FCC SAR TEST REPORT

Test File No : F690501/RF-SAR002154-A1

Equipment Under Test	Cellular/PCS GPRS and Cellular WCDMA/HSDPA/HSUPA USB Modem
Model No.	L-03F
Applicant	LG Electronics MobileComm U.S.A., Inc.
Address of Applicant	10101 Old Grove Road, San Diego, CA 92131
FCC ID	ZNFL03F
Device Category	Portable Device
Exposure Category	General Population/Uncontrolled Exposure
Standards	FCC 47 CFR Part 2 (2.1093) IEEE 1528, 2003 ANSI/IEEE C95.1, C95.3
Date of Test(s)	2014-02-25 ~ 2014-02-26
Date of Issue	2014-03-10

In the configuration tested, the EUT complied with the standards specified above.

Remarks:

Report prepared by /
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Test Engineer of SAR Part

Approved by /
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Revision history

Revision	Date of issue	Revisions	Revised By
-	February 28, 2014	Initial issue	-
A1	March 10, 2014	Updated report per reviewer's comments, including 1. Page 4 : Corrected typo, changed from "PCB" to "PCE" 2. Page 19 : Changed HSUPA target power 3. Updated KDB Publication-list the revision of KDB Publication 4. Page 30: Changed highest measured SAR plot	Jongwon Ma

Contents

1 Testing Laboratory

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2 Details of Manufacturer

Applicant	LG Electronics MobileComm U.S.A., Inc.
Address	10101 Old Grove Road, San Diego, CA 92131
Contact Person	Heeju -An
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3 Description of EUT(s)

EUT Type	Cellular/PCS GPRS and Cellular WCDMA/HSDPA/HSUPA USB Modem
Model	L-03F
Serial Number	N/A
Mode of Operation	GSM850 / GSM1900 / WCDMA850
Duty Cycle	8.3(GPRS 1Tx Slot), 4.15(GPRS 2Tx Slot), 2.77 (GPRS 3Tx Slot), 2.075 (GPRS 4Tx Slot), 1 (WCDMA)
Body worn Accessory	None
Tx Frequency Range	GSM850 (824.20 ~ 848.80 MHz) GSM1900 (1850.20 ~ 1909.80 MHz) WCDMA 850 (826.4 ~ 846.6 MHz)

4 The Highest Reported SAR Values

Exposure Configuration	Equipment Class	Band	Highest Reported SAR 1g (W/kg)
Body (Data)	**PCB**	GPRS 850	0.390
		GPRS 1900	1.101
		WCDMA 850	0.443
Simultaneous SAR per KDB 690783 D01v01r03			N/A

5 Test Methodology

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

Test tests documented in this report were performed in accordance with IEEE Standard 1528-2003 & IEEE 1528a-2005 and the following published KDB procedures.

In additions;

☒	KDB 865664 D01v01r03	SAR Measurement Requirements for 100 MHz to 6 GHz
☒	KDB 447498 D01v05r02	Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
☒	KDB 447498 D02v02	SAR Measurement Procedures for USB Dongle Transmitters
☐	KDB 248227 D01v01r02	SAR Measurement Procedures for 802.11a,b,g Transmitters
☐	KDB 615223 D01v01	802.16e/WiMax SAR Measurement Guidance
☐	KDB 616217 D04v01r01	SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers
☐	KDB 643646 D01v01r01	SAR Test Reduction Considerations for Occupational PTT Radios
☐	KDB 648474 D03v01r02	Evaluation and Approval Considerations for Handsets with Specific Wireless Charging Battery Covers
☐	KDB 648474 D04v01r02	SAR Evaluation Considerations for Wireless Handsets
☐	KDB 680106 D01v02	RF Exposure Considerations for Low Power Consumer Wireless Power Transfer Applications
☒	KDB 941225 D01v02	SAR Measurement Procedures for 3G Devices (CDMA 2000 / Ev-Do, WCDMA/HSDPA/HSPA
☒	KDB 941225 D02v02r02	SAR Guidance for HSPA, HSPA+, DC-HSDPA and 1x-Advanced
☒	KDB 941225 D03v01	Recommended SAR Test Reduction Procedures for GSM/GPRS/EDGE
☐	KDB 941225 D04v01	Evaluating SAR for GSM/(E)GPRS Dual Transfer Mode
☐	KDB 941225 D05v02r03	SAR Evaluation Considerations for LTE Devices
☐	KDB 941225 D06v01r01	SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities
☐	KDB 941225 D07v01r01	SAR Evaluation Procedures for UMPC Mini-Tablet Devices

6 Testing Environment

Ambient temperature	: 18°C ~ 25°C
Relative humidity	: 30% ~ 70%
Liquid temperature of during the test	: <± 2°C
Ambient noise & Reflection	: < 0.012 W/kg

7 Specific Absorption Rate (SAR)

7.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled

7.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = C\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

$$SAR = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

7.3 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate ("SAR") in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 ㎑ to 300 ㎓," ANSI/IEEE C95.3–2003, Copyright 2003 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 ㎑ to 6 ㎓. Portable devices that transmit at frequencies above 6 ㎓ are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 ㎓ should be made at a minimum distance of 5 cm from the radiating source.

(1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube). Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.

(2) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Partial Peak SAR (Partial)	1.60 m W/g	8.00 m W/g
Partial Average SAR (Whole Body)	0.08 m W/g	0.40 m W/g
Partial Peak SAR (Hands/Feet/Ankle/Wrist)	4.00 m W/g	20.00 m W/g

8 The SAR Measurement System

A block diagram of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY 5 professional system). The model EX3DV4 field probe is used to determine the internal electric fields. The SAR can be obtained from the equation SAR= σ ($|Ei|^2$)/ ρ where σ and ρ are the conductivity and mass density of the tissue-simulant.

The DASY 5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- A dosimeter 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.
- Data acquisition electronics (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.

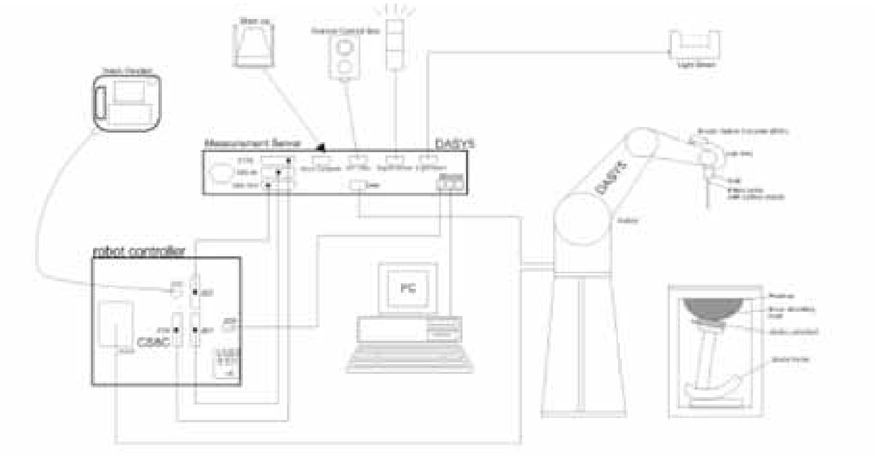


Fig a. The microwave circuit arrangement used for SAR system verification

- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows7
- DASY 5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The ELI phantom enabling testing left-hand and right-hand usage.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

9 System Components

9.1 Probe

EX3DV4 E-Field Probe

Construction	:	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	:	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 835 and HSL1900. Additional CF-Calibration for other liquids and frequencies upon request.
Frequency	:	10 ㎒ to 6 ㎓; Linearity: ± 0.2 ㏈ (30 ㎒ to 6 ㎓)
Directivity	:	± 0.3 ㏈ in HSL (rotation around probe axis) ± 0.5 ㏈ in tissue material (rotation normal to probe axis)
Dynamic Range	:	10μW/g to > 100 m W/g; Linearity: ± 0.2 ㏈(noise: typically < 1 μW/g)
Dimensions	:	Overall length: 337 ㎜ (Tip length: 20 ㎜) Tip diameter: 2.5 ㎜ (Body diameter: 12 ㎜) Distance from probe tip to dipole centers: 1 ㎜
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 ㎓ with precision of better 30%
Construction	:	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

NOTE:

1. The Probe parameters have been calibrated by the SPEAG. Please reference "APPENDIX C" for the Calibration Certification Report.

9.2 ELI Phantom

ELI Phantom

Construction	:	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 ㎒ to 6 ㎓. 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. ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4, but has reinforced top structure
Shell Thickness	:	2.0 mm ± 0.2 mm
Dimensions	:	Major axis: 600 ㎜ Minor axis: 400 ㎜

9.3 Device Holder

Construction: : In combination with the Twin SAM PhantomV4.0/V4.0C or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Device Holder

Construction: : Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (a.q.. laptops, Cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioned.

Device Holder

10 SAR Measurement Procedures

10.1 Normal SAR Measurement Procedure

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2 ㎜. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2 and 3: Area Scan & Zoom Scan Procedures

The entire evaluation of the spatial peak values is performed within the Post-processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan.
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1 g and 10 g.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement 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. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

< Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r03 >

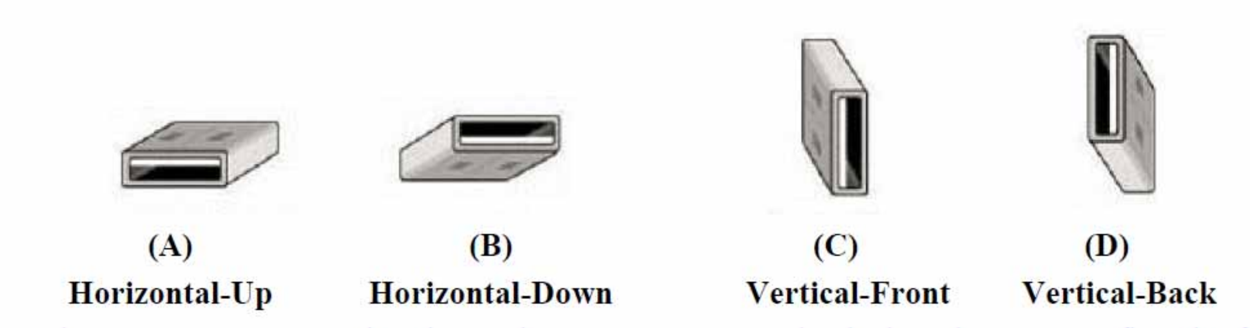
			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 ± 1 mm	$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5\cdot\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

11 SAR Test Configuration

According to KDB 447498 D02v02, the device that can be connected to a host through a cable must be tested with the device positioned in all applicable orientations against the flat phantom. And a separation distance ≤ 0.5 cm is required for USB-dongle transmitters.



USB Connector Orientations Implemented on Laptop Computers

Test Configurations	
1	Front side of the EUT was tested with the direct-connection to the host device with Horizontal-Up (A), and separation distance between EUT and Phantom is 5 mm.
2	Back side of the EUT was tested with the direct-connection to the host device with Horizontal-Down (B), and separation distance between EUT and Phantom is 5 mm.
3	Right side of the EUT was tested with the direct-connection to the host device with Vertical-Front (C), and separation distance between EUT and Phantom is 5 mm.
4	Left side of the EUT was tested with the direct-connection to the host device with Vertical-Back (D), and separation distance between EUT and Phantom is 5 mm.
5	Top side of the EUT was tested with the direct-connection to the host device, and separation distance between EUT and Phantom is 5 mm.
6	Bottom side of the EUT was tested with the direct-connection to the host device, and separation distance between EUT and Phantom is 5 mm.

12 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig. 1. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. These tests were done at 835 ㎒ and 1900 ㎒. The tests were conducted on the same days as the measurement of the DUT. The obtained results from the system accuracy verification are displayed in the table 1. (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the ambient temperature of the laboratory was in the range (22 ± 2) ° C, the relative humidity was in the range (55 ± 5) % R.H and the liquid depth above the ear reference points was ≥ 15 cm ± 5 mm (frequency ≤ 3 GHz) or ≥ 10 cm ± 5 mm (frequency > 3 G Hz)in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

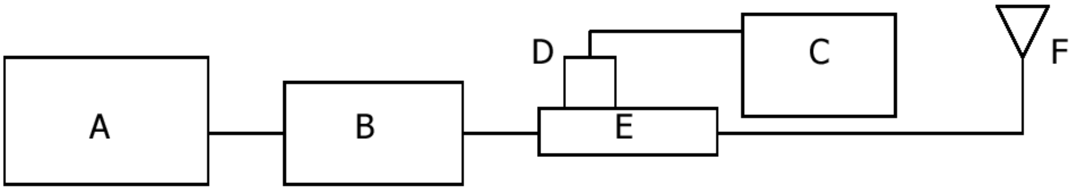


Fig 1. The microwave circuit arrangement used for SAR system verification

A. Agilent Model E4421B Signal Generator
B. EMPOWER Model 2001-BBS3Q7ECK Amplifier
C. Agilent Model E4419B Power Meter
D. Agilent Model 9300H Power Sensor
E. Agilent Model 86205A Directional RF Bridges
F. Reference dipole Antenna

Photo of the dipole Antenna

Verification Kit	Probe S/N	Tissue	Target SAR 1 g from Calibration Certificate (1 W)	Measured SAR 1 g (0.1 W)	Normalized SAR 1 g (1 W)	Deviation (%)	Date	Liquid Temp. (°C)
D1900V2 S/N: 5d158	3862	1900 ㎒ Body	39.7 W/kg	3.96 W/kg	**39.6 W/kg**	-0.25	2014-02-25	22.4
D835V2 S/N: 4d138	3862	835 ㎒ Body	9.32 W/kg	0.941 W/kg	**9.41 W/kg**	0.97	2014-02-26	21.7

Table1. Results system verification

13 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this simulant fluid were measured by using the Speag Model DAK-3.5 Dielectric Probe in conjunction with Agilent E5071C Network Analyzer(300 ㎑ - 6 ㎓) by using a procedure detailed in Section V.

f (㎒)	Tissue type	Limits / Measured	Dielectric Parameters		
			Permittivity	Conductivity	Simulated Tissue Temp(℃)
1900.0	Body	Measured, 2014-02-25	53.74	1.53	22.4
		Recommended Limits	*53.3*	*1.52*	21.0 ~ 23.0
		Deviation (%)	**0.83**	**0.66**	-
1850.2		Measured, 2014-02-25	53.92	1.47	22.4
		Deviation (%)	**1.16**	**-3.29**	-
1880.0		Measured, 2014-02-25	53.81	1.50	22.4
		Deviation (%)	**0.96**	**-1.32**	-
1909.8		Measured, 2014-02-25	53.72	1.54	22.4
		Deviation (%)	**0.79**	**1.32**	-
835.0	Body	Measured, 2014-02-26	54.99	0.94	21.7
		Recommended Limits	*55.2*	*0.97*	21.0 ~ 23.0
		Deviation(%)	**-0.38**	**-3.09**	-
824.2		Measured, 2014-02-26	55.10	0.93	21.7
		Deviation(%)	**-0.18**	**-4.12**	-
836.6		Measured, 2014-02-26	54.98	0.94	21.7
		Deviation(%)	**-0.40**	**-3.09**	-
848.8		Measured, 2014-02-26	54.87	0.95	21.7
		Deviation(%)	**-0.60**	**-2.06**	-

The composition of the brain & muscle tissue simulating liquid

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.

Ingredients (% by weight)	Frequency (㎒)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99 $^{+}$% Pure Sodium Chloride

Sugar: 98 $^{+}$% Pure Sucrose

Water: De-ionized, 16 $M\Omega^{+}$ 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

Simulating Liquids for 5 ㎓, Manufactured by SPEAG

Ingredients	(% by weight)
Water	78
Mineral Oil	11
Emulsifiers	9
Additives and Salt	2

14 Test System Validation

Per FCC KDB 865664 D01v01r03, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the require tissue-equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01v01r03. Since frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probe and tissue dielectric parameters has been included.

f (MHz)	Date	Probe S/N	Probe Cal point	Tissue Type	Dielectric Parameters		CW Validation			Modulated Validation		
					Permittivity	Conductivity	Sensitivity	Probe Linearity	Probe Isotropy	Mod. Type	Duty Factor	PAR
835	2014-02-17	3862	835	Body	56.04	0.94	PASS	PASS	PASS	GMSK	PASS	N/A
1900	2014-02-18	3862	1900	Body	54.07	1.49	PASS	PASS	PASS	GMSK	PASS	N/A

< SAR System Validation Summary>

15 Instruments List

Manufacturer	Device	Type	Serial Number	Cal Date	Cal Interval	Cal Due
Stäubli	Robot	TX90XL	F12/5LP8A1/A/01	N/A	N/A	N/A
Schmid& Partner Engineering AG	Dosimetric E-Field Probe	EX3DV4	3862	01/29/2014	Annual	01/29/2015
Schmid& Partner Engineering AG	835 ㎒ System Validation Dipole	D835V2	4d138	09/27/2013	Biennial	09/27/2015
Schmid& Partner Engineering AG	1900 ㎒ System Validation Dipole	D1900V2	5d158	09/27/2013	Biennial	09/27/2015
Schmid& Partner Engineering AG	Data acquisition Electronics	DAE4	1340	05/28/2013	Annual	05/28/2014
Schmid& Partner Engineering AG	Software	DASY5 V52	-	N/A	N/A	N/A
Schmid& Partner Engineering AG	Phantom	ELI Phantom	TP-1200	N/A	N/A	N/A
Agilent	Network Analyzer	E5071C	MY46111535	06/27/2013	Annual	06/27/2014
Schmid& Partner Engineering AG	Dielectric Assessment Kit	DAK-3.5	1108	03/05/2013	Annual	03/05/2014
Agilent	Power Meter	E4419B	GB43311715	06/26/2013	Annual	06/26/2014
Agilent	Power Sensor	E9300H	MY41495314	09/10/2013	Annual	09/10/2014
			MY41495307	09/10/2013	Annual	09/10/2014
Agilent	Signal Generator	E4421B	MY43350132	06/27/2013	Annual	06/27/2014
Empower RF Systems	Power Amplifier	2001-BBS3Q7ECK	1032 D/C 0336	01/02/2014	Annual	01/02/2015
Agilent	Directional RF Bridges	86205A	MY31402302	06/29/2013	Annual	06/29/2014
Microlab	LP Filter	LA-15N	N/A	09/09/2013	Annual	09/09/2014
Microlab	LP Filter	LA-30N	N/A	09/09/2013	Annual	09/09/2014
Agilent	Attenuator	8491B	50566	09/09/2013	Annual	09/09/2014
JUMBP	Hygro-Thermometer	BJ5478	12091382-1	07/02/2013	Annual	07/02/2014
LKM Electronic	Digital Thermometer	DTM3000	3027	07/01/2013	Annual	07/01/2014
Agilent	Spectrum Analyzer	E4445A	MY44020523	07/26/2013	Annual	07/26/2014
ROHDE& SCHWARZ	Communication Tester	CMU200	109456	06/27/2013	Annual	06/27/2014

16 FCC Power Measurement Procedures

The SAR measurement Software calculates a reference point at the start and end of the test to check for power drifts. If conducted power deviations of more than 5 % occurred, the tests were repeated.

17 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05r02, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. Test highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

18 Maximum Output Power Specifications

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05r02.

Mode / Band		Burst Average GMSK (dBm)			
		1 slot	2 slot	3 slot	4 slot
GSM850	**Maximum**	**33.2**	**30.5**	**28.5**	**27.2**
	Nominal	32.7	30.0	28.0	26.7
PCS1900	**Maximum**	**30.7**	**28.5**	**26.0**	**25.0**
	Nominal	30.2	28.0	25.5	24.5
Mode / Band		Frame Average GMSK (dBm)			
		1 slot	2 slot	3 slot	4 slot
GSM850	**Maximum**	**24.17**	**24.48**	**24.24**	**24.19**
	Nominal	23.67	23.98	23.74	23.69
PCS1900	**Maximum**	**21.67**	**22.48**	**21.74**	**21.99**
	Nominal	21.17	21.98	21.24	21.49
Tune-up Tolerance: -1.5 dB / + 0.5 dB					

Mode / Band		Modulated Average (dBm)		
		3GPP Rel 99	3GPP Rel 5	3GPP Rel 6
		RMC/AMR	HSDPA	HSUPA
WCDMA850	**Maximum**	**23.7**	**22.7**	**22.9**
	Nominal	23.2	22.2	22.4
Tune-up Tolerance: -1.5 dB / + 0.5 dB				

19 RF Conducted Power Measurement

The device in GSM and WCDMA was controlled by using a Communication tester (CMU200). The EUT was set to maximum power level during all tests. The DASY5 system measures power drift during SAR testing by comparing e-field in the same location at the beginning and at the end of measurement.

19.1 GSM Conducted Power

GSM	Channel	Frequency(㎒)	Burst -Conducted Average Power(㏈ m)			
			GPRS			
			1 Tx Slot	2 Tx Slot	3 Tx Slot	4 Tx Slot
GSM 850 Band	128	824.2	32.89	30.21	28.02	27.15
	190	836.6	32.86	30.18	27.84	26.95
	251	848.8	32.61	30.15	27.79	26.78
PCS 1900 Band	512	1850.2	30.28	27.56	25.38	24.38
	661	1880.0	30.16	27.54	25.34	24.58
	810	1909.8	30.09	27.31	25.12	24.15

GSM	Channel	Frequency(㎒)	Frame-Conducted Average Power(㏈ m)			
			GPRS			
			1 Tx Slot	2 Tx Slot	3 Tx Slot	4 Tx Slot
GSM 850 Band	128	824.2	23.86	**24.19**	23.76	24.14
	190	836.6	23.83	**24.16**	23.58	23.94
	251	848.8	23.58	**24.13**	23.53	23.77
PCS 1900 Band	512	1850.2	21.25	**21.54**	21.12	21.37
	661	1880.0	21.13	**21.52**	21.08	21.57
	810	1909.8	21.05	**21.59**	20.98	21.27

Note

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. The source-based frame-averaged output power was evaluated for all GPRS slot configurations. The configuration with the highest target frame averaged output power was evaluated for wireless router SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots war tested.
3. GPRS output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our investigation has shown that CS1 – CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
4. For body SAR testing, the EUT was set in GPRS multi-slot class12 with 2uplink slots for GSM850&PCS1900 due to maximum source-based time-averaged output power.

19.2 WCDMA

19.2.1 Output Power Verification

Maximum output power is measured on the High, Middle and Low channels for each applicable transmission band according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all “1s”.

19.2.2 Head SAR Measurements

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all “1s”. SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than ¼ dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signaling radio bearer using the exposure configuration that results in the highest SAR for that RF channel in 12.2 RMC.

19.2.3 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all “1s”.

19.2.4 SAR Measurements for Handsets With Release 5 HSDPA

Body SAR is not required for handsets with HSDPA capabilities when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is ≤ 75 % of the SAR limit. Otherwise, SAR is Measured for HSDPA, using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration in 12.2 kbps RMC without HSDPA, on the maximum output channel with the body exposure configuration that results in the highest SAR in 12.2 kbps RMC for that RF channel.

Sub-Test 1 Setup for Release 5 HSDPA

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

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$
Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15.
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 signaled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

19.2.5 SAR Measurements for Handsets With Release 6 HSUPA

Body SAR is not required for handsets with HSPA capabilities when the maximum average output of each RF channel with HSUPA/HSDPA active is less than ¼ dB higher than that measured without HSUPA/HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is ≤ 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 a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2, according to the highest body SAR configuration in 12.1 kbps RMC without HSPA. When VOIP is applicable for head exposure, SAR is not required when the maximum output of each RF channel with HSPA is less than ¼ dB higher than that measured using 12.2 kbps RMC; otherwise, the same HSPA configuration used for body measurement should be used to test for head exposure.

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

Note 1: Δ_{ACK}, 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 β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to 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 signaled 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.

3GPP Release Version	Mode		Power (dBm)			MPR	Bc	βd	Bc/βd	Sub-Test
	Channel		4132	4183	4233					
99	WCDMA	RMC	23.46	23.48	23.54	-	-	-	-	-
5	HSDPA (WCDMA Band 5)		22.50	22.44	22.56	0	2/15	15/15	2/15	1
5			22.61	22.44	22.59	0	12/15	15/15	12/15	2
5			22.18	21.91	22.12	-0.5	15/15	8/15	15/8	3
5			22.13	21.93	22.19	-0.5	15/15	4/15	15/4	4
6	HSUPA (WCDMA Band 5)		22.27	22.18	22.18	0	11/15	15/15	11/15	1
6			20.81	20.85	20.81	-2	6/15	15/15	6/15	2
6			21.35	21.25	21.21	-1	15/15	9/15	15/9	3
6			20.79	20.81	20.84	-2	2/15	15/15	2/15	4
6			22.41	22.22	22.07	0	15/15	15/15	15/15	5

Note

1. WCDMA SAR was tested under RMC 12.2 kbps with HSPA inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg

20 SAR Data Summary

Ambient Temperature (°C)	22.3
Liquid Temperature (°C)	21.7
Date	2014-02-26

GSM850 Body SAR

EUT Position	Traffic Channel		Distance (㎜)	Theta	Phi	Slot	Power(dBm)		1-g SAR (W/kg)		Plot No
	Frequency (㎒)	Channel					Measured Power	Tune-Up Limit	Measured SAR	Scaled SAR	
A	836.6	190	5	180	0	2	30.18	30.5	0.218	0.235	-
B	836.6	190	5	180	180	2	30.18	30.5	0.362	0.390	A.3
C	836.6	190	5	180	0	2	30.18	30.5	0.126	0.136	-
D	836.6	190	5	180	0	2	30.18	30.5	0.145	0.156	-
Top Edge	836.6	190	5	90	0	2	30.18	30.5	0.030	0.032	-
Bottom Edge	836.6	190	5	90	0	2	30.18	30.5	0.029	0.031	-

Ambient Temperature (°C)	22.9
Liquid Temperature (°C)	22.4
Date	2014-02-25

GSM1900 Body SAR

EUT Position	Traffic Channel		Distance (㎜)	Theta	Phi	Slot	Power(dBm)		1-g SAR (W/kg)		Plot No
	Frequency (㎒)	Channel					Measured Power	Tune-Up Limit	Measured SAR	Scaled SAR	
A	1880.0	661	5	180	0	2	27.54	28.5	0.763	0.952	-
	1850.2	512	5	180	0	2	27.56	28.5	0.886	1.100	A.4
	1909.8	810	5	180	0	2	27.31	28.5	0.837	1.101	-
B	1880.0	661	5	180	180	2	27.54	28.5	0.615	0.767	-
C	1880.0	661	5	180	0	2	27.54	28.5	0.394	0.491	-
D	1880.0	661	5	180	0	2	27.54	28.5	0.472	0.589	-
Top Edge	1880.0	661	5	90	0	2	27.54	28.5	0.325	0.405	-
Bottom Edge	1880.0	661	5	90	0	2	27.54	28.5	0.071	0.089	-
A	1850.2	512	5	180	0	2	27.56	28.5	0.880	1.093	-

Ambient Temperature (°C)	22.3
Liquid Temperature (°C)	21.7
Date	2014-02-26

WCDMA Body SAR

EUT Position	Traffic Channel		Distance (㎜)	Theta	Phi	Power(dBm)		1-g SAR (W/kg)		Plot No
	Frequency (㎒)	Channel				Measured Power	Tune-Up Limit	Measured SAR	Scaled SAR	
A	836.6	4183	5	180	0	23.48	23.7	0.266	0.280	-
B	836.6	4183	5	180	180	23.48	23.7	0.421	0.443	A.5
C	836.6	4183	5	180	0	23.48	23.7	0.125	0.131	-
D	836.6	4183	5	180	0	23.48	23.7	0.121	0.127	-
Top Edge	836.6	4183	5	90	0	23.48	23.7	0.033	0.035	-
Bottom Edge	836.6	4183	5	90	0	23.48	23.7	0.029	0.031	-

General Notes

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC KDB Publication 865664 D01v02r03 and FCC KDB Publication 447498 D01v05r02.
2. All modes of operation were investigated, and worst-case results are reported.
3. The EUT is tested 2^{nd} hot-spot peak, if it is less than 2 dB below the highest peak.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05r02.
6. Per FCC KDB Publication 865664 D01v01r03, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see section 21 for variability analysis.

GSM Notes

1. Justification for reduced test configurations per KDB Publication 941225 D03v01: The source-based time-averaged output power was evaluated for all multi-slot operations. The multi-slot configuration with the highest frame averaged output power was evaluated for SAR.
2. Per FCC KDB Publication 447498 D01v05r02, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $>$ $^1/_2$ dB, instead of the middle channel, the highest output power channel must be used.

WCDMA Notes

1. WCDMA mode in Body SAR was tested under RMC 12.2 kbps with HSPA inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 447498 D01v05r02, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $>$ $^1/_2$ dB, instead of the middle channel, the highest output power channel must be used

21 SAR Measurement Variability

21.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r03, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1. When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2. A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3. A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Test Mode	EUT Position	Traffic Channel		Distance (㎜)	Measured 1 g SAR (W/kg)	1st Repeated 1 g SAR (W/kg)	Ratio	2nd Repeated 1 g SAR (W/kg)	Ratio	3rd Repeated 1 g SAR (W/kg)	Ratio
		Frequency (㎒)	Channel								
GPRS1900 2Tx	A	1850.2	512	5	0.886	0.880	1.01	N/A	N/A	N/A	N/A

21.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01r03, the extended measurement uncertainty analysis per IEEE 1528-2003 was not required.

Appendixes List

Appendix A	A.1 Verification Test Plots for 835 MHz A.2 Verification Test Plots for 1900 MHz A.3 SAR Test Plots for GSM850 Band A.4 SAR Test Plots for GSM1900 Band A.5 SAR Test Plots for WCDMA850 Band
Appendix B	B.1 Uncertainty Analysis
Appendix C	C.1 Calibration certificate for Probe C.2 Calibration certificate for DAE C.3 Calibration certificate for Dipole

Appendix A.1

Verification Test Plots for 835 MHz

Date: 2014-02-26

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 835MHz System Verification.da53:0

Input Power : 100 mW

Ambient Temp : 22.3 ℃ Tissue Temp : 21.7 ℃

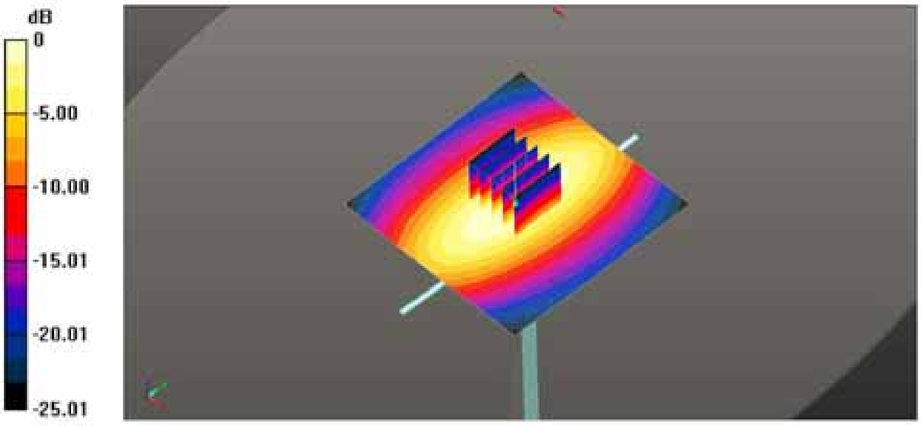
DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: 4d138

Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.941 S/m; ε_r = 54.991; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(9.52, 9.52, 9.52); Calibrated: 29.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 28.05.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1200
- DASY52 52.8.7(1137)SEMCAD X 14.6.10(7164)

System Verification/835MHz System Verification/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.17 W/kg

System Verification/835MHz System Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.986 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 1.36 W/kg
SAR(1 g) = 0.941 W/kg; SAR(10 g) = 0.628 W/kg
Maximum value of SAR (measured) = 1.18 W/kg



0 dB = 1.17 W/kg = 0.68 dBW/kg

Appendix A.2

Verification Test Plots for 1900 MHz

Date: 2014-02-25

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 1900MHz System Verification.da53:0

Input Power : 100 mW

Ambient Temp : 22.9 ℃ Tissue Temp : 22.4 ℃

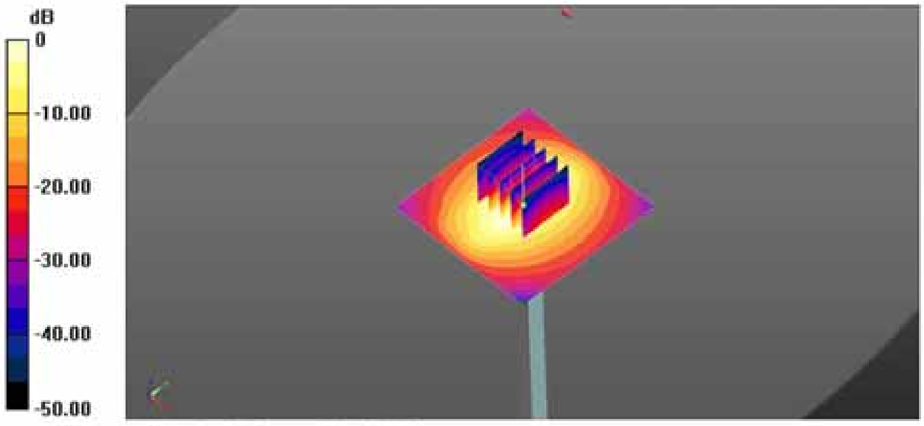
DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:5d158

Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.526 S/m; ε_r = 53.742; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.63, 7.63, 7.63); Calibrated: 29.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 28.05.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1200
- DASY52 52.8.7(1137)SEMCAD X 14.6.10(7164)

System Verification/1900MHz System Verification/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.48 W/kg

System Verification/1900MHz System Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 60.397 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 6.75 W/kg
SAR(1 g) = 3.96 W/kg; SAR(10 g) = 2.13 W/kg
Maximum value of SAR (measured) = 5.51 W/kg



0 dB = 5.48 W/kg = 7.39 dBW/kg

Appendix A.3

SAR Test Plots for GSM850 Band

Date: 2014-02-26

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS850_Side B_Theta 180_Phi 180_CH190_2TX.da53:0

Ambient Temp : 22.3 ℃ Tissue Temp : 21.7 ℃

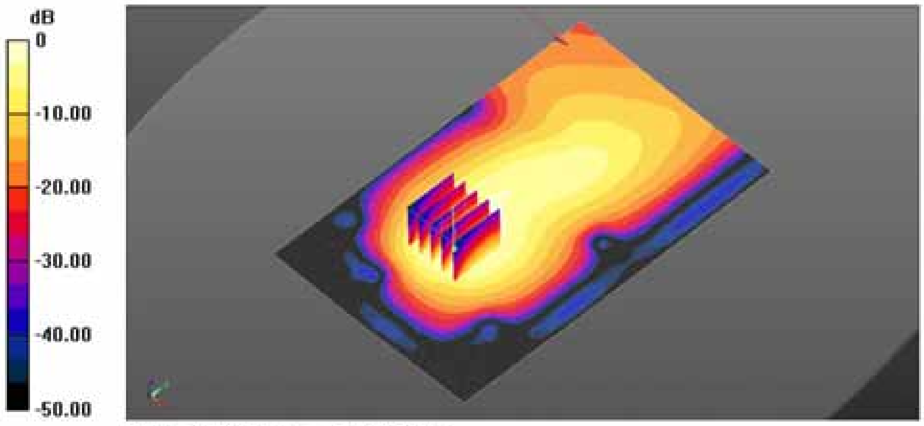
DUT: L-03F; Type: Cellular/PCS GPRS and cellular WCDMA/HSDPA/HSUPA USB Modem; Serial: N/A

Communication System: UID 0, GPRS850 2TX (0); Frequency: 836.6 MHz;Duty Cycle: 1:4.14954
Medium parameters used: f = 837 MHz; σ = 0.943 S/m; ε_r = 54.977; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(9.52, 9.52, 9.52); Calibrated: 29.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 28.05.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1200
- DASY52 52.8.7(1137)SEMCAD X 14.6.10(7164)

Body/GPRS850_Side B_Theta 180_Phi 180_CH190_2TX/Area Scan (91x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.545 W/kg

Body/GPRS850_Side B_Theta 180_Phi 180_CH190_2TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.722 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.594 W/kg
SAR(1 g) = 0.362 W/kg; SAR(10 g) = 0.232 W/kg
Maximum value of SAR (measured) = 0.444 W/kg



0 dB = 0.545 W/kg = -2.64 dBW/kg

Appendix A.4

SAR Test Plots for GSM1900 Band

Date: 2014-02-25

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS1900_Side A_Theta 180_Phi 0_CH512_2TX.da53:0

Ambient Temp : 22.9 ℃ Tissue Temp : 22.4 ℃

DUT: L-03F; Type: Cellular/PCS GPRS and cellular WCDMA/HSDPA/HSUPA USB Modem; Serial: N/A

Communication System: UID 0, GPRS1900 2TX (0); Frequency: 1850.2 MHz;Duty Cycle: 1:4.14954
Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.47 S/m; ε_r = 53.922; ρ = 1000 kg/m^3
Phantom section: Flat Section

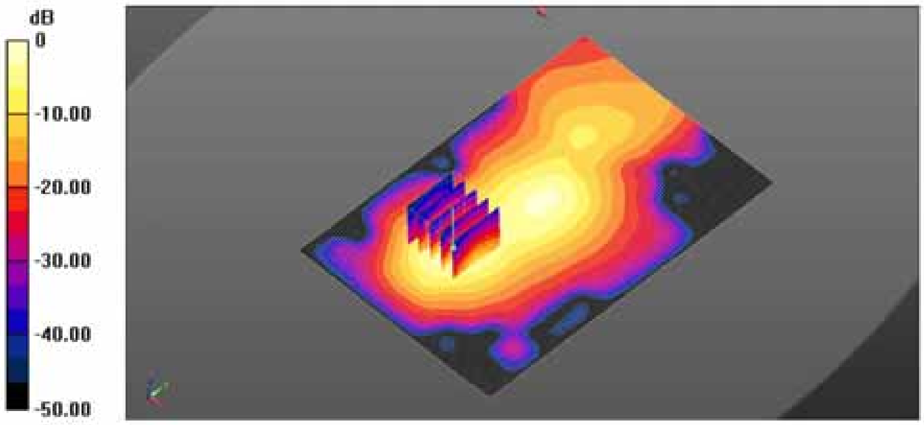
DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.63, 7.63, 7.63); Calibrated: 29.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 28.05.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1200
- DASY52 52.8.7(1137)SEMCAD X 14.6.10(7164)

Body/GPRS1900_Side A_Theta 180_Phi 0_CH512_2TX/Area Scan (91x131x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.28 W/kg

Body/GPRS1900_Side A_Theta 180_Phi 0_CH512_2TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.587 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.67 W/kg
SAR(1 g) = 0.886 W/kg; SAR(10 g) = 0.447 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.27 W/kg



0 dB = 1.28 W/kg = 1.07 dBW/kg

Appendix A.5

SAR Test Plots for WCDMA850 Band

Date: 2014-02-26

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: WCDMA V_Side B_Theta 180_Phi 180_CH4183.da53:0

Ambient Temp : 22.3 ℃ Tissue Temp : 21.7 ℃

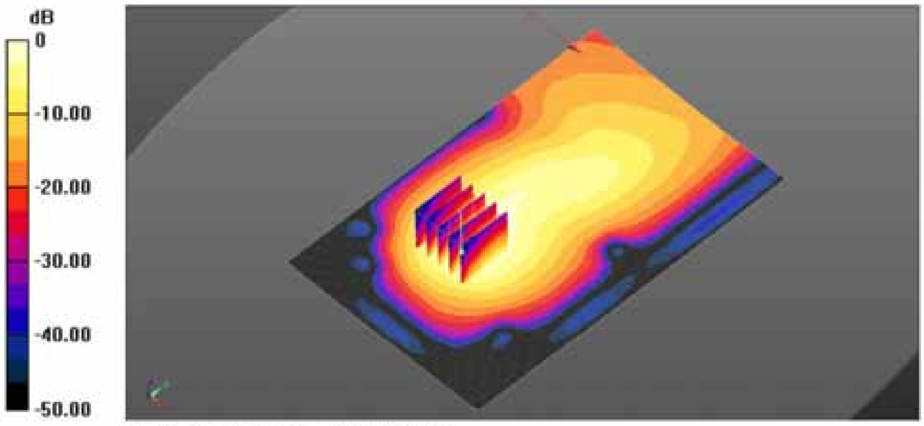
DUT: L-03F; Type: Cellular/PCS GPRS and cellular WCDMA/HSDPA/HSUPA USB Modem; Serial: N/A

Communication System: UID 0, WCDMA5 (0); Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium parameters used: f = 837 MHz; σ = 0.943 S/m; ε_r = 54.977; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(9.52, 9.52, 9.52); Calibrated: 29.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 28.05.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1200
- DASY52 52.8.7(1137)SEMCAD X 14.6.10(7164)

Body/WCDMA V_Side B_Theta 180_Phi 180_CH4183/Area Scan (91x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.653 W/kg

Body/WCDMA V_Side B_Theta 180_Phi 180_CH4183/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.030 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.695 W/kg
SAR(1 g) = 0.421 W/kg; SAR(10 g) = 0.270 W/kg
Maximum value of SAR (measured) = 0.512 W/kg



0 dB = 0.653 W/kg = -1.85 dBW/kg

Appendix B.1

Uncertainty Analysis

Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram

a	b	c	d	e = f(d,k)	g	i = cxg/e	k
Uncertainty Component	Section in P1528	Tol (%)	Prob . Dist.	Div.	Ci (1g)	1g ui (%)	Vi (Veff)
Probe calibration	E.2.1	6.0	N	1	1	6.00	∞
Axial isotropy	E.2.2	0.5	R	1.73	0.71	0.20	∞
hemispherical isotropy	E.2.2	2.6	R	1.73	0.71	1.06	∞
Boundary effect	E.2.3	1.0	R	1.73	1	0.58	∞
Linearity	E.2.4	0.6	R	1.73	1	0.35	∞
System detection limit	E.2.5	0.3	R	1.73	1	0.17	∞
Readout electronics	E.2.6	0.3	N	1	1	0.30	∞
Response time	E.2.7	0.8	R	1.73	1	0.46	∞
Integration time	E.2.8	2.6	R	1.73	1	1.50	∞
RF ambient Condition -Noise	E.6.1	3.0	R	1.73	1	1.73	∞
RF ambient Condition - reflections	E.6.1	3.0	R	1.73	1	1.73	∞
Probe positioning- mechanical tolerance	E.6.2	1.5	R	1.73	1	0.87	∞
Probe positioning- with respect to phantom	E.6.3	2.9	R	1.73	1	1.67	∞
Max. SAR evaluation	E.5.2	2.0	R	1.73	1	1.15	∞
Test sample positioning	E.4.2	1.45	N	1	1	1.45	19
Device holder uncertainty	E.4.1	3.6	N	1	1	3.60	∞
Output power variation -SAR drift measurement	6.6.3	5.0	R	1.73	1	2.89	∞
Phantom uncertainty (shape and thickness tolerances)	E.3.1	6.1	R	1.73	1	3.52	∞
Liquid conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	1.85	∞
Liquid conductivity - measurement uncertainty	E.3.2	1.91	N	1	0.64	1.22	5
Liquid permittivity - deviation from target values	E.3.3	5.0	R	1.73	0.6	1.73	∞
Liquid permittivity - deviation from target values	E.3.3	1.91	N	1	0.6	1.15	5
Combined standard uncertainty				RSS		9.80	26223
Expanded uncertainty (95% CONFIDENCE INTERVAL)				k=2		19.60	