JQA File No. : KL80150015R
Issue Date : May 18, 2015

TEST REPORT (SAR EVALUATION)

Applicant	:	Sharp Corporation, Communication Systems Division
Address	:	2-13-1, Iida, Hachihonmatsu, Higashi-Hiroshima City, Hiroshima, 739-0192, Japan
Products	:	Smart Phone
Model No.	:	SH-04G
Serial No.	:	004401115451045
FCC ID	:	APYHRO00223
Test Standard	:	FCC Rules and Regulations Title 47 CFR Part 2
Test Results	:	**Passed**
Date of Test	:	April 10 ~ 22, 2015

VLAC-001-2

Kousei Shibata
Manager
Japan Quality Assurance Organization
KITA-KANSAI Testing Center
SAITO EMC Branch
7-3-10, Saito-asagi, Ibaraki-shi, Osaka 567-0085, Japan

TABLE OF CONTENTS

1 Description of the Device Under Test (DUT)

1.1 General Information

1.	Manufacturer	:	Sharp Corporation, Communication Systems Division 2-13-1, Iida, Hachihonmatsu, Higashi-Hiroshima City, Hiroshima, 739-0192, Japan
2.	Products	:	Smart Phone
3.	Model No.	:	SH-04G
4.	Serial No.	:	004401115451045
5.	Product Type	:	Pre-production
6.	Date of Manufacture	:	February, 2015
7.	Transmitting Frequency	:	W-CDMA Band V (824 MHz – 849 MHz) LTE Band 17 (704 MHz – 716 MHz) WLAN 2.4 GHz (DTS : 2412 MHz – 2462 MHz) Bluetooth (2402 MHz – 2480 MHz)
8.	Battery Option	:	Lithium-ion Battery Pack UBATIA263AFN1 (2450mAh)
9.	Power Rating	:	4.0VDC
10.	EUT Grounding	:	None
11.	Device Category	:	Portable Device (§2.1093)
12.	Exposure Category	:	General Population/Uncontrolled Exposure
13.	FCC Rule Part(s)	:	22(H), 27(F), 15.247
14.	EUT Authorization	:	Certification
15.	Received Date of EUT	:	April 10, 2015

1.2 Wireless Technologies

Air Interface	Description	
W-CDMA	Frequency band(s)	Band V
	Operating mode	UMTS Rel.99 (Voice & Data) HSDPA Rel.8 HSUPA Rel.8
	VoIP	Supported
LTE (FDD)	Frequency band(s)	Band 17
	Operating mode	QPSK 16QAM
	VoLTE	Supported
WLAN (DTS)	Frequency band(s)	2.4 GHz
	Operating mode	802.11b 802.11g 802.11n [HT20]
	VoIP	Supported
	Wireless Router (Hotspot)	Supported
	Wi-Fi Direct	Supported
Bluetooth	Frequency band(s)	2.4 GHz
	Operating mode	Version 4.0+EDR Version 4.0 LE

1.3 Maximum Output Power

Mode		Max. Tune-up Limit (dBm)
W-CDMA Band V	Rel. 99	24.0
	HSDPA	23.8
	HSUPA	23.8
LTE Band 17	QPSK	24.0

Mode		Max. Tune-up Limit (dBm)
WLAN 2.4 GHz (DTS)	802.11b	15.0
	802.11g	13.0
	802.11n HT20	12.0

Mode	Max. Tune-up Limit (dBm)
Bluetooth	8.0
Bluetooth LE	8.0

1.4 General LTE SAR Test and Reporting Considerations

<table>
<tr><th>Item</th><th colspan="4">Description</th></tr>
<tr><td rowspan="4">Frequency range and channel bandwidth</td><td colspan="4">LTE Band 17 (704 MHz – 716 MHz)</td></tr>
<tr><td>Bandwidth</td><td>Low</td><td>Mid</td><td>High</td></tr>
<tr><td>5 MHz</td><td>23755 ch
706.5 MHz</td><td>23790 ch
710.0 MHz</td><td>23825 ch
713.5 MHz</td></tr>
<tr><td>10 MHz</td><td>23780 ch
709.0 MHz</td><td>23790 ch
710.0 MHz</td><td>23800 ch
711.0 MHz</td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td colspan="4">LTE Band 17 has one (1) Tx/Rx antenna and one (1) RX antenna.</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td colspan="4">Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1 and 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (N_{RB})</th><th rowspan="2">MPR (dB)</th></tr>
<tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr>
<tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr>
</table>
MPR Built-in by design
A-MPR (additional MPR) was disabled during SAR testing.</td></tr>
<tr><td>Power reduction</td><td colspan="4">No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td colspan="4">A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.</td></tr>
</table>

2 Summary of Test Results

Applied Standard : FCC Rules and Regulations Title 47 CFR Part 2 – Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
§2.1093 Radiofrequency radiation exposure evaluation: poratble devices

Test Configuration	*Reported* 1 g SAR (W/kg)			Limit (W/kg)
	Licensed	DTS	U-NII	
Head	0.49	0.24	N/A	1.6
Body-worn Accessory	0.68	0.72	N/A	
Wireless Router (Hotspot)	0.68	0.72	N/A	
Simultaneous Transmission	1.40	1.40	N/A	

The test results are passed for exposure limits specified in ANSI/IEEE Std. C95.1.

In the approval of test results,
- Determining compliance with the limits in this report was based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
- No deviations were employed from the applied standard.
- No modifications were conducted by JQA to achieve compliance to the limitations.

Reviewed by:

Shigeru Kinoshita
Assistant Manager
JQA KITA-KANSAI Testing Center
SAITO EMC Branch

Tested by:

Yasuhisa Sakai
Manager
JQA KITA-KANSAI Testing Center
SAITO EMC Branch

3 Test Procedure

The tests documented in this report were performed in accordance with FCC 47 CFR §2.1093, IEEE Std.1528–2013 and the following KDB Procedures.

248227 D01 802.11 Wi-Fi SAR v02
447498 D01 General RF Exposure Guidance v05r02
648474 D04 SAR Handset SAR v01r02
865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
865664 D02 RF Exposure Reporting v01r01
941225 D01 3G SAR Procedures v03
941225 D05 SAR for LTE Devices v02r03
941225 D06 Hot Spot SAR v02

4 Test Location

Japan Quality Assurance Organization (JQA)
KITA-KANSAI Testing Center
7-7, Ishimaru, 1-chome, Minoh-shi, Osaka, 562-0027, Japan
SAITO EMC Branch
7-3-10, Saito-asagi, Ibaraki-shi, Osaka 567-0085, Japan

5 Recognition of Test Laboratory

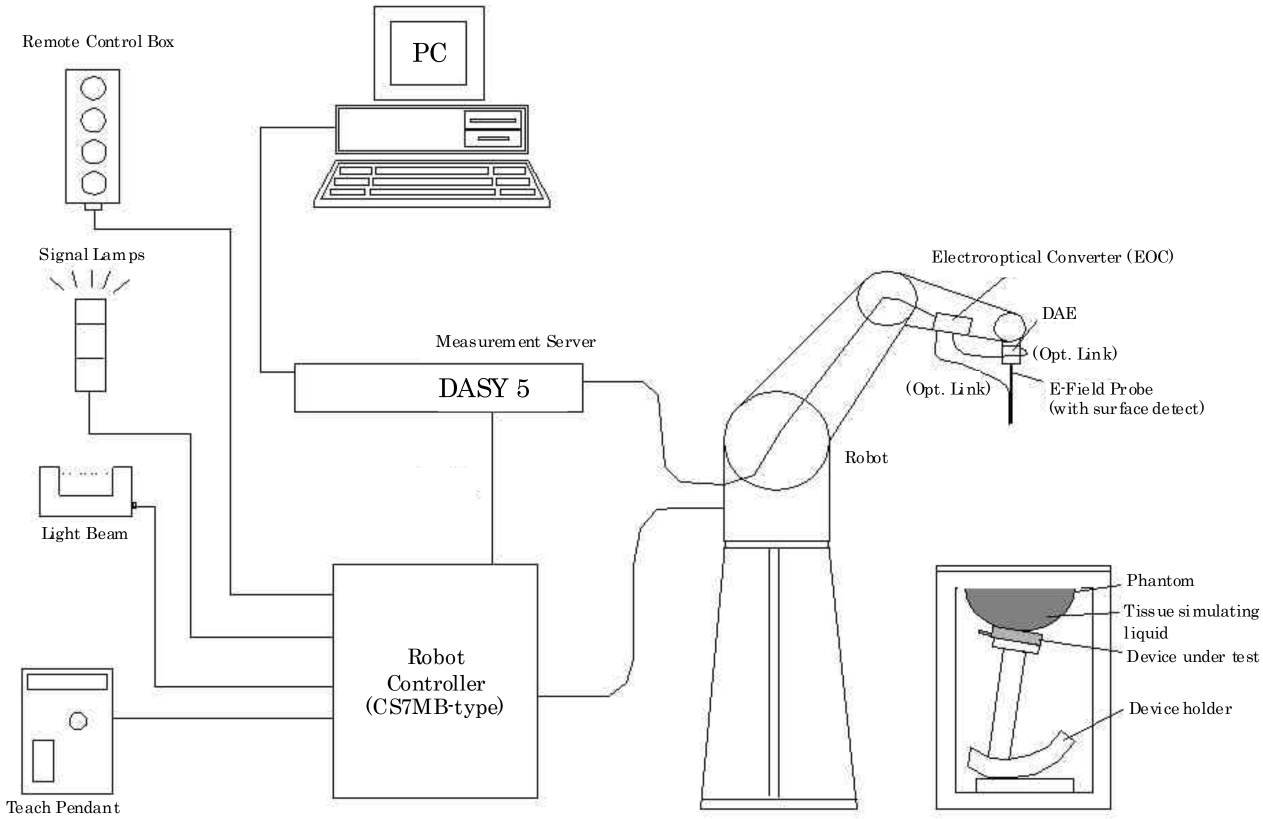
JQA KITA-KANSAI Testing Center SAITO EMC Branch is accredited under ISO/IEC 17025 by following accreditation bodies and the test facility is registered by the following bodies.

VLAC Accreditation No.	:	VLAC-001-2 (Expiry date : March 30, 2016)
VCCI Registration No.	:	A-0002 (Expiry date : March 30, 2016)
BSMI Registration No.	:	SL2-IS-E-6006, SL2-IN-E-6006, SL2-R1/R2-E-6006, SL2-A1-E-6006 (Expiry date : September 14, 2016)
IC Registration No.	:	2079E-3, 2079E-4 (Expiry date : July 16, 2017)

Accredited as conformity assessment body for Japan electrical appliances and material law by METI. (Expiry date : February 22, 2016)

6 Measurement System Diagram

These measurements are performed using the DASY5 automated dosimetric assessment system (manufactured by Schmid & Partner Engineering AG (SPEAG) in Zürich, Switzerland). It consists of high precision robotics system, cell controller system, DASY5 measurement server, personal computer with DASY5 software, data acquisition electronic (DAE) circuit, the Electro-optical converter (EOC), near-field probe, and the twin SAM phantom containing the equivalent tissue. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF).
The Robot is connected to the cell controller to allow software manipulation of the robot. The DAE is connected to the EOC. The DAE performs the signal amplification, signal multiplexing, A/D conversion, offset measurements, mechanical surface detection, collision detection, etc. The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the DASY5 measurement server.



7 System Components

7.1 Probe Specification ET3DV6

Construction : Symmetrical design with triangular core
Built-in optical fiber for surface detection system
Built-in shielding against static changes
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

Calibration : In air form 10 MHz to 2.3 GHz
In head tissue simulating liquid (HSL) and
muscle tissue simulating liquid
835 MHz (accuracy ± 12.0%; k=2)
900 MHz (accuracy ± 12.0%; k=2)
1450 MHz (accuracy ± 12.0%; k=2)
1750 MHz (accuracy ± 12.0%; k=2)
1900 MHz (accuracy ± 12.0%; k=2)
1950 MHz (accuracy ± 12.0%; k=2)

Frequency : 10 MHz to 2.3 GHz
Linearity: ± 0.2 dB (30 MHz to 2.3 GHz)

Directivity : ± 0.2 dB in HSL (rotation around probe axis)
± 0.4 dB in HSL (rotation normal to probe axis)

Dynamic Range : 5 μW/g to >100 mW/g; Linearity: ± 0.2 dB

Surface Detection : ± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces

Dimensions : Overall length 337 mm
Tip length 16 mm
Body diameter 12 mm
Tip diameter 6.8 mm
Distance from probe tip to dipole centers 2.7 mm

7.2 Probe Specification EX3DV4

Construction	: Symmetrical design with triangular core Built-in shielding against static changes PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	: In air form 10 MHz to 6 GHz In head tissue simulating liquid (HSL) and muscle tissue simulating liquid 2450 MHz (accuracy ± 12.0%; k=2) 2600 MHz (accuracy ± 12.0%; k=2) 5200 MHz (accuracy ± 13.1%; k=2) 5300 MHz (accuracy ± 13.1%; k=2) 5500 MHz (accuracy ± 13.1%; k=2) 5600 MHz (accuracy ± 13.1%; k=2) 5800 MHz (accuracy ± 13.1%; k=2)
Frequency	: 10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	: ± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	: 10 μW/g to >100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 μW/g)
Dimensions	: Overall length 337 mm Tip length 20 mm Body diameter 12 mm Tip diameter 2.5 mm Distance from probe tip to dipole centers 1 mm

7.3 Twin SAM Phantom

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

Shell Thickness	: 2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	: Volume Approx. 25 liters
Dimensions	: 810 × 1000 × 500 mm (H × L × W)

7.4 ELI4 Flat Phantom

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

Shell Thickness	: 2 ± 0.2 mm (sagging: <1%)	
Filling Volume	: Volume Approx. 30 liters	
Dimensions	: Major ellipse axis	: 600 mm
	Minor axis	: 400 mm

7.5 Mounting Device for Transmitters

In combination with the Twin SAM Phantom V4.0/V4.0c or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat point).

8 Measurement Process

Step 1 : Power Reference Measurement

The power reference job measures the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method. The minimum distance of probe sensors to surface set to 4 mm for an ET3DV6 probe, or 2 mm for EX3DV4 probe. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2 : Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations in relatively coarse grids. When an area scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. If only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maxima within 2 dB of the maximum SAR value are detected, the number of zoom scans has to be increased accordingly.

Step 3 : Zoom Scan

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The zoom scan measures points specified in standards within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure.

Step 4 : Z Scan

The Z scan measures points along a vertical straight line. The line runs along the Z axis of a one-dimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be larger than the step size in Z-direction.

Step 5 : Power Drift Measurement

The power drift measurement measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The power drift measurement gives the field difference in dB from the reading conducted within the last power reference measurement. The power reference measurement and power drift measurement are for monitoring the power drift of the device under test in the batch process.

9 Measurement Uncertainties

9.1 300 MHz to 3 GHz

Uncertainty Component	Tol. (± %)	Prob. Dist.	Div.	c_i (1g)	c_i (10g)	Std. Unc. (± %)		v_i
						1g	10g	
Measurement System								
Probe calibration	6.0	N	1	1	1	6.0	6.0	∞
Axial isotropy	4.7	R	√3	0.7	0.7	1.9	1.9	∞
Hemispherical isotropy	9.6	R	√3	0.7	0.7	3.9	3.9	∞
Boundary effects	1.0	R	√3	1	1	0.6	0.6	∞
Linearity	4.7	R	√3	1	1	2.7	2.7	∞
System detection limits	1.0	R	√3	1	1	0.6	0.6	∞
Modulation response	2.4	R	√3	1	1	1.4	1.4	∞
Readout electronics	0.3	N	1	1	1	0.3	0.3	∞
Response time	0.8	R	√3	1	1	0.5	0.5	∞
Integration time	2.6	R	√3	1	1	1.5	1.5	∞
RF ambient conditions – noise	3.0	R	√3	1	1	1.7	1.7	∞
RF ambient conditions – reflections	3.0	R	√3	1	1	1.7	1.7	∞
Probe positioner mechanical tolerance	0.4	R	√3	1	1	0.2	0.2	∞
Probe positioning with respect to phantom shell	2.9	R	√3	1	1	1.7	1.7	∞
Extrapolation, interpolation and integration algorithms for max. SAR evaluation	2.0	R	√3	1	1	1.2	1.2	∞
Test Sample Related								
Device holder uncertainty	2.9	N	1	1	1	2.9	2.9	5
Test sample positioning	3.4	N	1	1	1	3.4	3.4	23
Output power variation – SAR drift measurement	5.0	R	√3	1	1	2.9	2.9	∞
Power Scaling	0.0	R	√3	1	1	0.0	0.0	∞
Phantom and Tissue Parameters								
Phantom uncertainty	6.1	R	√3	1	1	3.5	3.5	∞
Algorithms for correcting SAR for deviations	1.9	R	√3	1	0.84	1.1	0.9	∞
Liquid Conductivity – measurement uncertainty	3.2	N	1	0.78	0.71	2.5	2.3	5
Liquid Permittivity – measurement uncertainty	3.0	N	1	0.26	0.26	0.8	0.8	5
Liquid Conductivity – temperature uncertainty	5.2	R	√3	0.78	0.71	2.3	2.1	∞
Liquid Permittivity – temperature uncertainty	0.8	R	√3	0.23	0.26	0.1	0.1	∞
Combined Standard Uncertainty		RSS				11.5	11.4	
Expanded Uncertainty (95% Confidence Interval)		k=2				22.9	22.7	

NOTES
1. Tol. : tolerance in influence quantity
2. Prob. Dist. : probability distributions
3. N, R : normal, rectanglar
4. Div. : divisor used to obtain standard uncertainty
5. c_i : sensitivity coefficient
6. Std. Unc. : standard uncertainty
7. Measurement uncertainties are according to IEEE Std.1528 and IEC 62209-1.

9.2 3 GHz to 6 GHz

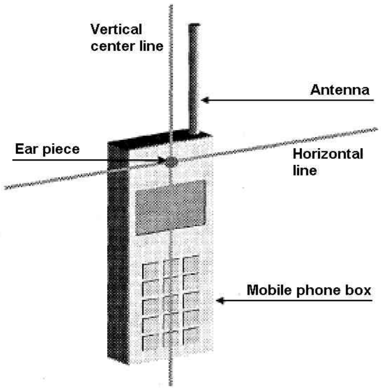
Uncertainty Component	Tol. (± %)	Prob. Dist.	Div.	c_i (1g)	c_i (10g)	Std. Unc. (± %) 1g	Std. Unc. (± %) 10g	v_i
Measurement System								
Probe calibration	6.6	N	1	1	1	6.6	6.6	∞
Axial isotropy	4.7	R	√3	0.7	0.7	1.9	1.9	∞
Hemispherical isotropy	9.6	R	√3	0.7	0.7	3.9	3.9	∞
Boundary effects	2.0	R	√3	1	1	1.2	1.2	∞
Linearity	4.7	R	√3	1	1	2.7	2.7	∞
System detection limits	1.0	R	√3	1	1	0.6	0.6	∞
Modulation response	2.4	R	√3	1	1	1.4	1.4	∞
Readout electronics	0.3	N	1	1	1	0.3	0.3	∞
Response time	0.8	R	√3	1	1	0.5	0.5	∞
Integration time	2.6	R	√3	1	1	1.5	1.5	∞
RF ambient conditions – noise	3.0	R	√3	1	1	1.7	1.7	∞
RF ambient conditions – reflections	3.0	R	√3	1	1	1.7	1.7	∞
Probe positioner mechanical tolerance	0.8	R	√3	1	1	0.5	0.5	∞
Probe positioning with respect to phantom shell	6.7	R	√3	1	1	3.9	3.9	∞
Extrapolation, interpolation and integration algorithms for max. SAR evaluation	4.0	R	√3	1	1	2.3	2.3	∞
Test Sample Related								
Device holder uncertainty	2.9	N	1	1	1	2.9	2.9	5
Test sample positioning	3.4	N	1	1	1	3.4	3.4	23
Output power variation – SAR drift measurement	5.0	R	√3	1	1	2.9	2.9	∞
Power Scaling	0.0	R	√3	1	1	0.0	0.0	∞
Phantom and Tissue Parameters								
Phantom uncertainty	6.6	R	√3	1	1	3.8	3.8	∞
Algorithms for correcting SAR for deviations	1.9	R	√3	1	0.84	1.1	0.9	∞
Liquid Conductivity – measurement uncertainty	3.2	N	1	0.78	0.71	2.5	2.3	5
Liquid Permittivity – measurement uncertainty	3.0	N	1	0.26	0.26	0.8	0.8	5
Liquid Conductivity – temperature uncertainty	3.4	R	√3	0.78	0.71	1.5	1.4	∞
Liquid Permittivity – temperature uncertainty	0.4	R	√3	0.23	0.26	0.1	0.1	∞
Combined Standard Uncertainty		RSS				12.5	12.4	
Expanded Uncertainty (95% Confidence Interval)		k=2				24.9	24.8	

NOTES
1. Tol. : tolerance in influence quantity
2. Prob. Dist. : probability distributions
3. N, R : normal, rectanglar
4. Div. : divisor used to obtain standard uncertainty
5. c_i : sensitivity coefficient
6. Std. Unc. : standard uncertainty
7. Measurement uncertainties are according to IEEE Std.1528 and IEC 62209-1.

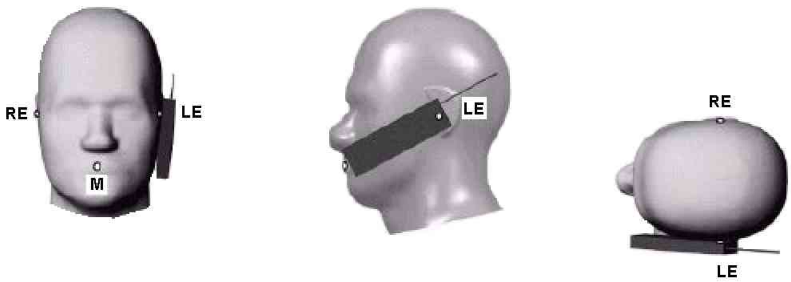
10 Test Arrangement

10.1 Head Exposure Conditions

10.1.1 Cheek-Touch Position

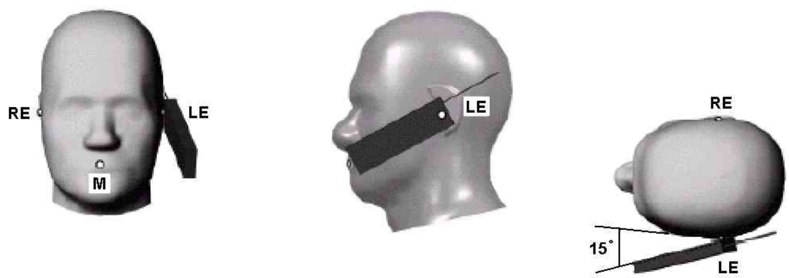


1. Position the device with the vertical center line of the body of the device and the horizontal line crossing the center of the ear piece in a plane parallel to the sagittal plane of the phantom.
2. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference points (M, RE and LE) and align the center of the ear piece with the line RE-LE.
3. Translate the mobile phone box towards the phantom with the ear piece aligned with the line RE-LE until the phone touches the ear.
4. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the box until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost.



10.1.2 Ear-Tilt Position

1. Position the device in the “Cheek-Touch Position”.
2. While maintaining the device in the reference plane and pivoting against the ear, move it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost.

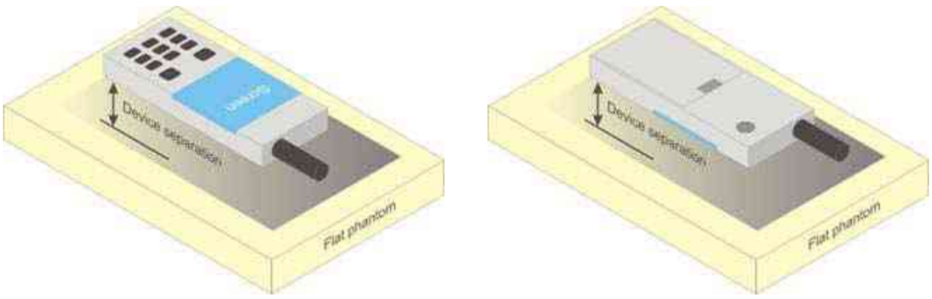


10.2 Body-worn Accessory Exposure Conditions

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. Both the physical spacing to the body of the user as dictated by the accessory and the materials used in an accessory affect the SAR produced by the transmitting device. For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do.

When multiple accessories that do not contain metallic components are supplied with the device, the device may be tested with only the accessory that dictates the closest spacing to the body. When multiple accessories that contain metallic components are supplied with the device, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (e.g., the same metallic belt-clip used with different holsters with no other metallic components), only the accessory that dictates the closest spacing to the body must be tested.

Body-worn accessories may not always be supplied or available as options for some devices that are intended to be authorized for body-worn use. A separation distance of 1.5 cm between the surface of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances. Other separation distances may be used, but they should not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.



10.3 Hotspot Mode Exposure Conditions

For cell phones that support hotspot mode operations, with wireless router capabilities and various web browsing functions, the relevant hand and body exposure conditions are tested according to the hotspot SAR procedures in KDB 941225. A test separation distance of 10 mm is required between the phantom and all surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge. When the form factor of a handset is smaller than 9 cm × 5 cm, a test separation distance of 5 mm (instead of 10 mm) is required for testing hotspot mode. When the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, in the same wireless mode and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface).

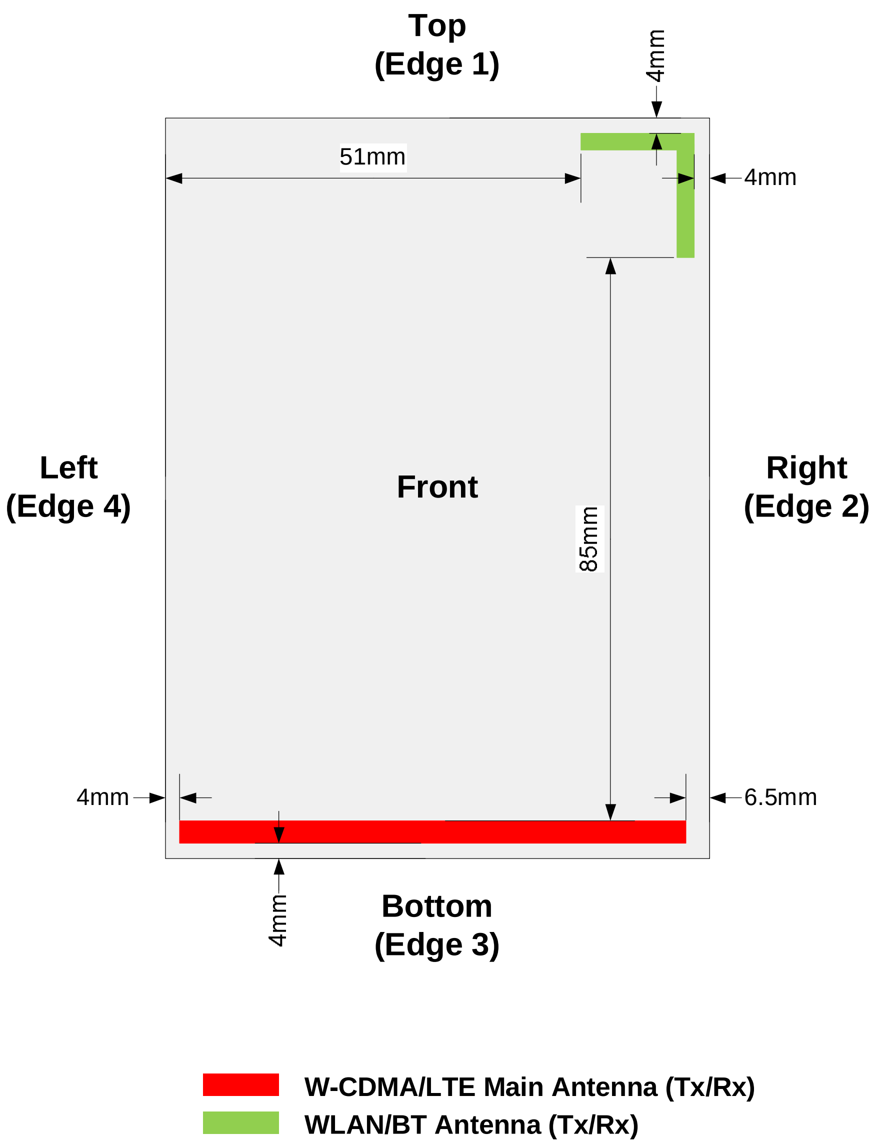
10.4 RF Exposure Conditions

Handsets are tested for SAR compliance in head, body-worn accessory and other use configurations according to the procedures described in KDB 648474 D04.

RF Exposure Conditions	DUT-to-User Separation	Wireless Technologies	Test Position	Antenna-to-edge/surface	SAR Required	Note
Head	0 mm	All Tx	Left Touch	N/A	YES	
			Left Tilt (15°)	N/A	YES	
			Right Touch	N/A	YES	
			Right Tilt (15°)	N/A	YES	
Body-worn	10 mm	All Tx	Rear	N/A	YES	
			Front	N/A	YES	
Hotspot	10 mm	W-CDMA LTE	Rear	< 25 mm	YES	
			Front	< 25 mm	YES	
			Top	> 25 mm	NO	1
			Bottom	< 25 mm	YES	
			Left	< 25 mm	YES	
			Right	< 25 mm	YES	
		WLAN (DTS) Bluetooth	Rear	< 25 mm	YES	
			Front	< 25 mm	YES	
			Top	< 25 mm	YES	
			Bottom	> 25 mm	NO	1
			Left	> 25 mm	NO	1
			Right	< 25 mm	YES	

Note(s):
1. SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06.

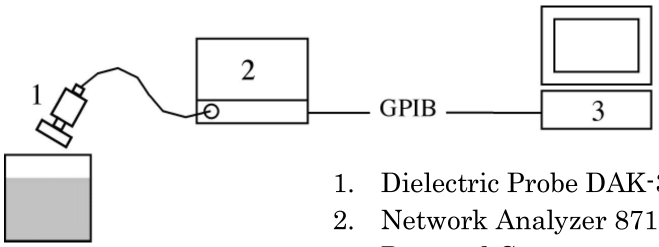
Antenna Location and Separation Distances



11 Tissue Verification

11.1 Tissue Verification Measurement Condition

The tissue dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use, or earlier if dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
The temperature of the tissue-equivalent medium used during measurement must be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.
It is verified by using the dielectric probe and the network analyzer.



1. Dielectric Probe DAK-3.5
2. Network Analyzer 8719ET
3. Personal Computer

11.2 Tissue Dielectric Properties

The tissue dielectric properties are specified in KDB 865664 D01.

Target Frequency [MHz]	Head		Body	
	Permittivity (ε_r)	Conductivity (σ)	Permittivity (ε_r)	Conductivity (σ)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

For tissue dielectric properties at other frequencies within the range, a linear interpolation method shall be used.

11.3 Composition of Ingredients for the Tissue Material Used in the SAR Tests

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Head and Body Liquids (Below 1 GHz)

Item	Head and Muscle Tissue Simulation Liquids HSL/MSL 750, HSL/MSL 900
H_2O	Water, 35 – 58 %
Sucrose	Sugar, white, refined, 40 – 60 %
NaCl	Sodium Chloride, 0 – 6 %
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), < 0.3 %
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone, 0.1 – 0.7 %

Head and Body Liquids (1 to 3 GHz)

Item	Head and Muscle Tissue Simulation Liquids HSL/MSL 1750, HSL/MSL 1900, HSL/MSL 2450
H_2O	Water, 52 – 75 %
$C_8H_{18}O_3$	Diethylene glycol monobutyl ether (DGBE), 25 – 48% (CAS-No. 112-34-5, EC-No. 203-961-6, EC-index-No. 603-096-00-8)
NaCl	Sodium Chloride, < 1.0 %

Head Liquids (3 to 6 GHz)

Item	Head Broad Band Tissue Simulation Liquids HBBL 3500-5800
Water	50 – 65 %
Mineral oil	10 – 30 %
Emulsifiers	8 – 25 %
Sodium salt	0 – 1.5 %
Safety relevant ingredients according to EU directives: EINECS-No 203-489-0 1.0 – 2.8 % 2-Methyl-pentane-2,4-diol (Hexylene Glycol): CAS-No 107-41-5 (Xi irritant, R36/38 irritant for eyes and skin)	

Body Liquids (3 to 6 GHz)

Item	Muscle Broad Band Tissue Simulation Liquids MBBL 3500-5800
Water	60 – 80 %
Esters, Emulsifiers, Inhibitors	20 – 40 %
Sodium salt	0 – 1.5 %
Safety relevant ingredients according to EU directives: none Safety relevant ingredients according to other directives: CAS-No 26399-02-0 10 – 28 % Oleic acid, alkylester	

11.4 Tissue Verification Results

Tissue dielectric parameters are measured at the low, middle and high frequency of each operating frequency range of the test device.

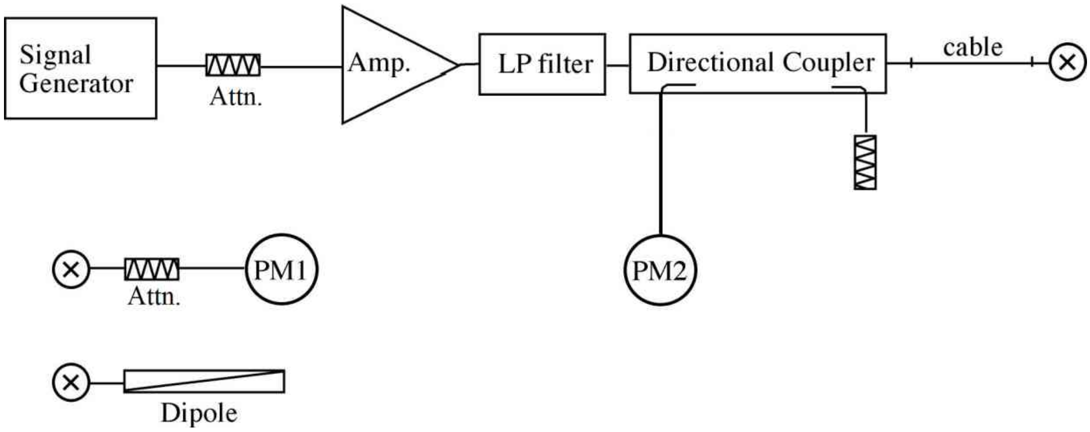
Date	Liquid	Frequency [MHz]	Parameters	Target	Measured	Deviation [%]	Limit [%]
4/13/2015	Body	2410	Permittivity (ε_r)	52.8	52.33	-0.89	± 5
			Conductivity (σ)	1.91	1.888	-1.15	± 5
		2450	Permittivity (ε_r)	52.7	52.19	-0.97	± 5
			Conductivity (σ)	1.95	1.944	-0.31	± 5
		2475	Permittivity (ε_r)	52.7	52.09	-1.16	± 5
			Conductivity (σ)	1.99	1.974	-0.80	± 5
4/14/2015	Head	2410	Permittivity (ε_r)	39.3	38.63	-1.70	± 5
			Conductivity (σ)	1.76	1.796	+2.05	± 5
		2450	Permittivity (ε_r)	39.2	38.47	-1.86	± 5
			Conductivity (σ)	1.80	1.844	+2.44	± 5
		2475	Permittivity (ε_r)	39.2	38.37	-2.12	± 5
			Conductivity (σ)	1.83	1.871	+2.24	± 5
4/19/2015	Head	820	Permittivity (ε_r)	41.6	42.21	+1.47	± 5
			Conductivity (σ)	0.90	0.894	-0.67	± 5
		835	Permittivity (ε_r)	41.5	42.00	+1.20	± 5
			Conductivity (σ)	0.90	0.907	+0.78	± 5
		850	Permittivity (ε_r)	41.5	41.80	+0.72	± 5
			Conductivity (σ)	0.92	0.921	+0.11	± 5
4/20/2015	Head	700	Permittivity (ε_r)	42.2	43.27	+2.54	± 5
			Conductivity (σ)	0.89	0.847	-4.83	± 5
		725	Permittivity (ε_r)	42.1	43.00	+2.14	± 5
			Conductivity (σ)	0.89	0.873	-1.91	± 5
		750	Permittivity (ε_r)	41.9	42.69	+1.89	± 5
			Conductivity (σ)	0.89	0.900	+1.12	± 5
4/21/2015	Body	820	Permittivity (ε_r)	55.3	55.32	+0.04	± 5
			Conductivity (σ)	0.97	0.965	-0.52	± 5
		835	Permittivity (ε_r)	55.2	55.25	+0.09	± 5
			Conductivity (σ)	0.97	0.982	+1.24	± 5
		850	Permittivity (ε_r)	55.2	55.20	+0.00	± 5
			Conductivity (σ)	0.99	0.997	+0.71	± 5
4/22/2015	Body	700	Permittivity (ε_r)	55.7	56.72	+1.83	± 5
			Conductivity (σ)	0.96	0.923	-3.85	± 5
		725	Permittivity (ε_r)	55.6	56.45	+1.53	± 5
			Conductivity (σ)	0.96	0.947	-1.35	± 5
		750	Permittivity (ε_r)	55.5	56.20	+1.26	± 5
			Conductivity (σ)	0.96	0.974	+1.46	± 5

12 System Performance Check

12.1 System Performance Check Measurement Condition

The power meter PM1 (including Attenuator) measures the forward power at the location of the validation dipole connector. The signal generator is adjusted for 250 mW (100 mW for 3 to 6 GHz) at the dipole connector and the power meter PM2 is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2.

The dipole antenna is matched to be used near flat phantom filled with tissue simulating solution. A specific distance holder is used in the positioning of the antenna to ensure correct spacing between the phantom and the dipole.



12.2 Target SAR Values for System Performance Check

The target SAR values can be obtained from the calibration certificate of system validation dipoles.

System Dipole		Cal. Date	Frequency [MHz]	Target SAR Values [W/kg]		
Type	Serial			1g/10g	Head	Body
D750V3	1124	8/28/2014	750	1g	8.27	8.71
				10g	5.45	5.81
D835V2	4d081	8/13/2014	835	1g	9.28	9.62
				10g	6.09	6.40
D2450V2	714	11/13/2014	2450	1g	53.1	50.6
				10g	24.8	23.6

12.3 System Performance Check Results

The SAR measured with a system validation dipole, using the required tissue-equivalent medium at the test frequency, must be within 10 % of the manufacturer calibrated dipole SAR target.

Date	System Dipole		Liquid	Measured SAR [W/kg] (Normalized to 1 W)		Target	Deviation [%]	Limit [%]
	Type	Serial						
4/13/2015	D2450V2	714	Body	1 g	52.00	50.6	+2.77	± 10
				10 g	24.56	23.6	+4.07	± 10
4/14/2015	D2450V2	714	Head	1 g	52.00	53.1	-2.07	± 10
				10 g	24.12	24.8	-2.74	± 10
4/19/2015	D835V2	4d081	Head	1 g	9.44	9.28	+1.72	± 10
				10 g	6.20	6.09	+1.81	± 10
4/20/2015	D750V3	1124	Head	1 g	8.32	8.27	+0.60	± 10
				10 g	5.48	5.45	+0.55	± 10
4/21/2015	D835V2	4d081	Body	1 g	9.72	9.62	+1.04	± 10
				10 g	6.48	6.40	+1.25	± 10
4/22/2015	D750V3	1124	Body	1 g	9.00	8.71	+3.33	± 10
				10 g	6.00	5.81	+3.27	± 10

13 RF Output Power Measurements

13.1 W-CDMA

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 specification.

Release 99 W-CDMA

Settings	Release 99	
Loopback Mode	Mode 1	OFF
Channel Coding	12.2kbps RMC	Voice AMR
TPC Bit Pattern	All 1	
Power Tolerance (dB)	+1.7/-3.7	

HSDPA

Settings	Release 8 HSDPA			
Sub-test	1	2	3	4
Loopback Mode	Mode 1			
Channel Coding	Fixed Reference Channel (QPSK)			
TPC Algorithm	2			
TPC Bit Pattern	All 1			
Beta C	2	11	15	15
Beta D	15	15	8	4
Delta ACK	8			
Delta NACK	8			
Delta CQI	8			
CQI Feedback Cycle	4 ms			
Ack-Nack Repetition Factor	3			
CQI Repetition Factor	2			
MPR (dB)	0	0	0.5	0.5
Power Tolerance (dB)	+1.7/-3.7	+1.7/-3.7	+2.7/-3.7	+3.7/-3.7

HSPA (HSDPA & HSUPA)

Settings	Release 8 HSPA				
Sub-test	1	2	3	4	5
Loopback Mode	Mode 1				
Channel Coding	E-DCH RF Test with TTI 10ms (QPSK)				
TPC Algorithm	2				1
TPC Bit Pattern	Inner Loop Power Control				All 1
Beta C	10	6	15	2	15
Beta D	15	15	9	15	0
Delta ACK	8				0
Delta NACK	8				0
Delta CQI	8				0
CQI Feedback Cycle	4 ms				
Ack-Nack Repetition Factor	3				
CQI Repetition Factor	2				
Delta E-DPCCH	6	8	8	5	0
Absolute Grant Value	20	12	15	17	12
E-TFCI	75	67	92	71	67
MPR (dB)	0	2	1	2	0
Power Tolerance (dB)	+1.7/-6.7	+3.7/-5.2	+2.7/-5.2	+3.7/-5.2	+1.7/-3.7

Band V Results

Mode		Conducted Average Power (dBm)			MPR
		4132 ch (826.4 MHz)	4182 ch (836.4 MHz)	4233 ch (846.6 MHz)	
Rel.99	12.2 kbps RMC	23.65	23.71	23.62	--
	64 kbps RMC	23.63	23.69	23.60	--
	144 kbps RMC	23.62	23.68	23.59	--
	384 kbps RMC	23.61	23.71	23.60	--
	Voice AMR	23.62	23.70	23.62	--
HSDPA	Sub-test 1	22.65	22.70	22.59	0
	Sub-test 2	22.68	22.71	22.57	0
	Sub-test 3	22.15	22.26	22.05	0.5
	Sub-test 4	22.14	22.24	22.13	0.5
HSPA	Sub-test 1	22.66	22.72	22.60	0
	Sub-test 2	20.67	20.76	20.65	2
	Sub-test 3	20.80	20.95	20.83	1
	Sub-test 4	20.70	20.84	20.72	2
	Sub-test 5	22.64	22.70	22.67	0

13.2 LTE

The following tests were completed according to the test requirements outlined in section 6.2 of the 3GPP TS36.101 specification.

For UE power class 1 and 3, the allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS36.101.

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1 and 3

Modulation	Channel bandwidth / Transmission bandwidth (N_{RB})						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS36.101 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of “NS_01”.

Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)

Network Signalling value	Requirements (subclause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	N/A
NS_03	6.6.2.2.1	2, 4,10, 23, 25, 35, 36	3	>5	≤ 1
			5	>6	≤ 1
			10	>6	≤ 1
			15	>8	≤ 1
			20	>10	≤ 1
NS_04	6.6.2.2.2	41	5	>6	≤ 1
			10, 15, 20	Table 6.2.4-4	
NS_05	6.6.3.3.1	1	10,15,20	≥ 50	≤ 1
NS_06	6.6.2.2.3	12, 13, 14, 17	1.4, 3, 5, 10	Table 5.6-1	N/A
NS_07	6.6.2.2.3 6.6.3.3.2	13	10	Table 6.2.4-2	
NS_08	6.6.3.3.3	19	10, 15	> 44	≤ 3
NS_09	6.6.3.3.4	21	10, 15	> 40	≤ 1
				> 55	≤ 2
NS_10		20	15, 20	Table 6.2.4-3	
NS_11	6.6.2.2.1	23	1.4, 3, 5, 10, 15, 20	Table 6.2.4-5	
...					
NS_32	-	-	-	-	-

Band 17 Results

Mode				Conducted Average Power (dBm)	MPR
BW [MHz]	Modulation	RB Allocation		23790 ch (710.0 MHz)	
		RB#	Offset		
5	QPSK	1	0	23.33	0
		1	13	23.49	0
		1	24	23.43	0
		12	0	22.49	1
		12	7	22.46	1
		12	13	22.54	1
		25	0	22.43	1
	16QAM	1	0	22.27	1
		1	13	22.38	1
		1	24	22.38	1
		12	0	21.46	2
		12	7	21.43	2
		12	13	21.51	2
		25	0	21.43	2
Mode				Conducted Average Power (dBm)	MPR
BW [MHz]	Modulation	RB Allocation		23790 ch (710.0 MHz)	
		RB#	Offset		
10	QPSK	1	0	23.35	0
		1	25	23.48	0
		1	49	23.52	0
		25	0	22.51	1
		25	13	22.47	1
		25	25	22.46	1
		50	0	22.53	1
	16QAM	1	0	22.32	1
		1	25	22.42	1
		1	49	22.47	1
		25	0	21.49	2
		25	13	21.46	2
		25	25	21.48	2
		50	0	21.51	2

Note(s):
LTE Band 17 does not support three non-overlapping channels in 5 / 10 MHz channel bandwidths. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing per KDB 941225 D05 SAR for LTE Devices

13.3 WLAN (DTS Band)

DTS Band Results

Band	Mode	Data Rate	Ch#	Frequency (MHz)	Average Power (dBm)	
					Measred	Spec. Max.
2.4 GHz (DTS)	802.11b	1 Mbps	1	2412	14.21	15.0
			6	2437	14.18	
			11	2462	14.21	
	802.11g	6 Mbps	1	2412	12.13	13.0
			6	2437	12.12	
			11	2462	12.12	
	802.11n [HT20]	MCS 0	1	2412	11.18	12.0
			6	2437	11.07	
			11	2462	11.05	

Note(s):
Power measurement is required for the transmission mode configuration with the highest maximum output power specified for production units. (802.11b DSSS and 802.11g/n OFDM configurations are considered separately.)

- When the same highest maximum output power specification applies to multiple transmission modes, the largest channel bandwidth configuration with the lowest order modulation and lowest data rate is measured.
- When the same highest maximum output power is specified for multiple largest channel bandwidth configurations with the same lowest order modulation or lowest order modulation and lowest data rate, power measurement is required for all equivalent 802.11 configurations with the same maximum output power.

13.4 Bluetooth

Maximum tune-up tolerance limit is 8.0 dBm from the rated nominal maximum output power.
This power level qualifies for exclusion of SAR testing.

13.5 Standalone SAR Test Exclusion Considerations (KDB 447498 D01)

The 1 g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by;
[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [$\sqrt{f_{(GHz)}}$] ≤ 3.0, where

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz.
- Power and distance are rounded to the nearest mW and mm before calculation.
- The result is rounded to one decimal place for comparison.
- When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied.

Band	Freq. (MHz)	Max. Power		Test Position	Distance (mm)	Threshold	Test Exclusion
		(dBm)	(mW)				
WLAN (DTS)	2462	15.0	32	Head	< 5	10.0	NO
				Body	10	5.0	NO
Bluetooth	2480	8.0	6	Head	< 5	1.9	YES
				Body	10	0.9	YES

14 SAR Measurements

SAR test reduction criteria are as follows:

When 10 g extremity SAR is required, SAR values indicated below are multiplied by 2.5, i.e. the ratio of the 1 g and extremity 10 g SAR limit.

KDB 447498 D01 General RF Exposure Guidance:
Testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1 g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg when the transmission band is ≥ 200 MHz

KDB 648474 D04 Handset SAR:
With headset attached, when the *reported* SAR for body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest *reported* SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

KDB 941225 D01 SAR test for 3G devices:
When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest *reported* SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

KDB 941225 D05 SAR for LTE Devices:
SAR test reduction is applied using the following criteria:

- Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
- When the *reported* SAR is > 0.8 W/kg, testing for other Channels is performed at the highest output power level for 1 RB, and 50% RB configuration for that channel.
- Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest *reported* SAR for 1 RB and 50% RB are > 0.8 W/kg. Testing for the remaining required channels is not needed because the *reported* SAR for 100% RB Allocation < 1.45 W/kg.
- Testing for 16-QAM modulation is not required because the *reported* SAR for QPSK is < 1.45 W/Kg and its output power is not more than ½ dB higher than that of QPSK.
- Testing for the other channel bandwidths is not required because the *reported* SAR for the highest channel bandwidth is < 1.45 W/Kg and its output power is not more than ½ dB higher than that of the highest channel bandwidth.

KDB 248227 D01 802.11 Wi-Fi SAR:

SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM in both 2.4 GHz and 5 GHz bands, an initial test configuration is first determined for each standalone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units. When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.

SAR is measured using the highest measured maximum output power channel for the determined exposure configurations. Channels with measured maximum output power within ¼ dB of each other are considered to have the same maximum output. When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement. When there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

An initial test position is applied to further reduce the number of SAR tests for devices operating in next to the ear, UMPC mini-tablet or hotspot mode exposure configurations that require multiple test positions SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration according to the OFDM procedures. The initial test position procedure is described in the following:

- When the *reported* SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other (remaining) test positions in that exposure configuration and 802.11 transmission mode combination within the frequency band or aggregated band.
- When the *reported* SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest extrapolated or estimated 1 g SAR conditions determined by area scans or next closest/smallest test separation distance and maximum RF coupling test positions based on manufacturer justification, on the highest maximum output power channel, until the *reported* SAR is ≤ 0.8 W/kg or all required test positions (left, right, touch, tilt or subsequent surfaces and edges) are tested.
- For all positions/configurations tested using the initial test position and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required channels are tested.

To determine the initial test position, Area Scans were performed to determine the position with the estimated 1 g SAR (fast SAR). The position that produced the highest fast SAR is considered the worst case position; thus used as the initial test position. The averaged fast SAR is scaled according to *reported* SAR requirements.

14.1 W-CDMA Band V

Rel.99 12.2kbps RMC – Duty Cycle 100%

RF Exposure Conditions	Test Position	Dist. [mm]	Ch#	Freq. [MHz]	Power [dBm]		1 g SAR [W/kg]		Plot No.
					Tune-up Limit	Meas.	Meas.	Scaled	
Head	Left Touch	0	4182	836.4	24.0	23.71	0.434	0.464	
	Left Tilt	0	4182	836.4	24.0	23.71	0.242	0.259	
	Right Touch	0	4182	836.4	24.0	23.71	0.462	0.494	1
	Right Tilt	0	4182	836.4	24.0	23.71	0.246	0.263	
Body-worn & Hotspot	Rear	10	4182	836.4	24.0	23.71	0.631	0.675	2
	Front	10	4182	836.4	24.0	23.71	0.564	0.603	
Hotspot	Bottom	10	4182	836.4	24.0	23.71	0.068	0.073	
	Left	10	4182	836.4	24.0	23.71	0.288	0.308	
	Right	10	4182	836.4	24.0	23.71	0.320	0.342	

14.2 LTE Band 17

QPSK 10 MHz BW – Duty Cycle 100%

RF Exposure Conditions	Test Position	Dist. [mm]	Ch#	Freq. [MHz]	RB#	Offset	Power [dBm]		1 g SAR [W/kg]		Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	
Head	Left Touch	0	23790	710.0	1	49	24.0	23.52	0.119	0.133	3
					25	0	23.0	22.51	0.087	0.097	
	Left Tilt	0	23790	710.0	1	49	24.0	23.52	0.072	0.080	
					25	0	23.0	22.51	0.050	0.056	
	Right Touch	0	23790	710.0	1	49	24.0	23.52	0.112	0.125	
					25	0	23.0	22.51	0.084	0.094	
	Right Tilt	0	23790	710.0	1	49	24.0	23.52	0.072	0.080	
					25	0	23.0	22.51	0.052	0.058	
Body-worn & Hotspot	Rear	10	23790	710.0	1	49	24.0	23.52	0.234	0.261	4
					25	0	23.0	22.51	0.171	0.191	
	Front	10	23790	710.0	1	49	24.0	23.52	0.161	0.180	
					25	0	23.0	22.51	0.113	0.126	
Hotspot	Bottom	10	23790	710.0	1	49	24.0	23.52	0.016	0.018	
					25	0	23.0	22.51	0.013	0.015	
	Left	10	23790	710.0	1	49	24.0	23.52	0.169	0.189	
					25	0	23.0	22.51	0.112	0.125	
	Right	10	23790	710.0	1	49	24.0	23.52	0.144	0.161	
					25	0	23.0	22.51	0.096	0.107	

14.3 WLAN (DTS Band)

802.11b (1 Mbps) – Duty Cycle 100%										
RF Exposure Conditions	Test Position	Dist. [mm]	Ch#	Freq. [MHz]	Averaged Fast SAR [W/kg]	Power [dBm]		1 g SAR [W/kg]		Plot No.
						Tune-up Limit	Meas.	Meas.	Scaled	
Head	Left Touch	0	6	2437	0.249	15.0	14.18	0.202	0.244	5
	Left Tilt	0	6	2437	0.109	15.0	14.18			
	Right Touch	0	6	2437	0.077	15.0	14.18			
	Right Tilt	0	6	2437	0.050	15.0	14.18			
Body-worn & Hotspot	Rear	10	6	2437	0.711	15.0	14.18	0.596	0.720	6
	Front	10	6	2437	0.065	15.0	14.18	0.054	0.065	
Hotspot	Top	10	6	2437	0.035	15.0	14.18			
	Right	10	6	2437	0.267	15.0	14.18	0.224	0.271	

Note(s):
SAR is not required for 802.11g/n OFDM configurations when the highest *reported* SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

14.4 SAR Measurement Variability

In accordance with the KDB 865664 D01, these additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The DUT should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

14.4.1 Highest Measured SAR Configuration in Each Frequency Band

Frequency Band [MHz]	Air Interface	Standalone SAR [W/kg]	
		Head	Body
750	LTE Band 17	0.119	0.234
835	W-CDMA Band V	0.462	0.631
2450	WLAN 802.11b	0.202	0.596

14.4.2 Repeated SAR Measurement Results

Repeated SAR measurement is not required because the highest measured SAR is < 0.80 W/kg.

14.5 Simultaneous Transmission SAR Analysis

14.5.1 Simultaneous Transmission Condition

WWAN can transmit simultaneously with WLAN/Bluetooth.
WLAN cannot transmit simultaneously with Bluetooth since they share an antenna port.

No.	Conditions	Head	Body	Hotspot
1	W-CDMA + WLAN 2.4 GHz	YES	YES	YES
2	LTE + WLAN 2.4 GHz	YES	YES	YES
3	W-CDMA + Bluetooth	YES	YES	NO
4	LTE + Bluetooth	YES	YES	NO

14.5.2 Standalone SAR Estimation

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:
[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [$\sqrt{f_{(GHz)}}$ / 7.5] W/kg for 1 g SAR, *test separation distances* ≤ 50 mm, or
0.4 W/kg for 1 g SAR, *test separation distances* > 50 mm
When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied.

Band	Frequency (MHz)	Max. Power (dBm)	Max. Power (mW)	Test Position	Distance (mm)	Estimated SAR (W/kg)
Bluetooth	2480	8.0	6	Head	< 5	0.252
				Body	10	0.126

14.5.3 Sum of the SAR for WWAN, WLAN & Bluetooth

RF Exposure Conditions	Simultaneous Transmission Scenario: WWAN	WLAN DTS Band	Bluetooth	Σ 1 g SAR (W/kg)
Head	0.494	0.244		0.738
	0.494		0.252	0.746
Body-worn	0.675	0.720		1.395
	0.675		0.126	0.801
Hotspot	0.675	0.720		1.395

<u>SAR to Peak Location Separation Ratio (SPLSR)</u>
As the sum of the 1 g SAR is < 1.6 W/kg, SPLSR assessment is not required.

<u>Conclusion:</u>
Simultaneous transmission SAR measurement (Volume Scan) is not required because the sum of the 1 g SAR is < 1.6 W/kg.

16 Test Instruments

Shielded Room S3				
Type	**Model**	**Serial No. (ID)**	**Manufacturer**	**Cal. Due**
E-Field Probe	ET3DV6	1679 (S-2)	SPEAG	2015/08/14
E-Field Probe	EX3DV4	3808 (S-17)	SPEAG	2015/09/14
DAE	DAE4	508 (S-3)	SPEAG	2015/11/06
Robot	RX60L	F02/5R10A1/A/01 (S-7)	Stäubli	N/A
Probe Alignment Unit	LB5/80	SE UKS 030 AA (S-13)	SPEAG	N/A
Network Analyzer	8719ET	MY42000159 (B-53)	Agilent	2015/08/04
Dielectric Probe	DAK-3.5	1124 (S-32)	SPEAG	2015/07/14
750MHz Dipole	D750V3	1124 (S-20)	SPEAG	2015/08/27
835MHz Dipole	D835V2	4d081 (S-23)	SPEAG	2015/08/12
2450MHz Dipole	D2450V2	714 (S-6)	SPEAG	2015/11/12
Signal Generator	MG3681A	6100216166 (B-3)	Anritsu	2015/08/14
RF Power Amplifier	CGA020M602-2633R	B10840 (A-51)	R&K	N/A
Directional Coupler	4226-20	03736 (D-87)	Narda	N/A
Base Station Simulator	MT8820C	6200918329 (B-5)	Anritsu	2016/03/02
Power Meter	E4417A	GB41290850 (B-51)	Agilent	2015/06/12
Power Sensor	E9323A	US40411939 (B-59)	Agilent	2015/06/15
Power Meter	N1911A	GB45100291 (B-63)	Agilent	2015/07/06
Power Sensor	N1921A	US44510470 (B-64)	Agilent	2015/07/09
Attenuator	54A-10	W5675 (D-28)	Weinschel	2015/09/24
Attenuator	2-20	BY7535 (D-36)	Weinschel	2015/10/26

NOTE : The calibration interval of the above test instruments is 12 months.

17 Appendix

Refer to separated files for the following appendixes.

Appendix 1 – System Performance Check Plots

Appendix 2 – Highest SAR Test Plots

Appendix 3 – Dosimetric E-Field Probe Calibration Data

Appendix 4 – System Validation Dipole Calibration Data