FCC SAR Compliance Test Report

Project Name: LTE/HSPA+/HSUPA/HSDPA/ UMTS/GSM/GPRS/EDGE Mobile Phone with Bluetooth

Model : 201HW

FCC ID : QISU9201L

Report No. : SYBH(Z-SAR)011062012-2

	APPROVED	CHECKED	PREPARED
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※ ※ Modified History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Release	2012-07-27	Yang Hang
Rev.1.1	Updated the report as below the following: 1) Update the LTE Band XLI tune-up power in table 1; 2) Updated the power difference used 50%RB allocation instead of all the RB allocation on page 31; 3) Update the target MPR value of 50%RB and remove MPR Allowed by 3GPP(dB) column on section 7.1.2 .	2012-08-09	Yang Hang
Rev.1.2	Add a brief explanation for the derivation of the 0.429 duty cycle into the SAR report on page 23~24.	2012-08-13	Yang Hang

1 General Information

1.1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for 201HW are as below Table 1.

Band	Test Configuration	Test Mode	Measured MAX SAR1g (W/kg)	MAX Conducted Power (dBm)	Tune-up Power (dBm)	Extrapolated Result (W/kg)
GSM 1900	Head	GSM	**0.439**	29.76	30.50	0.521
	Body Worn(10mm)	GPRS 2TS	0.603	26.79	28.00	0.797
	Hotspot(10mm)	GPRS 2TS	0.632	26.79	28.00	0.835
LTE Band XLI	Head	QPSK	0.270	23.31	23.50	0.282
	Body Worn(10mm)	QPSK	**0.716**	23.23	23.50	0.762
	Hotspot(10mm)	QPSK	**0.936**	23.31	23.50	0.978
WiFi	Head	802.11 b	0.227	15.73	/	/
	Body Worn(10mm)	802.11 b	0.179	15.73	/	/
	Hotspot(10mm)	802.11 b	0.179	15.73	/	/
Simultaneous SAR_{Max} is 0.936W/kg						

Table 1: Summary of test result

The device is in compliance with Specific Absorption Rate（SAR）for general population/uncontraolled exposure limits of 1.6 W/Kg as averaged over any 1 g tissue according to the FCC rule §2.1093, the ANSI/IEEE C 95.1:1999, the NCRP Report Number 86 for uncontrolled environment, according to the Health Canada's Safety Code 6 and the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2003 & IEEE Std 1528a-2005 and FCC OET Bulletin 65 Supplement C Edition 01-01.

1.2 RF exposure limits

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*** (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

Table 2: RF exposure limits

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

Notes:

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

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

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

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

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

1.3 EUT Description

Device Information:			
DUT Name:	LTE/HSPA+/HSUPA/HSDPA/UMTS/GSM/GPRS/EDGE Mobile Phone with Bluetooth		
Type Identification:	201HW		
FCC ID :	QISU9201L		
S/N No.:	T2E01B9231400082		
Device Type :	portable device		
Exposure Category:	uncontrolled environment / general population		
Hardware Version :	U9201L_VA		
Software Version :	U9201LV100R001C111B108		
Antenna Type :	Internal		
Battery Options :	Huawei Technologies Co., Ltd. Rechargeable Li-ion Battery Model: HB5R1H; Rated capacity: 1930mAh; Nominal Voltage: ⎓ +3.7V; Charging Voltage: ⎓ +4.2V.		
Others Accessories	Headset		
Device Operating Configurations:			
Supporting Mode(s)	GSM1900,LTE Band XLI,WiFi（Tested）; Bluetooth		
Test Modulation	GMSK，QPSK/16QAM		
Device Class	B		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM1900	1850-1910	1930-1990
	LTE Band XLI	2545-2575	2545-2575
	Bluetooth	2400-2483.5	2400-2483.5
	WiFi	2400-2483.5	2400-2483.5
GPRS Multislot Class (10)	Max Number of Timeslots in Uplink:		2
	Max Number of Timeslots in Downlink:		4
	Max Total Timeslot:		5
EGPRS Multislot Class (10)	Max Number of Timeslots in Uplink:		2
	Max Number of Timeslots in Downlink:		4
	Max Total Timeslot:		5
Power Class :	1, tested with power level 0 (GSM1900)		
	3, tested with power control all Max.(LTE Band XLI)		
Test Channels(low-mid-high):	512-661-810 (GSM1900)		
	40190-40290-40390(LTE Band XLI BW=10MHz)		
	40240-40290-40340(LTE Band XLI BW=20MHz)		
	1-6-11(WiFi)		

Table 3: Device information and operating configuration

1.3.1 General Description

201HW is subscriber equipment in the LTE/WCDMA/GSM system. The LTE frequency band is AXGP B41, it included in this report. The HSPA+/HSUPA/HSDPA/UMTS frequency band is Band I, Band VIII and Band XI, but not included in this report. The GSM/GPRS/EDGE frequency band includes GSM900 and DCS1800 and PCS1900, but only PCS1900MHz test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, LTE/WCDMA/GSM protocol processing, voice, video, MMS service, GPS, AGPS and WIFI etc. Externally it provides micro SD card interface, earphone port (to provide voice service) and USIM card interface. It also provides Bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other Bluetooth devices.

1.3.2 LTE information Summary

Items	Device Operating Configurations for LTE	Remark
1	Frequency Range of each LTE transmission band	Band 41: 2545 MHz to 2575 MHz
2	Channel Bandwidths	Band 41: 10MHz, 20MHz
3	H,M,L channel numbers and frequencies	10MHz： Ch No.: 40190（2550MHz） Ch No.: 40290（2560MHz） Ch No.: 40390（2570MHz） 20MHz： Ch No.: 40240（2555MHz） Ch No.: 40290（2560MHz） Ch No.: 40340（2565MHz）
4a	UE Category	3
4b	Modulations Supported in UL	QPSK, 16QAM
5	Description of LTE Tx and Ant. Implementation	Refer to page 33 , Definition of Antennas
6	Identify the LTE voice/data requirements in each operating mode and exposure condition	Exposure conditions 1) Head&Body SAR is required; 2) Hotspot SAR is required.
7	LTE MPR Permanently implement per 3GPP TS36.101 section 6.2.3~6.2.5?(manufacturer attestation to be provided)	Yes，pls refer to page 22. MPR is permanently built-in by design；A-MPR was disabled.
8	Conducted power table provided for 1RB(Low and high offset),50%RB(centered),100%RB	Refer to the RF Output Power Table
9~10	Non-LTE operating Modes and Band	* Supported band & Exposure conditions 1) Bluetooth 2.4GHz - Exposure Conditions: BT SAR is not required due to its low power and antenna separation distance. 2) WiFi 2.4GHz - Exposure Conditions: Head/Body SAR required * WiFi Hotspot is supported. 3) Supported WWAN bands: GSM1900 -Exposure Conditions: Head and Body SAR required; Hotspot SAR required on select modes.
11	Simultaneous Tx Conditions	Refer to page 34, Simultaneous Tx Combination
12	Power Reduction used for SAR Compliance	NO
13	Supporting descriptions for power reduction	NO
14	When appropriate, include a SAR test plan proposal with respect to the above	Not Applicable
15	If applicable, include preliminary SAR test data and/or supporting information in laboratory testing inquiries to address specific issues and concerns or for requesting further test reduction considerations appropriate for the device; for example,simultaneous transmission configurations	Not Applicable

Table 4: LTE information Summary per FCC KDB 941225 D05

1.4 Test specification(s)

IEEE Std C95.1 – 1999	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.
IEEE 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 Amendment 1: CAD File for Human Head Model (SAM Phantom)
OET Bulletin No. 65, Supplement C Edition 01-01– 2001	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields---Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions
Canada's Safety Code 6	Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz (99-EHD-237)
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands (Issue 4 of March 2010)
KDB248227 D01	SAR Measurement Procedures for 802.11 a,b,g Transmitters
KDB941225 D06	Hot Spot SAR v01
KDB941225 D05	SAR for LTE Devices v01
KDB648474 D01	SAR Handsets Multi Xmiter and Ant v01r05

1.5 Testing laboratory

Test Site	The Reliability Laboratory of Huawei Technologies Co., Ltd.
Test Location	Zone K3,Huawei Industrial Base, Bantian Industry Area, Longgang District, Shenzhen, Guangdong, China
Telephone	+86 755 28780808
Fax	+86 755 89652518
State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. CNAS Registration number: L0310 A2LA Registration number: 2174.01

1.6 Applicant and Manufacturer

Company Name	HUAWEI TECHNOLOGIES CO., LTD
Address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C

1.7 Application details

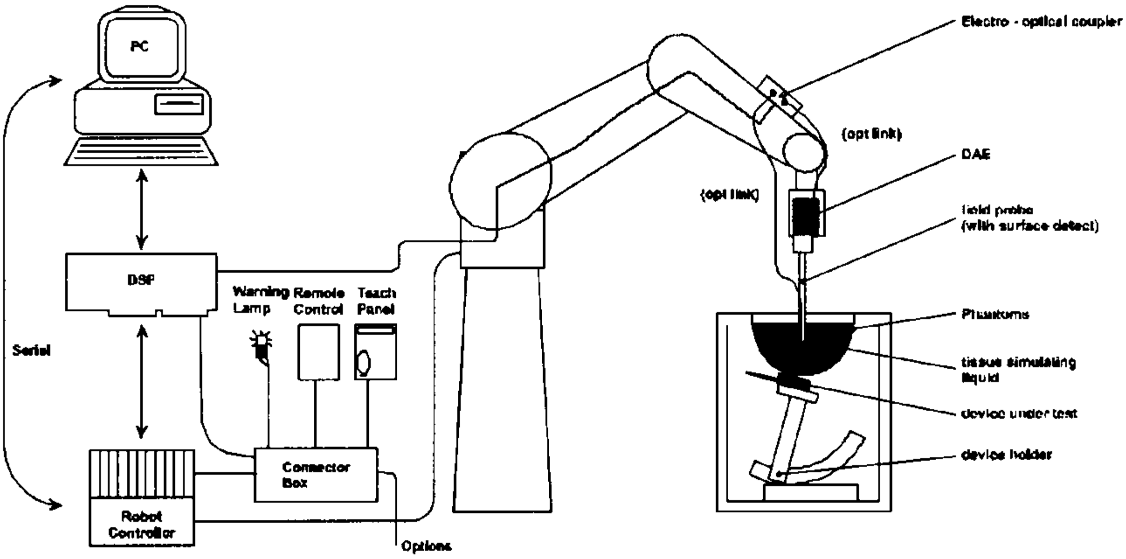
Start Date of test	2012-06-27
End Date of test	2012-07-23

1.8 Ambient Condition

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

2 SAR Measurement System

2.1 SAR Measurement Set-up



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

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

2.2 Test environment

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

2.3 Data Acquisition Electronics description

The data acquisition electronics (DAE) consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converte and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

DAE4

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

2.4 Probe description

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

Isotropic E-Field Probe ES3DV3 for Dosimetric Measurements

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

Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

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

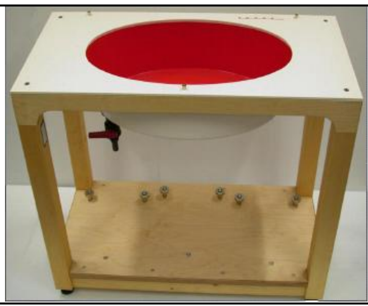
2.5 Phantom description

SAM Twin Phantom

Shell Thickness	2mm +/- 0.2 mm; The ear region: 6mm	
Filling Volume	Approximately 30 liters	
Dimensions	Length:1000mm; Width:500mm; Height: adjustable feet	
Measurement Areas	Left hand Right hand Flat phantom	

The bottom plate contains three pairs of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.
A white cover is provided to cover the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on top of this phantom cover are possible. Three reference marks are provided on the phantom counter. These reference marks are used to teach the absolute phantom position relative to the robot.

ELI4 Phantom

Shell Thickness	2mm +/- 0.2 mm	
Filling Volume	Approximately 30 liters	
Dimensions	Length:1000mm; Width:500mm; Height: adjustable feet	
Measurement Areas	Flat phantom	

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209-2 and all known tissue simulating liquids.

2.6 Device holder description

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

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

2.7 Test Equipment List

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

	Manufacturer	Device	Type	Serial number	Date of last calibration)*
☒	SPEAG	Dosimetric E-Field Probe	ES3DV3	3168	2011-09-27
☒	SPEAG	Dosimetric E-Field Probe	EX3DV4	3736	2012-04-26
☐	SPEAG	750 MHz Validation Dipole	D750V3	1044	2011-09-16
☐	SPEAG	835 MHz Validation Dipole	D835V2	4d126	2011-11-07
☐	SPEAG	1800 MHz Validation Dipole	D1800V2	2d184	2011-03-08
☒	SPEAG	1900 MHz Validation Dipole	D1900V2	5d143	2011-09-26
☒	SPEAG	2450 MHz Validation Dipole	D2450V2	860	2011-03-08
☒	SPEAG	2600 MHz Validation Dipole	D2600V2	1021	2011-11-22
☒	SPEAG	Data acquisition electronics	DAE4	852	2011-11-16
☒	SPEAG	Data acquisition electronics	DAE4	1236	2012-03-28
☐	SPEAG	Data acquisition electronics	DAE4	914	2011-12-08
☒	SPEAG	Software	DASY 5	N/A	N/A
☐	SPEAG	Twin Phantom	SAM1	TP-1475	N/A
☐	SPEAG	Twin Phantom	SAM2	TP-1474	N/A
☒	SPEAG	Twin Phantom	SAM3	TP-1597	N/A
☒	SPEAG	Twin Phantom	SAM4	TP-1620	N/A
☐	SPEAG	Flat Phantom	ELI 4.0	TP-1038	N/A
☐	SPEAG	Flat Phantom	ELI 4.0	TP-1111	N/A
☒	Anritsu	WideBand Radio Communication Tester	MT8820C	6200971028	2012-05-09
☒	R & S	Universal Radio Communication Tester	CMU 200	111379	2011-08-06
☒	Agilent)*	Network Analyser	E5071B	MY42404956	2012-02-14
☒	Agilent	Dielectric Probe Kit	85070E	2484	N/A
☒	Agilent	Signal Generator	N5181A	MY47420989	2012-02-14
☒	MINI-CIRCUITS	Amplifier	ZHL-42W	QA0746001	N/A
☒	Agilent	Power Meter	E4417A	MY45101339	2012-02-14
☒	Agilent	Power Meter Sensor	E9321A	MY44420359	2012-02-14

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.

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

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

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

3 SAR Measurement Procedure

3.1 Scanning procedure

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

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

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

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

- A 7x7x7 zoom scan measures the field in a volume around the 2D peak SAR value acquired in the previous coarse scan. This is a fine 7x7 grid where the robot additionally moves the probe in 7 steps along the z-axis away from the bottom of the Phantom. Grid spacing for the cube measurement is 5 mm in x and y-direction and 5 mm in z-direction. DASY5 is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in Appendix B. Test results relevant for the specified standard (see chapter 1.4.) are shown in table form in chapter 7.2.

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

3.2 Spatial Peak SAR Evaluation

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

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

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

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

Extrapolation

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

Interpolation

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

Volume Averaging

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

Advanced Extrapolation

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

3.3 Data Storage and Evaluation

Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".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:

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

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

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

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

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

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

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

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

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

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

with SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.The power flow density is calculated assuming the excitation field to be a free space field.

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

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

4 System Verification Procedure

4.1 Tissue Verification

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

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

Ingredients (% of weight)	Head Tissue					
Frequency Band (MHz)	750	835	1800	**1900**	**2450**	**2600**
Water	39.2	41.45	52.64	54.9	62.7	55.242
Salt (NaCl)	2.7	1.45	0.36	0.18	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
Cellulose	1.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	47.0	44.92	36.8	44.452
Preventol	0.1	0.0	0.0	0.0	0.0	0.0
Ingredients (% of weight)	Body Tissue					
Frequency Band (MHz)	750	835	1800	**1900**	**2450**	**2600**
Water	50.3	52.4	69.91	71.88	73.2	70.4
Salt (NaCl)	1.6	1.40	0.13	0.39	0.04	0.1
Sugar	47	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
Cellulose	1.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	29.96	29.44	26.7	29.5
Preventol	0.1	0.0	0.0	0.0	0.0	0.0

Table 5: 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

Tissue Type	Measured Frequency （MHz）	Target Tissue		Measured Tissue		Liquid Temp.	Test Date
		εr (+/-5%)	σ (S/m) (+/-5%)	εr	σ (S/m)		
1900H	1850	40.0 (38.00~42.00)	1.40 (1.33~1.47)	40.65	1.382	21.4°C	2012-6-27
	1880	40.0 (38.00~42.00)	1.40 (1.33~1.47)	40.60	1.410		
	1910	40.0 (38.00~42.00)	1.40 (1.33~1.47)	40.49	1.431		
	1900	40.0 (38.00~42.00)	1.40 (1.33~1.47)	40.39	1.428		
1900B	1850	53.3 (50.64~55.97)	1.52 (1.44~1.60)	52.60	1.534	21.4°C	2012-6-27
	1880	53.3 (50.64~55.97)	1.52 (1.44~1.60)	52.49	1.560		
	1900	53.3 (50.64~55.97)	1.52 (1.44~1.60)	52.34	1.584		
	1910	53.3 (50.64~55.97)	1.52 (1.44~1.60)	52.37	1.590		

2450H	2410	39.3 (37.34~41.26)	1.76 (1.67~1.85)	40.30	1.772	21.4°C	2012-07-09
	2435	39.2 (37.24~41.16)	1.79 (1.70~1.88)	40.21	1.799		
	2460	39.2 (37.24~41.16)	1.81 (1.72~1.90)	40.10	1.826		
	2450	39.2 (37.24~41.16)	1.80 (1.71~1.89)	40.14	1.815		
2450B	2410	52.8 (50.16~55.44)	1.91 (1.81~2.00)	52.10	1.938	21.4°C	2012-07-06
	2435	52.7 (50.07~55.34)	1.94 (1.84~2.04)	52.03	1.969		
	2460	52.7 (50.07~55.34)	1.96 (1.86~2.06)	51.96	2.000		
	2450	52.7 (50.07~55.34)	1.95 (1.85~2.05)	51.98	1.986		
2600H	2600	39.0 (37.05~40.95)	1.96 (1.86~2.06)	37.87	2.025	21.4°C	2012-07-21
2600B	2600	52.5 (49.88~55.13)	2.16 (2.05~2.27)	53.05	2.115	21.4°C	2012-07-22
ε_r= Relative permittivity, σ= Conductivity							

Table 6: Measured Tissue Parameter

Note:

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

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

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

4.2 System Check

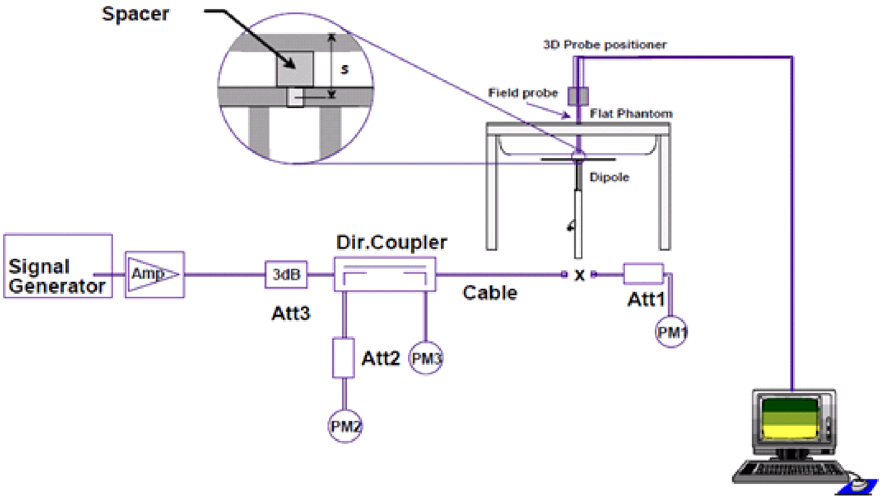
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system validation is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows validation results for all frequency bands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

System Check	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (mW/g)	10-g (mW/g)	1-g (mW/g)	10-g (mW/g)		
D1900V2 Head	40.60 (36.54~44.66)	21.20 (19.08~23.32)	39.32	20.04	21.4°C	2012-06-27
D2450V2 Head	53.70 (48.33~59.07)	24.90 (22.41~27.39)	53.60	24.64	21.4°C	2012-07-09
D2600V2 Head	58.80 (52.92~64.68)	26.40 (23.76~29.04)	60.00	26.48	21.4°C	2012-07-21
D1900V2 Body	41.40 (37.26~45.54)	21.80 (19.62~23.98)	41.20	21.36	21.4°C	2012-06-27
D2450V2 Body	52.80 (47.52~58.08)	24.50 (22.05~26.95)	54.00	25.12	21.4°C	2012-07-06
D2600V2 Body	55.60 (50.04~61.16)	24.90 (22.41~27.39)	59.60	26.48	21.4°C	2012-07-22

Table 7: System Check Results

4.3 Validation Procedure

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



5 Measurement Uncertainty Evaluation

5.1 Measurement uncertainty evaluation for SAR test

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

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

Table 8: Measurement uncertainties

5.2 Measurement uncertainty evaluation for system validation

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

Error Sources	Uncertainty Value	Probability Distribution	Divisor	c_i 1g	c_i 10g	Standard Uncertainty 1g	Standard Uncertainty10g	v_i^2 or v_{eff}
Measurement System								
Probe calibration	± 6.0%	Normal	1	1	1	± 6.0%	± 6.0%	∞
Axial isotropy	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%	∞
Hemispherical isotropy	± 9.6%	Rectangular	√3	0.7	0.7	± 0.0%	± 0.0%	∞
Boundary effects	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Probe linearity	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%	∞
System detection limits	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Readout electronics	± 0.3%	Normal	1	1	1	± 0.3%	± 0.3%	∞
Response time	± 0.0%	Rectangular	√3	1	1	± 0.0%	± 0.0%	∞
Integration time	± 0.0%	Rectangular	√3	1	1	± 0.0%	± 0.0%	∞
RF ambient conditions	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Probe positioner	± 0.4%	Rectangular	√3	1	1	± 0.2%	± 0.2%	∞
Probe positioning	± 2.9%	Rectangular	√3	1	1	± 1.7%	± 1.7%	∞
Max. SAR evaluation	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%	∞
Dipole								
Deviation of experimental dipole	± 5.5%	Rectangular	√3	1	1	± 3.2%	± 3.2%	∞
Dipole axis to liquid distance	± 2.0%	Rectangular	1	1	1	± 1.2%	± 1.2%	∞
Power drift	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%	∞
Phantom and Set-up								
Phantom uncertainty	± 4.0%	Rectangular	√3	1	1	± 2.3%	± 2.3%	∞
Liquid conductivity (target)	± 5.0%	Rectangular	√3	0.64	0.43	± 1.8%	± 1.2%	∞
Liquid conductivity (meas.)	± 2.5%	Normal	1	0.64	0.43	± 1.6%	± 1.1%	∞
Liquid permittivity (target)	± 5.0%	Rectangular	√3	0.6	0.49	± 1.7%	± 1.4%	∞
Liquid permittivity (meas.)	± 2.5%	Normal	1	0.6	0.49	± 1.5%	± 1.2%	∞
Combined Uncertainty						**± 9.5%**	**± 9.2%**	
Expanded Std. Uncertainty						**± 18.9%**	**± 18.4%**	

Table 9: Measurement uncertainties

6 SAR Test Configuration

6.1 GSM Test Configuration

SAR tests for GSM1900, a communication link is set up with a base station by air link. Using CMU200 the power lever is set to “0” in SAR of GSM1900. The tests in the band of GSM1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 10 for this EUT, it has at most 2 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5. The EGPRS class is 10 for this EUT, it has at most 2 timeslots in uplink, and at most 4 timeslots in downlink, the maximum total timeslot is 5.

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

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

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

Number of timeslots in uplink assignment		Reduction of maximum output power,(dB)		
Band	Time Slots	GPRS (GMSK)	EGPRS (GMSK)	EGPRS (8PSK)
GSM1900	1 TX slot	0	0	0
	2 TX slots	2.5	2.5	0

Table 10: The allowed power reduction in the multi-slot configuration of GSM

6.2 LTE Test Configuration

SAR for LTE band exposure configurations is measured according to the Procedures of KDB941225 D05. The MT8820C WideBand Radio Communication Tester was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing.

When MPR is implemented permanently within the UE, regardless of network requirements, only those RB configurations allowed (see 3GPP standards) for the channel bandwidth and modulation combinations may be tested with MPR. Configurations with RB allocations below the required RB thresholds must be tested without MPR. A-MPR must always be disabled.

LTE Band XLI MPR as belows:

Modulation	Channel bandwidth / Transmission bandwidth configuration [RB]		MPR
	10 MHz	20 MHz	
QPSK	1	1	0
QPSK	≤ 12	≤ 18	0
QPSK	> 12	> 18	1
16 QAM	≤ 12	≤ 18	1
16 QAM	> 12	> 18	2

For LTE TDD, which shares the same channel bandwidth between the uplink (UL) and the downlink (DL). And for TDD Type 2 Frame Structure, Each radio frame of length $T_f = 307200 \cdot T_s = 10\,\text{ms}$ consists of two half-frames of length $153600 \cdot T_s = 5\,\text{ms}$ each. Each half-frame consists of five subframes of length $30720 \cdot T_s = 1\,\text{ms}$.

Table 6.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS).

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	$6592 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$	$7680 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$
1	$19760 \cdot T_s$			$20480 \cdot T_s$		
2	$21952 \cdot T_s$			$23040 \cdot T_s$		
3	$24144 \cdot T_s$			$25600 \cdot T_s$		
4	$26336 \cdot T_s$			$7680 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$
5	$6592 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$	$20480 \cdot T_s$		
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			-	-	-
8	$24144 \cdot T_s$			-	-	-

Table 6.2-2: Uplink-downlink configurations.

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Table 6.2-1 and Table 6.2-2 from 3GPP spec 36211-a00 shows the configuration of special subframe (lengths of DwPTS/GP/UpPTS) and uplink-downlink configurations. 201HW only supports Uplink-downlink configuration 1 and configuration 2. For configuration of special subframe, 201HW only support Normal cyclic prefix in uplink, Extended cyclic prefix in uplink is not supported.

From Table 4.2-1 and 201HW Specific Uplink-downlink configurations and Configuration of special subframes, We listed all the uplink duty factor below for 201HW. The maximum duty factor for 201HW is 0429.

Uplink/Downlink Configuration	Special subframe configuration	UpPTS(Ts)	UpPTS(Subframe)	Uplink Subframes(Subframe)	Uplink duty factor
1	0	2192	0.07	2	0.414
	1	2192	0.07	2	0.414
	2	2192	0.07	2	0.414
	3	2192	0.07	2	0.414
	4	2192	0.07	2	0.414
	5	4384	0.14	2	0.429
	6	4384	0.14	2	0.429
	7	4384	0.14	2	0.429
	8	4384	0.14	2	0.429
2	0	2192	0.07	1	0.214

	1	2192	0.07	1	0.214
	2	2192	0.07	1	0.214
	3	2192	0.07	1	0.214
	4	2192	0.07	1	0.214
	5	4384	0.14	1	0.229
	6	4384	0.14	1	0.229
	7	4384	0.14	1	0.229
	8	4384	0.14	1	0.229

For each LTE frequency band, detail reduce test information is referred to section 7.2.3 to 7.2.4 and final test summary is as belows:

a. Per KDB941225 D05 page 4,3) A),QPSK with 50% RB is requied for the highest bandwide(20MHz).

b. Per KDB941225 D05 page 4,3) B),QPSK with 1 RB for both channel edges are requied for the highest bandwide(20MHz).

c. Per KDB941225 D05 page 4,4) A),16QAM with 50% RB is requied for the highest bandwide (20MHz).

d. Per KDB941225 D05 page 4,4) B),16QAM with 1 RB for both channel edges are requied for the highest bandwide(20MHz).

e. Per KDB941225 D05 page 4, 3) A) I and 4) A) I,100% RB allocation is not requied to be tested since SAR is not >1.45W/kg for the highest bandwide(20MHz).

f. Per KDB941225 D05 page 5,5) B), 10MHz BW is not requied to be tested since the max average conducted power is within ½ dB for 20MHzBW, and SAR of QPSK with 50% RB (20MHz) is < 1.45 W/kg.

Band XLI Head and Hotspot Body SAR

Bandwidth	Modulation Type	RB Size and Allocation	Test Channel	SAR Test
20MHz	QPSK	50% Centered	High Channel	No Test*
			Middle Channel	Tested*
			Low Channel	No Test*
		1RB Lower EDGE	High Channel	No Test
			Middle Channel	Tested
			Low Channel	No Test
		1RB Upper EDGE	High Channel	No Test
			Middle Channel	Tested
			Low Channel	No Test
	16QAM	50% Centered	High Channel	No Test
			Middle Channel	Tested
			Low Channel	No Test
		1RB Lower EDGE	High Channel	No Test
			Middle Channel	No Test
			Low Channel	Tested
		1RB Upper EDGE	High Channel	No Test
			Middle Channel	No Test
			Low Channel	Tested

*Please check SAR test result table of middle channel is <0.8W/kg, other channels are not required.

6.3 WiFi Test Configuration

For the 802.11b/g SAR tests, a communication link is set up with the test mode software for WiFi mode test. The Absolute Radio Frequency Channel Number(ARFCN) is allocated to 1,6 and 11 respectively in the case of 2450 MHz.During the test,at the each test frequency channel, the EUT is operated at the RF continuous emission mode.Each channel should be tested at the lowest data rate.
802.11b/g operating modes are tested independently according to the service requirements in each frquency band. 802.11b/g modes are tested on channel 1,6,11; however,if output power reduction is necessary for channels 1 and/or 11 to meet restricted band requirements the highest output channel closest to each of these channels must be tested instead.
SAR is not required for 802.11g channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

Mode	Band	GHz	Channel	"Default Test Channels"	
				802.11b	802.11g
802.11b/g	2.4 GHz	2.412	1#	√	△
		2.437	6	√	△
		2.462	11#	√	△

Notes:
√ = "default test channels"
△= possible 802.11g channels with maximum average output ¼ dB the "default test channels"
= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

802.11 Test Channels per FCC Requirements

7 SAR Measurement Results

7.1 Conducted power measurements

For the measurements a Rohde & Schwarz Radio Communication Tester CMU 200 and WideBand Radio Communication Tester MT8820C were used.

SAR drift measured at the same position in liquid before and after each SAR test as below 7.2 chapter.

Note:1)CMU200 measures GSM peak and average output power for active timeslots. For SAR the timebased average power is relevant. The difference in between depends on the duty cycle of the TDMA signal :

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

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.

2）MT8820C measures LTE TDD peak and average output power for active timeslots. For SAR the timebased average power is relevant. The difference in between depends on the duty cycle of the TDMA signal (The device is just for supporting configuration 1 and 2) :

No. of Configuration	1	2
Duty Cycle	0.429	0.229
timebased avg. power compared to slotted avg. power	-3.68dB	-6.40dB

Note： According to duty cycle of configuration 1 and configuration 2，Max outpower should be Configuration 1， so we just tested the conduction power and SAR of configuration 1.

7.1.1 Conducted power measurements GSM1900

GSM1900		Burst Average Power (dBm)			Division Factors	Frame Average Power (dBm)		
		512CH	661CH	810CH		512CH	661CH	810CH
GSM (CS)		29.72	29.76	29.87	-9	20.72	20.76	20.87
GPRS (GMSK)	1 Tx Slot	29.45	29.57	29.64	-9	20.45	20.57	20.64
	2 Tx Slots	26.69	26.79	26.96	-6	20.69	20.79	20.96
EDGE (GMSK)	1 Tx Slot	29.51	29.58	29.48	-9	20.51	20.58	20.48
	2 Tx Slots	26.71	26.78	26.89	-6	20.71	20.78	20.89
EDGE (8PSK)	1 Tx Slot	25.48	25.39	25.54	-9	16.48	16.39	16.54
	2 Tx Slots	25.43	25.46	25.57	-6	19.43	19.46	19.57

Table 11: Test results conducted power measurement GSM1900

Note: The conducted power of GSM1900 is measured with RMS detector.

7.1.2 Conducted power measurements LTE Band XLI

Low Channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Target MPR(dB)	Burst Average Power (dBm)	Frame Average Power (dBm)
40190	10	1	0	QPSK	0	22.95	**19.27**
		1	49	QPSK	0	22.73	19.05
		25	13	QPSK	1	21.86	18.18
		50	0	QPSK	1	21.73	18.05
		1	0	16-QAM	1	21.95	18.27
		1	49	16-QAM	1	21.79	18.11
		25	13	16-QAM	2	20.81	17.13
		50	0	16-QAM	2	20.72	17.04
40240	20	1	0	QPSK	0	22.93	19.25
		1	99	QPSK	0	22.83	19.15
		50	25	QPSK	1	21.77	18.09
		100	0	QPSK	1	21.88	18.20
		1	0	16-QAM	1	22.15	18.47
		1	99	16-QAM	1	22.21	18.53
		50	25	16-QAM	2	20.59	16.91
		100	0	16-QAM	2	20.78	17.10

Mid Channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Target MPR(dB)	Burst Average Power (dBm)	Frame Average Power (dBm)
40290	10	1	0	QPSK	0	23.19	19.51
		1	49	QPSK	0	23.18	19.50
		25	13	QPSK	1	21.89	18.21
		50	0	QPSK	1	21.68	18.00
		1	0	16-QAM	1	21.89	18.21
		1	49	16-QAM	1	21.88	18.20
		25	13	16-QAM	2	20.75	17.07
		50	0	16-QAM	2	20.66	16.98
	20	1	0	QPSK	0	23.31	**19.63**
		1	99	QPSK	0	23.23	19.55
		50	25	QPSK	1	21.86	18.18
		100	0	QPSK	1	21.88	18.20
		1	0	16-QAM	1	22.07	18.39
		1	99	16-QAM	1	22.02	18.34
		50	25	16-QAM	2	20.63	16.95
		100	0	16-QAM	2	20.65	16.97

High Channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Target MPR(dB)	Burst Average Power (dBm)	Frame Average Power (dBm)
40390	10	1	0	QPSK	0	22.83	19.15
		1	49	QPSK	0	22.87	19.19
		25	13	QPSK	1	21.89	18.21
		50	0	QPSK	1	21.82	18.14
		1	0	16-QAM	1	21.79	18.11
		1	49	16-QAM	1	21.77	18.09
		25	13	16-QAM	2	20.67	16.99
		50	0	16-QAM	2	20.69	17.01
40340	20	1	0	QPSK	0	22.89	19.21
		1	99	QPSK	0	22.92	**19.24**
		50	25	QPSK	1	21.63	17.95
		100	0	QPSK	1	21.75	18.07
		1	0	16-QAM	1	22.08	18.40
		1	99	16-QAM	1	22.02	18.34
		50	25	16-QAM	2	20.57	16.89
		100	0	16-QAM	2	20.71	17.03

Note: The conducted power of LTE Band XLI is measured with RMS detector, and 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 10 timesolts.

7.2 SAR measurement Result

7.2.1 Head SAR of GSM1900

Test Position of Head	Test Mode	Test channel /Frequency	SAR Value (W/kg) 1-g	SAR Value (W/kg) 10-g	Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
Left Hand Touched	GSM	661/1880	**0.439**	0.254	0.080	29.76	21.4°C
Left Hand Tilted 15°	GSM	661/1880	0.145	0.084	-0.040		21.4°C
Right Hand Touched	GSM	661/1880	0.239	0.146	0.170		21.4°C
Right Hand Tilted 15°	GSM	661/1880	0.151	0.092	0.090		21.4°C

7.2.2 Hotspot/Body SAR of GSM1900

Test Position of Body with 10mm	**Test Mode**	**Test channel /Frequency**	**SAR Value (W/kg) 1-g**	**SAR Value (W/kg) 10-g**	**Power Drift (dB)**	**Conducted Power (dBm)**	**Liquid Temp.**
Towards Phantom	GPRS 1TS	661/1880	0.302	0.181	0.130	29.57	21.4°C
Towards Phantom	GPRS 2TS	661/1880	0.340	0.203	0.140	26.79	21.4°C
Towards Ground	GPRS 2TS	661/1880	0.603	0.337	0.060		21.4°C
Left edge	GPRS 2TS	661/1880	0.202	0.118	0.080		21.4°C
Right edge	GPRS 2TS	661/1880	0.040	0.024	-0.160		21.4°C
Bottom edge	GPRS 2TS	661/1880	**0.632**	0.348	-0.020		21.4°C
Bottom edge	EDGE 1TS	661/1880	0.550	0.303	-0.080	29.58	21.4°C
Bottom edge	EDGE 2TS	661/1880	0.603	0.337	-0.120	26.78	21.4°C
Towards Ground with Headset	GSM	661/1880	0.564	0.315	-0.130	29.76	21.4°C

Note: 1) The value with **bold** colour is the maximum SAR value of each test band. 2) If the SAR measured at mid-band channel for each test configuration is at least 3.0 dB lower than the SAR limit (< 0.8 W/kg), testing at the high and low channels is optional.

7.2.3 Head SAR of LTE Band XLI

Test Position	Test channel /Frequency	LTE Configuration	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
20M/QPSK							
Left Hand Touched	40290/2560	50%RB/#25	0.193	0.099	-0.030	21.86	21.4°C
Left Hand Tilted 15°	40290/2560		0.064	0.033	0.020		21.4°C
Right Hand Touched	40290/2560		0.116	0.062	0.170		21.4°C
Right Hand Tilted15°	40290/2560		0.103	0.051	0.190		21.4°C
20M/QPSK							
Left Hand Touched	40290/2560	1RB/#0	**0.270**	0.140	0.100	23.31	21.4°C
Left Hand Tilted 15°	40290/2560		0.090	0.048	0.110		21.4°C
Right Hand Touched	40290/2560		0.158	0.085	0.040		21.4°C
Right Hand Tilted15°	40290/2560		0.147	0.073	0.020		21.4°C
20M/QPSK							
Left Hand Touched	40290/2560	1RB/#99	0.257	0.132	-0.170	23.23	21.4°C
Left Hand Tilted 15°	40290/2560		0.100	0.052	-0.030		21.4°C
Right Hand Touched	40290/2560		0.159	0.085	0.180		21.4°C
Right Hand Tilted15°	40290/2560		0.166	0.082	0.090		21.4°C
20M/16QAM							
Left Hand Touched	40290/2560	50%RB/#25	0.136	0.070	0.110	20.63	21.4°C
Left Hand Tilted 15°	40290/2560		0.051	0.026	-0.120		21.4°C
Right Hand Touched	40290/2560		0.085	0.045	-0.070		21.4°C
Right Hand Tilted15°	40290/2560		0.084	0.042	0.030		21.4°C
20M/16QAM							
Left Hand Touched	40240/2555	1RB/#0	0.174	0.089	-0.010	22.15	21.4°C
Left Hand Tilted 15°	40240/2555		0.057	0.030	0.150		21.4°C
Right Hand Touched	40240/2555		0.108	0.058	-0.010		21.4°C
Right Hand Tilted15°	40240/2555		0.100	0.049	0.020		21.4°C
20M/16QAM							
Left Hand Touched	40240/2555	1RB/#99	0.200	0.101	-0.010	22.21	21.4°C
Left Hand Tilted 15°	40240/2555		0.065	0.034	0.150		21.4°C
Right Hand Touched	40240/2555		0.115	0.062	0.100		21.4°C
Right Hand Tilted15°	40240/2555		0.114	0.057	-0.040		21.4°C

7.2.4 Hotspot/Body SAR of LTE Band XLI

Test Position	Test channel /Frequency	LTE Configuration	SAR Value (W/kg) 1-g	SAR Value (W/kg) 10-g	Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
20M/QPSK							
Towards Phantom	40290/2560	50%RB/#25	0.280	0.149	0.170	21.86	21.4°C
Towards Ground	40290/2560		0.481	0.241	0.120		21.4°C
Left edge	40290/2560		0.107	0.058	0.080		21.4°C
Right edge	40290/2560		0.104	0.058	0.020		21.4°C
Bottom edge	40290/2560		0.642	0.324	0.170		21.4°C
20M/QPSK							
Towards Phantom	40290/2560	1RB/#0	0.365	0.194	0.000	23.31	21.4°C
Towards Ground	40290/2560		0.703	0.354	-0.070		21.4°C
Left edge	40290/2560		0.149	0.080	-0.100		21.4°C
Right edge	40290/2560		0.061	0.038	-0.080		21.4°C
Bottom edge	40290/2560		**0.936**	0.469	0.120		21.4°C
20M/QPSK							
Towards Phantom	40290/2560	1RB/#99	0.394	0.210	-0.080	23.23	21.4°C
Towards Ground	40290/2560		0.716	0.356	0.130		21.4°C
Left edge	40290/2560		0.158	0.083	0.060		21.4°C
Right edge	40290/2560		0.056	0.035	0.130		21.4°C
Bottom edge	40290/2560		0.914	0.460	0.100		21.4°C
20M/16QAM							
Towards Phantom	40290/2560	50%RB/#25	0.212	0.112	0.130	20.63	21.4°C
Towards Ground	40290/2560		0.382	0.190	-0.150		21.4°C
Left edge	40290/2560		0.084	0.048	-0.030		21.4°C
Right edge	40290/2560		0.035	0.022	-0.030		21.4°C
Bottom edge	40290/2560		0.496	0.247	0.050		21.4°C
20M/16QAM							
Towards Phantom	40240/2555	1RB/#0	0.272	0.144	0.010	22.15	21.4°C
Towards Ground	40240/2555		0.478	0.240	0.070		21.4°C
Left edge	40240/2555		0.106	0.058	0.120		21.4°C
Right edge	40240/2555		0.042	0.025	0.030		
Bottom edge	40240/2555		0.644	0.324	0.080		21.4°C
20M/16QAM							
Towards Phantom	40240/2555	1RB/#99	0.282	0.149	0.090	22.21	21.4°C
Towards Ground	40240/2555		0.496	0.247	-0.030		21.4°C
Left edge	40240/2555		0.111	0.062	0.050		21.4°C
Right edge	40240/2555		0.046	0.028	0.150		
Bottom edge	40240/2555		0.619	0.311	0.050		21.4°C

Note:

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

2) A-MPR was disabled by Radio Communication Tester for all SAR tests.

3) Per Crest factor is 2.33(1/duty cycle), so we set the PAR for 3.67dB during the SAR measurement.

4) LTE Head SAR was evaluated to cover third-party VoIP applications that may result in LTE being used near the head.

5) Per KDB 941225 D06-we performed the SAR testing at 10mm from the front and rear surfaces（Towards Phantom & Towards Ground） and also from side edges with a transmitting antenna ≤ 2.5 cm from an edge（the distance refers to section 7.3 of Rear Side View picture）.

6) LTE Band XLI test reduce is as below the following:

a. Per KDB941225 D05 page 4,3) A),QPSK with 50% RB is requied for the highest bandwide(20MHz).
When the maximum output power variation across H, M and L channels is ≤½ dB, start with the middle channel; otherwise, start with the highest output power channel. When the measured 1-g SAR for the middle or highest output power channel is≤ 0.8 W/kg, testing of the remaining two channels in that device and exposure configuration is not necessary.

LTE Band XLI	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Conducted Power (dBm)	Max Difference
Low Channel	40240	20	50	25	QPSK	21.77	**0.23**
Mid Channel	40290	20	50	25	QPSK	**21.86**	
High Channel	40340	20	50	25	QPSK	21.63	

➔Band XLI, Mid channel , 20MHz BW, 50%RB#25, QPSK has been selected.

b. Per KDB941225 D05 page 4,3) B),QPSK with 1 RB for both channel edges are requied for the highest bandwide.

If the maximum average conducted output power for a 1 RB allocation is > ½ dB higher than the 50% RB allocation, instead of using the highest SAR channel measured for QPSK and 50% RB allocation, measure SAR on the highest output power channel for the 1 RB allocation.

LTE Band XLI	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Conducted Power (dBm)	Difference
Low Channel	40240	20	1	0	QPSK	22.93	1.16
		20	49	25	QPSK	21.77	
Mid Channel	40290	20	1	0	QPSK	**23.31**	**1.45**
		20	49	25	QPSK	21.86	
High Channel	40340	20	1	0	QPSK	22.89	1.26
		20	49	25	QPSK	21.63	

➔Band XLI, Mid channel, 20 MHz BW, 1RB/#0, has been selected.

LTE Band XLI	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	40240	20	1	99	QPSK	22.83	1.06
		20	49	25	QPSK	21.77	
Mid Channel	40290	20	1	99	QPSK	**23.23**	**1.37**
		20	49	25	QPSK	21.86	
High Channel	40340	20	1	99	QPSK	22.92	1.29
		20	49	25	QPSK	21.63	

➔ Band XLI, Mid channel, 20 MHz BW, 1RB/#99, has been selected.

For measured SAR in QPSK with 1 RB is < 1.45 W/kg-> Test 1RB configuration on other channels is not required. (Refer to LTE SAR test result)

c. Per KDB941225 D05 page 4,4) A),16QAM with 50% RB is requied for the highest bandwide.

If the maximum average conducted output power for 16QAM is more than ¼ dB higher than QPSK, apply the procedures for QPSK in 3) to test 16QAM.

If the maximum average conducted output power for 16QAM with 50% RB allocation is > ½ dB higher than QPSK with 50% RB allocation, instead of using the highest SAR channel measured in QPSK measure SAR on the highest output power channel for 16QAM with 50% RB allocation.

LTE Band XLI	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	40240	20	1	99	16QAM	22.21	-0.72
		20	1	0	QPSK	22.93	
Mid Channel	40290	20	1	0	16QAM	22.07	**-1.24**
		20	1	0	QPSK	23.31	
High Channel	40340	20	1	0	16QAM	22.08	-0.84
		20	1	99	QPSK	22.92	

LTE Band XLI	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	40240	20	50	25	16QAM	20.59	-1.18
		20	50	25	QPSK	21.77	
Mid Channel	40290	20	50	25	16QAM	20.63	**-1.23**
		20	50	25	QPSK	21.86	
High Channel	40340	20	50	25	16QAM	20.57	-1.06
		20	50	25	QPSK	21.63	

➔ **Band XLI,** QPSK 50#RB High SAR channel, 20 MHz BW , 16QAM has been selected.

d. Per KDB941225 D05 page 4,4) B), 16QAM with 1 RB for both channel edges are requied for the highest bandwide.

If the maximum average conducted output power for a 1 RB allocation is > ½ dB higher than the 50% RB allocation, instead of using the highest SAR channel measured for 16QAM and 50% RB measure SAR on the highest output power channel for the 1 RB allocation.

LTE Band XLI	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	40240	20	1	0	16QAM	**22.15**	**1.56**
		20	49	25	16QAM	20.59	
Mid Channel	40290	20	1	0	16QAM	22.07	1.44
		20	49	25	16QAM	20.63	
High Channel	40340	20	1	0	16QAM	22.08	1.51
		20	49	25	16QAM	20.57	

➔ **Band XLI, Low channel, 20 MHz BW, 1RB/#0, 16QAM has been selected**

LTE Band XLI	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	40240	20	1	99	16QAM	**22.21**	**1.62**
		20	50	25	16QAM	20.59	
Mid Channel	40290	20	1	99	16QAM	22.02	1.39
		20	50	25	16QAM	20.63	
High Channel	40340	20	1	99	16QAM	22.02	1.45
		20	50	25	16QAM	20.57	

➔ **Band XLI, Low channel,** 20 MHz BW, **1RB/#99**, 16QAM has been selected

For measured SAR in QPSK with 1 RB is < 1.45 W/kg-> Test 1RB configuration on other channels is not required. (Refer to LTE SAR test result)

e. Per KDB941225 D05 page 5,5) B), 10MHz BW is not requied to be tested since the max average conducted power is within ½ dB for 10MHzBW, and SAR of QPSK with 50% RB (10MHz) is < 1.45 W/kg.

Band XLI

Bandwidth(MHz)	20 MHz	10 MHz
Max Power	23.31	23.19
Difference	--	-0.12

SAR of QPSK with 50% RB (10MHz) is < 1.45 W/kg.

Therefore: that smaller channel bandwidth does not need testing

7.2.5 Head SAR of WiFi

Test Position of Head	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
Left Hand Touched	802.11 b	1/2412	0.202	0.098	0.030	15.73	21.4°C
Left Hand Tilted 15°	802.11 b	1/2412	**0.277**	0.130	0.070		21.4°C
Right Hand Touched	802.11 b	1/2412	0.201	0.098	0.140		21.4°C
Right Hand Tilted 15°	802.11 b	1/2412	0.273	0.128	0.090		21.4°C

7.2.6 Hotspot/Body SAR of WiFi

Test Position of Body with 10mm	Test Mode	Test channel /Frequency	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
Towards Phantom	802.11 b	1/2412	0.068	0.035	0.100	15.73	21.4°C
Towards Ground	802.11 b	1/2412	**0.179**	0.091	-0.140		21.4°C
Left edge	802.11 b	1/2412	0.029	0.016	0.090		21.4°C
Right edge	802.11 b	1/2412	0.035	0.019	-0.050		21.4°C
Top edge	802.11 b	1/2412	0.208	0.097	0.190		21.4°C

Note:

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

2) Per KDB248227，Tests high average RF output power channel for the lowest data rate, other modes including 802.11 g/n were not investigated since the average output powers were not greater than 0.25dB than that of the corresponding channel in the lowest data rate IEEE 802.11b mode.

3) Testing at higher data rates is not required, when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate.

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

5) Per KDB 941225 D06 hotspot procedures, we performed the SAR testing at 10mm from the front and rear surfaces（Towards Phantom & Towards Ground） and also from side edges with a transmitting antenna ≤ 2.5 cm from an edge（the distance refers to section 7.3 of Rear Side View picture）.

7.3 Multiple Transmitter Evaluation

7.3.1 Stand-alone SAR

These procedures were followed according to FCC "KDB648474 D01 SAR Handsets Multi Xmiter and Ant, v01r05", Sept 2008. The procedures are applicable to phones with built-in unlicensed transmitters, such as 802.11 a/b/g and Bluetooth devices.

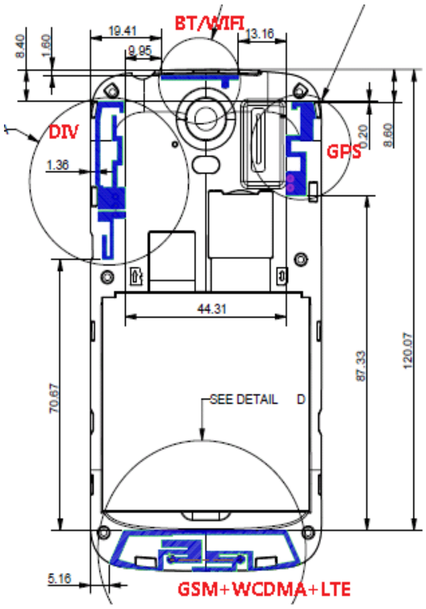
	2.45	5.15 - 5.35	5.47 - 5.85	GHz
P_{Ref}	12	6	5	mW
Device output power should be rounded to the nearest mW to compare with values specified in this table.				

Table 12: Output Power Thresholds for Unlicensed Transmitters

<table>
<tr><th></th><th>Individual Transmitter</th><th>Simultaneous Transmission</th></tr>
<tr><td>Licensed Transmitters</td><td>Routine evaluation required</td><td rowspan="2">SAR not required:
Unlicensed only
○ when stand-alone 1-g SAR is not required and antenna is ≥ 5 cm from other antennas
Licensed & Unlicensed
○ when the sum of the 1-g SAR is < 1.6 W/kg for all simultaneous transmitting antennas
○ when SAR to peak location separation ratio of simultaneous transmitting antenna pair is < 0.3
SAR required:
Licensed & Unlicensed
antenna pairs with SAR to peak location separation ratio ≥ 0.3; test is only required for the configuration that results in the highest SAR in stand-alone configuration for each wireless mode and exposure condition
Note: simultaneous transmission exposure conditions for head and body can be different for different style phones; therefore, different test requirements may apply</td></tr>
<tr><td>Unlicensed Transmitters</td><td>When there is no simultaneous transmission –
○ output ≤ 60/f: SAR not required
○ output > 60/f: stand-alone SAR required
When there is simultaneous transmission –
Stand-alone SAR not required when
○ output ≤ 2·P_{Ref} and antenna is ≥ 5.0 cm from other antennas
○ output ≤ P_{Ref} and antenna is ≥ 2.5 cm from other antennas
○ output ≤ P_{Ref} and antenna is < 2.5 cm from other antennas, each with either output power ≤ P_{Ref} or 1-g SAR < 1.2 W/kg
Otherwise stand-alone SAR is required
When stand-alone SAR is required
○ test SAR on highest output channel for each wireless mode and exposure condition
○ if SAR for highest output channel is > 50% of SAR limit, evaluate all channels according to normal procedures</td></tr>
</table>

Table 13: Summary of SAR Evaluation Requirements for a Cell Phone with Multiple Transmitters

The closest distance between BT/WiFi antenna and main antenna is 12.007cm > 5cm， and the location of the antennas inside mobile phone is shown as below picture:



Rear Side View

The output power of BT antenna is as following:

BT 2450MHz	Average Conducted Power (dBm)		
	0CH	39CH	78CH
	1.23	**3.43**	2.08

Table 14: Test results conducted power measurement BT 2450 MHz

Note: The conducted power of BT is measured with RMS detector.

The output power of WiFi antenna is as following:

Wi-Fi 2450MHz	Channel	Average Power (dBm) for Data Rates (Mbps)							
		1	2	5.5	11	/	/	/	/
802.11b	1	15.73	15.74	15.81	**15.83**	/	/	/	/
	6	15.65	15.57	15.42	15.54	/	/	/	/
	11	15.50	15.57	15.55	15.72	/	/	/	/
802.11g	Channel	6	9	12	18	24	36	48	54
	1	11.96	12.3	12.14	12.15	12.2	12.12	12.10	12.21
	6	12.05	12.00	11.95	12.01	12.06	11.93	11.95	12.00
	11	12.40	12.30	12.34	12.34	12.30	12.40	12.40	12.40
802.11n (HT20)	Channel	6.5	13	19.5	26	39	52	58.5	65
	1	10.90	10.90	10.91	10.96	11.02	11.00	10.90	10.97
	6	10.92	10.97	10.92	10.93	10.88	10.90	10.90	10.99
	11	11.24	11.08	11.24	11.22	11.26	11.31	11.28	11.25

Table 15: Test results conducted power measurement WiFi 2450 MHz

Note: The conducted power of WiFi is measured with RMS detector.

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

1) stand-alone SAR evaluation is not required for BT, because the output power of BT unlicensed is 3.43 dBm ≤ 2PRef (13.8dBm) and antenna is >5cm from other antennas.
2) Stand-alone SAR evaluation is required for WiFi, because the output power of WiFi unlicensed transmitter is 15.83dBm ≥ 24mW (13.8dBm).

7.3.2 Simultaneous Transmission Possibilities

The following table shows exposure conditions for all transmitters:

No.	Capable Tx Configration	LTE	GSM Voice	GPRS/EDGE	WiFi 2.4GHz
1	LTE	---	NO	NO	Yes
2	GSM Voice	NO	---	NO	Yes
3	GPRS/EDGE	NO	NO	---	Yes
4	WiFi 2.4GHz	Yes	Yes	Yes	---
5	BT 2.4GHz	No SAR test			

Table 16: Simultaneous Transmission Possibilities

Note: This mode doesn't support simultaneous BT and WiFi, because they share the same antenna.

7.3.3 SAR Summation Scenario

Antenna	Antenna Use	Technologies	TX Bands
1	Voice/DATA TX/RX	GSM/LTE	GSM1900/LTE XGP_B41 (2545MHz~2575MHz)
2	DATA RX Diversity	LTE	LTE XGP_B41(2545MHz~2575MHz)
3	WLAN/BT	WIFI/Bluetooth	2400MHz
Key Features: Mobile Hotspot support.			

Table 17: Definition of Antennas

Test Position		GSM1900 SAR(W/kg)	LTE Band XLI SAR(W/kg)	WiFi SAR (W/kg)	Σ1-g SARmax (W/kg)
Head SAR	Left Hand Touched	**0.439**	0.270	0.202	0.641
	Left Hand Tilted 15°	0.145	0.100	0.277	0.422
	Right Hand Touched	0.239	0.159	0.201	0.440
	Right Hand Tilted 15°	0.151	0.166	0.273	0.439
Hotspot Body SAR	Towards Phantom	0.340	0.394	0.068	0.462
	Towards Ground	0.603	0.716	0.179	0.895
	Left edge	0.202	0.158	0.029	0.231
	Right edge	0.040	0.104	0.035	0.139
	Top edge	0	0	0.208	0.208
	Bottom edge	0.632	**0.936**	0	**0.936**

Table 18: Simultaneous Tx Combination (GSM/LTE+WLAN)

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

1) Simultaneous Transmission SAR evaluation is not required for GSM/LTE& BT,because stand-alone SAR are not required for BT and the sum of 1-g SAR_{max} is 0.936W/kg < 1.6 W/kg for all simultaneous transmitting antennas.
2) Simultaneous Transmission SAR evaluation is not required for GSM/LTE & WiFi, because the sum of the 1g SAR_{max} is 0.936W/kg < 1.6W/kg for all simultaneous transmitting antennas.

Appendix A. System Check Plots

(Pls See Appendix A.)

Appendix B. SAR Measurement Plots

(Pls See Appendix B.)

Appendix C. Calibration Certificate

(Pls See Appendix C.)

Appendix D. Photo documentation

(Pls See Appendix D.)

End