TESTING
No. L0310

ACCREDITED
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FCC SAR Compliance Test Report

Project Name: Mobile WiFi

Model : E589u-512

FCC ID : QISE589U-512

Report No. : SYBH(Z-SAR)007072012-2

	APPROVED	CHECKED	PREPARED
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※ ※ Modified History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	2012-08-15	Gongzhong
Rev.1.1	1.Revised the frequency band of WiFi in table 3 page 5 2.Added the simultaneous transmission configuration list in page 57	2012-09-11	Gongzhong
Rev.1.2	1.Added the test sample type in table 3, page 5. 2.Added dimension of the device in table 3, page 5. 3.Updated the test standards list in chapter 1.4, page 7. 4.Revised the description of Bandwidths in chapter 6.3, page 28. 5.Deleted the test channel table in chapter 6.3 from page 28 to 29. 6.Revised the description of test reduction for LTE mode in note2) from page 45 to 47.	2012-09-12	Gongzhong
Rev.1.1	Revised the RB configuration in page 48	2012-09-13	Gongzhong
Rev.1.2	1.Added the RF exposure conditions in table 3 page 5. 2.Revised the comment of item 6 in table 4 page 6. 3.Revised the test distance in tables under chapter 7.2.1, 7.2.2, 7.2.3 and 7.2.4 from page 42 to 44.	2012-10-09	Gongzhong

1 General Information

1.1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for E589u-512 is as below Table 1.

Band	Position	Measured MAX SAR_{1g} (W/kg)	Conducted Power (dBm)	Tune-up Power (dBm)	Extraploted Result (W/kg)
GSM850	Rear Side 10mm	0.519	31.08	31.20	0.534
GSM1900	Front Side 10mm	0.916	27.83	28.20	0.997
UMTS Band V	Rear Side 10mm	0.734	22.43	23.40	0.918
UMTS Band II	Front Side 10mm	1.030	22.36	23.40	1.309
LTE Band II	Front Side 10mm	1.040	22.16	23.20	1.321
LTE Band IV	Front Side 10mm	1.150	22.65	23.20	1.305
LTE Band VII	Bottom Side 10mm	**1.280**	22.98	23.20	1.347

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 95.1:1992, 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 01-01-2001.

1.2 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain/Body/Arms/Legs)	**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:	Mobile WiFi		
Type Identification:	E589u-512		
FCC ID:	QISE589U-512		
SN No.:	Y3E01A9262900070		
Device Type :	portable device		
Test Sample:	production		
Dimension	113(length)×62(width)×13.5(height)(mm^3)		
Exposure Category:	uncontrolled environment / general population		
RF exposure conditions	hotspot (wireless router)		
Hardware Version :	CL1E589M22		
Software Version :	11.433.13.C0.167		
Antenna Type :	internal antenna		
Battery Options :	Huawei Technologies Co., Ltd. Rechargeable Li-ion Battery Model: HB5P1H; Rated capacity: 3000mAh; Nominal Voltage: ⎓ +3.7V; Charging Voltage: ⎓ +4.2V.		
Device Operating Configurations:			
Supporting Mode(s)	GSM850/1900,UMTS Band V/Band II, LTE Band II/IV/VII(tested),WiFi(untested)		
Test Modulation	GSM(GMSK), UMTS(QPSK),LTE(QPSK,16QAM)		
Device Class	B		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM850	824-849	869-894
	GSM1900	1850-1910	1930-1990
	UMTS Band V	824-849	869-894
	UMTS Band II	1850-1910	1930-1990
	LTE Band II	1850-1910	1930-1990
	LTE Band IV	1710-1755	2110-2155
	LTE Band VII	2500-2570	2620-2690
	WiFi	2412-2462	2412-2462
GPRS Multislot Class(12)	Max Number of Timeslots in Uplink:	4	
	Max Number of Timeslots in Downlink:	4	
	Max Total Timeslot:	5	
EGPRS Multislot Class(12)	Max Number of Timeslots in Uplink:	4	
	Max Number of Timeslots in Downlink:	4	
	Max Total Timeslot:	5	
HSDPA UE Category	14		
HSUPA UE category	6		
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 V)		
	3, tested with power control “all 1”(UMTS Band II)		
	3, tested with power control all Max.(LTE Band II)		
	3, tested with power control all Max.(LTE Band IV)		
	3, tested with power control all Max.(LTE Band VII)		
Test Channels (low-mid-high):	128-190-251(GSM850)		
	512-661-810 (GSM1900)		
	4132-4182-4233(UMTS Band V)		

	9262-9400-9538 (UMTS Band II)
	18625-18900-19175(LTE Band II BW=5MHz)
	18650-18900-19150(LTE Band II BW=10MHz)
	18675-18900-19125(LTE Band II BW=15MHz)
	18700-18900-19100(LTE Band II BW=20MHz)
	19975-20175-20375(LTE Band IV BW=5MHz)
	20000-20175-20350(LTE Band IV BW=10MHz)
	20025-20175-20325(LTE Band IV BW=15MHz)
	20050-20175-20300(LTE Band IV BW=20MHz)
	20775-21100-21425(LTE Band VII BW=5MHz)
	20800-21100-21400(LTE Band VII BW=10MHz)
	20825-21100-21375(LTE Band VII BW=15MHz)
	20850-21100-21350(LTE Band VII BW=20MHz))

Table 3:Device information and operating configuratio

1.3.1 General Description

E589u-512 is a LTE/UMTS/GSM triple mode and WiFi Wireless mobile Router; it can be used as a WiFi Access Point based on standard of IEEE802.11b/g/n. It supports 3G WCDMA and 4G LTE wireless internet accessing function. About 3G WCDMA wireless mode, it supports WCDMA and HSDPA/HSUPA/HSPA+/DC-HSPA+, operating in Band2 and Band 5, and the 4G LTE, operating in Band2, Band4 and Band7. The WiFi frequency is 2.4GHz.E589u-512 supports 1Tx2Rx for 3G WCDMA and 4G LTE, WiFi only supports 1Tx1Rx.

1.3.2 LTE information Summary

Items	Device Operating Configurations for LTE	Remark
1	Frequency Range of each LTE transmission band	Refer to table 3
2	Channel Bandwidths	Band II/IV/VII(5 MHz,10MHz,15 MHz,20MHz)
3	H,M,L channel numbers and frequencies	Refer to table 3
4a	UE Category	3
4b	Modulations Supported in UL	QPSK, 16QAM
5	Description of LTE Tx and Ant. Implementation	Refer to page 55 , Definition of Antennas
6	Identify the LTE voice/data requirements in each operating mode and exposure condition	exposure condition hotspot (wireless router)
7	LTE MPR Permanently implement per 3GPP TS36.101 section 6.2.3~6.2.5?(manufacturer attestation to be provided)	Yes
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	Refer to table 3
11	Simultaneous Tx Conditions	Refer to Section 7.3
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)

ANSI Std C95.1 – 1992	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.(IEEE Std C95.1 – 1991)
IEEE Std 1528-2003	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
IEEE Std 1528a-2005	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques 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 D01	SAR test for 3G devices v02
KDB941225 D03	SAR Test Reduction GSM GPRS EDGE vo1
KDB941225 D05	SAR for LTE Devices v01
KDB941225 D06	Hot Spot SAR v01
KDB648474 D01	SAR Handsets Multi Xmiter and Ant v01r05
KDB450824 D01	SAR Probe Calibration and System Verification
KDB450824 D02	Dipole SAR Validation Verification v01

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

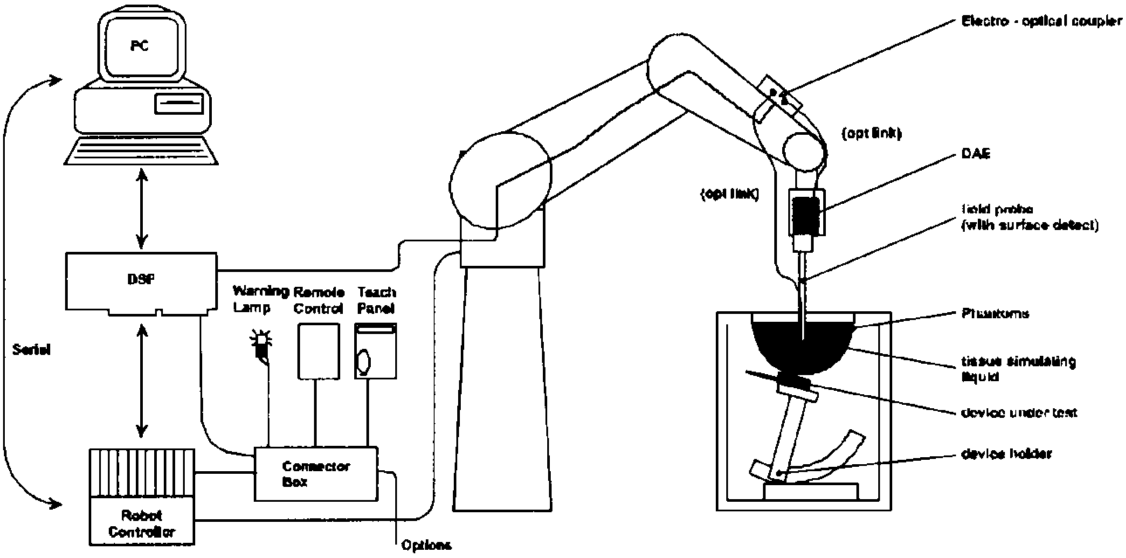
Start Date of test	2012-07-07
End Date of test	2012-07-31

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 m^3, 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 m^2 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: 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	

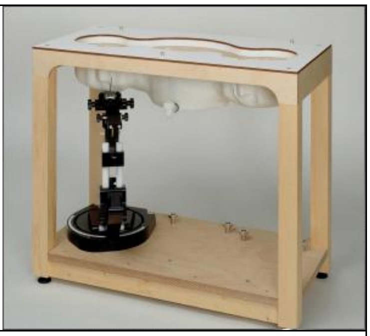
Isotropic E-Field Probe EX3DV4 for Dosimetric Measurements

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	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 HSL (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 length: 20 mm Body diameter: 12 mm Tip diameter:2.5 mm Distance from probe tip to dipole centers: 1.0 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	

2.5 Phantom description

SAM Twin Phantom

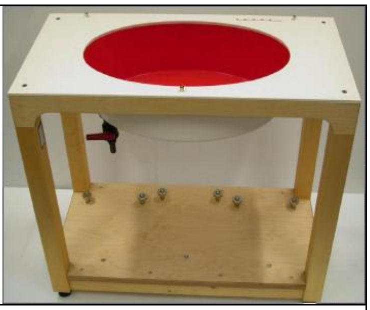
Shell Thickness	2mm +/- 0.2 mm; The ear region: 6mm
Filling Volume	Approximately 30 liters
Dimensions	Length:1000mm; Width:500mm; Height: adjustable feet
Measurement Areas	Left hand Right hand Flat phantom



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	EX3DV4	3736	2012-04-26
☐	SPEAG	Dosimetric E-Field Probe	ES3DV3	3168	2011-09-27
☒	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	2000 MHz Validation Dipole	D2000V2	1052	2011-03-10
☐	SPEAG	2300 MHz Validation Dipole	D2300V2	1016	2011-11-22
☐	SPEAG	2450 MHz Validation Dipole	D2450V2	860	2011-03-08
☒	SPEAG	2600 MHz Validation Dipole	D2600V2	1021	2011-11-21
☒	SPEAG	Data acquisition electronics	DAE4	852	2011-11-16
☐	SPEAG	Data acquisition electronics	DAE4	1236	2012-03-28
☒	SPEAG	Software	DASY 5	N/A	N/A
☐	SPEAG	Twin Phantom	SAM1	TP-1475	N/A
☐	SPEAG	Twin Phantom	SAM2	TP-1474	N/A
☒	SPEAG	Twin Phantom	SAM3	TP-1597	N/A
☒	SPEAG	Twin Phantom	SAM4	TP-1620	N/A
☐	SPEAG	Flat Phantom	ELI 4.0	TP-1038	N/A
☐	SPEAG	Flat Phantom	ELI 4.0	TP-1111	N/A
☒	R & S	Universal Radio Communication Tester	CMU 200	113989	2012-06-07
☒	R & S	WideBand Radio Communication Tester	CMW 500	112936	2011-08-17
☒	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.

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

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)	Body Tissue					
Frequency Band (MHz)	450	**835**	**1800**	**1900**	2450	**2600**
Water	51.16	52.4	69.91	71.88	73.2	70.04
Salt (NaCl)	1.49	1.40	0.13	0.39	0.04	0.1
Sugar	46.78	45.0	0.0	0.0	0.0	0.0
HEC	0.52	1.0	0.0	0.0	0.0	0.0
Bactericide	0.05	0.1	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	29.96	29.44	26.7	29.5

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)		
835B	825	55.20 (52.44~57.96)	0.97 (0.92~1.02)	53.41	0.957	21.4°C	2012-07-07
	835	55.20 (52.44~57.96)	0.97 (0.92~1.02)	53.09	0.969		
	850	55.20 (52.44~57.96)	0.99 (0.94~1.04)	52.88	0.990		
1800B	1710	53.50 (50.83~56.18)	1.46 (1.39~1.53)	53.10	1.476	21.4°C	2012-07-12
	1730	53.50 (50.83~56.18)	1.48 (1.41~1.55)	53.01	1.499		
	1750	53.40 (50.73~56.07)	1.49 (1.42~1.56)	52.92	1.521		
	1800	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.72	1.573		
1900B	1850	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.61	1.531	21.4°C	2012-07-10
	1880	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.49	1.560		
	1910	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.34	1.590		
	1900	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.37	1.584		
1900B	1850	53.30 (50.64~55.97)	1.52 (1.44~1.60)	53.10	1.532	21.4°C	2012-07-11
	1880	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.99	1.558		
	1910	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.84	1.588		
	1900	53.30 (50.64~55.97)	1.52 (1.44~1.60)	52.87	1.582		

2600B	2600	52.5 (49.88~55.13)	2.16 (2.05~2.27)	53.05	2.115	21.4°C	2012-07-27
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 bsssssse 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）For LTE measurements in AWS band, and for 1800 MHz system verification the same TSL and 1750 MHz SAR probe calibration point have been used.

4.2 System Check

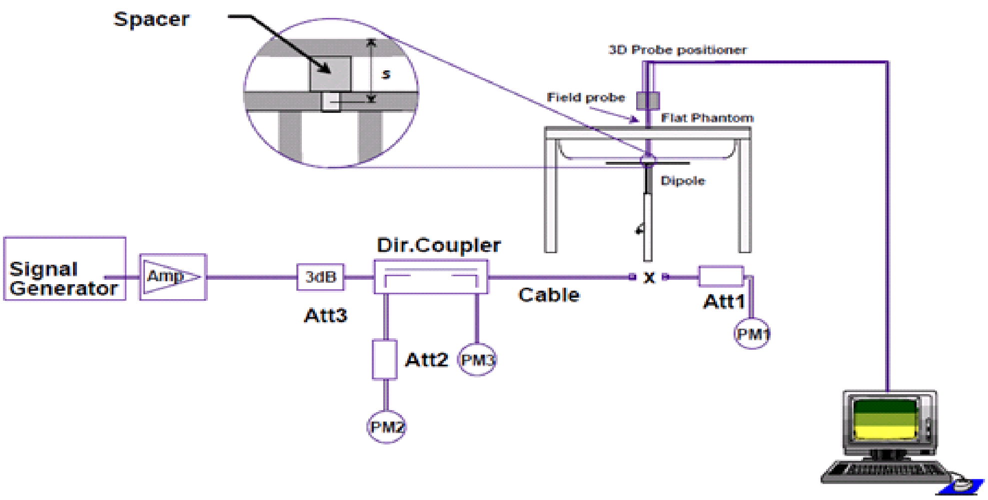
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system validation is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows validation results for all frequency bands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

System Check	Target SAR (1W) (+/-10%)		Measured SAR (Normalized to 1W)		Liquid Temp.	Test Date
	1-g (mW/g)	10-g (mW/g)	1-g (mW/g)	10-g (mW/g)		
D835V2 Body	9.54 (8.59~10.49)	6.29 (5.66~6.92)	10.28	6.76	21.4°C	2012-07-07
D1800V2 Body	38.80 (34.92~42.68)	20.40 (18.36~22.44)	37.76	19.64	21.4°C	2012-07-12
D1900V2 Body	41.40 (37.26~45.54)	21.80 (19.62~23.98)	42.40	22.04	21.4°C	2012-07-10
D1900V2 Body	41.40 (37.26~45.54)	21.80 (19.62~23.98)	42.40	22.00	21.4°C	2012-07-11
D2600V2 Body	55.60 (50.04~61.16)	24.90 (22.41~27.39)	56.80	25.84	21.4°C	2012-07-27

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 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	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	$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$					± 10.9%	± 10.7%	387
Expanded Std. Uncertainty	$u_e = 2u_c$	**Normal**	**K=2**			**± 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	Divi -sor	c_i 1g	c_i 10g	Standard Uncertainty 1g	Standard Uncertainty y10g	v_i^2 or v_{eff}
Measurement System								
Probe calibration	± 6.0%	Normal	1	1	1	± 6.0%	± 6.0%	∞
Axial isotropy	± 4.7%	Rectangular	√3	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	$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$					**± 9.5%**	**± 9.2%**	
Expanded Std. Uncertainty	$u_e = 2u_c$	**Normal**	**K=2**			**± 18.9%**	**± 18.4%**	

Table 9:Measurement uncertainties

6 SAR Test Configuration

6.1 GSM Test Configuration

SAR tests for GSM850/1900, a communication link is set up with a base station by air link. Using CMU200 the power lever is set to “5”and “0” in SAR of GSM 850 and GSM 1900.The tests in the band of GSM850/1900 are performed in the mode of GPRS/EGPRS function. 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 timeslot is 5. The EGPRS class is 12 for this EUT, it has at most 4 timeslots in uplink, and at most 4 timeslots in downlink, the maximum total timeslot is 5.

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

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

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

Number of timeslots in uplink assignment		Reduction of maximum output power, (dB)		
Band	Time Slots	GPRS (GMSK）	EGPRS (GMSK)	EGPRS (8PSK)
GSM850	1 TX slot	0	0	0
	2 TX slots	2	2	2.5
	3 TX slots	4	4	4.5
	4 TX slots	5	5	5.5
GSM1900	1 TX slot	0	0	0
	2 TX slots	2	2	2
	3 TX slots	4	4	4
	4 TX slots	5	5	5

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

6.2 UMTS Test Configuration

1) RMC

As the SAR body tests for UMTS Band V/ II, we established the radio link through call processing. The maximum output power were verified on high, middle and low channels for each test band according to 3GPP TS 34.121 with the following configuration:

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

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

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

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

2) HSDPA

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

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

Sub-test	β_c	β_d	β_d (SF)	β_c / β_d	β_{hs} (1)	CM(dB)(2)	MPR (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0
2	12/15(3)	15/15(3)	64	12/15(3)	24/15	1.0	0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: ΔACK, ΔNACK and ΔCQI = 8 , A_{hs} = β_{hs}/β_c = 30/15 , β_{hs} = 30/15 * β_c

Note 2 : CM=1 for β_c/β_d= 12/15, β_{hs}/β_c = 24/15. For all other combinations of DPDCH,DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 3 : For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1,TF1) to β_c = 11/15 and β_d = 15/15

Table 11: Sub-tests for UMTS Release 5 HSDPA

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

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

Table 12:settings of required H-Set 1 QPSK acc. to 3GPP 34.121

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

14	15	1	42196	259200
15	15	1	23370	345600
16	15	1	27952	345600

Table 13:HSDPA UE category

3) HSUPA

Body SAR is also measured for HSPA when the maximum average outputs of each RF channel with HSPA active is at ¼ dB higher than that measured without HSPA using 12.2kbps RMC or the maximum SAR 12.2kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-set 1 and QPSK for FRC and 12.2kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.2 kbps RMC without HSPA.

Due to inner loop power control requirements in HSPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA should be configured according to the values indicated below as well as other applicable procedures described in the ‘UMTS Handset’ and ‘Release 5 HSPA Data Device’ sections of 3G device.

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

Note 1: ΔACK, ΔNACK and ΔCQI = 8 , $A_{hs} = \beta_{hs}/\beta_c = 30/15$, $\beta_{hs} = 30/15 * \beta_c$

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, 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 signalled gain factors for the reference TFC (TF1,TF1) to β_c = 10/15 and β_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 signalled gain factors for the reference TFC (TF1,TF1) to β_c = 14/15 and β_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 Table 5.1g

Note 6: β_{ed} can not be set directly; it is set by Absolute Grant Value.

Table 14:Subtests for UMTS Release 6 HSUPA

UE E-DCH Category	Maximum E-DCH Codes Transmitted	Number of HARQ Processes	E-DCH TTI(ms)	Minimum Speading 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	10	2SF2&2SF4	11484	5.76
	4	4	2		20000	2.00
7 (No DPDCH)	4	8	2	2SF2&2SF4	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 support QPSK only.UE category 7 supports QPSK and 16QAM.(TS25.306-7.3.0).						

Table 15:HSUPA UE category

4) DC-HSDPA

In DC-HSDPA implementation of this device, the uplink parameters are the same as HSDPA. No additional channels and modulations (16 QAM, and 64 QAM) are supported in uplink. The difference is only in the downlink parameters, where two carriers are supported. HSDPA settings were used on uplink.

For Rel. 8 DC-HSDPA apply the four subtests from HSDPA Release 5 except use fixed reference channel H-Set 12 for DC-HSDPA. And we can apply the same SAR test exclusion criteria used for Rel. 6 HSPA for Rel. 7 HSPA+ and Rel. 8 DC-HSDPA. That is, if the HSPA, HSPA+, or the DC-HSDPA maximum output is not more than 0.25 dB higher than WCDMA, SAR measurement for those modes is not required.

The following tests were completed according to procedures in section 7.3.13 of 3GPP TS34.108 v9.5.0. A summary of these settings are illustrated below:

Downlink Physical Channels are set as per 3GPP TS34.121-1 v9.0.0 E.5.0

Table E.5.0: Levels for HSDPA connection setup

Parameter During Connection setup	Unit	Value
P-CPICH_Ec/Ior	dB	-10
P-CCPCH and SCH_Ec/Ior	dB	-12
PICH _Ec/Ior	dB	-15
HS-PDSCH	dB	off
HS-SCCH_1	dB	off
DPCH_Ec/Ior	dB	-5
OCNS_Ec/Ior	dB	-3.1

Call is set up as per 3GPP TS34.108 v9.5.0 sub clause 7.3.13

The configurations of the fixed reference channels for HSDPA RF tests are described in 3GPP TS 34.121, annex C for FDD and 3GPP TS 34.122.

The measurements were performed with a Fixed Reference Channel (FRC) H-Set 12 with QPSK

Parameter	Value
Nominal average inf. bit rate	60 kbit/s
Inter-TTI Distance	1 TTI's
Number of HARQ Processes	6 Processes
Information Bit Payload	120 Bits
Number Code Blocks	1 Block
Binary Channel Bits Per TTI	960 Bits
Total Available SMLs in UE	19200 SMLs
Number of SMLs per HARQ Process	3200 SMLs
Coding Rate	0.15
Number of Physical Channel Codes	1

Table 16:settings of required H-Set 12 QPSK acc. to 3GPP 34.121

Note:

1.The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table above.

2.Maximum number of transmission is limited to 1,i.e.,retransmission is not allowed. The redundancy and constellation version 0 shall be used.

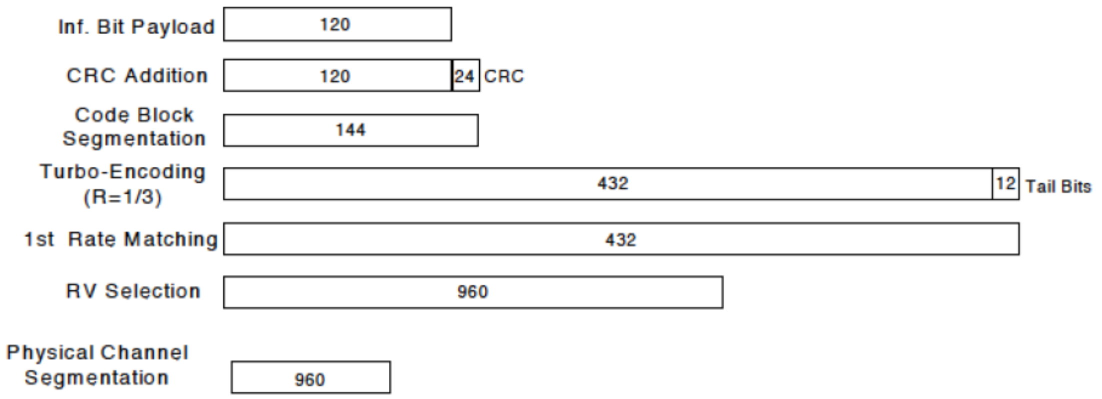


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

The following 4 Sub-tests for HSDPA were completed according to Release 5 procedures. A summary of subtest settings are illustrated below:

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	CM(dB)(2)	MPR (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0
2	12/15(3)	15/15(3)	64	12/15(3)	24/15	1.0	0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ ACK, Δ NACK and Δ CQI = 8 $A_{hs} = \beta_{hs}/\beta_c = 30/15$ $\beta_{hs} = 30/15 * \beta_c$

Note 2 : CM=1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH,DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 3 : For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1,TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$

Up commands are set continuously to set the UE to Max power.

Note:1.The Dual Carriers transmission only applies to HSDPA physical channels

2.The Dual Carriers belong to the same Node and are on adjacent carriers.

3.The Dual Carriers do not support MIMO to serve UEs configured for dual cell operation

4.The Dual Carriers operate in the same frequency band .

5.The device doesn't support the modulation of 16QAM in uplink but 64QAM in downlink for DC-HSDPA mode.

6.The device doesn't support carrier aggregation for its release version is Release 8.

6.3 LTE Test Configurations

SAR for LTE band exposure configurations is measured according to the Procedures of KDB941225 D05. The CMW500 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 II / Band IV MPR as belows:

Modulation	Channel bandwidth / Transmission bandwidth configuration [RB]				MPR
	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	1	1	1	1	0
QPSK	≤ 8	≤ 12	≤ 16	≤ 18	0
QPSK	> 8	> 12	> 16	> 18	1
16 QAM	≤ 8	≤ 12	≤ 16	≤ 18	1
16 QAM	> 8	> 12	> 16	> 18	2

For each LTE frequency band, detail reduce test information is referred to section 7.2.4 to 7.2.5 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), 15MHz/10MHz/5MHz BW is not requied to be tested since the max average conducted power is within ½ dB for 20MHz BW, and SAR of QPSK with 50% RB (20MHz) is < 1.45 W/kg.

Band II Body SAR

6.4 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/n channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

Mode	GHz	Channel	Turbo Channel	"Default Test Channels"			
				§15.247		UNII	
				802.11b	802.11g		
802.11 b/g	2.412	1#		√	∇		
	2.437	6	6	√	∇		
	2.462	11#		√	∇		

7 SAR Measurement Results

7.1 Conducted power measurements

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 as below 7.2 chapter.

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

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

7.1.1 Conducted power measurements GSM850

GSM850		Burst-Averaged output Power (dBm)			Division Factors	Frame-Averaged output Power (dBm)		
		128CH	190CH	251CH		128CH	190CH	251CH
GSM(CS)		32.68	32.49	32.66	-9	23.68	23.49	23.66
GPRS (GMSK)	1 Tx Slot	32.72	32.60	32.69	-9	23.72	23.60	23.69
	2 Tx Slots	30.79	31.08	30.98	-6	24.79	25.08	24.98
	3 Tx Slots	28.33	28.51	28.40	-4.25	24.08	24.26	24.15
	4 Tx Slots	26.82	26.84	27.10	-3	23.82	23.84	24.10
EDGE (GMSK)	1 Tx Slot	32.64	32.52	32.62	-9	23.64	23.52	23.62
	2 Tx Slots	30.76	31.05	30.96	-6	24.76	25.05	24.96
	3 Tx Slots	28.30	28.48	28.37	-4.25	24.05	24.23	24.12
	4 Tx Slots	26.83	26.85	27.05	-3	23.83	23.85	24.05
EDGE (8PSK)	1 Tx Slot	27.13	27.12	27.19	-9	18.13	18.12	18.19
	2 Tx Slots	24.32	24.32	24.38	-6	18.32	18.32	18.38
	3 Tx Slots	22.04	22.35	22.24	-4.25	17.79	18.10	17.99
	4 Tx Slots	20.93	21.06	20.99	-3	17.93	18.06	17.99

Table 17:Test results conducted power measurement GSM 850MHz

Note: 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 timesolts.

7.1.2 Conducted power measurements GSM1900

GSM1900		Burst-Averaged output Power (dBm)			Division Factors	Frame-Averaged output Power (dBm)		
		512CH	661CH	810CH		512CH	661CH	810CH
GSM(CS)		30.05	29.81	30.19	-9	21.05	20.81	21.19
GPRS (GMSK)	1 Tx Slot	30.05	29.75	29.80	-9	21.05	20.75	20.80
	2 Tx Slots	28.21	27.73	27.84	-6	22.21	21.73	21.84
	3 Tx Slots	25.94	25.55	25.60	-4.25	21.69	21.30	21.35
	4 Tx Slots	24.51	24.26	24.34	-3	21.51	21.26	21.34
EDGE (GMSK)	1 Tx Slot	30.06	29.71	29.74	-9	21.06	20.71	20.74
	2 Tx Slots	28.19	27.69	27.83	-6	22.19	21.69	21.83
	3 Tx Slots	25.89	25.53	25.60	-4.25	21.64	21.28	21.35
	4 Tx Slots	24.47	24.22	24.35	-3	21.47	21.22	21.35
EDGE (8PSK)	1 Tx Slot	26.21	26.18	26.15	-9	17.21	17.18	17.15
	2 Tx Slots	23.61	23.37	23.43	-6	17.61	17.37	17.43
	3 Tx Slots	21.44	21.19	21.23	-4.25	17.19	16.94	16.98
	4 Tx Slots	20.31	20.09	20.06	-3	17.31	17.09	17.06

Table 18:Test results conducted power measurement GSM 1900MHz

Note: 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 timesolts.

7.1.3 Conducted power measurements UMTS Band V

UMTS Band V		Average Power (dBm)		
		4132CH	4182CH	4233CH
WCDMA	12.2kbps RMC	22.29	22.49	22.15
	64kbps RMC	22.34	22.48	22.14
	144kbps RMC	22.33	22.47	22.14
	384kbps RMC	22.31	22.49	22.15
HSDPA	Subtest 1	22.33	22.43	22.15
	Subtest 2	22.34	22.22	22.09
	Subtest 3	21.82	21.70	21.74
	Subtest 4	21.58	21.56	21.52
HSUPA	Subtest 1	21.33	21.95	21.90
	Subtest 2	20.75	20.34	20.55
	Subtest 3	20.81	20.82	20.83
	Subtest 4	20.56	20.75	20.88
	Subtest 5	21.34	21.99	21.89
DC-HSDPA	Subtest 1	22.36	22.28	22.09
	Subtest 2	22.35	22.29	22.07
	Subtest 3	21.88	21.84	21.62
	Subtest 4	21.72	21.69	21.57

Table 19:Test results conducted power measurement UMTS Band V

Note: The conducted power of UMTS Band V is measured with RMS detector.

7.1.4 Conducted power measurements UMTS Band II

UMTS Band II		Average Power (dBm)		
		9262CH	9400CH	9538CH
WCDMA	12.2kbps RMC	22.31	22.38	22.36
	64kbps RMC	22.41	22.38	22.28
	144kbps RMC	22.29	22.37	22.26
	384kbps RMC	22.34	22.39	22.28
HSDPA	Subtest 1	22.36	22.42	22.21
	Subtest 2	22.15	22.32	21.39
	Subtest 3	21.67	21.85	20.08
	Subtest 4	21.41	21.52	20.22
HSUPA	Subtest 1	21.26	21.39	21.45
	Subtest 2	20.12	20.37	19.93
	Subtest 3	20.88	20.94	20.68
	Subtest 4	20.96	20.84	20.44
	Subtest 5	21.90	21.81	21.58
DC-HSDPA	Subtest 1	22.41	22.26	22.13
	Subtest 2	22.24	22.38	21.47
	Subtest 3	21.77	21.89	20.17
	Subtest 4	21.56	21.63	20.24

Table 20:Test results conducted power measurement UMTS Band II

Note: The conducted power of UMTS Band II is measured with RMS detector.

7.1.5 Conducted power measurements LTE Band II

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
18625	5	1	0	QPSK	0~2	0	22.02
		1	24	QPSK	0~2	0	21.97
		12	6	QPSK	0~2	1	20.82
		25	0	QPSK	0~3	1	20.75
		1	0	16-QAM	0~3	1	21.22
		1	24	16-QAM	0~3	1	21.14
		12	6	16-QAM	0~3	2	19.71
		25	0	16-QAM	0~4	2	19.78
18650	10	1	0	QPSK	0~2	0	21.78
		1	49	QPSK	0~2	0	21.72
		25	13	QPSK	0~3	1	20.84
		50	0	QPSK	0~3	1	20.88
		1	0	16-QAM	0~3	1	20.45
		1	49	16-QAM	0~3	1	20.47
		25	13	16-QAM	0~4	2	19.85
		50	0	16-QAM	0~4	2	19.77
18675	15	1	0	QPSK	0~2	0	22.06
		1	74	QPSK	0~2	0	21.82
		36	18	QPSK	0~3	1	20.88
		75	0	QPSK	0~3	1	20.84
		1	0	16-QAM	0~3	1	21.24
		1	74	16-QAM	0~3	1	20.81
		36	18	16-QAM	0~4	2	19.84
		75	0	16-QAM	0~4	2	19.81
18700	20	1	0	QPSK	0~2	0	22.04
		1	99	QPSK	0~2	0	21.75
		50	25	QPSK	0~3	1	20.75
		100	0	QPSK	0~3	1	20.78
		1	0	16-QAM	0~3	1	21.22
		1	99	16-QAM	0~3	1	20.86
		50	25	16-QAM	0~4	2	19.67
		100	0	16-QAM	0~4	2	19.80

Table 21:Test results conducted power measurement LTE Band II Low channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
18900	5	1	0	QPSK	0~2	0	22.13
		1	24	QPSK	0~2	0	22.13
		12	6	QPSK	0~2	1	21.06
		25	0	QPSK	0~3	1	20.95
		1	0	16-QAM	0~3	1	21.20
		1	24	16-QAM	0~3	1	21.30
		12	6	16-QAM	0~3	2	19.74
		25	0	16-QAM	0~4	2	20.11
	10	1	0	QPSK	0~2	0	21.82
		1	49	QPSK	0~2	0	21.84
		25	13	QPSK	0~3	1	20.87
		50	0	QPSK	0~3	1	20.83
		1	0	16-QAM	0~3	1	21.03
		1	49	16-QAM	0~3	1	21.12
		25	13	16-QAM	0~4	2	19.94
		50	0	16-QAM	0~4	2	19.88
	15	1	0	QPSK	0~2	0	21.90
		1	74	QPSK	0~2	0	22.09
		36	18	QPSK	0~3	1	20.96
		75	0	QPSK	0~3	1	20.92
		1	0	16-QAM	0~3	1	20.51
		1	74	16-QAM	0~3	1	20.65
		36	18	16-QAM	0~4	2	19.86
		75	0	16-QAM	0~4	2	19.92
	20	1	0	QPSK	0~2	0	21.77
		1	99	QPSK	0~2	0	22.16
		50	25	QPSK	0~3	1	20.93
		100	0	QPSK	0~3	1	21.04
		1	0	16-QAM	0~3	1	21.24
		1	99	16-QAM	0~3	1	21.42
		50	25	16-QAM	0~4	2	20.04
		100	0	16-QAM	0~4	2	20.00

Table 22: Test results conducted power measurement LTE Band II Mid Channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
19175	5	1	0	QPSK	0~2	0	22.03
		1	24	QPSK	0~2	0	21.25
		12	6	QPSK	0~2	1	20.67
		25	0	QPSK	0~3	1	20.62
		1	0	16-QAM	0~3	1	21.17
		1	24	16-QAM	0~3	1	20.37
		12	6	16-QAM	0~3	2	19.49
		25	0	16-QAM	0~4	2	19.54
19150	10	1	0	QPSK	0~2	0	22.16
		1	49	QPSK	0~2	0	21.42
		25	13	QPSK	0~3	1	20.93
		50	0	QPSK	0~3	1	20.94
		1	0	16-QAM	0~3	1	20.76
		1	49	16-QAM	0~3	1	20.10
		25	13	16-QAM	0~4	2	19.90
		50	0	16-QAM	0~4	2	19.65
19125	15	1	0	QPSK	0~2	0	22.14
		1	74	QPSK	0~2	0	21.21
		36	18	QPSK	0~3	1	21.00
		75	0	QPSK	0~3	1	20.93
		1	0	16-QAM	0~3	1	21.21
		1	74	16-QAM	0~3	1	20.31
		36	18	16-QAM	0~4	2	20.07
		75	0	16-QAM	0~4	2	19.89
19100	20	1	0	QPSK	0~2	0	22.08
		1	99	QPSK	0~2	0	21.22
		50	25	QPSK	0~3	1	20.94
		100	0	QPSK	0~3	1	20.87
		1	0	16-QAM	0~3	1	21.27
		1	99	16-QAM	0~3	1	20.18
		50	25	16-QAM	0~4	2	19.89
		100	0	16-QAM	0~4	2	19.91

Table 23: Test results conducted power measurement LTE Band II High Channel

Note: The conducted power of LTE Band II is measured with RMS detector.

7.1.6 Conducted power measurements LTE Band IV

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
19975	5	1	0	QPSK	0~2	0	22.38
		1	24	QPSK	0~2	0	22.49
		12	6	QPSK	0~2	1	21.36
		25	0	QPSK	0~3	1	21.36
		1	0	16-QAM	0~3	1	21.54
		1	24	16-QAM	0~3	1	21.63
		12	6	16-QAM	0~3	2	20.28
		25	0	16-QAM	0~4	2	20.33
20000	10	1	0	QPSK	0~2	0	22.17
		1	49	QPSK	0~2	0	22.43
		25	13	QPSK	0~3	1	21.34
		50	0	QPSK	0~3	1	21.40
		1	0	16-QAM	0~3	1	20.95
		1	49	16-QAM	0~3	1	21.12
		25	13	16-QAM	0~4	2	20.46
		50	0	16-QAM	0~4	2	20.37
20025	15	1	0	QPSK	0~2	0	22.43
		1	74	QPSK	0~2	0	22.61
		36	18	QPSK	0~3	1	21.36
		75	0	QPSK	0~3	1	21.35
		1	0	16-QAM	0~3	1	21.34
		1	74	16-QAM	0~3	1	21.44
		36	18	16-QAM	0~4	2	20.34
		75	0	16-QAM	0~4	2	20.49
20050	20	1	0	QPSK	0~2	0	22.33
		1	99	QPSK	0~2	0	22.49
		50	25	QPSK	0~3	1	21.50
		100	0	QPSK	0~3	1	21.52
		1	0	16-QAM	0~3	1	21.47
		1	99	16-QAM	0~3	1	21.69
		50	25	16-QAM	0~4	2	20.47
		100	0	16-QAM	0~4	2	20.65

Table 24:Test results conducted power measurement LTE Band IV Low channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
20175	5	1	0	QPSK	0~2	0	22.58
		1	24	QPSK	0~2	0	22.61
		12	6	QPSK	0~2	1	21.39
		25	0	QPSK	0~3	1	21.43
		1	0	16-QAM	0~3	1	21.34
		1	24	16-QAM	0~3	1	21.26
		12	6	16-QAM	0~3	2	20.23
		25	0	16-QAM	0~4	2	20.56
	10	1	0	QPSK	0~2	0	22.54
		1	49	QPSK	0~2	0	22.33
		25	13	QPSK	0~3	1	21.44
		50	0	QPSK	0~3	1	21.45
		1	0	16-QAM	0~3	1	21.82
		1	49	16-QAM	0~3	1	21.73
		25	13	16-QAM	0~4	2	20.59
		50	0	16-QAM	0~4	2	20.43
	15	1	0	QPSK	0~2	0	22.47
		1	74	QPSK	0~2	0	22.41
		36	18	QPSK	0~3	1	21.48
		75	0	QPSK	0~3	1	21.41
		1	0	16-QAM	0~3	1	21.81
		1	74	16-QAM	0~3	1	21.77
		36	18	16-QAM	0~4	2	20.44
		75	0	16-QAM	0~4	2	20.50
	20	1	0	QPSK	0~2	0	22.65
		1	99	QPSK	0~2	0	22.31
		50	25	QPSK	0~3	1	21.42
		100	0	QPSK	0~3	1	21.43
		1	0	16-QAM	0~3	1	21.73
		1	99	16-QAM	0~3	1	21.49
		50	25	16-QAM	0~4	2	20.36
		100	0	16-QAM	0~4	2	20.47

Table 25:Test results conducted power measurement LTE Band IV Mid channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
20375	5	1	0	QPSK	0~2	0	22.32
		1	24	QPSK	0~2	0	22.17
		12	6	QPSK	0~2	1	21.08
		25	0	QPSK	0~3	1	21.09
		1	0	16-QAM	0~3	1	21.52
		1	24	16-QAM	0~3	1	21.29
		12	6	16-QAM	0~3	2	20.24
		25	0	16-QAM	0~4	2	20.19
20350	10	1	0	QPSK	0~2	0	21.97
		1	49	QPSK	0~2	0	21.81
		25	13	QPSK	0~3	1	21.25
		50	0	QPSK	0~3	1	21.19
		1	0	16-QAM	0~3	1	21.07
		1	49	16-QAM	0~3	1	20.84
		25	13	16-QAM	0~4	2	20.20
		50	0	16-QAM	0~4	2	20.21
20325	15	1	0	QPSK	0~2	0	22.43
		1	74	QPSK	0~2	0	22.11
		36	18	QPSK	0~3	1	21.21
		75	0	QPSK	0~3	1	21.19
		1	0	16-QAM	0~3	1	21.40
		1	74	16-QAM	0~3	1	21.16
		36	18	16-QAM	0~4	2	20.26
		75	0	16-QAM	0~4	2	20.17
20300	20	1	0	QPSK	0~2	0	22.45
		1	99	QPSK	0~2	0	22.01
		50	25	QPSK	0~3	1	21.30
		100	0	QPSK	0~3	1	21.28
		1	0	16-QAM	0~3	1	21.86
		1	99	16-QAM	0~3	1	21.40
		50	25	16-QAM	0~4	2	20.42
		100	0	16-QAM	0~4	2	20.33

Table 26:Test results conducted power measurement LTE Band IV High channel

Note: The conducted power of LTE Band IV is measured with RMS detector.

7.1.7 Conducted power measurements LTE Band VII

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
20775	5	1	0	QPSK	0~2	0	22.03
		1	24	QPSK	0~2	0	22.14
		12	6	QPSK	0~2	1	20.99
		25	0	QPSK	0~3	1	20.90
		1	0	16-QAM	0~3	1	20.90
		1	24	16-QAM	0~3	1	20.95
		12	6	16-QAM	0~3	2	19.90
		25	0	16-QAM	0~4	2	19.87
20800	10	1	0	QPSK	0~2	0	21.93
		1	49	QPSK	0~2	0	22.02
		25	13	QPSK	0~3	1	20.99
		50	0	QPSK	0~3	1	20.93
		1	0	16-QAM	0~3	1	21.09
		1	49	16-QAM	0~3	1	21.20
		25	13	16-QAM	0~4	2	20.12
		50	0	16-QAM	0~4	2	20.05
20825	15	1	0	QPSK	0~2	0	22.16
		1	74	QPSK	0~2	0	22.25
		36	18	QPSK	0~3	1	21.05
		75	0	QPSK	0~3	1	20.97
		1	0	16-QAM	0~3	1	20.80
		1	74	16-QAM	0~3	1	20.90
		36	18	16-QAM	0~4	2	20.04
		75	0	16-QAM	0~4	2	20.07
20850	20	1	0	QPSK	0~2	0	22.10
		1	99	QPSK	0~2	0	22.16
		50	25	QPSK	0~3	1	21.13
		100	0	QPSK	0~3	1	21.03
		1	0	16-QAM	0~3	1	21.27
		1	99	16-QAM	0~3	1	21.22
		50	25	16-QAM	0~4	2	20.04
		100	0	16-QAM	0~4	2	20.15

Table 27:Test results conducted power measurement LTE Band VII Low channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
21100	5	1	0	QPSK	0~2	0	22.10
		1	24	QPSK	0~2	0	21.97
		12	6	QPSK	0~2	1	20.99
		25	0	QPSK	0~3	1	20.96
		1	0	16-QAM	0~3	1	20.86
		1	24	16-QAM	0~3	1	20.69
		12	6	16-QAM	0~3	2	19.80
		25	0	16-QAM	0~4	2	20.11
	10	1	0	QPSK	0~2	0	22.07
		1	49	QPSK	0~2	0	21.95
		25	13	QPSK	0~3	1	20.99
		50	0	QPSK	0~3	1	20.94
		1	0	16-QAM	0~3	1	21.30
		1	49	16-QAM	0~3	1	21.13
		25	13	16-QAM	0~4	2	20.15
		50	0	16-QAM	0~4	2	20.08
	15	1	0	QPSK	0~2	0	22.11
		1	74	QPSK	0~2	0	22.03
		36	18	QPSK	0~3	1	20.97
		75	0	QPSK	0~3	1	20.80
		1	0	16-QAM	0~3	1	21.09
		1	74	16-QAM	0~3	1	20.99
		36	18	16-QAM	0~4	2	19.89
		75	0	16-QAM	0~4	2	19.93
	20	1	0	QPSK	0~2	0	22.98
		1	99	QPSK	0~2	0	21.88
		50	25	QPSK	0~3	1	21.00
		100	0	QPSK	0~3	1	21.08
		1	0	16-QAM	0~3	1	21.33
		1	99	16-QAM	0~3	1	21.14
		50	25	16-QAM	0~4	2	20.04
		100	0	16-QAM	0~4	2	20.15

Table 28:Test results conducted power measurement LTE Band VII Mid channel

Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	MPR Allowed by 3GPP(dB)	Target MPR(dB)	Average Power (dBm)
21425	5	1	0	QPSK	0~2	0	21.37
		1	24	QPSK	0~2	0	21.21
		12	6	QPSK	0~2	1	20.32
		25	0	QPSK	0~3	1	20.34
		1	0	16-QAM	0~3	1	20.48
		1	24	16-QAM	0~3	1	20.34
		12	6	16-QAM	0~3	2	19.41
		25	0	16-QAM	0~4	2	19.43
21400	10	1	0	QPSK	0~2	0	21.61
		1	49	QPSK	0~2	0	21.38
		25	13	QPSK	0~3	1	20.42
		50	0	QPSK	0~3	1	20.40
		1	0	16-QAM	0~3	1	20.80
		1	49	16-QAM	0~3	1	20.45
		25	13	16-QAM	0~4	2	19.39
		50	0	16-QAM	0~4	2	19.54
21375	15	1	0	QPSK	0~2	0	21.85
		1	74	QPSK	0~2	0	21.36
		36	18	QPSK	0~3	1	20.67
		75	0	QPSK	0~3	1	20.59
		1	0	16-QAM	0~3	1	20.70
		1	74	16-QAM	0~3	1	20.28
		36	18	16-QAM	0~4	2	19.74
		75	0	16-QAM	0~4	2	19.69
21350	20	1	0	QPSK	0~2	0	21.74
		1	99	QPSK	0~2	0	21.34
		50	25	QPSK	0~3	1	20.68
		100	0	QPSK	0~3	1	20.66
		1	0	16-QAM	0~3	1	21.03
		1	99	16-QAM	0~3	1	20.63
		50	25	16-QAM	0~4	2	19.70
		100	0	16-QAM	0~4	2	19.78

Table 29:Test results conducted power measurement LTE Band VII High channel

Note: The conducted power of LTE Band VII is measured with RMS detector.

7.2 SAR measurement Result

7.2.1 SAR measurement Result of GSM850

Test Position of Body with 10mm	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
Front Side	190/836.6	GPRS 1TS	0.426	0.290	0.070	32.60	21.4°C
		GPRS 2TS	0.435	0.297	0.120	31.08	21.4°C
		GPRS 3TS	0.359	0.244	-0.050	28.51	21.4°C
		GPRS 4TS	0.364	0.248	-0.110	26.84	21.4°C
Rear Side	190/836.6	GPRS 2TS	**0.519**	0.342	-0.040	31.08	21.4°C
Left Side			0.204	0.133	0.020		21.4°C
Right Side			0.375	0.263	-0.060		21.4°C
Bottom Side			0.150	0.091	-0.120		21.4°C
Rear Side	190/836.6	EDGE 1TS	0.478	0.315	0.060	32.52	21.4°C
		EDGE 2TS	0.509	0.336	-0.100	31.05	21.4°C
		EDGE 3TS	0.437	0.287	-0.130	28.48	21.4°C
		EDGE 4TS	0.424	0.280	-0.130	26.85	21.4°C

Table 30: Test results Body SAR GSM 850MHz

Note: 1) The maximum SAR value of each test band is shown in **bold** letters.

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

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

7.2.2 SAR measurement Result of GSM1900

Test Position of Body with 10mm	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
Front Side	661/1880	GPRS 1TS	0.564	0.336	0.070	29.75	21.4°C
	810/1909.8	GPRS 2TS	0.910	0.542	-0.070	27.84	21.4°C
	661/1880		0.841	0.502	-0.150	27.73	21.4°C
	512/1850.2		0.737	0.442	-0.080	28.21	21.4°C
	661/1880	GPRS 3TS	0.748	0.446	-0.090	25.55	21.4°C
	810/1909.8	GPRS 4TS	0.823	0.482	0.110	24.34	21.4°C
	661/1880		0.812	0.482	-0.130	24.26	21.4°C
	512/1850.2		0.723	0.428	-0.110	24.51	21.4°C
Rear Side	661/1880	GPRS 2TS	0.680	0.395	0.160	27.73	21.4°C
Left Side			0.261	0.151	-0.030		21.4°C
Right Side			0.321	0.190	0.070		21.4°C
Bottom Side			0.404	0.229	-0.100		21.4°C
Front Side	661/1880	EDGE 1TS	0.601	0.353	-0.030	29.71	21.4°C
	810/1909.8	EDGE 2TS	**0.916**	0.540	0.050	27.83	21.4°C
	661/1880		0.860	0.508	-0.190	27.69	21.4°C
	512/1850.2		0.835	0.496	-0.030	28.19	21.4°C
	661/1880	EDGE 3TS	0.689	0.406	0.100	25.53	21.4°C
	810/1909.8	EDGE 4TS	0.877	0.514	-0.080	24.35	21.4°C
	661/1880		0.812	0.475	-0.160	24.22	21.4°C
	512/1850.2		0.694	0.410	-0.160	24.47	21.4°C

Table 31: Test results Body SAR GSM 1900MHz

Note: 1) The maximum SAR value of each test band is shown in **bold** letters.

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

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

7.2.3 SAR measurement Result of UMTS Band V

Test Position of Body with 10mm	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
Front Side	4182/836.4	RMC	0.675	0.474	0.030	22.49	21.4°C
Rear Side			0.729	0.504	-0.060		21.4°C
Left Side			0.386	0.262	0.040		21.4°C
Right Side			0.328	0.232	0.040		21.4°C
Bottom Side			0.087	0.055	-0.050		21.4°C
Rear Side	4182/836.4	HSDPA	**0.734**	0.505	-0.070	22.43	21.4°C
		HSUPA	0.665	0.458	-0.040	21.99	21.4°C

Table 32:Test results Body SAR UMTS Band V

Note: 1) The maximum SAR value of each test band is shown in **bold** letters.

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

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

4) For the the DC-HSDPA maximum output is not more than 0.25 dB higher than WCDMA, SAR measurement for DC-HSDPA is not required.

7.2.4 SAR measurement Result of UMTS Band II

Test Position of Body with 10mm	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
Front Side	9538/1907.6	RMC	**1.030**	0.608	-0.020	22.36	21.4°C
	9400/1880		0.976	0.572	-0.040	22.38	21.4°C
	9262/1852.4		1.010	0.593	0.030	22.31	21.4°C
Rear Side	9400/1880	RMC	0.711	0.419	-0.110	22.38	21.4°C
Left Side			0.286	0.166	0.030		21.4°C
Right Side			0.330	0.193	0.100		21.4°C
Bottom Side			0.415	0.233	-0.140		21.4°C
Front Side	9538/1907.6	HSDPA	1.010	0.601	0.040	22.21	21.4°C
		HSUPA	0.707	0.421	-0.100	21.58	21.4°C

Table 33:Test results Body SAR UMTS Band II

Note: 1) The maximum SAR value of each test band is shown in **bold** letters.

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

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

4) For the the DC-HSDPA maximum output is not more than 0.25 dB higher than WCDMA, SAR measurement for DC-HSDPA is not required.

7.2.5 Results overview of LTE Band II

Test Position of Body with 10mm	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
20M QPSK							
Front Side	18900/1880	50%RB#25	0.767	0.464	0.040	20.93	21.4°C
Rear Side			0.458	0.268	-0.040		21.4°C
Left Side			0.252	0.124	0.150		21.4°C
Right Side			0.129	0.079	0.170		21.4°C
Bottom Side			0.314	0.177	0.030		21.4°C
20M QPSK							
Front Side	19100/1900	1RB#0	1.020	0.618	0.040	22.08	21.4°C
Rear Side			0.664	0.399	0.040		21.4°C
Left Side			0.282	0.168	0.100		21.4°C
Right Side			0.205	0.124	0.070		21.4°C
Bottom Side			0.477	0.268	-0.050		21.4°C
20M QPSK							
Front Side	18900/1880	1RB#99	**1.040**	0.633	-0.010	22.16	21.4°C
Rear Side			0.672	0.406	-0.050		21.4°C
Left Side			0.295	0.177	0.010		21.4°C
Right Side			0.196	0.119	0.090		21.4°C
Bottom Side			0.382	0.215	0.000		21.4°C
20M 16QAM							
Front Side	18900/1880	50%RB#25	0.607	0.366	-0.070	20.04	21.4°C
Rear Side			0.411	0.252	-0.060		21.4°C
Left Side			0.152	0.087	0.060		21.4°C
Right Side			0.114	0.068	0.120		21.4°C
Bottom Side			0.242	0.136	0.010		21.4°C
20M 16QAM							
Front Side	19100/1900	1RB#0	0.876	0.527	0.040	21.27	21.4°C
Rear Side			0.591	0.354	0.020		21.4°C
Left Side			0.243	0.144	0.070		21.4°C
Right Side			0.180	0.109	0.190		21.4°C
Bottom Side			0.383	0.217	-0.120		21.4°C
20M 16QAM							
Front Side	18900/1880	1RB#99	0.961	0.578	-0.100	21.42	21.4°C
Rear Side			0.604	0.359	-0.020		21.4°C
Left Side			0.241	0.137	-0.110		21.4°C
Right Side			0.183	0.110	0.030		21.4°C
Bottom Side			0.395	0.222	-0.070		21.4°C

Table 34:Test results Body SAR LTE Band II

Note: 1) The maximum SAR value of each test band is shown in **bold** letters.

2) 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.

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

7.2.6 Results overview of LTE Band IV

Test Position of Body with 10mm	Test channel /Frequency	Test Mode	SAR Value (W/kg)		Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
			1-g	10-g			
20M QPSK							
Front Side	20300/1745	50%RB#25	0.824	0.474	0.130	21.30	21.4°C
	20175/1732.5		0.924	0.531	-0.010	21.42	21.4°C
	20050/1720		0.885	0.507	-0.010	21.50	21.4°C
Rear Side	20175/1732.5	50%RB#25	0.664	0.377	-0.050	21.42	21.4°C
Left Side			0.246	0.144	0.100		21.4°C
Right Side			0.210	0.128	0.140		21.4°C
Bottom Side			0.309	0.176	0.040		21.4°C
20M QPSK							
Front Side	20175/1732.5	1RB#0	**1.150**	0.665	-0.090	22.65	21.4°C
Rear Side			0.835	0.475	0.020		21.4°C
Left Side			0.305	0.179	0.130		21.4°C
Right Side			0.281	0.169	0.010		21.4°C
Bottom Side			0.396	0.226	0.030		21.4°C
20M QPSK							
Front Side	20050/1720	1RB#99	1.110	0.660	0.060	22.49	21.4°C
Rear Side			0.744	0.428	0.020		21.4°C
Left Side			0.298	0.174	-0.040		21.4°C
Right Side			0.130	0.079	0.170		21.4°C
Bottom Side			0.374	0.212	0.110		21.4°C
20M 16QAM							
Front Side	20175/1732.5	50%RB#25	0.760	0.448	0.190	20.36	21.4°C
Rear Side			0.474	0.274	-0.080		21.4°C
Left Side			0.201	0.117	0.190		21.4°C
Right Side			0.178	0.107	0.100		21.4°C
Bottom Side			0.248	0.141	0.130		21.4°C
20M 16QAM							
Front Side	20300/1745	1RB#0	0.937	0.538	0.020	21.86	21.4°C
Rear Side			0.578	0.332	0.030		21.4°C
Left Side			0.216	0.125	0.070		21.4°C
Right Side			0.228	0.137	0.160		21.4°C
Bottom Side			0.319	0.181	0.080		21.4°C
20M 16QAM							
Front Side	20050/1720	1RB#99	0.926	0.538	-0.060	21.69	21.4°C
Rear Side			0.625	0.359	0.110		21.4°C
Left Side			0.234	0.138	0.170		21.4°C
Right Side			0.236	0.142	0.120		21.4°C
Bottom Side			0.323	0.183	0.130		21.4°C

Table 35:Test results Body SAR LTE Band IV

Note: 1) The maximum SAR value of each test band is shown in **bold** letters.

2) 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.

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

7.2.7 Results overview of LTE Band VII

Test Position of Body with 10mm	Test channel /Frequency	Test Mode	SAR Value (W/kg) 1-g	SAR Value (W/kg) 10-g	Power Drift (dB)	Conducted Power (dBm)	Liquid Temp.
20M QPSK							
Front Side	21100/2535	50%RB#25	0.608	0.305	0.010	21.00	21.4°C
Rear Side			0.680	0.340	-0.010		21.4°C
Left Side			0.127	0.071	0.020		21.4°C
Right Side			0.082	0.050	0.090		21.4°C
Bottom Side	21350/2560	50%RB#25	0.909	0.451	0.180	20.68	21.4°C
	21100/2535		1.040	0.522	-0.180	21.00	21.4°C
	20850/2510		0.878	0.441	0.130	21.13	21.4°C
20M QPSK							
Front Side	21100/2535	1RB#0	0.704	0.354	0.040	22.98	21.4°C
Rear Side			0.824	0.414	-0.060		21.4°C
Left Side			0.172	0.095	-0.070		21.4°C
Right Side			0.108	0.066	0.190		21.4°C
Bottom Side			**1.280**	0.642	-0.120		21.4°C
20M QPSK							
Front Side	20850/2510	1RB#99	0.665	0.337	0.100	22.16	21.4°C
Rear Side			0.735	0.368	0.100		21.4°C
Left Side			0.179	0.098	0.170		21.4°C
Right Side			0.090	0.055	0.030		21.4°C
Bottom Side			1.180	0.596	0.040		21.4°C
20M 16QAM							
Front Side	21100/2535	50%RB#25	0.539	0.269	-0.030	20.04	21.4°C
Rear Side			0.578	0.288	0.190		21.4°C
Left Side			0.045	0.026	0.110		21.4°C
Right Side			0.066	0.040	0.170		21.4°C
Bottom Side			0.835	0.415	0.130		21.4°C
20M 16QAM							
Front Side	21100/2535	1RB#0	0.675	0.341	-0.120	21.33	21.4°C
Rear Side			0.761	0.383	0.030		21.4°C
Left Side			0.044	0.026	-0.030		21.4°C
Right Side			0.089	0.054	0.160		21.4°C
Bottom Side			0.995	0.499	-0.130		21.4°C
20M 16QAM							
Front Side	20850/2510	1RB#99	0.633	0.319	0.070	21.22	21.4°C
Rear Side			0.719	0.359	0.070		21.4°C
Left Side			0.140	0.077	0.130		21.4°C
Right Side			0.085	0.051	-0.100		21.4°C
Bottom Side			0.941	0.471	0.150		21.4°C

Table 36:Test results Body SAR LTE Band VII

Note: 1) The maximum SAR value of each test band is shown in **bold** letters.

2) 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.

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

1) LTE band II/IV/VII 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 II	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Max Difference
Low Channel	18700	20	50%	25	QPSK	20.75	**0.19**
Mid Channel	18900	20	50%	25	QPSK	**20.93**	
High Channel	19100	20	50%	25	QPSK	20.94	

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

LTE Band IV	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Max Difference
Low Channel	20050	20	50%	25	QPSK	21.50	**0.20**
Mid Channel	20175	20	50%	25	QPSK	**21.42**	
High Channel	20300	20	50%	25	QPSK	21.30	

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

LTE Band VII	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Max Difference
Low Channel	20850	20	50%	25	QPSK	21.13	**0.45**
Mid Channel	21100	20	50%	25	QPSK	**21.00**	
High Channel	21350	20	50%	25	QPSK	20.68	

➔Band VII, 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 II	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	18700	20	1	0	QPSK	22.04	1.29
		20	50	25	QPSK	20.75	
Mid Channel	18900	20	1	0	QPSK	21.77	0.84
		20	50	25	QPSK	20.93	
High Channel	19100	20	1	0	QPSK	**22.08**	1.14
		20	50	25	QPSK	20.94	

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

LTE Band IV	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20050	20	1	0	QPSK	22.33	0.83
		20	50	25	QPSK	21.50	
Mid Channel	20175	20	1	0	QPSK	**22.65**	1.23
		20	50	25	QPSK	21.42	
High Channel	20300	20	1	0	QPSK	22.45	1.15
		20	50	25	QPSK	21.30	

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

LTE Band VII	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20850	20	1	0	QPSK	22.10	0.97
		20	50	25	QPSK	21.13	
Mid Channel	21100	20	1	0	QPSK	**22.98**	1.98
		20	50	25	QPSK	21.00	
High Channel	21350	20	1	0	QPSK	21.74	1.06
		20	50	25	QPSK	20.68	

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

LTE Band II	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	18700	20	1	99	QPSK	21.75	1.00
		20	50	25	QPSK	20.75	
Mid Channel	18900	20	1	99	QPSK	**22.16**	1.23
		20	50	25	QPSK	20.93	
High Channel	19100	20	1	99	QPSK	21.22	0.28
		20	50	25	QPSK	20.94	

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

LTE Band IV	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20050	20	1	99	QPSK	**22.49**	0.99
		20	50	25	QPSK	21.50	
Mid Channel	20175	20	1	99	QPSK	22.31	0.89
		20	50	25	QPSK	21.42	
High Channel	20300	20	1	99	QPSK	22.01	0.71
		20	50	25	QPSK	21.30	

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

LTE Band VII	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20850	20	1	99	QPSK	**22.16**	1.03
		20	50	25	QPSK	21.13	
Mid Channel	21100	20	1	99	QPSK	21.88	0.88
		20	50	25	QPSK	21.00	
High Channel	21350	20	1	99	QPSK	21.34	0.66
		20	50	25	QPSK	20.68	

➔Band VII, Low 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 II	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	18700	20	1	0	16QAM	21.22	-0.82
		20	1	0	QPSK	22.04	
Mid Channel	18900	20	1	99	16-QAM	21.42	-0.74
		20	1	99	QPSK	22.16	
High Channel	19100	20	1	0	16-QAM	21.27	-0.81
		20	1	0	QPSK	22.08	

LTE Band II	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	18700	20	50	25	16QAM	19.67	-1.08
		20	50	25	QPSK	20.75	
Mid Channel	18900	20	50	25	16-QAM	20.04	-0.89
		20	50	25	QPSK	20.93	
High Channel	19100	20	50	25	16-QAM	19.89	-1.05
		20	50	25	QPSK	20.94	

➔ Band II, using the highest SAR channel measured in 3) A).

LTE Band IV	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20050	20	1	99	16QAM	21.69	-0.80
		20	1	99	QPSK	22.49	
Mid Channel	20175	20	1	0	16-QAM	21.73	-0.92
		20	1	0	QPSK	22.65	
High Channel	20300	20	1	0	16-QAM	21.86	-0.59
		20	1	0	QPSK	22.45	

LTE Band IV	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20050	20	50	25	16QAM	20.47	-1.03
		20	50	25	QPSK	21.50	
Mid Channel	20175	20	50	25	16-QAM	20.36	-1.06
		20	50	25	QPSK	21.42	
High Channel	20300	20	50	25	16-QAM	20.42	-0.88
		20	50	25	QPSK	21.30	

➔ Band IV, using the highest SAR channel measured in 3) A).

LTE Band VII	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20850	20	1	0	16QAM	21.27	-0.89
		20	1	99	QPSK	22.16	
Mid Channel	21100	20	1	0	16-QAM	21.33	-1.65
		20	1	0	QPSK	22.98	
High Channel	21350	20	1	0	16-QAM	21.03	-0.71
		20	1	0	QPSK	21.74	

LTE Band VII	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20850	20	50	25	16QAM	20.04	-1.09
		20	50	25	QPSK	21.13	
Mid Channel	21100	20	50	25	16-QAM	20.04	-0.96
		20	50	25	QPSK	21.00	
High Channel	21350	20	50	25	16-QAM	19.70	-0.98
		20	50	25	QPSK	20.68	

➔ Band VII, using the highest SAR channel measured in 3) A).

d. Per KDB941225 D05 page 4,4) B) Measure SAR in 16QAM with 1 RB allocated at the high end of the channel edge using the SAR channel measured in A); and then repeat the measurement at the low end of the channel edge.

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 II	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	18700	20	1	0	16QAM	21.22	1.55
		20	50	25	16QAM	19.67	
Mid Channel	18900	20	1	0	16QAM	21.24	1.20
		20	50	25	16QAM	20.04	
High Channel	19100	20	1	0	16QAM	**21.27**	1.38
		20	50	25	16QAM	19.89	

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

LTE Band II	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	18700	20	1	99	16QAM	20.86	1.19
		20	50	25	16QAM	19.67	
Mid Channel	18900	20	1	99	16QAM	**21.42**	1.38
		20	50	25	16QAM	20.04	
High Channel	19100	20	1	99	16QAM	20.18	0.29
		20	50	25	16QAM	19.89	

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

LTE Band IV	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20050	20	1	0	16QAM	21.47	1.00
		20	50	25	16QAM	20.47	
Mid Channel	20175	20	1	0	16QAM	21.73	1.37
		20	50	25	16QAM	20.36	
High Channel	20300	20	1	0	16QAM	**21.86**	1.44
		20	50	25	16QAM	20.42	

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

LTE Band IV	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20050	20	1	99	16QAM	**21.69**	1.22
		20	50	25	16QAM	20.47	
Mid Channel	20175	20	1	99	16QAM	21.49	1.13
		20	50	25	16QAM	20.36	
High Channel	20300	20	1	99	16QAM	21.40	0.98
		20	50	25	16QAM	20.42	

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

LTE Band VII	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	18700	20	1	0	16QAM	21.27	1.23
		20	50	25	16QAM	20.04	
Mid Channel	18900	20	1	0	16QAM	**21.33**	1.29
		20	50	25	16QAM	20.04	
High Channel	19100	20	1	0	16QAM	21.03	1.33
		20	50	25	16QAM	19.70	

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

LTE Band VII	Uplink Channel Number	BW [MHz]	RB Size	RB Offset	Mod	Max Conducted Power (dBm)	Difference
Low Channel	20850	20	1	99	16QAM	**21.22**	1.18
		20	50	25	16QAM	20.04	
Mid Channel	21100	20	1	99	16QAM	21.14	1.10
		20	50	25	16QAM	20.04	
High Channel	21350	20	1	99	16QAM	20.63	**0.93**
		20	50	25	16QAM	19.70	

➔ Band VII, Low 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)

e. Per KDB941225 D05 page 5,5) A) 5MHz/10MHz/15MHz BW is not requied to be tested since the smaller channel bandwidth maximum average conducted power is at least ½ dB lower for 20MHz BW.

LTE Band VII	20MHz	15MHz	10MHz	5MHz
Max Power	22.98	22.25	22.07	22.14
Difference	/	-0.73	-0.91	-0.84

Therefore: LTE Band VII cannot be tested in the smaller channel bandwidth of QPSK/16QAM.

f. Per KDB941225 D05 page 5,5) B), 5MHz/10MHz/15MHz BW is not requied to be tested since the smaller channel bandwidth maximum average conducted power is within ½ dB,higher or lower,for 20MHz BW and SAR is < 1.45 W/kg.

LTE Band II	20MHz	15MHz	10MHz	5MHz
Max Power	22.16	22.14	22.16	22.13
Difference	/	-0.02	0	-0.03
LTE Band IV	20MHz	15MHz	10MHz	5MHz
Max Power	22.65	22.61	22.54	22.58
Difference	/	-0.04	-0.11	-0.07

Therefore: LTE Band II/VII cannot be tested in the smaller channel bandwidth of QPSK/16QAM.

7.3 Multiple Transmitter Evaluation

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.

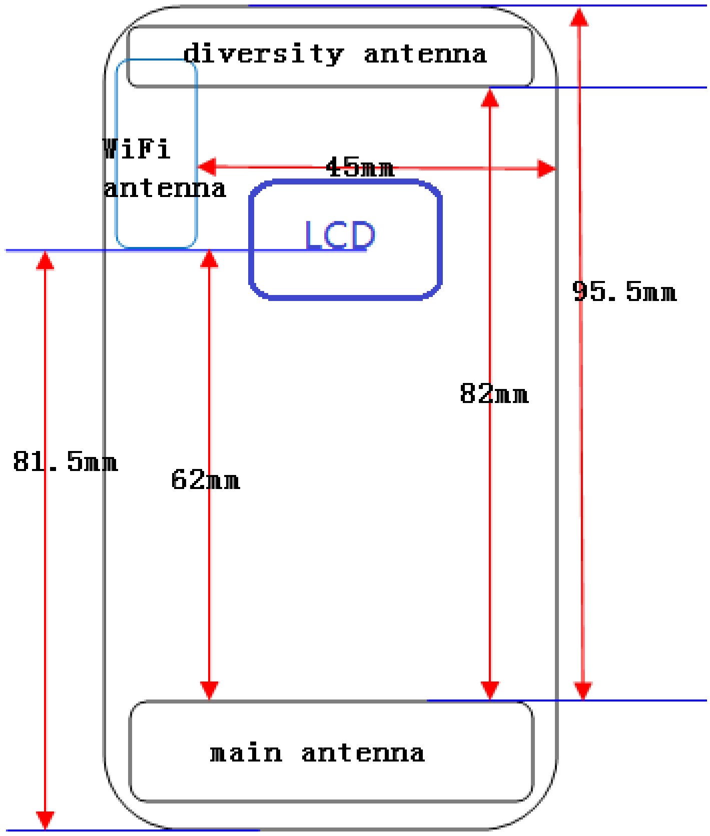
	2.45	5.15 - 5.35	5.47 - 5.85	GHz
P_{Ref}	12	6	5	mW
Device output power should be rounded to the nearest mW to compare with values specified in this table.				

Table 37: Output Power Thresholds for Unlicensed Transmitters

	Individual Transmitter	Simultaneous Transmission
Licensed Transmitters	Routine evaluation required	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
Unlicensed Transmitters	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	

Table 38: Summary of SAR Evaluation Requirements for a Cell Phone with Multiple Transmitters

The closest distance between BT/WiFi antenna and main antenna is 6.2cm≥5cm, and the location of the antennas inside mobile phone is shown as below picture:



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	**13.58**	13.38	13.25	13.10	/	/	/	/
	6	13.25	13.21	13.17	12.92	/	/	/	/
	11	12.99	12.94	12.88	12.74	/	/	/	/
802.11g	Channel	6	9	12	18	24	36	48	54
	1	11.58	11.47	11.39	11.17	11.04	10.78	10.59	10.38
	6	11.39	11.28	11.19	10.96	10.78	10.55	10.25	10.16
	11	11.14	11.07	10.94	10.79	10.57	10.37	10.14	10.04
802.11n HT20	Channel	6.5	13	19.5	26	39	52	58.5	65
	1	11.48	11.27	11.07	10.85	10.69	10.46	10.28	10.14
	6	11.35	11.15	10.88	10.77	10.44	10.28	10.17	10.06
	11	11.09	10.98	10.78	10.68	10.37	10.16	9.99	9.89

Table 39:Test results conducted power measurement WiFi .

Note:

1. The conducted power of WiFi is measured with RMS detector.
2. Per KDB248227, For each frequency band, Testing at higher data rates and higher order modulations 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.

Stand-alone SAR

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

Stand-alone SAR evaluation is not required for WiFi, because the output power of WiFi unlicensed transmitter is 13.58Bm ≤ 24mW (13.8dBm)and its antenna(s) is 6.2cm ≥ 5.0 cm from main antenna.

Simultaneous SAR

Simultaneous Transmission Configuration				
Mode	2G Data	3G Data	4G Data	WLAN
2G Data	---	No	No	Yes
3G Data	No	---	No	Yes
4G Data	No	No	---	Yes
WLAN	Yes	Yes	Yes	---

Note:

This mode doesn't support simultaneous 2G, 3G and 4G, because they share the same antenna.

Test Position		GSM&UMTS&LTE SAR_{Max}(W/kg)	WiFi SAR (W/kg)	Σ1-g SARmax(W/kg)
Body SAR	Front side	1.150	0	1.150
	Rear side	0.924	0	0.924
	Left side	0.386	0	0.386
	Right side	0.375	0	0.375
	Bottom side	1.280	0	**1.280**

Simultaneous Transmission SAR evaluation is not required for WiFi and GSM&UMTS&LTE, because the sum of the 1g SAR is 1.280W/kg < 1.6W/kg for WiFi and GSM&UMTS&LTE.

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