-0.158	1.6	21.6°C
Bottom edge	GPRS 2TS	661/1880	0.948	0.492	-0.169	1.6	21.6°C
Towards Ground	GPRS 2TS	810/1909.8	0.925	0.500	-0.087	1.6	21.6°C
Towards Ground	GPRS 2TS	512/1850.2	0.794	0.473	-0.012	1.6	21.6°C
Bottom edge	GPRS 2TS	810/1909.8	0.978	0.511	-0.004	1.6	21.6°C
Bottom edge	GPRS 2TS	512/1850.2	0.753	0.403	0.006	1.6	21.6°C
Bottom edge	EDGE 1TS	661/1880	0.607	0.319	0.030	1.6	21.6°C
Bottom edge	EDGE 2TS	661/1880	0.935	0.492	0.029	1.6	21.6°C
Bottom edge	EDGE 2TS	810/1909.8	**1.030**	0.530	0.003	1.6	21.6°C
Bottom edge	EDGE 2TS	512/1850.2	0.778	0.413	0.084	1.6	21.6°C
Towards Ground with Headset	GSM	661/1880	0.553	0.303	0.081	1.6	21.6°C

Table 19: Test results body SAR GSM 1900 MHz

Note: 1) The value with blod colour is the maximum SAR value of each test band.

2) The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

3) Tests in body position were performed with 10 mm air gap between DUT and SAM to simulate the use of a non-metallic belt-clip or holster.

4) The addition body test was performed at Body-worn worst case.

5) For the antenna-to-edge distance is greater than 2.5 cm,so the top edge side does not need to be tested

7.2.3 SAR measurement Result of WCDMA Band IV

Test Position of Head	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Left Hand Touched	RMC	1413/1732.6	0.731	0.443	-0.144	1.6	21°C
Left Hand Tilted 15°	RMC	1413/1732.6	0.354	0.223	-0.052	1.6	21°C
Right Hand Touched	RMC	1413/1732.6	0.711	0.448	-0.153	1.6	21°C
Right Hand Tilted 15°	RMC	1413/1732.6	0.327	0.199	-0.401	1.6	21°C
Left Hand Touched	RMC	1513/1752.6	**0.837**	0.506	-0.016	1.6	21°C
Left Hand Touched	RMC	1312/1712.4	0.713	0.435	-0.004	1.6	21°C

Table 20: Test results head SAR UMTS FDD IV 1700 MHz

Test Position of Body with 10mm	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Towards Phantom	RMC	1413/1732.6	0.652	0.391	0.034	1.6	21.5°C
Towards Ground	RMC	1413/1732.6	1.030	0.592	0.014	1.6	21.5°C
Towards Ground	RMC	1513/1752.6	1.190	0.684	-0.040	1.6	21.5°C
Towards Ground	RMC	1312/1712.4	1.150	0.656	-0.278	1.6	21.5°C
Left edge	RMC	1413/1732.6	0.239	0.142	-0.115	1.6	21.5°C
Right edge	RMC	1413/1732.6	0.273	0.164	-0.069	1.6	21.5°C
Bottom edge	RMC	1413/1732.6	0.598	0.324	0.002	1.6	21.5°C
Towards Ground	HSDPA	1513/1752.6	**1.210**	0.693	0.020	1.6	21.5°C
Towards Ground with Headset	RMC	1513/1752.6	1.100	0.632	-0.006	1.6	21.5°C

Table 21: Test results body SAR UMTS FDD IV 1700 MHz

Note: 1) The value with bold colour is the maximum SAR value of each test band.

2) The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

3) Tests in body position were performed with 10 mm air gap between DUT and SAM to simulate the use of a non-metallic belt-clip or holster.

4) The addition body test was performed at Body-worn worst case.

5) For the antenna-to-edge distance is greater than 2.5 cm,so the top edge side does not need to be tested

7.2.4 SAR measurement Result of WiFi

Test Position of Head	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Left Hand Touched	802.11 b	11\2462	0.046	0.035	-0.172	1.6	21.4°C
Left Hand Tilted 15°	802.11 b	11\2462	0.043	0.024	0.109	1.6	21.4°C
Right Hand Touched	802.11 b	11\2462	**0.064**	0.044	-0.030	1.6	21.4°C
Right Hand Tilted 15°	802.11 b	11\2462	0.035	0.023	0.161	1.6	21.4°C
Right Hand Touched	802.11 b	6\2437	0.051	0.037	0.097	1.6	21.4°C
Right Hand Touched	802.11 b	1\2412	0.050	0.036	0.061	1.6	21.4°C

Table 22: Test results head SAR WiFi 2450MHz

Test Position of Body with 15mm	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Limit (W/kg)	Liquid Temp.
			1-g	10-g			
Towards Phantom	802.11 b	11\2462	0.021	0.014	-0.038	1.6	21.4°C
Towards Ground	802.11 b	11\2462	**0.069**	0.030	0.018	1.6	21.4°C
Left edge	802.11 b	11\2462	0.029	0.016	0.078	1.6	21.4°C
Top edge	802.11 b	11\2462	0.036	0.015	0.183	1.6	21.4°C
Towards Ground	802.11 b	6\2437	0.058	0.026	-0.092	1.6	21.4°C
Towards Ground	802.11 b	1\2412	0.059	0.028	0.130	1.6	21.4°C

Table 23: Test results body SAR WiFi 2450MHz

Note: 1) The value with bold colour is the maximum SAR value of each test band.

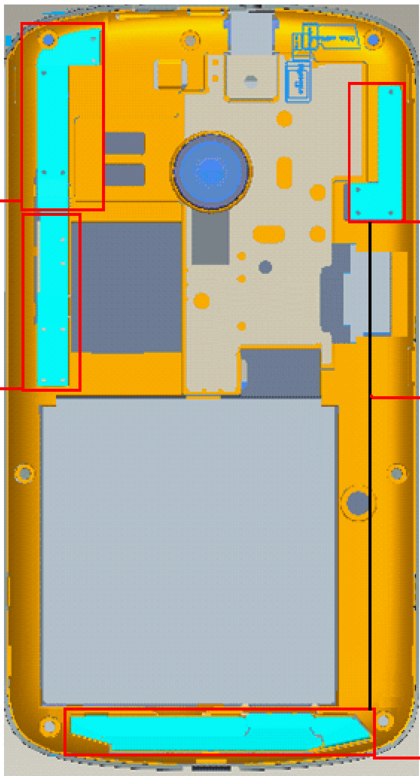
2) The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

3) Tests in body position were performed with 10 mm air gap between DUT and SAM to simulate the use of a non-metallic belt-clip or holster.

4) For the antenna-to-edge distance is greater than 2.5 cm,so the bottom and right edge sides do not need to be tested

7.3 Multiple Transmitter Evaluation

The closest distance between BT/WiFi antenna and main antenna is 7.3cm>5cm，and the location of the antennas inside mobile phone is shown as below picture:



The output power of BT antenna is as following:

BT 2450MHz	Average Conducted Power (dBm)		
	0CH	39CH	78CH
	6.01	7.55	7.18

Table 24: Test results conducted power measurement BT 2450 MHz

The output power of WiFi antenna is as following:

Wi-Fi 2450MHz	Channel	Average Power (dBm) for Data Rates (Mbps)							
		1	2	5.5	11	/	/	/	/
802.11b	1	14.42	14.39	14.36	14.35	/	/	/	/
	6	15.41	15.37	15.33	15.36	/	/	/	/
	11	**15.86**	15.85	15.82	15.84	/	/	/	/
802.11g	Channel	6	9	12	18	24	36	48	54
	1	9.82	9.79	9.77	9.78	9.74	9.75	9.76	9.73
	6	10.82	10.79	10.78	10.81	10.76	10.73	10.75	10.77
	11	11.18	11.15	11.14	11.17	11.1	11.09	11.08	11.11
802.11n HT20	Channel	6.5	13	19.5	26	39	52	58.5	65
	1	5.76	5.75	5.73	5.72	5.74	5.69	5.68	5.71
	6	6.98	6.95	6.97	6.98	6.94	6.96	6.93	6.91
	11	6.91	6.88	6.87	6.84	6.85	6.83	6.86	6.82

Table 25: Test results conducted power measurement WiFi 2450 MHz

Stand-alone SAR

According to the output power measurement results and the distance between BT antenna and GSM/WCDMA antenna we can draw the conclusion that:

stand-alone SAR evaluation is not required for BT, because the output power of BT unlicensed transmitter is 7.55≤ 2 · PRef (24mW)and its antenna(s) is 7.3≥ 5.0 cm from main antenna.

Stand-alone SAR evaluation is required for WiFi, because the output power of WiFi unlicensed transmitter is 15.86dBm ≥ 24mW (13.8dBm).

Simultaneous SAR

Simultaneous Transmission SAR evaluation is not required for BT& GSM/WCDMA, because stand-alone SAR are not required for BT and its antenna(s) is 7.3≥ 5.0 cm from main antenna.

Simultaneous Transmission SAR evaluation is not required for WiFi and GSM/WCDMA, because the sum of the 1g SAR is 1.279W/kg < 1.6W/kg for WiFi and GSM/WCDMA

Simultaneous Transmission SAR evaluation is not required for BT and WiFi, because the sum of the 1g SAR is 0.062W/kg < 1.6 W/kg for BT and WiFi

Appendix A. System Check Plots

(Pls See Appendix A.)

Appendix B. SAR Measurement Plots

(Pls See Appendix B.)

Appendix C. Calibration Certificate

(Pls See Appendix C.)

Appendix D. Photo documentation

(Pls See Appendix D.)

End