SAR TEST REPORT

For

UMTS Mobile Phone

Model Number: HUAWEI Y560-U23,Y560-U23

FCC ID: QISY560-U23

Report Number : WT158002031

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Test report declaration

Applicant	:	Huawei Technologies Co.,Ltd.
Address	:	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C
Manufacturer	:	Huawei Technologies Co.,Ltd.
Address	:	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C
EUT Description	:	UMTS Mobile Phone
Model No	:	HUAWEI Y560-U23, Y560-U23
Trade mark	:	HUAWEI
FCC ID	:	QISY560-U23

Test Standards:

ANSI Std C95.1-1992，IEEE Std 1528-2003, IEEE Std 1528a-2005, KDB941225 D01, KDB941225 D06, KDB447498 D01,KDB648474 D04,KDB248227 D01,KDB 865664 D01,KDB865664 D02,KDB690783 D01

The EUT described above is tested by Shenzhen Academy of Metrology and Quality Inspection EMC Laboratory to determine the compliance of the applicable standards stated above. Shenzhen Academy of Metrology and Quality Inspection EMC Laboratory is assumed full responsibility for the accuracy of the test results.

The results documented in this report only apply to the tested sample, under the conditions and modes of operation as described herein.

The test report shall not be reproduced in part without written approval of the laboratory.

Project Engineer:	(Liu Zheng)	Date:	Jun.09.2015
Checked by:	(Yang Dongping)	Date:	Jun.09.2015
Approved by:	(Lin Bin)	Date:	Jun.09.2015

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1. REPORTED SAR SUMMARY

1.1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing are as follows.

Band	Max Reported SAR(W/kg)		
	1-g Head	1-g Body-worn(15mm)*	1-g Hotspot(10mm)
GSM850	0.67	1.10	1.12
GSM1900	0.26	0.44	0.84
UMTS Band II	0.50	0.47	1.10
UMTS Band V	0.67	0.63	0.83
WiFi 2.4G	0.43	0.12	0.13
The highest simultaneous SAR value is 1.24W/kg per KDB690783-D01			

Table 1: Summary of test result

Note:

*For body-worn operation, this device has been tested and meets FCC RF exposure guidelines when used with any accessory that contains no metal and that positions the handset a minimum of 15mm from the body. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

The device is in compliance with Specific Absorption Rate(SAR) for general population/ uncontrolled exposure limits according to the FCC rule 2.1093 , the ANSI/IEEE C95.1:1992, the NCRP Report Number 86 for uncontrolled environment, according to 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 Std 1528-2003& IEEE Std 1528a-2005.

1.2 RF exposure limits (ICNIRP Guidelines)

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain/Body)	**1.60 mW/g**	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Limbs)	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 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

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

*** The Spatial Peak value of the SAR averaged over any 1 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 if employment or occupation.)

1.3 Ratings and System Details

Device type :	portable device	
DUT Name:	UMTS Mobile Phone	
Type Identification:	HUAWEI Y560-U23, Y560-U23	
IMEI No : IMEI2 No :	004401722582950 004401722592546	
exposure category:	uncontrolled environment / general population	
test device production information	production unit	
operating mode(s)	GSM850/1900,UMTS Band II/V,, WiFi2.4G,BT	
Test modulation	GSM(GMSK/8PSK),UMTS(QPSK),WiFi(OFDM/DSSS)	
Device Class :	B	
HSDPA Category	14	
HSUPA Category	6	
DC-HSDPA Category	24	
operating frequency range(s)	transmitter frequency range	receiver frequency range
GSM850 (tested):	824.2-848.8 MHz	869.2-893.8 MHz
GSM1900 (tested):	1850.2-1909.8 MHz	1930.2-1989.8 MHz
UMTS Band II (tested):	1852.5-1907.6 MHz	1932.5-1987.6MHz
UMTS Band V (tested):	826.4-846.6 MHz	871.4-891.6 MHz
WiFi(tested):	2412-2462 MHz	2412-2462 MHz
BT:	2402-2480 MHz	2402-2480 MHz
Power class :	4,tested with power level 5(GSM850)	
	1,tested with power level 0(GSM1900)	
	3, tested with power control “all 1”(UMTS Band II)	
	3, tested with power control “all 1”(UMTS Band V)	
test channels (low-mid-high) :	128-190-251(GSM850)	
	512-661-810(GSM1900)	
	9262-9400-9538(UMTS Band II)	
	4132-4183-4233(UMTS Band V)	
	1-6-11(WiFi 802.11b)	
hardware version :	Ver.A	
software version :	Y560-U23V100R001C464B005	
antenna type :	Integrated antenna	
battery options :	1#: BYD Lithium Battery Company Limited 2#: SCUD (FUJIAN) Electronics Co., Ltd.	Huawei Technologies Co., Ltd. Rechargeable Li-ion Battery Model: HB474284RBC Rated capacity: 2000mAh Nominal Voltage: ⎓ +3.7V Charging Voltage: ⎓ +4.2V
Earphone	GoerTek Inc.	Earphone Model:HA1-3
	GoerTek Inc.	Earphone Model:HG-04A
	Boluo County Quancheng Electronic Co., Ltd	Earphone Model: 1293#+3283# 3.5MM-150
	Jiangxi Liangchuang Hongsheng Electronic Co., Ltd	MEMD1532B528000

1.4 Product Function and Intended Use

HUAWEI Y560-U23, Y560-U23 is subscriber equipment in the WCDMA/GSM system. The HSPA+/HSUPA/HSDPA/UMTS frequency band is Band I and Band II and Band V, Band II and Band V can be used in this report. The GSM/GPRS/EDGE frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900, but only GSM850MHz and DCS1900MHz bands test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, HSPA+/HSUPA/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 Micro 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.

1.5 Test specification(s)

ANSI Std C95.1-1992	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz-300GHz.(IEEE Std C95.1-1991)
IEEE Std 1528-2003	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate(SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
IEEE Std 1528a-2005	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate(SAR) in the Human head from Wireless Communications Devices: Measurement Techniques Amendment1: CAD File for Human Head Model(SAM Phantom)
KDB941225 D01 SAR test for 3G SAR Procedures v03	3G SAR MEAUREMENT PROCEDURES
KDB941225 D06 Hotspot Mode v02	SAR Evaluation Procedures for portable Devices with Wireless Router Capabilities
KDB 447498 D01 Mobile Portable RF Exposure v05r02	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB 648474 D04 Handset SAR v01r02	SAR Evaluation Considerations for Wireless Handsets.
KDB 248227 D01 SAR meas for 802 11 a b g v02r01	SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS
KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03	SAR Measurement Requirements for 100 MHz to 6 GHz
KDB 865664 D02 RF Exposure Reporting v01r01	RF Exposure Compliance Reporting and Documentation Considerations
KDB 690783 D01 SAR Listings on Grants v01r03	SAR Listings on Equipment Authorization Grants

1.6 List of Test and Measurement Instruments

No.	Equipment	Model No.	Serial No.	Manufacturer	Last Calibration Date	Period
1	SAR test system	TX60L	F08/5AY8A1/A/01+F08/	SPEAG	NCR	NCR
2	Electronic Data Transmitter	DAE4	876	SPEAG	2015.03.09	1year
3	SAR Probe	ES3DV3	3203	SPEAG	2014.12.19	1year
4	SAR Probe	EX3DV4	3881	SPEAG	2014.07.22	1year
5	System Validation Dipole,835MHz	D835V2	4d141	SPEAG	2012.09.24	3year
6	System Validation Dipole,1900MHz	D1900V2	5d162	SPEAG	2012.09.21	3year
7	System Validation Dipole,2450MHz	D2450V2	818	SPEAG	2012.10.17	3year
8	Dielectric Probe Kit	85070E	MY44300455	Agilent	NCR	NCR
9	Dual-directional coupler,0.10-2.0GHz	778D	MY48220198	Agilent	NCR	NCR
10	Dual-directional coupler,2.00-18GHz	772D	MY46151160	Agilent	NCR	NCR
11	Coaxial attenuator	8491A	MY39266348	Agilent	NCR	NCR
12	Power Amplifier	ZHL42W	81709	MINI-CIRCUITS	NCR	NCR
13	Signal Generator	SMR20	100047	R&S	2015.01.14	1year
14	Power Meter	NRVD	100041	R&S	2015.01.22	1year
15	Call Tester	CMU 200	100110	R&S	2015.01.06	1year
16	Network Analyzer	E5071C	MY46109550	Agilent	2015.04.23	1Year
17	Flat Phantom	ELI4.0	TP-1904	SPEAG	NCR	NCR
18	Twin Phantom	SAM	TP-1504	SPEAG	NCR	NCR

Table 3: List of Test and Measurement Equipment

Note: All the test equipments are calibrated once a year, except the dipoles, which are calibrated every three years. Moreover, we have self-calibration every year to the dipoles.

2. GENERAL INFORMATION

2.1. Report information

This report is not a certificate of quality; it only applies to the sample of the specific product/equipment given at the time of its testing. The results are not used to indicate or imply that they are application to the similar items. In addition, such results must not be used to indicate or imply that SMQ approves recommends or endorses the manufacture, supplier or use of such product/equipment, or that SMQ in any way guarantees the later performance of the product/equipment.

The sample/s mentioned in this report is/are supplied by Applicant, SMQ therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture or any information supplied.

Additional copies of the report are available to the Applicant at an additional fee. No third part can obtain a copy of this report through SMQ, unless the applicant has authorized SMQ in writing to do so.

2.2. Laboratory Accreditation and Relationship to Customer

The testing report were performed by the Shenzhen Academy of Metrology and quality Inspection EMC Laboratory (Guangdong EMC compliance testing center), in their facilities located at Bldg. of Metrology & Quality Inspection, Longzhu Road, Nanshan District, Shenzhen, Guangdong, China. At the time of testing, Laboratory is accredited by the following organizations:

China National Accreditation Service for Conformity Assessment (CNAS) accredits the Laboratory for conformance to FCC standards, EMC international standards and EN standards. The Registration Number is CNAS L0579.

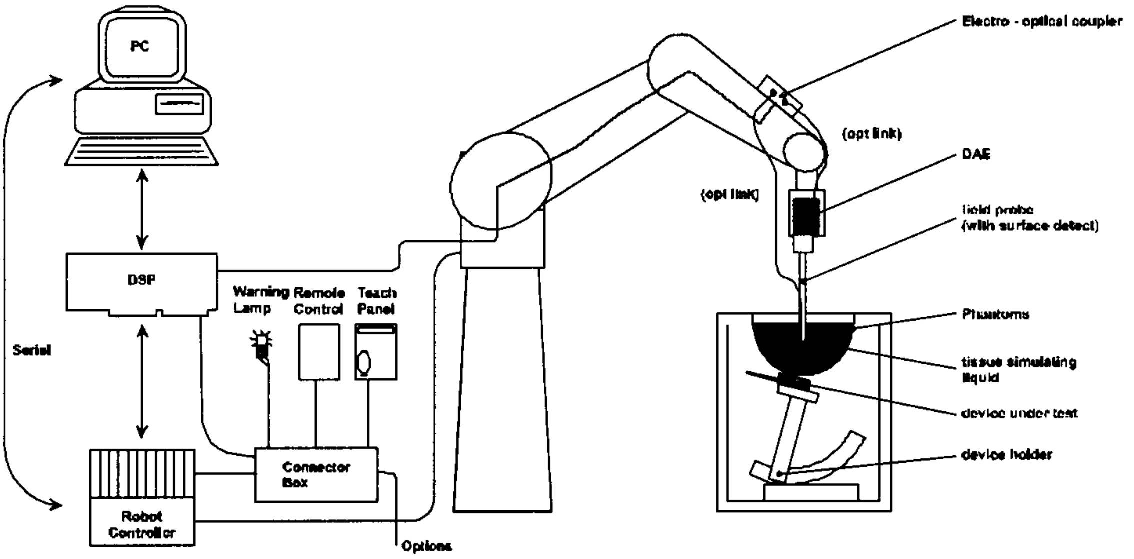
The Laboratory is listed in the United States of American Federal Communications Commission (FCC), and the registration number are 446246 806614 994606 (semi anechoic chamber).

The Laboratory is registered to perform emission tests with Industry Canada (IC), and the registration number is IC4174.

TUV Rhineland accredits the Laboratory for conformance to IEC and EN standards, the registration number is E2024086Z02.

3. SAR MEASUREMENT SYSTEM CONFIGURATION

3.1. 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 check dipoles allowing to validate the proper functioning of the system.

3.1.1. Test environment

The DASY5 measurement system is placed at the head end of a room with dimensions: 4.5 x 4 x 3 m^3; the SAM phantom is placed in a distance of 1.3 m from the side walls and 1.1m from the rear wall.

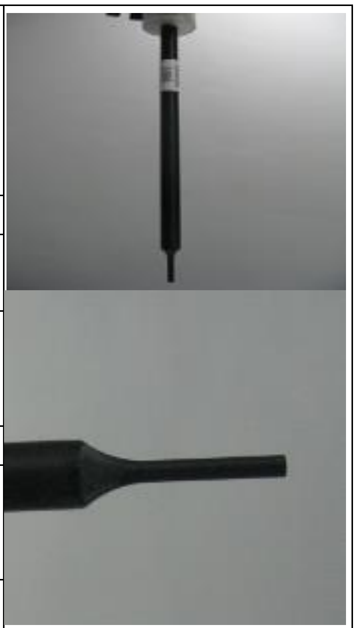
Picture 1 of the photo documentation shows a complete view of the test environment.

3.1.2. Probe description

Isotropic E-Field Probe EX3DV4 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 >6 GHz (dosimetry); Linearity: ±0.2 dB (30 MHz to 6 GHz)	
Directivity	±0.3 dB in HSL (rotation around probe axis) ±0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic range	10 μW/g to > 100 mW/g; Linearity: ±0.2 dB (noise: typically<1 μW/g)	
Dimensions	Overall length: 337 mm (Tip: 20mm) Tip length: 2.5 mm (Body: 12mm) Typical distance from probe tip to dipole centers: 1mm	
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%.	

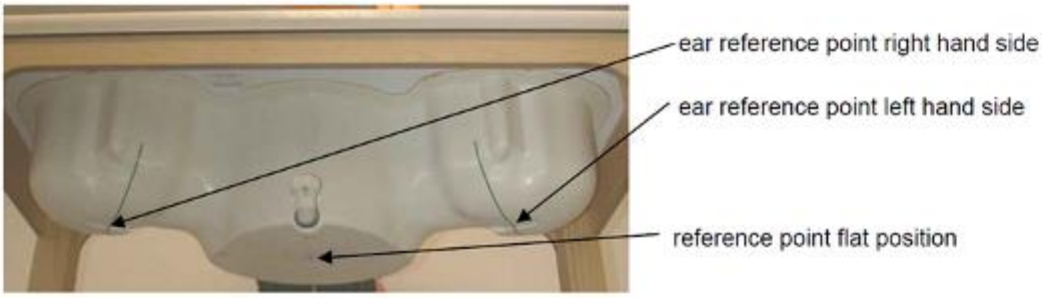
Isotropic E-Field Probe ES3DV3 for Dosimetric Measurements

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: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones	

3.1.3. Phantom description

The used SAM Phantom meets the requirements specified in Edition 01-01 of Supplement C to OET Bulletin 65 for Specific Absorption Rate (SAR) measurements.

The phantom consists of a fibreglass shell integrated in a wooden table. It allows left-hand and right-hand head as well as body-worn measurements with a maximum liquid depth of 18 cm in head position and 22 cm in planar position (body measurements). The thickness of the Phantom shell is 2 mm +/- 0.1 mm.



ELI4 Phantom

Shell Thickness	2mm+/- 0.2mm
Filling Volume	Approximately 30 liters
Measurement Areas	Flat phantom
The ELI4 phantom is in 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 lastest draft of the standard IEC 62209-2 and all known tissue simulating liquids.	

The phantom shell material is resistant to all ingredients used in the tissue-equivalent liquid recipes. The shell of the phantom including ear spacers is constructed from low permittivity and low loss material, with a relative permittivity≤5 and a loss tangent ≤0.05.

3.1.4. 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.

4. SAR MEASUREMENT PROCEDURE

4.1. Scanning procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and system check. 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 strenth 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(≤2GHz) , 12 mm in x- and y-dimension(2-4 GHz) and 10mm in x- and y- dimension(4-6GHz). 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 Appendix B.

- A "zoom scan" measures the field in a volume around the 2D peak SAR value acquired in the previous "coarse" scan. This is a fine grid with maximum scan spatial resolution: Δx_{zoom}, Δy_{zoom} ≤2GHZ≤ 8 mm, 2-4GHz - ≤ 5 mm and 4-6 GHz-≤ 4 mm; Δz_{zoom} ≤ 3GHz - ≤ 5 mm, 3-4 GHz- ≤ 4 mm and 4-6GHz-≤2mm where the robot additionally moves the probe along the z-axis away from the bottom of the Phantom. DASY5 is also able to perform repeated zoom scans if more than 1 peak is found during area scan. Test results relevant for the specified standard (see chapter 1.5.) are shown in table form in chapter 3.2.

- A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 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 Appendix B.

  The following table summarizes the area scan and zoom scan resolutions per FCC KDB 865664D01:

Frequency	Maximum Area Scan resolution (Δx_{area}, Δy_{area})	Maximum Zoom Scan spatial resolution(Δx_{zoom} Δy_{zoom})	Maximum Zoom Scan spatial resolution			Minimum zoom scan volume (x,y,z)
			Uniform Grid	Graded Grad		
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)$	$\Delta z_{zoom}(n>1)$	
≤ 2GHz	≤ 15mm	≤ 8mm	≤ 5mm	≤ 4mm	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 30mm
2-3GHz	≤ 12mm	≤ 5mm	≤ 5mm	≤ 4mm	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 30mm
3-4GHz	≤ 10mm	≤ 5mm	≤ 4mm	≤ 3mm	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 28mm
4-5GHz	≤ 10mm	≤ 4mm	≤ 3mm	≤ 2.5mm	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 25mm
5-6GHz	≤ 10mm	≤ 4mm	≤ 2mm	≤ 2mm	≤ 1.5* $\Delta z_{zoom}(n-1)$	≥ 22mm

4.1.1. 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 5 x 5 x 7 points(with 8mm horizontal resolution) or 7 x 7 x 7 points(with 5mm horizontal resolution). 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 neigh boring 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.

4.1.2. 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 DAE4. 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:

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

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: $E_i = (V_i / Norm_i \bullet ConvF)^{1/2}$

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

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.

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

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.

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

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

5. SYSTEM VERIFICATION PROCEDURE

5.1. Tissue Verification

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric 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)	750	835	1750	1900	2450	2600
Water	39.2	41.45	52.64	55.242	62.7	55.242
Salt(NaCl)	2.7	1.45	0.36	0.306	0.5	0.306
Sugar	57.0	56.0	0.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	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	47.0	44.542	36.8	44.452
Ingredients(% of weight)	Body Tissue					
Frequency Band(MHz)	750	835	1750	1900	2450	2600
Water	50.3	52.4	69.91	69.91	73.2	64.493
Salt(NaCl)	1.60	1.40	0.13	0.13	0.04	0.024
Sugar	47.0	45.0	0.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	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	29.96	29.96	26.7	32.252

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

Head Tissue-equivalent liquid measurements:

Used Target Frequency	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
	ε r (+/-5%)	σ (S/m) (+/-5%)	ε r	σ (S/m)		
835MHz Head	41.50 (39.43~43.58)	0.90 (0.86~0.95)	41.50	0.89	22°C	2015-05-25
1900MHz Head	40.0 (38.00~42.00)	1.40 (1.33~1.47)	39.75	1.45	22°C	2015-05-27
2450MHz Head	39.2 (37.24~41.16)	1.80 (1.71~1.89)	38.40	1.85	22°C	2015-05-28
ε_r= Relative permittivity, σ= Conductivity						

Body Tissue-equivalent liquid measurements:

Used Target Frequency	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
	ε r (+/-5%)	σ (S/m) (+/-5%)	ε r	σ (S/m)		
835MHz Body	55.20 (52.44~57.96)	0.97 (0.92~1.02)	55.87	0.96	22°C	2015-05-25
1900MHz Body	53.30 (50.64~55.97)	1.52 (1.44~1.60)	51.05	1.57	22°C	2015-05-27
2450MHz Body	52.70 (50.07~55.34)	1.95 (1.85~2.05)	50.71	2.02	22°C	2015-05-28
ε_r= Relative permittivity, σ= Conductivity						

System Check

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

System checking, Head Tissue-equivalent liquid:

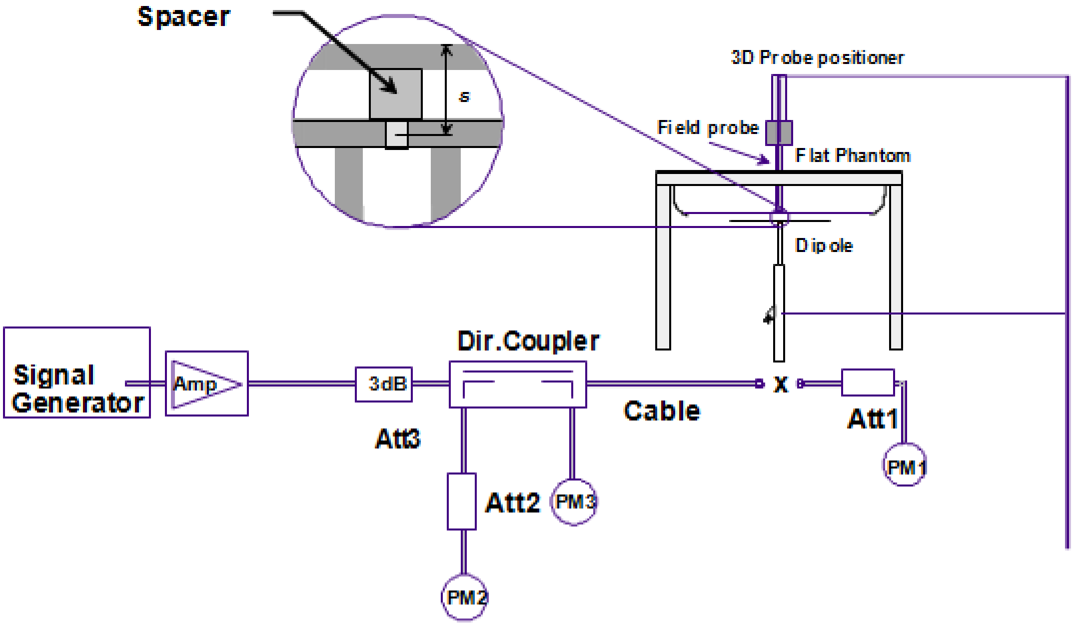
System Check	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (W/kg)	10-g (W/kg)	1-g (W/kg)	10-g (W/kg)		
D835V2 Head	9.35 (8.415~10.285)	6.12 (5.508~6.732)	9.32	6.04	22°C	2015-05-25
D1900V2 Head	39.40 (35.46~43.34)	20.70 (18.63~21.67)	40.40	20.00	22°C	2015-05-27
D2450V2 Head	52.30 (47.07~57.53)	24.50 (22.05~26.95)	53.20	25.16	22°C	2015-05-28

System checking, Body Tissue-equivalent liquid:

System Check	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (W/kg)	10-g (W/kg)	1-g (W/kg)	10-g (W/kg)		
D835V2 Body	9.46 (8.514~10.406)	6.25 (5.625~6.875)	9.92	6.44	22°C	2015-05-25
D1900V2 Body	40.70 (36.63~44.77)	21.60 (19.44~23.76)	44.40	22.04	22°C	2015-05-27
D2450V2 Body	50.80 (45.72~55.88)	23.80 (21.42~26.18)	55.60	25.16	22°C	2015-05-28

5.2. System Checking

The manufacturer calibrates the probes annually. A system check measurement was made following the determination of the dielectric parameters of the tissue-equivalent liquid, using the dipole validation kit. A power level of 250mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom.



The system checking results (dielectric parameters and SAR values) are given in the table below.

6. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

7.1 SAR measurement variability

Per KDB865664 D01 SAR measurement 100MHz to 6GHz v01v03, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurement requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is <0.80 W/kg; step2) through 4) do not apply.
2) When the original highest measured SAR is ≥0.8 W/kg， repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is >1.20 or when the original or repeated measurement is ≥1.45 W/kg(~10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is >1.20.

   The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

7.2 SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100MHz to 6GHz v01v03, when the highest measured 1-g SAR within a frequency band is <1.5W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2003 is not required in SAR reports submitted for equipment approval. The equivalent ratio(1.5/1.6) is applied to extremity and occupational exposure conditions.

7. TEST CONFIGURATION

The DUT is tested using a CMU 200 communications tester as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted peak power.
Test positions as described in the tables above are in accordance with the specified test standard.

GSM Test Configurations

SAR tests for GSM 850 and GSM 1900, a communication link is set up with a System Simulator (SS) by air link. Using E5515C the power level is set to “5” for GSM 850, set to “0” for GSM 1900. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslots is 5.

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:

Output power of reductions:

Number of timeslots in uplink assignment	Permissible nominal reduction of maximum output power,(dB)
1	0
2	0 to 3,0
3	1,8 to 4,8
4	3,0 to 6,0

UMTS Test Configurations

3G SAR Test Reduction Procedure

In the following procedures, the mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.3 This is referred to as the 3G SAR test reduction procedure in the following SAR test guidance, where the primary mode is identified in the applicable wireless mode test procedures and the secondary mode is wireless mode being considered for SAR test reduction by that procedure. When the 3G SAR test reduction procedure is not satisfied, it is identified as "otherwise" in the applicable procedures; SAR measurement is required for the secondary mode.

Output power Verification

Maximum output power is verified on the high, middle and low channels according to procedures described in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all "1's" for WCDMA/HSDPA or by applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HSDPA, HSPA) are requied in the SAR report. All configurations that are not supported by the handset or cannot be measured due to technical or equipment limitations must be clearly identified.

Head SAR

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest reported SAR configuration in 12.2 kbps RMC for head exposure.

Body-Worn Accessory SAR

SAR for body-worn accessory configurations is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCHn configurations supported by the handset with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured using an applicable RMC configuration with the corresponding spreaing code or DPDCHn, for the highest reported body-worn accessory exposure SAR configuration in 12.2 kbps RMC. When more than 2 DPDCHn are supported by the handset, it may be necessary to configure additional DPDCHn using FTM (Factory Test Mode) or other chipset based test approaches with parameters similar to those used in 384 kbps and 768 kbps RMC.

Handsets with Release 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body-worn accessory configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSDPA using the HSDPA body SAR procedures in the "Release 5 HSDPA Data Devices" section of this document, for the highest reported SAR body-worn accessory exposure configuration in 12.2 kbps RMC. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

HSDPA should be configured according to the UE category of a test device.The number of HSDSCH/ HS-PDSCHs, HARQ 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 conditions, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4 ms with a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors(βc, βd), and HS-DPCCH power offset parameters (ΔACK, ΔNACK, ΔCQI) should be set according to values indicated in the Table below. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the H-set.

Sub-set	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (note 1, note 2)	CM(dB) (note 3)	MPR(dB)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (note 4)	15/15 (note 4)	64	12/15 (note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI}= 8 ⇔ $A_{hs} = \beta_{hs}/\beta_c = 30/15$ ⇔ $\beta_{hs} = 30/15 * \beta_c$

Note2: CM=1 for β_c/β_d =12/15, β_{hs}/β_c=24/15.

Note3: For subtest 2 the $\beta_c\beta_d$ ratio of 12/15 for the TFC during the measurement period(TF1,TF0) is achieved by setting the signaled gain factors for the reference TFC (TFC1,TF1) to β_c=11/15 and β_d=15/15.

HSUPA Test Configuration

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body-worn accessory configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures in the “Release 6 HSPA Data Devices” section of this document, for the highest reported body-worn accessory exposure SAR configuration in 12.2 kbps RMC. When VOIP is applicable for next to the ear head exposure in HSPA, the 3G SAR test reduction procedure is applied to HSPA with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body-worn accessory measurements is tested for next to the ear head exposure.

Due to inner loop power control requirements in HSPA, a communication test set is required for output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA are configured according to the β values indicated in Table 2 and other applicable procedures described in the ‘WCDMA Handset’ and ‘Release 5 HSDPA Data Devices’ sections of this document

Sub-set	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM (2) (dB)	MPR (dB)	AG(4) Index	E-TFCI
1	11/15(3)	15/15(3)	64	11/15(3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}:47/15 β_{ed2}:47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15(4)	15/15(4)	64	15/15(4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, $\Delta NACK$ and Δ_{CQI} = 8 ⇔ $A_{hs} = \beta_{hs}/\beta_c$ = 30/15 ⇔ β_{hs}= 30/15 *β_c.

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

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

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

Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Figure 5.1g.

Note 6: βed can not be set directly; it is set by Absolute Grant Value.

UE E-DCH Category	Maximum E-DCH Codes Transmitted	Number of HARQ Processes	E-DCH TTI (ms)	Minimum Spreading Factor	Maximum E-DCH Transport Block Bits	Max Rate (Mbps)
1	1	4	10	4	7110	0.7296
2	2	8	2	4	2798	1.4592
	2	4	10	4	14484	
3	2	4	10	4	14484	1.4592
4	2	8	2	2	5772	2.9185
	2	4	10	2	20000	2.00
5	2	4	10	2	20000	2.00
6 (No DPDCH)	4	8	2	2 SF2 & 2 SF4	11484	5.76
	4	4	10		20000	2.00
7 (No DPDCH)	4	8	2	2 SF2 & 2 SF4	22996	?
	4	4	10		20000	?

NOTE: When 4 codes are transmitted in parallel, two codes shall be transmitted with SF2 and two with SF4.
UE Categories 1 to 6 supports QPSK only. UE Category 7 supports QPSK and 16QAM. (TS25.306-7.3.0)

HSPA, HSPA+ and DC-HSDPA Test Configuration

measurement is required for HSPA, HSPA+ or DC-HSDPA, a KDB inquiry is required to confirm that the wireless mode configurations in the test setup have remained stable throughout the SAR measurements.35 Without prior KDB confirmation to determine the SAR results are acceptable, a PBA is required for TCB approval.

SAR test exclusion for HSPA, HSPA+ and DC-HSDPA is determined according to the following:

1) The HSPA procedures are applied to configure 3GPP Rel. 6 HSPA devices in the required sub-test mode(s) to determine SAR test exclusion.

2) SAR is required for Rel. 7 HSPA+ when SAR is required for Rel. 6 HSPA; otherwise, the 3G SAR test reduction procedure is applied to (uplink) HSPA+ with 12.2 kbps RMC as the primary mode.36 Power is measured for HSPA+ that supports uplink 16 QAM according to configurations in Table C.11.1.4 of 3GPP TS 34.121-1 to determine SAR test reduction.

3) SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

4) Regardless of whether a PBA is required, the following information must be verified and included in the SAR report for devices supporting HSPA, HSPA+ or DC-HSDPA: a) The output power measurement results and applicable release version(s) of 3GPP TS 34.121.

i) Power measurement difficulties due to test equipment setup or availability must be resolved between the grantee and its test lab.

b) The power measurement results are in agreement with the individual device implementation and specifications. When Enhanced MPR (E-MPR) applies, the normal MPR targets may be modified according to the Cubic Metric (CM) measured by the device, which must be taken into consideration.

c) The UE category, operating parameters, such as the β and Δ values used to configure the device for testing, power setback procedures described in 3GGPP TS 34.121 for the power measurements, and HSPA/HSPA+ channel conditions (active and stable) for the entire duration of the measurement according to the required E-TFCI and AG index values.

5) When SAR measurement is required, the test configurations, procedures and power measurement results must be clearly described to confirm that the required test parameters are used, including E-TFCI and AG index stability and output power conditions.

HS-DSCH category	Maximum number of HS-DSCH codes received	Minimum inter-TTI interval	Maximum number of bits of an HS-DSCH transport block received within an HS-DSCH TTI NOTE 1	Total number of soft channel bits	Supported modulations without MIMO operation or dual cell operation	Supported modulations with MIMO operation and without dual cell operation	Supported modulations with dual cell operation
Category 1	5	3	7298	19200	QPSK, 16QAM	Not applicable (MIMO not supported)	Not applicable (dual cell operation not supported)
Category 2	5	3	7298	28800			
Category 3	5	2	7298	28800			
Category 4	5	2	7298	38400			
Category 5	5	1	7298	57600			
Category 6	5	1	7298	67200			
Category 7	10	1	14411	115200			
Category 8	10	1	14411	134400			
Category 9	15	1	20251	172800			
Category 10	15	1	27952	172800			
Category 11	5	2	3630	14400	QPSK		
Category 12	5	1	3630	28800			
Category 13	15	1	35280	259200	QPSK, 16QAM, 64QAM		
Category 14	15	1	42192	259200			
Category 15	15	1	23370	345600	QPSK, 16QAM		
Category 16	15	1	27952	345600			
Category 17 NOTE 2	15	1	35280	259200	QPSK, 16QAM, 64QAM	–	
			23370	345600	–	QPSK, 16QAM	
Category 18 NOTE 3	15	1	42192	259200	QPSK, 16QAM, 64QAM	–	
			27952	345600	–	QPSK, 16QAM	
Category 19	15	1	35280	518400	QPSK, 16QAM, 64QAM		
Category 20	15	1	42192	518400			
Category 21	15	1	23370	345600	-	-	QPSK, 16QAM
Category 22	15	1	27952	345600			
Category 23	15	1	35280	518400			QPSK, 16QAM, 64QAM
Category 24	15	1	42192	518400			

WIFI Test Configurations

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal. The Tx power is set according to tune up procedure for 802.11 b mode by software. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

For the 802.11b/g/n SAR tests, a communication link is set up with the test mode software for WiFi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode.

8. TUNE-UP LIMIT

GSM/GPRS/EDGE850（GMSK）:

1TXslot: 33 dBm[-2.0dB~~+1.0dB]

2TXslot: 30 dBm[-2.0dB~~+1.0dB]

3TXslot: 29 dBm[-2.0dB~~+1.0dB]

4TXslot: 27 dBm [-2.0dB~~+1.0dB]

EDGE850（8PSK）:

1TXslot: 27 dBm[-2.0dB~~+1.0dB]

2TXslot: 25 dBm[-2.0dB~~+1.0dB]

3TXslot: 23 dBm[-2.0dB~~+1.0dB]

4TXslot: 22 dBm [-2.0dB~~+1.0dB]

PCS/GPRS/EDGE 1900（GMSK）:

1TXslot: 30 dBm [-2.0dB~~+1.0dB]

2TXslot: 28 dBm [-2.0dB~~+1.0dB]

3TXslot: 26 dBm [-2.0dB~~+1.0dB]

4TXslot: 25 dBm[-2.0dB~~+1.0dB]

EDGE 1900（8PSK）:

1TXslot: 26 dBm [-2.0dB~~+1.0dB]

2TXslot: 24 dBm [-2.0dB~~+1.0dB]

3TXslot: 22 dBm [-2.0dB~~+1.0dB]

4TXslot: 21 dBm [-2.0dB~~+1.0dB]

The UMTS Band 2/5 power adjust procedure

WCDMA：23 dBm [-3dB~~+1dB]

HSDPA：

HSDPA Subtest 1：22 dBm [-3.7dB~~+1.0dB]

HSDPA Subtest 2：21 dBm [-3.7dB~~+1.0dB]

HSDPA Subtest 3：21 dBm [-3.7dB~~+1.0dB]

HSDPA Subtest 4：21 dBm [-3.7dB~~+1.0dB]

HSUPA：

HSUPA Subtest 1：21 dBm [-6.7dB~~+1.0dB]

HSUPA Subtest 2：21 dBm [-5.2dB~~+1.0dB]

HSUPA Subtest 3：20 dBm [-5.2dB~~+1.0dB]

HSUPA Subtest 4：21 dBm [-5.2dB~~+1.0dB]

HSUPA Subtest 5：21 dBm [-3.7dB~~+1.0dB]

BT Average Power:

BT：8dBm [-3dB~~+1.0dB]
BLE：1dBm [-3dB~~+1.0dB]

The Wi-Fi RF test procedure

WIFI

Average Power：
11b：15dBm[-4dB~~+1.0dB]
11g：13.5dBm[-4dB~~+1.0dB]
11n：10.5dBm[-4dB~~+1.0dB]

9. MEASUREMENT RESULTS

Result: **Passed**

Date of testing 2015-05-25 to 2015-05-28
Ambient temperature : 20℃~22℃
Relative humidity : 50~68%

9.1. Conducted Power

For the measurements a Rohde & Schwarz Radio Communication Tester CMU 200 was used.
SAR drift measured at the same position in liquid before and after each SAR test.

Note: CMU200 measures GSM peak and average output power for active timeslots. For SAR the time based 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	1:8.3	1:4.1	1:2.77	1:2.08
Time based avg. power compared to slotted avg. power	-9.19dB	-6.13dB	-4.42dB	-3.18dB

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.

GSM Conducted Power Measurement Results

Band: GSM850	Burst Average Power (dBm)			Frame Average Power (dBm)		
Channel	**128**	**190**	**251**	**128**	**190**	**251**
Frequency (MHz)	**824.2**	**836.6**	**848.8**	**824.2**	**836.6**	**848.8**
GSM (CS)	33.83	33.73	33.54	24.64	24.54	24.35
GPRS/EDGE (GMSK, 1 Tx slot)	33.83	33.72	33.53	24.64	24.53	24.34
GPRS/EDGE (GMSK, 2 Tx slots)	30.94	31.00	30.85	24.81	**24.87**	24.72
GPRS/EDGE (GMSK, 3 Tx slots)	29.21	28.83	28.76	24.79	24.41	24.34
GPRS/EDGE (GMSK, 4 Tx slots)	27.76	27.27	27.31	24.58	24.09	24.13
EDGE (8PSK, 1 Tx slot)	27.22	27.23	27.09	18.03	18.04	17.9
EDGE (8PSK, 2 Tx slots)	24.91	24.87	24.68	18.78	18.74	18.55
EDGE (8PSK, 3 Tx slots)	23.03	22.99	22.91	18.61	18.57	18.49
EDGE (8PSK, 4 Tx slots)	21.86	21.79	21.58	18.68	18.61	18.4

Remark:

1) The conducted power of GSM850 is measured with RMS detector.
2) Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
3) Per KDB941225 D01v03, the bolded GPRS 2Tx mode was selected as the primary mode for SAR testing according to the highest frame- averaged output power table.

Band: GSM1900	Burst Average Power (dBm)			Frame Average Power (dBm)		
Channel	**512**	**661**	**810**	**512**	**661**	**810**
Frequency (MHz)	**1850.2**	**1880**	**1909.8**	**1850.2**	**1880**	**1909.8**
GSM (CS)	29.93	29.87	30.28	20.74	20.68	21.09
GPRS/EDGE (GMSK, 1 Tx slot)	29.87	29.83	30.19	20.68	20.64	21.00
GPRS/EDGE (GMSK, 2 Tx slots)	28.96	28.88	28.90	22.83	**22.75**	22.77
GPRS/EDGE (GMSK, 3 Tx slots)	25.53	25.40	25.71	21.11	20.98	21.29
GPRS/EDGE (GMSK, 4 Tx slots)	24.82	24.59	24.64	21.64	21.41	21.46
EGPRS (8PSK, 1 Tx slot)	26.38	26.32	26.45	17.19	17.13	17.26
EGPRS (8PSK, 2 Tx slots)	23.91	23.83	23.93	17.78	17.7	17.80
EGPRS (8PSK, 3 Tx slots)	22.11	21.97	22.03	17.69	17.55	17.61
EGPRS (8PSK, 4 Tx slots)	20.61	20.57	20.69	17.43	17.39	17.51

Remark:

1) The conducted power of GSM1900 is measured with RMS detector.
2) Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
3) Per KDB941225 D01v03, the bolded GPRS 2Tx mode was selected as the primary mode for SAR testing according to the highest frame- averaged output power table.

UMTS Conducted Power Measurement Results

Band	WCDMA Band V		
Channel	**4,132**	**4,182**	**4,233**
Frequency (MHz)	**826.4**	**836.4**	**846.6**
RMC 12.2K	23.68	23.56	23.63
RMC 64kbps	22.63	22.67	22.59
RMC 144kbps	22.60	22.64	22.63
RMC 384kbps	22.58	22.68	22.59
HSDPA Subtest-1	21.83	21.73	21.61
HSDPA Subtest-2	20.99	20.95	20.83
HSDPA Subtest-3	20.93	20.89	20.69
HSDPA Subtest-4	20.89	20.86	20.66
HSUPA Subtest-1	20.96	21.06	20.80
HSUPA Subtest-2	21.19	21.10	20.97
HSUPA Subtest-3	20.20	20.29	20.16
HSUPA Subtest-4	21.28	21.64	21.48
HSUPA Subtest-5	21.26	21.36	21.17
DC-HSDPA Subtest-1	21.33	21.28	21.36
DC-HSDPA Subtest-2	20.73	20.78	20.76
DC-HSDPA Subtest-3	20.46	20.52	20.46
DC-HSDPA Subtest-4	20.36	20.22	20.26

Remark:

1) The conducted power of UMTS Band V is measured with RMS detector
2) Per KDB 941225 D01v03, When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤0.25 dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and adjusted SAR is ≤ 1.2W/kg, SAR measurement is not required for the secondary mode.

Band		WCDMA Band II	
Channel	9262	9400	9538
Frequency (MHz)	1852.4	1880.0	1907.6
RMC 12.2K	23.83	23.95	23.88
RMC 64kbps	22.21	22.16	22.26
RMC 144kbps	22.18	22.13	22.3
RMC 384kbps	22.16	22.17	22.26
HSDPA Subtest-1	21.46	21.23	21.72
HSDPA Subtest-2	21.43	21.55	21.80
HSDPA Subtest-3	20.90	21.05	21.26
HSDPA Subtest-4	20.90	21.06	21.26
HSUPA Subtest-1	20.60	21.11	21.12
HSUPA Subtest-2	20.02	20.52	20.75
HSUPA Subtest-3	20.25	20.33	20.36
HSUPA Subtest-4	20.33	20.12	20.13
HSUPA Subtest-5	21.31	21.43	21.67
DC-HSDPA Subtest-1	21.11	21.19	21.32
DC-HSDPA Subtest-2	21.08	21.16	21.36
DC-HSDPA Subtest-3	21.06	21.2	21.32
DC-HSDPA Subtest-4	21.05	21.12	21.28

Remark:

1) The conducted power of UMTS Band II is measured with RMS detector
2) Per KDB 941225 D01v03, When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤0.25 dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and adjusted SAR is ≤ 1.2W/kg, SAR measurement is not required for the secondary mode.

WLAN 2.4GHz Band Conducted Power

Wi-Fi 2450MHz	Channel	Average Power (dBm) for Data Rates (Mbps)								Sar test (Yes or NO)
		1	2	5.5	11	/	/	/	/	Yes Initial Test Configuration
802.11b 2.4G(DSSS)	1(2412)	14.61	14.49	14.44	14.33	/	/	/	/	
	6(2437)	**14.70**	**13.96**	**13.49**	**14.04**	/	/	/	/	
	11(2462)	14.64	14.94	14.00	14.54	/	/	/	/	
802.11g 2.4G(OFDM)	Channel	6	9	12	18	24	36	48	54	Yes Subsequent Test Configuration
	1(2412)	13.56	12.81	12.86	12.78	12.7	12.58	12.36	12.24	
	6(2437)	13.81	13.62	13.59	13.65	13.7	13.37	13.09	12.94	
	11(2462)	13.41	13.24	13.19	12.99	13.04	12.94	12.56	12.42	
802.11n-HT20 2.4G(OFDM)	Channel	MCS0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7	Yes Subsequent Test Configuration
	1(2412)	10.64	9.91	9.88	9.82	9.69	9.47	9.35	8.99	
	6(2437)	10.71	10.59	10.60	10.44	10.34	9.98	9.89	9.70	
	11(2462)	10.65	10.44	10.21	10.33	10.2	9.87	9.65	9.28	
802.11n-HT40 2.4G(OFDM)	Channel	MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7	Yes Subsequent Test Configuration
	3(2422)	10.26	10.21	9.78	9.59	8.75	8.20	7.85	7.60	
	6(2437)	10.31	10.27	10.00	9.85	9.01	8.54	8.22	7.94	
	9(2452)	10.24	10.25	10.01	9.42	8.65	8.10	7.81	7.67	

Remark:

Output Power Measurement Considerations for Wi-Fi 2.4 GHz band
1. 2.4 GHz 802.11b DSSS:

- Output power measurement is not required:
o When SAR Test Exclusion according to KDB 447498 D01 applies.

o When other power measurement reduction applies.
- Otherwise, output power measurement is required on:
o Channels 1, 6, and 11, when the output power specified for other channels is no higher than the abovementioned channels.

o The closest adjacent channels to the aforementioned channels, when the output power specified for these adjacent channels is higher.
- For ease of identification, 802.11b DSSS is identified as the Initial Test Configuration for the 2.4 GHz band.

2. 2.4 GHz 802.11g/n OFDM

- Output power measurement is not required:

o When SAR Test Exclusion according to KDB 447498 D01 applies.

o When SAR Test Exclusion procedures for 2.4 GHz 802.11g/n OFDM applies, according to the SAR measurement results from 802.11b DSSS; see Section 11 of the report for details.
- Otherwise, output power measurement is required for 2.4 GHz 802.11g/n OFDM, with the following considerations:
o If 40 MHz bandwidth configurations are supported, measure power for either Channel 6 or the highest specified output power channel.

o Output power measurement requirements for smaller bandwidth configurations are dependent on the SAR measurement results from the 40 MHz bandwidth configurations.

o If no 40 MHz bandwidth configurations are supported, then a channel selection process similar to 802.11b DSSS is applied.
- The output power measurement is required for 2.4 GHz 802.11g/n OFDM as a result of 802.11b DSSS reported SAR results, the required test configurations in 2.4 GHz 802.11g/n OFDM are identified as Subsequent Test Configurations with respect to the Initial Test Configuration status assigned to 802.11b DSSS.

- If, for a particular antenna or transmit diversity condition supported by the device, no 802.11b DSSS configurations are available, output power should also be measured as a default for 802.11g/n OFDM when SAR Test Exclusion according to KDB 447498 D01 does not apply; these 802.11g/n OFDM configurations are considered the Initial Test Configurations for the respective antenna/transmit diversity condition.
Initial Test Position SAR Test Reduction
For both DSSS and OFDM wireless modes, when an Initial Test Configuration is found to require SAR measurements, an Initial Test Position is established for each applicable exposure configuration (Head, Body, etc.) using either:
- Design implementation details from the manufacturer, or

- Investigative results by the test lab, obtained by performing area scans on the Initial Test Configuration for all applicable test positions and identifying the highest measured SAR from the area scan-only measurements.

Complete SAR scans are then performed on the established Initial Test Position on each exposure configuration, using the Initial Test Configuration. When the reported SAR for this Initial Test Position is: - ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in the exposure configuration and wireless mode combination within the frequency band or aggregated band. - > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the initial test position to measure the subsequent next closest/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel until the reported SAR is ≤ 0.8 W/kg or all required test positions are tested.
- For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, measure the SAR for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required test channels are considered.

Bluetooth 2.4GHz Band Conducted Power

BT	Average Conducted Power (dBm)		
2450	0CH	39CH	78CH

DH1	8.4	**8.9**	8.4
DH3	8.3	**8.4**	8.4
DH5	8.3	**8.3**	8.2
3DH1	4.3	**4.4**	4.3
3DH3	3.8	**3.9**	3.9
3DH5	3.1	**3.1**	3.0

BLE 2450	Average Conducted Power (dBm)		
	0CH	20CH	38CH
	1.4	**1.5**	1.5

9.2. SAR measurement Results

General Notes:

1) Per KDB447498 D01v05r02, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.
2) Per KDB447498 D01v05r02, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is :≤0.8 W/kg or 2.0W/kg, for 1-g or 10-g respectively, when the transmission band is ≤100MHz. When the maximum output power variation across the required test channels is >1/2 dB, instead of the middle channel, the highest output power channel must be used.
3) Per KDB865664 D01v01r03, for each frequency band, repeated SAR measurement is required only when the measure SAR is ≥0.8W/kg; if the deviation among the repeated measurement is ≤20%, and the measured SAR<1.45W/kg, only one repeated measurement is required.
4) Per KDB 941225 D06 Hotspot Mode SAR v02:, the DUT dimension is bigger than 9cm*5cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm, such position does not need to be tested.
5) Per KDB648474 D04v01r02, SAR is evaluated without a headset connected to the device. When the standalone reported body-worn SAR is ≤1.2W/kg, no additional SAR evaluations using a headset are required.
6) Per KDB865664 D02v01r01, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; plots are also required when the measured SAR is >1.5W/kg, or >7.0W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan plots-processing (refer to appendix B for details).

GSM Notes:

Per KDB941225 D01v03, SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested.

UMTS Notes:

Per KDB 941225 D01v03, when maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤1/4dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤1.2 W/kg, SAR measurement is not required for the secondary mode..

Per KDB941225 D01v03, SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

WLAN Notes

Per KDB 248227 D01v02, for all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

Per KDB 248227 D01v02, for 802.11g/n SAR testing is required. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is > 1.2 W/kg.

Per KDB 248227 D01v02, for OFDM transmission configurations in the 2.4 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11g/n mode is used for SAR measurement, on the highest measured output power channel for each frequency band.

Per KDB248227D01,the highest SAR measured for the initial test position or initial test configuration should be used to determine SAR test exclusion according to the sum of 1-g SAR and SAR peak to location ratio provisions in KDB 447498. In addition, a test lab may also choose to perform standalone SAR measurements for test positions and 802.11 configurations that are not required by the initial test position or initial test configuration procedures and apply the results to determine simultaneous transmission SAR test exclusion, according to sum of 1-g and SAR peak to location ratio requirements to reduce the number of simultaneous transmission SAR measurements.

9.3. GSM 850 SAR results

GSM850 Head

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
GSM850	GSM Voice	Right Cheek	190	836.6	33.73	34	1.064	0.626	**0.666**
GSM850	GSM Voice	Right Tilted	190	836.6	33.73	34	1.064	0.362	0.385
GSM850	GSM Voice	Left Cheek	190	836.6	33.73	34	1.064	0.603	0.642
GSM850	GSM Voice	Left Tilted	190	836.6	33.73	34	1.064	0.401	0.427

GSM850	GSM Voice (Battery2#)	Right Cheek	190	836.6	33.73	34	1.064	0.569	0.605
GSM850	GSM Voice(SIM 2#)	Right Cheek	190	836.6	33.73	34	1.064	0.570	0.607

GSM 850 Body

Distance 10mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
GSM850	GPRS (GMSK, 2 Tx slots)	Front Side	190	836.6	31.00	31	1.000	0.766	0.766
GSM850	GPRS (GMSK, 2 Tx slots)	Back Side	128	824.2	30.94	31	1.014	1.060	1.075
GSM850	GPRS (GMSK, 2 Tx slots)	Back Side	190	836.6	31.00	31	1.000	1.060	1.060
GSM850	GPRS (GMSK, 2 Tx slots)	Back Side	251	848.8	30.85	31	1.035	1.080	**1.118**
GSM850	GPRS (GMSK, 2 Tx slots)	Left Side	128	836.6	30.94	31	1.014	0.876	0.888
GSM850	GPRS (GMSK, 2 Tx slots)	Left Side	190	836.6	31.00	31	1.000	0.988	0.988
GSM850	GPRS (GMSK, 2 Tx slots)	Left Side	251	836.6	30.85	31	1.035	0.965	0.999
GSM850	GPRS (GMSK, 2 Tx slots)	Right Side	190	836.6	31.00	31	1.000	0.735	0.735
GSM850	GPRS (GMSK, 2 Tx slots)	Bottom Side	190	836.6	31.00	31	1.000	0.063	0.063
GSM850	GPRS (GMSK, 2 Tx slots,Battery2 #)	Back Side	251	848.8	30.85	31	1.035	1.06	1.097
GSM850	GPRS (GMSK, 2 Tx slots, SIM 2#)	Back Side	251	848.8	30.85	31	1.035	1.064	1.101

Distance 15 mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
GSM850	GSM Voice	Front Side	128	824.2	33.83	34	1.040	0.704	0.732
GSM850	GSM Voice	Front Side	190	836.6	33.73	34	1.064	0.704	0.749
GSM850	GSM Voice	Front Side	251	848.8	33.54	34	1.112	0.730	0.812
GSM850	GSM Voice	Back Side	128	824.2	33.83	34	1.040	1.060	**1.102**
GSM850	GSM Voice	Back Side	190	836.6	33.73	34	1.064	0.930	0.990
GSM850	GSM Voice	Back Side	251	848.8	33.54	34	1.112	0.917	1.019
GSM850	GSM Voice (Battery 2#)	Back Side	128	824.2	33.83	34	1.040	1.051	1.093

9.4. GSM 1900 SAR results

GSM1900 Head

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
GSM1900	GSM Voice	Right Cheek	661	1880.0	29.87	31	1.297	0.198	**0.257**
GSM1900	GSM Voice	Right Tilted	661	1880.0	29.87	31	1.297	0.06	0.078
GSM1900	GSM Voice	Left Cheek	661	1880.0	29.87	31	1.297	0.054	0.070
GSM1900	GSM Voice	Left Tilted	661	1880.0	29.87	31	1.297	0.058	0.075
GSM1900	GSM Voice (Battery2#)	Right Cheek	661	1880.0	29.87	31	1.297	0.138	0.179
GSM1900	GSM Voice(SIM 2#)	Right Cheek	661	1880.0	29.87	31	1.297	0.145	0.188

GSM 1900 Body

Distance 10 mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
GSM1900	GPRS (GMSK, 2 Tx slots)	Front Side	661	1880.0	28.88	29	1.028	0.244	0.251
GSM1900	GPRS (GMSK, 2 Tx slots)	Back Side	661	1880.0	28.88	29	1.028	0.664	0.683
GSM1900	GPRS (GMSK, 2 Tx slots)	Left Side	661	1880.0	28.88	29	1.028	0.048	0.049
GSM1900	GPRS (GMSK, 2 Tx slots)	Right Side	661	1880.0	28.88	29	1.028	0.141	0.145
GSM1900	GPRS (GMSK, 2 Tx slots)	Bottom Side	661	1880.0	28.88	29	1.028	0.546	0.561
GSM1900	GPRS (GMSK, 2 Tx slots,Battery2#)	Back Side	810	1909.8	28.90	29	1.023	0.819	**0.838**
GSM1900	GPRS (GMSK, 2 Tx slots,Battery2#)	Back Side	512	1850.2	28.96	29	1.009	0.681	0.687
GSM1900	GPRS (GMSK, 2 Tx slots,Battery2#)	Back Side	661	1880.0	28.88	29	1.028	0.704	0.724
GSM1900	GPRS (GMSK, 2 Tx slots, SIM 2#)	Back Side	810	1909.8	28.90	29	1.023	0.672	0.688

Distance 15 mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
GSM1900	GSM Voice	Front Side	661	1880.0	29.87	31	1.297	0.128	0.166
GSM1900	GSM Voice	Back Side	661	1880.0	29.87	31	1.297	0.341	**0.442**
GSM1900	GSM Voice (Battery 2#)	Back Side	661	1880.0	29.87	31	1.297	0.323	0.419
GSM1900	GSM Voice (Battery SIM#)	Back Side	661	1880.0	29.87	31	1.297	0.294	0.381

9.5. UMTS Band V　SAR results

UMTS Band V Head

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
UMTS Band V	RMC12.2	Right Cheek	4182	836.4	22.76	24	1.330	0.259	0.345
UMTS Band V	RMC12.2	Right Tilted	4182	836.4	22.76	24	1.330	0.382	0.508
UMTS Band V	RMC12.2	Left Cheek	4182	836.4	22.76	24	1.330	0.506	**0.673**
UMTS Band V	RMC12.2	Left Tilted	4182	836.4	22.76	24	1.330	0.259	0.345
UMTS Band V	RMC12.2 (Battery 2#)	Left Cheek	4182	836.4	22.76	24	1.330	0.411	0.547

UMTS Band V Body

Distance 10mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
UMTS Band V	RMC12.2	Front Side	4182	836.4	23.56	24	1.107	0.598	0.662
UMTS Band V	RMC12.2	Back Side	4132	826.4	23.68	24	1.076	0.773	**0.832**
UMTS Band V	RMC12.2	Back Side	4182	836.4	23.56	24	1.107	0.727	0.805
UMTS Band V	RMC12.2	Back Side	4233	846.6	23.63	24	1.089	0.732	0.797
UMTS Band V	RMC12.2	Left Side	4182	836.4	23.56	24	1.107	0.370	0.409
UMTS Band V	RMC12.2	Right Side	4182	836.4	23.56	24	1.107	0.413	0.457
UMTS Band V	RMC12.2	Bottom Side	4182	836.4	23.56	24	1.107	0.029	0.032
UMTS Band V	RMC12.2 (Battery 2#)	Back Side	4132	826.4	23.68	24	1.076	0.723	0.778

Distance 15mm

Band	**Mode**	**Test Position**	**Ch.**	**Freq. (MHz)**	**Burst Average Power (dBm)**	**Tune-Up Limit (dBm)**	**Scaling Factor**	**Measured SAR 1-g (W/kg)**	**Reported SAR 1-g (W/kg)**
UMTS Band V	RMC12.2	Front Side	4182	836.4	23.68	24	1.057	0.504	0.543
UMTS Band V	RMC12.2	Back Side	4182	836.4	23.68	24	1.057	**0.584**	**0.629**
UMTS Band V	RMC12.2 (Battery 2#)	Back Side	4182	836.4	23.68	24	1.057	0.547	0.589

9.6. UMTS Band II SAR results

UMTS Band II Head

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
UMTS Band II	RMC12.2	Right Cheek	9400	1880.0	23.95	24	1.012	0.489	**0.495**
UMTS Band II	RMC12.2	Right Tilted	9400	1880.0	23.95	24	1.012	0.113	0.114
UMTS Band II	RMC12.2	Left Cheek	9400	1880.0	23.95	24	1.012	0.307	0.311
UMTS Band II	RMC12.2	Left Tilted	9400	1880.0	23.95	24	1.012	0.177	0.179

UMTS Band II Body

Distance 10mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
UMTS Band II	RMC12.2	Front Side	9400	1880.0	23.95	24	1.012	0.314	0.318
UMTS Band II	RMC12.2	Back Side	9262	1852.4	23.83	24	1.040	0.931	0.968
UMTS Band II	RMC12.2	Back Side	9400	1880.0	23.95	24	1.012	1.09	**1.103**
UMTS Band II	RMC12.2	Back Side	9538	1907.6	23.88	24	1.028	0.923	0.949
UMTS Band II	RMC12.2	Left Side	9400	1880.0	23.95	24	1.012	0.026	0.026
UMTS Band II	RMC12.2	Right Side	9400	1880.0	23.95	24	1.012	0.109	0.110
UMTS Band II	RMC12.2	Bottom Side	9262	1852.4	23.83	24	1.040	0.940	0.978
UMTS Band II	RMC12.2	Bottom Side	9400	1880.0	23.95	24	1.012	0.900	0.910
UMTS Band II	RMC12.2	Bottom Side	9538	1907.6	23.88	24	1.028	0.850	0.874
UMTS Band II	RMC12.2 (Battery 2#)	Back Side	9400	1880.0	23.95	24	1.012	0.863	0.873

Distance 15mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
UMTS Band II	RMC12.2	Front Side	9400	1880.0	23.95	24	1.012	0.388	0.392
UMTS Band II	RMC12.2	Back Side	9400	1880.0	23.95	24	1.012	0.465	**0.470**
UMTS Band II	RMC12.2 (Battery 2#)	Back Side	9400	1880.0	23.95	24	1.012	0.405	0.410

9.7. WIFI SAR results

WIFI Head

Band	Mode	Test Position	Ch.	Freq. (MHz)	Area scan SAR 1-g (W/kg)	
WIFI 2.4G	11b	Left Cheek	6	2437	0.141	Initial test position
WIFI 2.4G	11b	Left Tilted	6	2437	0.112	/
WIFI 2.4G	11b	Right Cheek	6	2437	0.131	/
WIFI 2.4G	11b	Right Tilted	6	2437	0.055	/

Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
WIFI 2.4G	11b	Left Cheek	6	2437	14.70	16	1.349	0.143	0.193
WIFI 2.4G	11b (Battery 2#)	Left Cheek	6	2437	14.70	16	1.349	0.322	**0.434**
WIFI 2.4G	11b (Battery 2#)	Left Tilted	6	2437	14.70	16	1.349	0.119	0.161
WIFI 2.4G	11b (Battery 2#)	Right Cheek	6	2437	14.70	16	1.349	0.135	0.182
WIFI 2.4G	11b (Battery 2#)	Right Tilted	6	2437	14.70	16	1.349	0.063	0.085

WIFI Body

Distance 10mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Area scan SAR 1-g (W/kg)	
WIFI 2.4G	11b	Back Side	6	2437	0.093	Initial test position
WIFI 2.4G	11b	Front Side	6	2437	0.064	/
WIFI 2.4G	11b	Left Side	6	2437	0.035	/
WIFI 2.4G	11b	Top Side	6	2437	0.062	/

Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
WIFI 2.4G	11b	Back Side	6	2437	14.70	16	1.349	0.093	**0.125**
WIFI 2.4G	11b (Battery 2#)	Back Side	6	2437	14.70	16	1.349	0.091	0.123

Distance 15mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Area scan SAR 1-g (W/kg)	
WIFI 2.4G	11b	Front Side	6	2437	0.050	/
WIFI 2.4G	11b	Back Side	6	2437	0.093	Initial test position

Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
WIFI 2.4G	11b	Back Side	6	2437	14.70	16	1.349	0.091	0.123
WIFI 2.4G	11b (Battery 2#)	Back Side	6	2437	14.70	16	1.349	0.092	**0.124**

9.8. Repeated SAR results

Remark:

1. Per KDB 865664 D01v01r03, for each frequency band, repeated SAR measurement is required only when the measured SAR is ⩾0.8W/kg.

2. Per KDB 865664 D01v01r03, if the ratio among the repeated measurement is ⩽ 1.2 and the measured SAR<1.45W/kg, only one repeated measurement is required.

3. The ratio is the difference in percentage between original and repeated measured SAR.

4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR 1-g (W/kg)	Reported SAR 1-g (W/kg)
GSM850	GPRS (GMSK, 2 Tx slots)	Back Side 10mm	251	848.8	30.85	31	1.035	1.066	1.103
GSM850	GSM Voice	Back Side 15mm	128	824.2	33.83	34	1.040	1.040	1.082
GSM1900	GPRS (GMSK, 2 Tx slots,Battery2 #)	Back Side 10mm	810	1909.8	28.90	29	1.023	0.803	0.822
UMTS II	RMC12.2	Back Side 10mm	9538	1907.6	23.88	24	1.028	0.911	0.937
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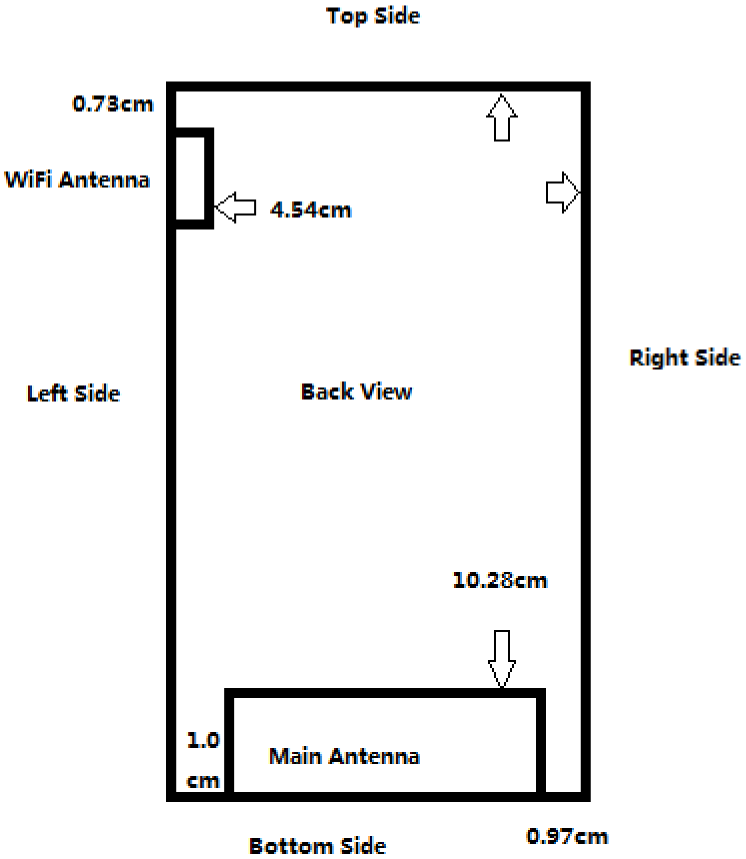
Measured SAR of all frequency band are lower than 0.8W/kg, repeated SAR is not required .

10. EXPOSURE POSITIONS CONSIDERATION

10.1. Multiple Transmitter Evaluation



Mode	Front Side	Back Side	Left Side	Right Side	Top Side	Bottom Side
Main Antenna	YES	YES	YES	YES	NO	YES
WiFi 2.4G Antenna	YES	YES	YES	NO	YES	NO

10.2. Stand-alone SAR test exclusion

Per FCC KDB447498D01v05, the 1-g SAR and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances ≤50 mm are determined by:

[(max.power of channel, including tune-up tolerance,Mw)/(min.test separation distance,mm)]*[√f(GHz)]) ≤3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where:

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

When the minimum test separation distance is <5mm, a distance of 5 mm is applied to determine SAR test exclusion.

Mode	Position	P_{max} (dBm)	P_{max} (mW)	Distance (mm)	f(GHz)	Calculation result	SAR Exclusion threshold	SAR Test exclusion
BT	Body-worn	9	7.94	15	2.45	0.83	3	yes

Table 5 standalone SAR test exclusion for BT

Note:

1) *- maximum possible output power declared by manufacturer

2) Held to ear configurations are not applicable to Bluetooth for this device.

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

[(max.power of channel, including tune-up tolerance,Mw)/(min.test separation distance,mm)]*[√ f(GHz)/x]W/kg for test separation distances≤ 50mm,where x=7.5 for 1-g SAR and x=18.75 for 10-g SAR.

When the minimum test separation distance is <5mm, a distance of 5 mm is applied to determine SAR test exclusion

Mode	Position	P_{max} (dBm)	P_{max} (mW)	Distance (mm)	f(GHz)	X	Estimated SAR(W/Kg)*
BT	Body-worn	9	7.94	15	2.45	7.5	0.111

Table 6： Estimated SAR calculation for BT

1) *- maximum possible output power declared by manufacturer

2) Held to ear configurations are not applicable to Bluetooth and therefore were not considered for simultaneous transmission.

10.3.Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities of this device are as below:

No.	Configuration	Head	Body-worn	Hotspot
1	GSM(voice)+ WiFi2.4G	Yes	Yes	N/A
2	GPRS/EDGE(DATA)+ WiFi2.4G	N/A	N/A	Yes
3	GSM(voice)+ BT	N/A	Yes	N/A
4	GPRS/EDGE(DATA)+ BT	N/A	N/A	N/A
5	UMTS(Voice)+ WiFi2.4G	Yes	Yes	N/A
6	UMTS(DATA)+ WiFi2.4G	N/A	Yes	Yes
7	UMTS(Voice)+ BT	N/A	Yes	N/A
8	UMTS(DATA)+ BT	N/A	Yes	N/A

Table 7: Simultaneous Transmission Possibilities

Note:

1) Wi-Fi 2.4G and Bluetooth share the same Tx antenna and can’t transmit simultaneously.
2) 2G&3G can’t transmit simultaneously.
3) Held to ear configurations are not applicable to Bluetooth and therefore were not considered for simultaneous transmission.

10.4.**SAR Summation Scenario**

Test Position		Left hand touched	Left hand tilted 15 °	Right hand touched	Right hand tilted 15 °
MAX 1-g SAR (W/kg)	GSM850	0.642	0.427	0.666	0.385
	GSM1900	0.070	0.075	0.257	0.078
	UMTS Band II	0.311	0.179	0.495	0.114
	UMTS Band V	0.673	0.345	0.345	0.508
	2.4G WiFi	0.434	0.161	0.182	0.085
Σ1-g SAR(W/kg)		1.107	0.588	0.848	0.593

Test Position		Front Side (10mm)	Back Side (10mm)	Left Side (10mm)	Right Side (10mm)	Top Side (10mm)	Bottom Side (10mm)	Front Side (15mm)	Back Side (15mm)
MAX 1-g SAR (W/kg)	GSM850	0.766	1.118	0.999	0.735	/	0.063	0.812	1.102
	GSM1900	0.251	0.838	0.049	0.145	/	0.561	0.166	0.442
	UMTS Band II	0.318	1.103	0.026	0.110	/	0.978	0.392	0.470
	UMTS Band V	0.662	0.832	0.409	0.457	/	0.032	0.543	0.629
	2.4G WiFi	0.125	0.125	0.125	/	0.125	/	0.124	0.124
Σ1-g SAR(W/kg)		0.891	1.243	1.124	0.735	0.125	0.561	0.936	1.226

Test Position		Front Side(15mm)	Back Side(15mm)
MAX 1-g SAR (W/kg)	GSM850	0.812	1.102
	GSM1900	0.166	0.442
	UMTS Band II	0.392	0.470
	UMTS Band V	0.543	0.629
	BT	0.111	0.111
Σ1-g SAR(W/kg)		0.923	1.213

10.5.Simultaneous Transmission Conclusion

The above numeral summed SAR results and SPLSR analysis is sufficient to determine that simultaneous cases will not exceed the SAR limit and therefore simultaneous transmission SAR with Volume Scan is not required per KDB 447498 D01v05r02

11. PHOTOGRAPHS OF THE TEST SET-UP

Photo 1: Measurement System DASY5	N/A
	N/A

Photograph: Liquid depth

Photo 2: HSL850 Depth (15.1cm)	Photo 3: HSL1900 Depth (15cm)

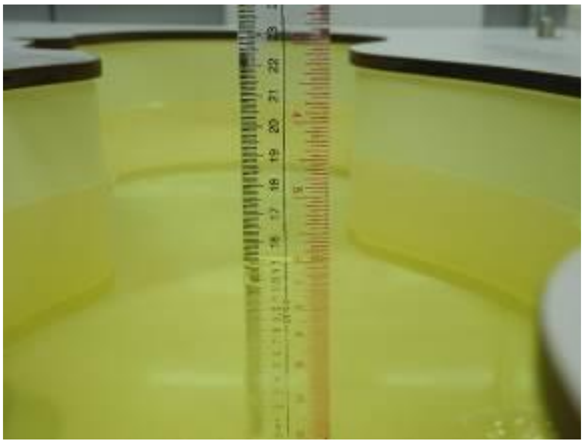
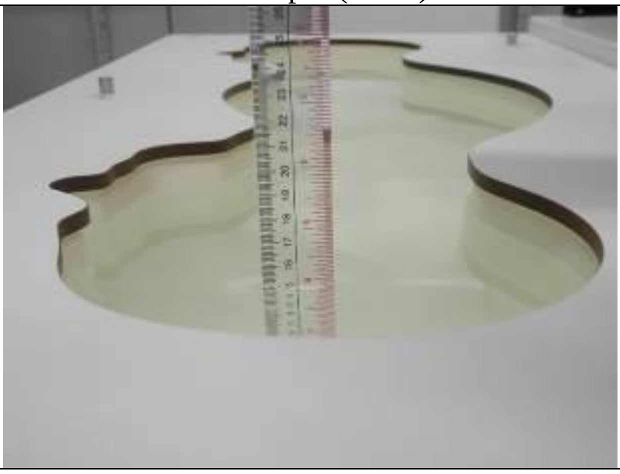
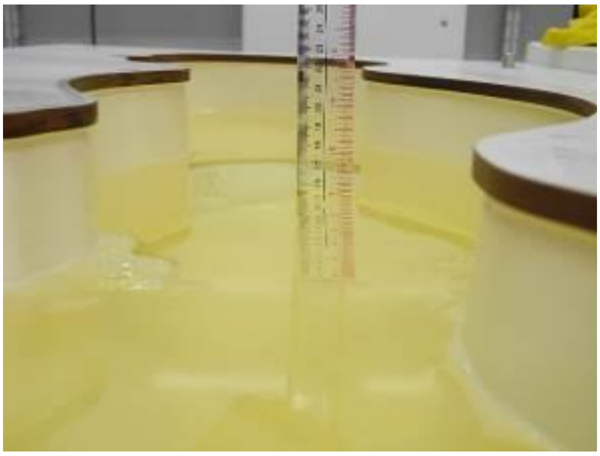
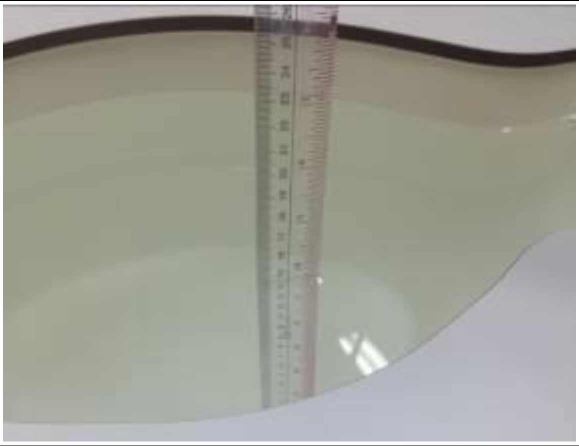

	

Photo 4: HSL2450 Depth (15.0cm)	Photo 5: Body 850 Depth (15.0cm)
	
Photo 6: Body1900 Depth (15.0cm)	Photo 7: Body2450 Depth (15.0cm)
	

Appendix A. System Check Plots
(Pls see Appendix A)

Appendix B. MEASUREMENT SCANS
(Pls see Appendix B)

AppendixC RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)
(Pls see Appendix C)

Appendix D. RELEVANT PAGES FROM DAE&DIPOLE VALIDATION KIT REPORT(S)
(Pls see Appendix D)