

SAR TEST REPORT

For

Handheld Data Terminal

Model Number: i6200S

FCC ID: SWSI6200S

Report Number: WT168001369

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Test report declaration

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EUTDescription : Handheld Data Terminal
Model No : i6200S
Trade mark : UROVO
FCC ID : SWSI6200S

Test Standards:

IEEE Std 1528-2013, KDB941225 D01, KDB941225 D05, 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.

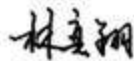
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Date: Apr 22, 2016

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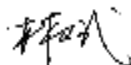
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1. REPORTED SAR SUMMARY

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	0.227	0.177	0.209
GSM1900	0.137	0.211	0.204
UMTS Band II	0.272	0.313	0.449
UMTS Band V	0.193	0.209	0.294
Wi-Fi 2.4G	1.11	0.108	0.155

The highest simultaneous SAR value is 1.38W/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 1528-2013& 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)	1.60mW/g	8.00mW/g
Spatial Average SAR** (Whole Body)	0.08mW/g	0.40mW/g
Spatial Peak SAR***(Limbs)	4.00mW/g	20.00mW/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 of employment or occupation.)

1.3 Ratings and System Details

Device type :	Portable Device	
DUT Name:	Handheld Data Terminal	
Type Identification:	i6200S	
IMEI No :	35817305102727708	
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/GPRS(GMSK),EDGE(8PSK),UMTS(QPSK),Wi-Fi(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
Wi-Fi(tested):	2400-2483.5 MHz	
BT:	2400-2483.5 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 IV)	
	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(Wi-Fi 802.11b)	
Hardware version :	V04	
Software version :	4.3	
Antenna type :	Integrated Antenna	
Battery options :	Shenzhen Urovo Technology Co., Ltd. Bao An Factory	Gionee Communication Equipment Co., Ltd Li-polymer Battery Battery Model: HBL6200 Rated capacity: Nominal Voltage: $\text{---} +3.80\text{V}$ Charge Voltage: $\text{---} +4.35\text{V}$

1.4 Product Function and Intended Use

i6200S is subscriber equipment in the WCDMA/GSM system.

The HSPA+/HSUPA/HSDPA/UMTS frequency band is Band I, Band II, Band V and Band VIII. Band V and Band II 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 SAM card interface, SIM 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 1528-2013	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 devices v03r01	3G SAR MEAUREMENT PROCEDURES
KDB941225 D06 Hotspot Mode v02r01	SAR Evaluation Procedures for portable Devices with Wireless Router Capabilities
KDB447498 D01 General RF Exposure Guidance v06	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB 648474 D04 Handset SAR v01r03	SAR Evaluation Considerations for Wireless Handsets.
KDB 248227 D01 802.11 Wi-Fi SAR v02r02	SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS
KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04	SAR Measurement Requirements for 100 MHz to 6 GHz
KDB 865664 D02 RF Exposure Reporting v01r02	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	2016.03.02	1year
3	SAR Probe	ES3DV3	3203	SPEAG	2016.01.12	1year
4	SAR Probe	EX3DV4	3881	SPEAG	2015.07.24	1year
5	Software	85070	--	SPEAG	--	--
6	Software	DASY5	--	SPEAG	--	--
7	System Validation Dipole,835MHz	D835V2	4d141	SPEAG	2015.09.24	3year
8	System Validation Dipole,1900MHz	D1900V2	5d162	SPEAG	2015.09.16	3year
9	System Validation Dipole,2450MHz	D2450V2	818	SPEAG	2015.09.14	3year
10	Dielectric Probe Kit	85070E	MY44300455	Agilent	NCR	NCR
11	Dual-directional coupler,0.10-2.0GHz	778D	MY48220198	Agilent	2014.12.18	3year
12	Dual-directional coupler,2.00-18GHz	772D	MY46151160	Agilent	2014.12.18	3year
13	Coaxial attenuator	8491A	MY39266348	Agilent	2014.12.11	3year
14	Power Amplifier	ZHL42W	81709	MINI-CIRCUITS	2014.12.18	3year
15	Power Amplifier	ZVE-8G	SC280800926	MINI-CIRCUITS	2014.12.18	3year
16	Signal Generator	SMR20	100047	R&S	2015.05.12	1year
17	Power Meter	NRVD	100041	R&S	2015.04.16	1year
18	Call Tester	CMU 200	100110	R&S	2015.12.06	1year
19	Network Analyzer	E5071C	MY46109550	Agilent	2015.07.02	1Year
20	Flat Phantom	ELI4.0	TP-1904	SPEAG	NCR	NCR
21	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.

3. GENERAL INFORMATION

3.1. 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.

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3.2. 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.

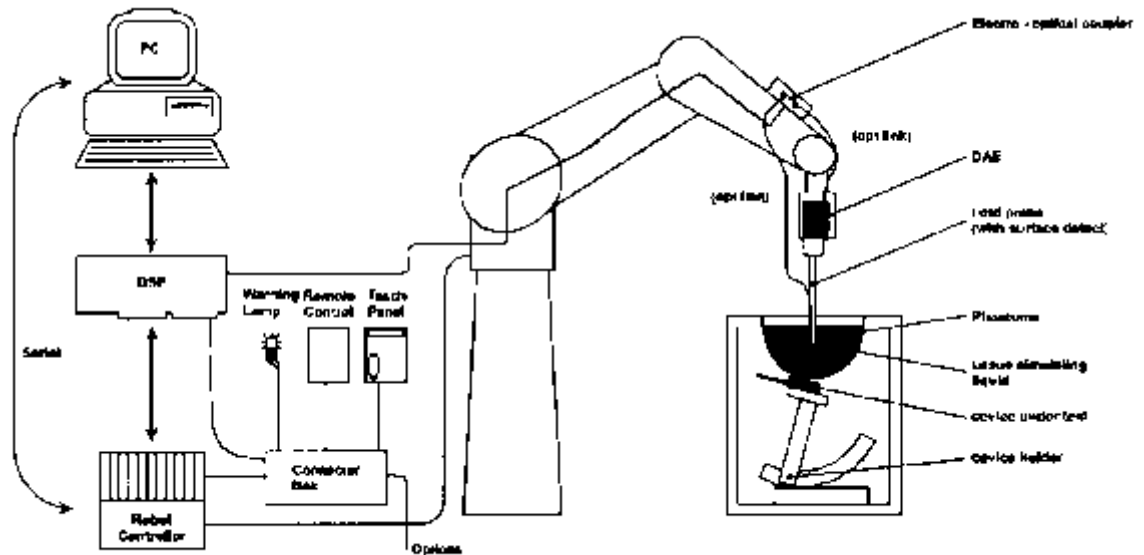
The Laboratory is listed in the United States of American Federal Communications Commission (FCC), and the registration number are 446246 806614 994606 (semi anechoic chamber).

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.

4. SAR MEASUREMENT SYSTEM CONFIGURATION

4.1. 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 checks dipoles allowing validating the proper functioning of the system.
- Test environment
- The DASY5 measurement system is placed at the head end of a room with dimensions: 4.5 x 4 x 3 m³, 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.

4.2. 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%.	

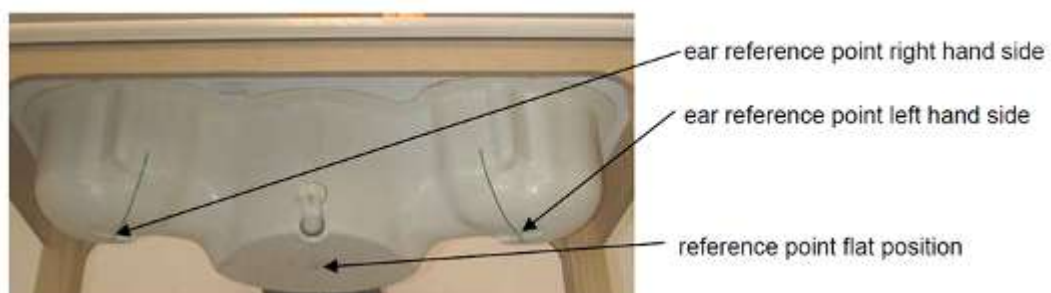
Isotropic E-Field Probe ES3DV3 for Dosimetric Measurements

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 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones	

4.3. 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 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.	

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 .

4.4. 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.

5. SAR MEASUREMENT PROCEDURE

5.1. 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 $\pm 0.1\text{mm}$). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within $\pm 30^\circ$.)
- 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 ($\leq 2\text{GHz}$), 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} , $\Delta y_{\text{zoom}} \leq 2\text{GHz} \leq 8 \text{ mm}$, $2\text{-}4\text{GHz} - \leq 5 \text{ mm}$ and $4\text{-}6 \text{ GHz} - \leq 4 \text{ mm}$; $\Delta z_{\text{zoom}} \leq 3\text{GHz} - \leq 5 \text{ mm}$, $3\text{-}4 \text{ GHz} - \leq 4 \text{ mm}$ and $4\text{-}6\text{GHz} - \leq 2\text{mm}$ 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 ($\Delta x_{\text{area}}, \Delta y_{\text{area}}$)	Maximum Zoom Scan spatial resolution ($\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}}$)	Maximum Zoom Scan spatial resolution			Minimum zoom scan volume (x,y,z)
			Uniform Grid	Graded Grad		
				$\Delta z_{\text{zoom}}(n)$	$\Delta z_{\text{zoom}}(1)$	
$\leq 2\text{GHz}$	$\leq 15\text{mm}$	$\leq 8\text{mm}$	$\leq 5\text{mm}$	$\leq 4\text{mm}$	$\leq 1.5 * \Delta z_{\text{zoom}}(n-1)$	$\geq 30\text{mm}$
2-3GHz	$\leq 12\text{mm}$	$\leq 5\text{mm}$	$\leq 5\text{mm}$	$\leq 4\text{mm}$	$\leq 1.5 * \Delta z_{\text{zoom}}(n-1)$	$\geq 30\text{mm}$
3-4GHz	$\leq 10\text{mm}$	$\leq 5\text{mm}$	$\leq 4\text{mm}$	$\leq 3\text{mm}$	$\leq 1.5 * \Delta z_{\text{zoom}}(n-1)$	$\geq 28\text{mm}$
4-5GHz	$\leq 10\text{mm}$	$\leq 4\text{mm}$	$\leq 3\text{mm}$	$\leq 2.5\text{mm}$	$\leq 1.5 * \Delta z_{\text{zoom}}(n-1)$	$\geq 25\text{mm}$
5-6GHz	$\leq 10\text{mm}$	$\leq 4\text{mm}$	$\leq 2\text{mm}$	$\leq 2\text{mm}$	$\leq 1.5 * \Delta z_{\text{zoom}}(n-1)$	$\geq 22\text{mm}$

Spatial Peak SAR Evaluation

- The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have

been done. The bases 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 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 compensate boundary effects on E-field probes.

6.1.1.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	Normi, ai0, ai1, ai2
- Conversion factor	ConvFi	
- Diode compression point	Dcpi	
Device parameters:	- Frequency	f
- Crest factor	cf	
Media parameters:	- Conductivity	σ
- Density	ρ	

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the 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:

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

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)

$dcpi$ = 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/cm³

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. 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/cm²

E_{tot} = total electric field strength in V/m

H_{tot} = total magnetic field strength in A/m

7. SYSTEM VERIFICATION PROCEDURE

7.1. Tissue Verification

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within $\pm 5\%$ of the target values.

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

Ingredients(% of weight)	Head Tissue		
Frequency Band(MHz)	835	1900	2450
Water	41.45	55.242	62.7
Salt(NaCl)	1.45	0.306	0.5
Sugar	56.0	0.0	0.0
HEC	1.0	0.0	0.0
Bactericide	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0
DGBE	0.0	44.542	36.8
Ingredients(% of weight)	Body Tissue		
Frequency Band(MHz)	835	1900	2450
Water	52.4	69.91	73.2
Salt(NaCl)	1.40	0.13	0.04
Sugar	45.0	0.0	0.0
HEC	1.0	0.0	0.0
Bactericide	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0
DGBE	0.0	29.96	26.7

Table 4 : Tissue Dielectric Properties

Salt: 99+% Pure Sodium Chloride; Sugar: 98+% Pure Sucrose; Water: De-ionized, 16M Ω + 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)		
850MHz Head	41.5 (39.43~43.58)	0.90 (0.86~0.95)	42.0	0.91	22°C	2016/4/6
1900MHz Head	40.0 (38.00~42.00)	1.40 (1.33~1.47)	40.5	1.39	22°C	2016/4/7
2450MHz Head	39.2 (37.24~41.16)	1.80 (1.71~1.89)	39.4	1.80	22°C	2016/4/8
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)		
850MHz Body	55.2 (52.44~57.96)	0.97 (0.92~1.02)	56.1	0.98	22°C	2016/4/6
1900MHz Body	53.3 (50.64~55.97)	1.52 (1.44~1.60)	54.2	1.50	22°C	2016/4/7
2450MHz Body	52.7 (50.07~55.34)	1.95 (1.85~2.05)	52.2	1.93	22°C	2016/4/8
ϵ_r = Relative permittivity, σ = Conductivity						

System checking, Head Tissue-equivalent liquid:

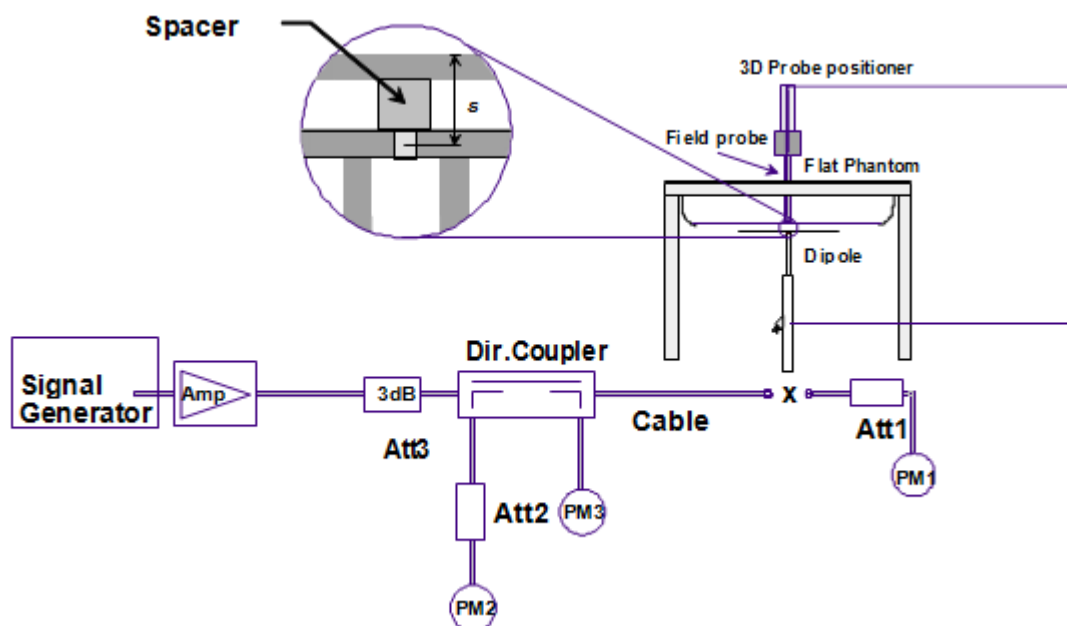
System Check	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (W/kg)	10-g (W/kg)	1-g (W/kg)	10-g (W/kg)		
D835V2 Head	9.45 (8.5~10.4)	6.11 (5.50~6.72)	9.48	6.16	22°C	2016/4/6
D1900V2 Head	40.4 (36.4~44.4)	21.0 (18.9~23.1)	40.4	20.0	22°C	2016/4/7
D2450V2 Head	52.7 (47.4~58.0)	24.6 (22.1~27.1)	55.2	23.8	22°C	2016/4/8

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	9.51 (8.6~10.5)	6.25 (5.6~7.2)	9.92	6.44	22°C	2016/4/6
D1900V2 Body	41.2 (37.1~45.3)	21.6 (19.4~23.8)	44.4	21.96	22°C	2016/4/7
D2450V2 Body	51.1 (46.0~56.2)	23.9 (21.5~26.3)	53.2	23.2	22°C	2016/4/8

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.

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).

8. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

8.1. SAR measurement variability

Per KDB865664 D01 SAR measurement 100MHz to 6GHz v01r04, 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 ≥ 1.5 W/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.

8.2. SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100MHz to 6GHz v01r03, when the highest measured 1-g SAR within a frequency band is <1.5 W/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.

9. Test Configuration

The DUT is tested using a CMU 200 or E5515C 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 CMU 200 or 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 $\leq \frac{1}{4}$ 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 required 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 spreading 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 (β_c , β_d), and HS-DPCCH power offset parameters (Δ_{ACK} , Δ_{NACK} , Δ_{CQI}) 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 $\Delta_{CQI} = 8$ $\beta_{hs} = \beta_c/\beta_d = 30/15$ $\beta_{hs} = 30/15 * \beta_c$
 Note2: CM=1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$.
 Note3: 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 signaled gain factors for the reference TFC (TFC1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$.

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	$\beta_{hs}^{(1)}$	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	$\beta_{ed1}:47/15$ $\beta_{ed2}:47/15$	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: $\Delta_{ACK}, \Delta_{NACK}$ and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.
 Note 2: CM = 1 for $\beta_c/\beta_d = 12/15, \beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
 Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.
 Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$.
 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: β_{ed} 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 3GPP 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				QPSK, 16QAM, 64QAM
Category 13	15	1	35280	259200				QPSK, 16QAM
Category 14	15	1	42192	259200				QPSK, 16QAM
Category 15	15	1	23370	345600	QPSK, 16QAM			
Category 16	15	1	27952	345600	QPSK, 16QAM			
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	QPSK, 16QAM, 64QAM			
Category 21	15	1	23370	345600	QPSK, 16QAM, 64QAM			
Category 22	15	1	27952	345600	QPSK, 16QAM, 64QAM			
Category 23	15	1	35280	518400	-	-	QPSK, 16QAM	
Category 24	15	1	42192	518400	-	-	QPSK, 16QAM, 64QAM	

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.

10. TUNE-UP LIMIT

GSM/GPRS850 (GMSK) :

1TXslot: 32 dBm [-2.0dB~~+1.0dB]

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

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

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

EDGE850 (8PSK) :

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

2TXslots: 23 dBm [-2.0dB~~+1.0dB]

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

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

PCS/GPRS 1900 (GMSK) :

1TXslot: 31 dBm [-2.0dB~~+1.0dB]

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

3TXslots: 27 dBm [-2.0dB~~+1.0dB]

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

EDGE 1900 (8PSK) :

1TXslot: 25 dBm [-2.0dB~~+1.0dB]

2TXslots: 22 dBm [-2.0dB~~+1.0dB]

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

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

The UMTS Band II power adjust procedure

WCDMA : 24 dBm [-3dB~~+1dB]

HSDPA :

HSDPA Subtest 1 : 23 dBm [-2dB~~+1.0dB]

HSDPA Subtest 2 : 23 dBm [-2dB~~+1.0dB]

HSDPA Subtest 3 : 23 dBm [-2dB~~+1.0dB]

HSDPA Subtest 4 : 23 dBm [-2dB~~+1.0dB]

HSUPA :

HSUPA Subtest 1 : 22 dBm [-2.0dB~~+1.0dB]

HSUPA Subtest 2 : 22 dBm [-2.0dB~~+1.0dB]

HSUPA Subtest 3 : 21 dBm [-2.0dB~~+1.0dB]

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

HSUPA Subtest 5 : 21 dBm [-2.0dB~~+1.0dB]

The UMTS Band V power adjust procedure

WCDMA : 24 dBm [-3dB~~+1dB]

HSDPA :

HSDPA Subtest 1 : 23 dBm [-3.7dB~~+1.0dB]

HSDPA Subtest 2 : 22 dBm [-3.7dB~~+1.0dB]

HSDPA Subtest 3 : 22 dBm [-3.7dB~~+1.0dB]

HSDPA Subtest 4 : 22 dBm [-3.7dB~~+1.0dB]

HSUPA :

HSUPA Subtest 1 : 22 dBm [-2dB~~+1.0dB]

HSUPA Subtest 2 : 22 dBm [-2dB~~+1.0dB]

HSUPA Subtest 3 : 21 dBm [-2dB~~+1.0dB]

HSUPA Subtest 4 : 22 dBm [-2dB~~+1.0dB]

HSUPA Subtest 5 : 22 dBm [-2dB~~+1.0dB]

BT Average Power:

BT : 0 dBm [-3dB~~+2.0dB]

BLE : 0 dBm [-3dB~~+1.0dB]

The Wi-Fi RF test procedure

Average Power :

11b : 14 dBm [-1dB~~+1.0dB]

11g : 8 dBm [-3dB~~+1.0dB]

11n : 8 dBm [-6dB~~+1.0dB]

11. MEASUREMENT RESULTS

Result: Passed

Date of testing : 2016.04.06~2016.04.08
 Ambient temperature : 20°C~22°C
 Relative humidity : 50~68%

11.1. 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)		
	128	190	251	128	190	251
Channel	824.2	836.6	848.8	824.2	836.6	848.8
Frequency (MHz)	824.2	836.6	848.8	824.2	836.6	848.8
GSM (CS)	32.39	32.31	32.10	23.2	23.12	22.91
GPRS/EDGE (GMSK, 1 Tx slot)	32.48	32.33	32.06	23.29	23.14	22.87
GPRS/EDGE (GMSK, 2 Tx slots)	30.16	30.10	29.88	24.03	23.97	23.75
GPRS/EDGE (GMSK, 3 Tx slots)	29.23	29.03	28.82	24.81	24.61	24.4
GPRS/EDGE (GMSK, 4 Tx slots)	27.25	27.19	26.84	24.07	24.01	23.66
EDGE (8PSK, 1 Tx slot)	26.44	26.36	26.09	17.25	17.17	16.9
EDGE (8PSK, 2 Tx slots)	23.43	23.42	23.14	17.3	17.29	17.01
EDGE (8PSK, 3 Tx slots)	22.50	22.34	22.12	18.08	17.92	17.7

EDGE (8PSK, 4 Tx slots)	21.57	21.44	21.07	18.39	18.26	17.89
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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 3 Tx 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)	30.74	31.01	31.21	21.55	21.82	22.02
GPRS/EDGE (GMSK, 1 Tx slot)	30.79	31.05	31.28	21.6	21.86	22.09
GPRS/EDGE (GMSK, 2 Tx slots)	27.92	28.19	28.46	21.79	22.06	22.33
GPRS/EDGE (GMSK, 3 Tx slots)	26.74	26.99	27.25	22.32	22.57	22.83
GPRS/EDGE (GMSK, 4 Tx slots)	24.68	24.97	25.07	21.5	21.79	21.89
EGPRS (8PSK, 1 Tx slot)	25.19	25.49	25.59	16	16.3	16.4
EGPRS (8PSK, 2 Tx slots)	22.48	22.66	22.85	16.35	16.53	16.72
EGPRS (8PSK, 3 Tx slots)	21.93	22.27	22.47	17.51	17.85	18.05
EGPRS (8PSK, 4 Tx slots)	21.11	21.43	21.65	17.93	18.25	18.47

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.

Per KDB941225 D01v03, the bolded GPRS 3 Tx mode was selected as the primary mode for SAR testing according to the highest frame- averaged output power table.

UMTS Conducted Power Measurement Results

UMTS Band II		Conducted Power (dBm)		
		9263CH	9400CH	9538CH
WCDMA	12.2kbps RMC	24.36	23.87	24.03
	64kbps RMC	24.14	23.78	23.99
	144kbps RMC	24.11	23.75	24.03
	384kbps RMC	24.09	23.79	23.99
HSDPA	Subtest 1	23.25	23.16	23.39
	Subtest 2	23.05	22.47	22.66
	Subtest 3	23.17	22.51	22.55
	Subtest 4	23.29	22.39	22.82
HSUPA	Subtest 1	22.97	22.48	22.55
	Subtest 2	21.74	21.90	22.14
	Subtest 3	21.42	21.44	21.67
	Subtest 4	22.16	21.98	22.24
	Subtest 5	21.54	21.30	20.97

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 ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

UMTS Band V		Conducted Power (dBm)		
		4132CH	4182CH	4233CH
WCDMA	12.2kbps RMC	24.47	24.37	24.00
	64kbps RMC	24.4	24.32	23.95
	144kbps RMC	24.42	24.24	24.00
	384kbps RMC	24.45	24.36	24.00
HSDPA	Subtest 1	23.41	23.20	22.96
	Subtest 2	22.70	22.57	22.34
	Subtest 3	22.60	22.43	22.22
	Subtest 4	22.78	22.41	22.38
HSUPA	Subtest 1	22.78	22.61	22.34
	Subtest 2	22.15	21.82	21.69
	Subtest 3	21.82	21.34	21.29
	Subtest 4	22.63	22.33	22.08
	Subtest 5	22.32	21.69	21.10

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 ≤ 1.2 W/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	/	/	/	/	
802.11b 2.4G(DSSS)	1(2412)	13.05	12.93	12.88	12.77	/	/	/	/	Yes Initial Test Configurati on
	6(2437)	13.75	13.01	12.54	13.09	/	/	/	/	
	11(2462)	14.08	14.38	13.44	13.98	/	/	/	/	
802.11g 2.4G(OFDM)	Channel	6	9	12	18	24	36	48	54	Yes Subsequen t Test Configurati on
	1(2412)	6.44	5.69	5.74	5.66	5.58	5.46	5.24	5.12	
	6(2437)	8.08	7.89	7.86	7.92	7.97	7.64	7.36	7.21	
	11(2462)	6.34	6.17	6.12	5.92	5.97	5.87	5.49	5.35	
802.11n-HT 20 2.4G(OFDM)	Channel	MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7	Yes Subsequen t Test Configurati on
	1(2412)	6.45	5.72	5.69	5.63	5.5	5.28	5.16	4.8	
	6(2437)	8.1	7.98	7.99	7.83	7.73	7.37	7.28	7.09	
	11(2462)	8.51	8.3	8.07	8.19	8.06	7.73	7.51	7.14	

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 2450	Average Conducted Power (dBm)		
	0CH	39CH	78CH
DH1	-0.25	0.77	1.47
DH3	-0.24	0.76	1.46
DH5	-0.26	0.75	1.45
3DH1	-0.35	0.35	1.0
3DH3	-0.36	0.34	0.99
3DH5	-0.37	0.33	0.98

BLE 2450	Average Conducted Power (dBm)		
	0CH	20CH	39CH
	-0.8	0.003	0.76

11.2.SAR measurement Results

General Notes:

- 1) Per KDB447498 D01v06, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.
- 2) Per KDB447498 D01v06, 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 ≤ 100 MHz. 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 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measure SAR is ≥ 0.8 W/kg; if the deviation among the repeated measurement is $\leq 20\%$, and the measured SAR <1.45 W/kg, only one repeated measurement is required.
- 4) Per KDB 941225 D06 Hotspot Mode SAR v02:r01, 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 D04v01r03, SAR is evaluated without a headset connected to the device. When the standalone reported body-worn SAR is ≤ 1.2 W/kg, no additional SAR evaluations using a headset are required.
- 6) Per KDB865664 D02v01r02, 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 >1.5 W/kg, or >7.0 W/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 D01v03r01, 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 D01v03r01, when maximum output power and tune-up tolerance specified for production units in a secondary mode is $\leq 1/4$ 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..

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 D01v02r02, 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 D01v02r02, 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 D01v02r02, 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.

11.3.GSM 850 SAR results

GSM 850 Head

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
GSM850	GSM Voice	Right Cheek	190	836.6	32.31	33	1.172	0.194	0.227
GSM850	GSM Voice	Right Tilted	190	836.6	32.31	33	1.172	0.076	0.089
GSM850	GSM Voice	Left Cheek	190	836.6	32.31	33	1.172	0.095	0.111
GSM850	GSM Voice	Left Tilted	190	836.6	32.31	33	1.172	0.031	0.036

GSM 850 Body

Distance 10mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
GSM850	GPRS (GMSK, 3 Tx slots)	Front Side	190	836.6	29.03	30	1.25	0.126	0.158
GSM850	GPRS (GMSK, 3 Tx slots)	Back Side	190	836.6	29.03	30	1.25	0.167	0.209
GSM850	GPRS (GMSK, 3 Tx slots)	Left Side	190	836.6	29.03	30	1.25	0.105	0.131
GSM850	GPRS (GMSK, 3 Tx slots)	Right Side	190	836.6	29.03	30	1.25	0.104	0.13
GSM850	GPRS (GMSK, 3 Tx slots)	Bottom Side	190	836.6	29.03	30	1.25	0.076	0.095

Distance 15 mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
GSM850	GSM Voice	Front Side	190	836.6	32.31	33	1.172	0.116	0.136
GSM850	GSM Voice	Back Side	190	836.6	32.31	33	1.172	0.151	0.177

11.4.PCS 1900 SAR results

GSM1900 Head

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
GSM1900	GSM Voice	Right Cheek	661	1880.0	31.01	32	1.256	0.109	0.137
GSM1900	GSM Voice	Right Tilted	661	1880.0	31.01	32	1.256	0.034	0.043
GSM1900	GSM Voice	Left Cheek	661	1880.0	31.01	32	1.256	0.084	0.106
GSM1900	GSM Voice	Left Tilted	661	1880.0	31.01	32	1.256	0.017	0.021

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 (W/kg)	Reported SAR (W/kg)
GSM1900	GPRS (GMSK, 3 Tx slots)	Front Side	661	1880	26.99	27	1.002	0.116	0.116
GSM1900	GPRS (GMSK, 3 Tx slots)	Back Side	661	1880	26.99	27	1.002	0.204	0.204
GSM1900	GPRS (GMSK, 3 Tx slots)	Left Side	661	1880	26.99	27	1.002	0.119	0.119
GSM1900	GPRS (GMSK, 3 Tx slots)	Right Side	661	1880	26.99	27	1.002	0.127	0.127
GSM1900	GPRS (GMSK, 3 Tx slots)	Bottom Side	661	1880	26.99	27	1.002	0.079	0.079

Distance 15 mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
GSM1900	GSM Voice	Front Side	661	1880.0	31.01	32	1.256	0.079	0.099
GSM1900	GSM Voice	Back Side	661	1880.0	31.01	32	1.256	0.168	0.211

11.5.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 (W/kg)	Reported SAR (W/kg)
UMTS Band II	RMC12.2	Right Cheek	9400	1880.0	23.87	24	1.03	0.264	0.272
UMTS Band II	RMC12.2	Right Tilted	9400	1880.0	23.87	24	1.03	0.146	0.15
UMTS Band II	RMC12.2	Left Cheek	9400	1880.0	23.87	24	1.03	0.146	0.15
UMTS Band II	RMC12.2	Left Tilted	9400	1880.0	23.87	24	1.03	0.076	0.078

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 (W/kg)	Reported SAR (W/kg)
UMTS Band II	RMC12.2	Front Side	9400	1880.0	23.87	24	1.03	0.178	0.183
UMTS Band II	RMC12.2	Back Side	9400	1880.0	23.87	24	1.03	0.436	0.449
UMTS Band II	RMC12.2	Left Side	9400	1880.0	23.87	24	1.03	0.192	0.198
UMTS Band II	RMC12.2	Right Side	9400	1880.0	23.87	24	1.03	0.204	0.21
UMTS Band II	RMC12.2	Bottom Side	9400	1880.0	23.87	24	1.03	0.104	0.107

Distance 15mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
UMTS Band II	RMC12.2	Front Side	9400	1880.0	23.87	24	1.03	0.266	0.274
UMTS Band II	RMC12.2	Back Side	9400	1880.0	23.87	24	1.03	0.304	0.313

11.6.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 (W/kg)	Reported SAR (W/kg)
UMTS Band V	RMC12.2	Right Cheek	4182	836.4	24.37	25	1.156	0.2	0.231
UMTS Band V	RMC12.2	Right Tilted	4182	836.4	24.37	25	1.156	0.143	0.165
UMTS Band V	RMC12.2	Left Cheek	4182	836.4	24.37	25	1.156	0.167	0.193
UMTS Band V	RMC12.2	Left Tilted	4182	836.4	24.37	25	1.156	0.102	0.118

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 (W/kg)	Reported SAR (W/kg)
UMTS Band V	RMC12.2	Front Side	4182	836.4	24.37	25	1.156	0.174	0.201
UMTS Band V	RMC12.2	Back Side	4182	836.4	24.37	25	1.156	0.273	0.316
UMTS Band V	RMC12.2	Left Side	4182	836.4	24.37	25	1.156	0.184	0.213
UMTS Band V	RMC12.2	Right Side	4182	836.4	24.37	25	1.156	0.254	0.294
UMTS Band V	RMC12.2	Bottom Side	4182	836.4	24.37	25	1.156	0.076	0.088

Distance 15mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
UMTS Band V	RMC12.2	Front Side	4182	836.4	24.37	25	1.156	0.142	0.164
UMTS Band V	RMC12.2	Back Side	4182	836.4	24.37	25	1.156	0.181	0.209

11.7.WIFI SAR results

WIFI Head

Band	Mode	Test Position	Ch.	Freq. (MHz)	Area scan SAR 1-g (W/kg)	
WIFI 2.4G	802.11b	Left Cheek	6	2437	0.45	Initial test position
WIFI 2.4G	802.11b	Left Tilted	6	2437	0.13	Initial test position
WIFI 2.4G	802.11b	Right Cheek	6	2437	0.777	Initial test position
WIFI 2.4G	802.11b	Right Tilted	6	2437	0.22	Initial test position

Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
WIFI 2.4G	802.11b	Left Cheek	6	2437	13.75	15	1.334	0.403	0.537
WIFI 2.4G	802.11b	Left Tilted	6	2437	13.75	15	1.334	0.127	0.169
WIFI 2.4G	802.11b	Right Cheek	1	2412	13.05	15	1.972	0.709	1.11
WIFI 2.4G	802.11b	Right Cheek	6	2437	13.75	15	1.334	0.808	1.08
WIFI 2.4G	802.11b	Right Cheek	11	2462	14.08	15	1.236	0.786	0.971
WIFI 2.4G	802.11b	Right Tilted	6	2437	13.75	15	1.334	0.217	0.289

WIFI Body

Distance 10mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Area scan SAR 1-g (W/kg)	
WIFI 2.4G	802.11b	Front Side	6	2437	0.11	/
WIFI 2.4G	802.11b	Back Side	6	2437	0.118	Initial test position
WIFI 2.4G	802.11b	Right Side	6	2437	0.03	/
WIFI 2.4G	802.11b	Top Side	6	2437	0.12	/

Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
WIFI 2.4G	802.11b	Front Side	6	2437	13.75	15	1.334	0.116	0.155

Distance 15mm

Band	Mode	Test Position	Ch.	Freq. (MHz)	Area scan SAR 1-g (W/kg)	
WIFI 2.4G	802.11b	Front Side	6	2437	0.081	Initial test position
WIFI 2.4G	802.11b	Back Side	6	2437	0.1	/

Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Measured SAR (W/kg)	Reported SAR (W/kg)
WIFI 2.4G	802.11b	Front Side	6	2437	13.75	15	1.334	0.081	0.108

11.8.Repeated SAR results

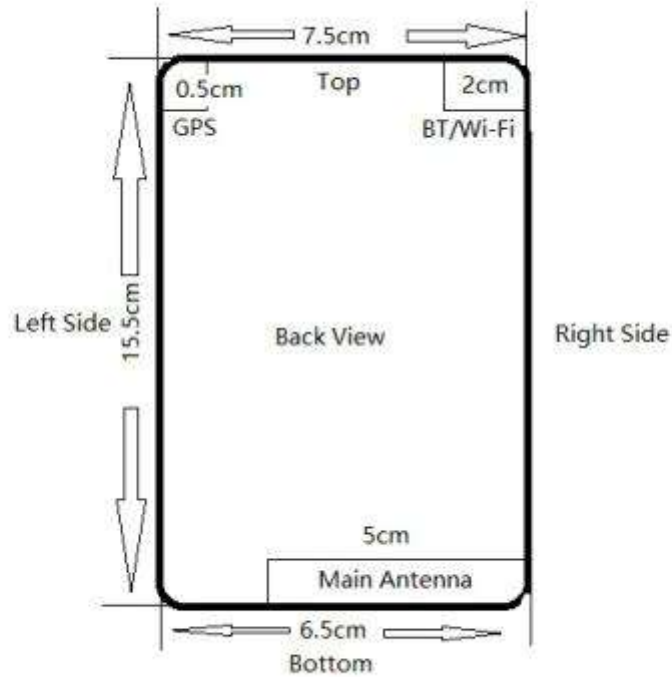
Remark:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is $\geq 0.8\text{W/kg}$.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR $< 1.45\text{W/kg}$, 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 (W/kg)	Reported SAR (W/kg)
WIFI 2.4G	802.11b	Right Cheek	1	2412	13.05	15	1.972	0.7	1.1
WIFI 2.4G	802.11b	Right Cheek	6	2437	13.75	15	1.334	0.792	1.06
WIFI 2.4G	802.11b	Right Cheek	11	2462	14.08	15	1.236	0.76	0.94

12. EXPOSURE POSITIONS CONSIDERATION

12.1. Multiple Transmitter Evaluation



Mode	Front Side	Back Side	Left Side	Right Side	Top Side	Bottom Side
Main Antenna	YES	YES	YES	YES	NO	YES
Wi-Fi 2.4G Antenna	YES	YES	NO	YES	YES	NO

12.2. Stand-alone SAR test exclusion

Per FCC KDB447498D01v06, the 1-g SAR and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances ≤ 50 mm are determined by:

$$\left[\frac{\text{(max.power of channel, including tune-up tolerance, Mw)}}{\text{(min.test separation distance, mm)}} \right] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$$
 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	Pmax (dBm)	Pmax (mW)	Distance (mm)	f(GHz)	Calculation result	SAR Exclusion threshold	SAR Test exclusion
BT	Body-worn	1.47	1.4	15	2480	0.1	1	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:

$$\left[\frac{\text{max.power of channel, including tune-up tolerance, Mw}}{\text{min.test separation distance, mm}} \right]^x \cdot \sqrt{f(\text{GHz})} / \text{W/kg}$$
 for test separation distances $\leq 50\text{mm}$, 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	Pmax (dBm)	Pmax (mW)	Distance (mm)	f(GHz)	X	Estimated SAR(W/Kg)*
BT	Body-worn	1.47	1.4	15	2480	7.5	0.019

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.

12.3.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&4G can't transmit simultaneously.
- 3) Held to ear configurations are not applicable to Bluetooth and therefore were not considered for simultaneous transmission.

12.4.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	0.111	0.036	0.227	0.089
	GSM1900	0.106	0.021	0.137	0.043
	UMTS Band II	0.15	0.078	0.272	0.15
	UMTS Band V	0.193	0.118	0.231	0.165
	2.4G Wi-Fi	0.537	0.169	1.11	0.289
Σ 1-g SAR(W/kg)		0.73	0.287	1.38	0.454





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	0.158	0.209	0.131	0.13	--	0.095	0.136	0.177
	GSM1900	0.116	0.204	0.119	0.127	--	0.079	0.099	0.211
	UMTS Band II	0.183	0.449	0.198	0.21	--	0.107	0.274	0.313
	UMTS Band V	0.201	0.316	0.213	0.294	--	0.088	0.164	0.209
	2.4G Wi-Fi	0.11	0.155	--	0.03	0.12	--	0.108	0.1
Σ 1-g SAR(W/kg)		0.311	0.604	0.213	0.324	0.12	0.107	0.382	0.413

Test Position		Front Side(15mm)	Back Side(15mm)
MAX 1-g SAR (W/kg)	GSM850	0.136	0.177
	GSM1900	0.099	0.211
	UMTS Band II	0.274	0.313
	UMTS Band V	0.164	0.209
	BT	0.019	0.019
Σ 1-g SAR(W/kg)		0.293	0.332

12.5.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 D01v06

13. PHOTOGRAPHS OF THE TEST SET-UP

Photo 1: Measurement System DASY5	Photo 2: Front View
	
Photo 3: Rear View	Photo 4: Left hand touched
	
Photo 5: Left hand tilted 15°	Photo 6: Right hand touched
	








<p>Photo 7: Right hand tilted 15°</p>	<p>Photo 8: Front Side 15mm</p>
	
<p>Photo 9: Back Side 15mm</p>	<p>Photo 10: Front Side 10mm</p>
	
<p>Photo 11: Back Side 10mm</p>	<p>Photo 12: Left Side 10mm</p>
	

Photo 13: Right Side 10mm	Photo 14: Top Side 10mm
	
Photo 15: Bottom Side 10mm	N/A
	N/A

Photograph: Liquid depth

<p>Photo 16: HSL850 Depth (15.1cm)</p>	<p>Photo 17: HSL1900 Depth (15cm)</p>
<p>A close-up photograph of a yellow liquid in a container. A vertical ruler is placed in the center, showing the liquid level at approximately 15.1 cm.</p>	<p>A photograph of a white container with a wavy edge. A vertical ruler is placed in the center, showing the liquid level at 15 cm.</p>
<p>Photo 18: HSL2450 Depth (15.0cm)</p>	<p>Photo 19: Body 850 Depth (15.0cm)</p>
<p>A close-up photograph of a white container. A vertical ruler is placed in the center, showing the liquid level at 15.0 cm.</p>	<p>A photograph of a yellow liquid in a container. A vertical ruler is placed in the center, showing the liquid level at 15.0 cm.</p>
<p>Photo 20: Body1900 Depth (15.0cm)</p>	<p>Photo 21: Body2450 Depth (15.0cm)</p>
<p>A close-up photograph of a green liquid in a container. A vertical ruler is placed in the center, showing the liquid level at 15.0 cm.</p>	<p>A photograph of a white container. A vertical ruler is placed in the center, showing the liquid level at 15.0 cm.</p>

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)