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SAR EVALUATION REPORT

For

**CELLULAR/PCS GSM/GPRS/EDGE AND AWS WCDMA/HSPA PHONE WITH
BLUETOOTH AND WLAN**

MODEL: LG-P930, P930, LGP930 LG-P935, LGP935, P935

FCC ID: BEJP930

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Revision History

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--	November 22, 2011	Initial Issue supplemental to FCC SAR report 11U13917-6A Added additional Channel Bandwidth of 15MHz for LTE Band 4	--

Table of Contents

1. Attestation of Test Results	5
2. Test Methodology	6
3. FACILITIES AND ACCREDITATION.....	6
4. Calibration and Uncertainty	7
4.1. <i>Measuring Instrument Calibration.....</i>	<i>7</i>
4.2. <i>Measurement Uncertainty.....</i>	<i>8</i>
5. Equipment Under Test	9
5.1. <i>Band and Air interlaces</i>	<i>9</i>
5.2. <i>Personal Hotspot Mode</i>	<i>9</i>
5.3. <i>KDB 941225 D05 "SAR for LTE Devices v01".....</i>	<i>10</i>
5.4. <i>Simultaneous Transmission Conditions.....</i>	<i>13</i>
6. Liquid Parameters Check.....	15
6.1. <i>Liquid Check Results.....</i>	<i>16</i>
7. System Verification	17
7.1. <i>System Check Results.....</i>	<i>18</i>
8. SAR Measurement Procedures	19
9. RF Output Power Measurement	20
9.1. <i>LTE Band Band 4</i>	<i>20</i>
10. Summary of Test Results for Highest 1g SAR	21
11. Standalone SAR Test Results	22
11.1. <i>LTE Band 4.....</i>	<i>22</i>
12. Worst-case SAR Plots.....	27
12.1. <i>Worst-case SAR Plots for WWAN.....</i>	<i>27</i>
4. Simultaneous Transmission SAR Analysis (KDB 648474)	31
4.1. <i>Head Exposure Condition.....</i>	<i>31</i>
4.2. <i>Body-worn exposure condition</i>	<i>32</i>
4.3. <i>Body-hotspot Exposure Condition</i>	<i>33</i>
13. Appendixes.....	34
13.1. <i>Appendix A: System check plots.....</i>	<i>34</i>
13.2. <i>Appendix B: SAR test plots for LTE Band 4; 15MHz Head.....</i>	<i>34</i>

13.3.	<i>Appendix C: SAR test plots for LTE Band 4; 15MHz Body.....</i>	<i>34</i>
13.4.	<i>Appendix D: Calibration certificate for E-Field Probe EX3DV4 SN 3686</i>	<i>34</i>
13.5.	<i>Appendix E: Calibration certificate for D1750V2 SN 1053.....</i>	<i>34</i>
14.	Antenna Location & Separation Distances.....	35
15.	Setup Photos	36
16.	External Photos	41

1. Attestation of Test Results

Applicant:	LG ELECTRONICS, INC.		
EUT description:	CELLULAR/PCS GSM/GPRS/EDGE AND AWS WCDMA/HSPA PHONE WITH BLUETOOTH AND WLAN		
Model number:	LG-P930, P930, LGP930 LG-P935, LGP935, P935, IMEI: 004402-34-038179-1		
Device category:	Portable devices		
Exposure category:	General Population/Uncontrolled Exposure		
Date tested:	November 9 - 12, 2011		
FCC / IC Rule Parts	Freq. Range [MHz]	Highest 1-g SAR (W/kg)	Limit (W/kg)
27 (LTE Band 4) / RSS-139	1710-1755	Head: 0.588 W/kg (Right Touch) Body: 1.05 W/kg (Rear with 10mm distance)	1.6
Applicable Standards			Test Results
FCC OET Bulletin 65 Supplement C 01-01, IEEE Std 1528:2003 & IC RSS 102 Issue 4			Pass
Compliance Certification Services, Inc. (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report. Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.			
Approved & Released For UL CCS By:		Tested By:	
			
Dave Weaver Staff Engineer Compliance Certification Services (UL CCS)		Bobby Bayani SAR Engineer Compliance Certification Services (UL CCS)	

2. Test Methodology

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C Edition 01-01, IEEE STD 1528:2003, RSS-102 Issue 4, March 2010, and RSS-102 Supplementary Procedures (SPR)-001, January 1, 2011 and the following KDB Procedures.

- o 648474 D01 SAR Handsets Multiple Xmitter and Ant, v01r05
- o 248227 D01 SAR meas for 802 11abg v01r02
- o 941225 D01 SAR test for 3G devices v02
- o 941225 D02 Guidance for 3GPP R6 and R7 HSPA v02v01
- o 941225 D03 SAR Test Reduction GSM GPRS EDGE v01
- o 941225 D05 SAR for LTE Devices v01

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

4. Calibration and Uncertainty

4.1. Measuring Instrument Calibration

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations and is traceable to recognized national standards.

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due date		
				MM	DD	Year
Dielectronic Probe kit	HP	85070C	N/A	N/A		
ESA Series Network Analyzer	Agilent	E5071B	MY42100131	2	2	2012
Synthesized Signal Generator	HP	83732B	US34490599	7	14	2012
E-Field Probe	SPEAG	EX3DV4	3772	5	3	2012
Thermometer	ERTCO	639-1S	1718	7	19	2012
Data Acquisition Electronics	SPEAG	DAE4	1239	10	18	2012
System Validation Dipole	SPEAG	D1750V2	1050	4	19	2012
Power Meter	Giga-tronics	8651A	8651404	5	13	2012
Power Sensor	Giga-tronics	80701A	1834588	5	13	2012
Power Meter	HP	437B	3125U16345	5	13	2012
Power Sensor	HP	8481A	2702A60780	5	13	2012
Amplifier	MITEQ	4D00400600-50-30P	1620606	N/A		
Directional coupler	Werlatone	C8060-102	2141	N/A		

4.2. Measurement Uncertainty

Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram					
Component	error, %	Probe Distribution	Divisor	Sensitivity	U (X), %
Measurement System					
Probe Calibration (k=1) @ 1750 MHz	5.05	Normal	1	1	5.05
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	9.20	Rectangular	1.732	0.7071	3.76
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	3.45	Rectangular	1.732	1	1.99
System Detection Limits	1.00	Rectangular	1.732	1	0.58
Readout Electronics	0.30	Normal	1	1	0.30
Response Time	0.80	Rectangular	1.732	1	0.46
Integration Time	2.60	Rectangular	1.732	1	1.50
RF Ambient Conditions - Noise	3.00	Rectangular	1.732	1	1.73
RF Ambient Conditions - Reflections	3.00	Rectangular	1.732	1	1.73
Probe Positioner Mechanical Tolerance	0.40	Rectangular	1.732	1	0.23
Probe Positioning with respect to Phantom	2.90	Rectangular	1.732	1	1.67
Extrapolation, Interpolation and Integration	1.00	Rectangular	1.732	1	0.58
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder Uncertainty	3.60	Normal	1	1	3.60
Output Power Variation - SAR Drift	5.00	Rectangular	1.732	1	2.89
Phantom and Tissue Parameters					
Phantom Uncertainty (shape and thickness)	4.00	Rectangular	1.732	1	2.31
Liquid Conductivity - deviation from target	5.00	Rectangular	1.732	0.64	1.85
Liquid Conductivity - measurement @ Body 1750 MHz	-4.88	Normal	1	0.64	-3.12
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement @ Body 1750 MHz	-3.54	Normal	1	0.6	-2.12
Combined Standard Uncertainty $U_c(y)$ =					10.58
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				21.15	%
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				1.67	dB

5. Equipment Under Test

CELLULAR/PCS GSM/GPRS/EDGE AND AWS WCDMA/HSPA PHONE WITH BLUETOOTH AND WLAN
Model: LG-P930, P930, LGP930 LG-P935, LGP935, P935

Normal operation:	- Held to head, - Body-worn (Rear and Front sides) with 10 mm separation distance. - Personal Hotspot with 10 mm separation distance to all sides and edges.
Body Worn Accessory	- Headset
Antenna-to-antenna and antenna-to-edges' separation distances:	Please refer to Section "15 Antenna Locations & Separation Distances" for details

5.1. Band and Air interlaces

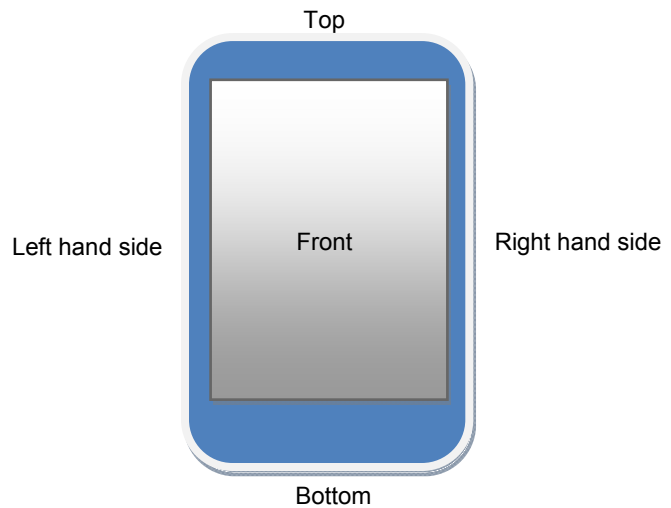
Tx Frequency Bands:	Cellular: 824 – 849 MHz PCS: 1850 – 1910 MHz 802.11b/g/n: 2412 – 2462MHz, HT20 Bluetooth: 2402-2480 MHz
Air Interfaces:	GSM, GPRS, EGPRS. WCDMA (Rel 99), HSDPA (Rel 6, CAT 10), HSUPA (Rel 6, CAT 6). LTE 802.11b/g/n. Bluetooth
Uplink Modulations:	GSM Modes: GMSK, 8PSK UMTS Modes: BPSK, QPSK 802.11b: DSS CCK 802.11g: OFDM 802.11n: OFDM Bluetooth: DQPSK, 8DPSK, GFSK
GPRS Multi-Slot Class:	10
Capability Class:	B

5.2. Personal Hotspot Mode

The device is capable of personal hotspot mode. The hotspot mode can be enabled by the users. SAR measurements in the Personal hot spot function are performed with 10 m separation distance to all sides and edges to the body phantom.

5.3. KDB 941225 D05 "SAR for LTE Devices v01"

#	Description	Parameter
1	Identify the operating frequency range of each LTE transmission band used by the device	Band 4: 1710 to 1755 MHz
2	Identify the channel bandwidths used in each frequency band; 1.4, 3, 5, 10, 15, 20 MHz etc	Band 4: added 15 MHz
3	Identify the high, middle and low (H, M, L) channel numbers and frequencies in each LTE frequency band	LTE Band 4 1) Low channel - Bandwidth: 15MHz Ch. #: 20025, Frequency: 1717.5 MHz 2) Middle channel - Bandwidth: 15 MHz Ch. #: 20175, Frequency: 1732.5 MHz 3) High channel - Bandwidth: 10 MHz Ch. #: 20325, Frequency: 1747.5 MHz
4	Specify the UE category and uplink modulations used	The UE Category is 3 Uplink modulations: QPSK, 16QAM
5	Descriptions of the LTE transmitter and antenna implementation & identify whether it is a standalone transmitter operating independently of other wireless transmitters in the device or sharing hardware components and/or antenna(s) with other transmitters etc.	This model(P930) has the same HW and one Tx antenna for GSM/WCDMA/LTE. For details, please refer to the antenna distance diagram

#	Description	Parameter
6	Identify the LTE voice/data requirements in each operating mode and exposure condition with respect to head and body test configurations, antenna locations, handset flip-cover or slide positions, antenna diversity conditions, etc.	The following exposure condition with respect to head and body test are required for both voice and data modes due to EUT functionality and antenna locations. 1) Body SAR is required at 10 mm separation distance 2) Mobile Hot Spot Mode will be tested by positioning the smart phone with 10 mm separation distance. - Wireless Personal Hotspot mode with consideration for the Front Display of EUT, Rear of EUT, Left Hand side of EUT, Right Hand side of EUT, Top Edge of EUT and Bottom Edge of EUT with respect to the antenna location. The test separation distance between the EUT edge and phantom flat surface for this mode will be 10mm as the dimensions of the device is > 9cm x 5cm. 3) Head SAR is required in LTE mode as this model supports SVLTE operation.  The diagram shows a blue smartphone with a white screen. The screen is labeled 'Front'. The top of the phone is labeled 'Top', the bottom is labeled 'Bottom', the left side is labeled 'Left hand side', and the right side is labeled 'Right hand side'.
7	Identify if Maximum Power Reduction (MPR) is optional or mandatory, i.e. built-in by design: a) only mandatory MPR may be considered during SAR testing, when the maximum output power is permanently limited by the MPR implemented within the UE; and only for the applicable RB (resource block) configurations specified in LTE standards b) A-MPR (additional MPR) must be disabled.	The EUT incorporates MPR as per 36.101 as shown in the table below. MPR cannot be disabled after the phone is manufactured, MPR is mandatory. For details, please see the conducted power table. * Target MPR(15 MHz) - QPSK 1RB 0 offset: 0dB, QPSK 1RB 74 offset: 0dB - 16QAM 1RB 0 offset: 1dB, 16QAM 1RB 74 offset: 1dB - QPSK 36RB 18 offset: 1dB, 16QAM 36RB 18 offset: 2dB - QPSK 75RB 0 offset: 1dB, 16QAM 75RB 0 offset: 2dB A-MPR is always disabled during the SAR testing.
8	Include the maximum average conducted output power measured on the required test channels for each channel bandwidth and UL modulation used in each frequency band: a) with 1 RB allocated at the upper edge of a channel b) with 1 RB allocated at the lower edge of a channel c) using 50% RB allocation centered within a channel	Refer to section 10 RF output power table

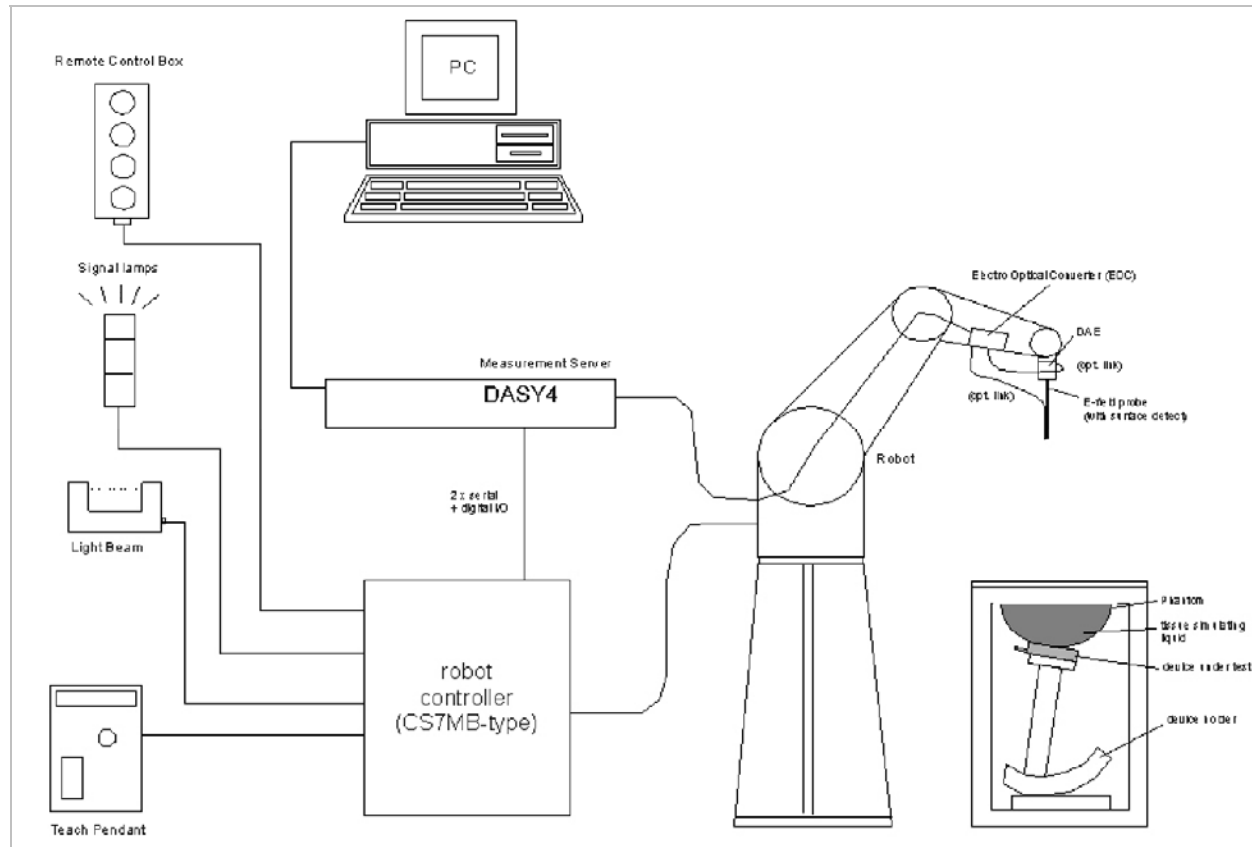
	d) using 100% RB allocation	
9	Identify all other U.S. wireless operating modes (3G, Wi-Fi, WiMax, Bluetooth etc), device/exposure configurations (head and body, antenna and handset flip-cover or slide positions, antenna diversity conditions etc.) and frequency bands used for these modes	The following bands are supported for the exposure conditions 1) GSM850/1900 and UMTS (WCDMA) band V (850) & band II (1900) Exposure conditions: Head/Body worn SAR required for GSM/UMTS (WCDMA) and wireless personal hotspot. DTM is not supported. 2) Bluetooth 2.4GHz (Basic Rate & EDR) - Exposure conditions: BT SAR is not required as maximum output power < 12 mW & antenna separation distance 3) WiFi 2.4GHz - Exposure conditions: Head/Body SAR required for wireless personal hotspot. No power reduction.
10	Include the maximum average conducted output power measured for the other wireless mode and frequency bands	See section 10 RF output power measurements in SAR report.
11	Identify the simultaneous transmission conditions for the voice and data configurations supported by all wireless modes, device configurations and frequency bands, for the head and body exposure conditions and device operating configurations (handset flip or cover positions, antenna diversity conditions etc.)	Simultaneous transmission conditions 1) GSM Voice or WCDMA Voice + WiFi data. 2) GSM hotspot: GPRS/EDGE + WiFi 3) WCDMA Voice/WCDMA Data hotspot: WCDMA Voice/WCDMA data + WiFi 4) LTE Hotspot: LTE + WiFi - WCDMA Voice & LTE doesn't transmit simultaneously. - WCDMA Voice & WCDMA data doesn't transmit simultaneously. - WCDMA & LTE & WCDMA data doesn't transmit simultaneously. - GSM & LTE doesn't transmit simultaneously. - DTM is not supported. - SVLTE is not supported. For details about the simultaneous transmission configurations, Please refer to the table in section 4.1
12	When power reduction is applied to certain wireless modes to satisfy SAR compliance for simultaneous transmission conditions, other equipment certification or operating requirements, include the maximum average conducted output power measured in each power reduction mode applicable to the simultaneous voice/data transmission configurations for such wireless configurations and frequency bands; and also include details of the power reduction implementation and measurement setup	No power reduction applied.
13	Include descriptions of the test equipment, test software, built-in test firmware etc. required to support testing the device when power reduction is applied to one or more transmitters/antennas for simultaneous voice/data transmission	No power reduction applied.
14	When appropriate, include a SAR test plan proposal with respect to the above	No power reduction applied.
15	If applicable, include preliminary SAR test data and/or supporting information in laboratory testing inquiries to address specific issues and concerns or for requesting further test reduction considerations appropriate for the device; for example, simultaneous transmission configurations	No power reduction applied.

5.4. Simultaneous Transmission Conditions

- GSM voice + WiFi
GSM voice can transmit simultaneously with WiFi
- GPRS + WiFi
GPRS can transmit simultaneously with WiFi
- EGPRS + WiFi
EGPRS can transmit simultaneously with WiFi
- WCDMA voice + WiFi
WCDMA voice can transmit simultaneously with WiFi
- WCDMA data + WiFi
WCDMA data can transmit simultaneously with WiFi
- LTE + WiFi
LTE can transmit simultaneously with WiFi

Note – Only the LTE band 4, 15MHz channel bandwidth conditions were assessed. All other conditions were assessed in UL CCS report number 11U13917

System Specifications



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition 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.
- 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 Windows 2000 or Windows XP.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing validating the proper functioning of the system.

6. Liquid Parameters Check

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. For frequencies in 300 MHz to just under 2 GHz, the measured conductivity and relative permittivity should be within $\pm 5\%$ of the target values. For frequencies in the range of 2–3 GHz and above the measured conductivity should be within $\pm 5\%$ of the target values. The measured relative permittivity tolerance can be relaxed to no more than $\pm 10\%$.

Reference Values of Tissue Dielectric Parameters for Head & Body Phantom

The body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE Standard 1528.

Target Frequency (MHz)	Head		Body	
	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
150	52.3	0.76	61.9	0.8
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
750	41.96	0.89	55.6	0.96
835	41.5	0.9	55.2	0.97
900	41.5	0.97	55	1.05
915	41.5	0.98	55	1.06
1450	40.5	1.2	54	1.3
1610	40.3	1.29	53.8	1.4
1750	40.08	1.37	53.44	1.49
1800 – 2000	40	1.4	53.3	1.52
2450	39.2	1.8	52.7	1.95
3000	38.5	2.4	52	2.73

(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000 \text{ kg/m}^3$)

6.1. Liquid Check Results

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
11/9/2011	Head 1720	e'	39.8084	Relative Permittivity (ϵ_r):	39.81	40.13	-0.80	5
		e''	13.9835	Conductivity (σ):	1.34	1.35	-1.09	5
	Head 1735	e'	39.7424	Relative Permittivity (ϵ_r):	39.74	40.11	-0.91	5
		e''	14.0202	Conductivity (σ):	1.35	1.36	-0.59	5
	Head 1750	e'	39.6685	Relative Permittivity (ϵ_r):	39.67	40.08	-1.04	5
		e''	14.0583	Conductivity (σ):	1.37	1.37	-0.07	5
11/10/2011	Body 1720	e'	53.3534	Relative Permittivity (ϵ_r):	53.35	53.52	-0.31	5
		e''	14.5979	Conductivity (σ):	1.40	1.47	-4.88	5
	Body 1735	e'	53.3140	Relative Permittivity (ϵ_r):	53.31	53.48	-0.31	5
		e''	14.6418	Conductivity (σ):	1.41	1.48	-4.36	5
	Body 1750	e'	53.2769	Relative Permittivity (ϵ_r):	53.28	53.44	-0.31	5
		e''	14.6886	Conductivity (σ):	1.43	1.49	-3.83	5
11/11/2011	Body 1720	e'	53.5072	Relative Permittivity (ϵ_r):	53.51	53.52	-0.02	5
		e''	15.1181	Conductivity (σ):	1.45	1.47	-1.49	5
	Body 1735	e'	53.4544	Relative Permittivity (ϵ_r):	53.45	53.48	-0.05	5
		e''	15.1587	Conductivity (σ):	1.46	1.48	-0.98	5
	Body 1750	e'	53.3987	Relative Permittivity (ϵ_r):	53.40	53.44	-0.08	5
		e''	15.2012	Conductivity (σ):	1.48	1.49	-0.47	5
11/12/2011	Head 1720	e'	39.3134	Relative Permittivity (ϵ_r):	39.31	40.13	-2.04	5
		e''	13.5055	Conductivity (σ):	1.29	1.35	-4.47	5
	Head 1735	e'	39.2542	Relative Permittivity (ϵ_r):	39.25	40.11	-2.13	5
		e''	13.5343	Conductivity (σ):	1.31	1.36	-4.03	5
	Head 1750	e'	39.1945	Relative Permittivity (ϵ_r):	39.19	40.08	-2.22	5
		e''	13.5654	Conductivity (σ):	1.32	1.37	-3.58	5
11/12/2011	Body 1720	e'	51.6389	Relative Permittivity (ϵ_r):	51.64	53.52	-3.51	5
		e''	14.7412	Conductivity (σ):	1.41	1.47	-3.94	5
	Body 1735	e'	51.5946	Relative Permittivity (ϵ_r):	51.59	53.48	-3.52	5
		e''	14.7697	Conductivity (σ):	1.42	1.48	-3.53	5
	Body 1750	e'	51.5505	Relative Permittivity (ϵ_r):	51.55	53.44	-3.54	5
		e''	14.8040	Conductivity (σ):	1.44	1.49	-3.07	5

7. System Verification

The system performance check is performed prior to any usage of the system in order to verify SAR system measurement accuracy. The system performance check verifies that the system operates within its specifications of $\pm 10\%$.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Head or Body simulating liquid of the following parameters.
- The DASY4 system with an E-Field Probe EX3DV4, SN: 3686 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 fine cube was chosen for cube
- Distance between probe sensors and phantom surface was set to 3 mm.
For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW
- The results are normalized to 1 W input power.

Reference SAR Values for HEAD & BODY-tissue from calibration certificate of SPEAG.

System validation dipole	Cal. certificate #	Cal. date	SAR Avg (mW/g)		
			Tissue:	Head	Body
D1750V2	D1750V2-1050_Apr11	4/19/11	1g SAR:	36.80	36.40
			10g SAR:	19.60	19.40

7.1. System Check Results

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
D1750V2 Head	11/09/11	1g SAR:	35.5	36.08	-1.61	±10
		10g SAR:	18.8	19.16	-1.88	
D1750V2 Body	11/10/11	1g SAR:	36.9	36.40	1.37	±10
		10g SAR:	19.7	19.40	1.55	
D1750V2 Body	11/11/11	1g SAR:	38.5	36.40	5.77	±10
		10g SAR:	20.4	19.40	5.15	
D1750V2 Head	11/12/11	1g SAR:	35.5	36.08	-1.61	±10
		10g SAR:	18.9	19.16	-1.36	
D1750V2 Body	11/12/11	1g SAR:	36.1	36.40	-0.82	±10
		10g SAR:	19.4	19.40	0.00	

8. SAR Measurement Procedures

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 2.1 mm. 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 DASY4 software can find the maximum locations even 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. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums 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 $\geq 7 \times 7 \times 9$ (above 4.5 GHz) or $5 \times 5 \times 7$ (below 3 GHz) points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

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.

Step 5: 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.

9. RF Output Power Measurement

9.1. LTE Band Band 4

Output power for LTE Band 4 (15 MHz Channel Bandwidth)

Modulation	UL Channel	Freq. (MHz)	RB Size	RB Offset	MPR (dB)	Max Avg Power (dBm)
QPSK	20025	1717.5	1	0	0	23.50
			1	74	0	23.50
			36	18	1	22.65
			75	0	1	22.70
16-QAM			1	0	1	22.81
			1	74	1	22.71
			36	18	2	21.77
			75	0	2	21.71
QPSK	20175	1732.5	1	0	0	23.50
			1	74	0	23.50
			36	18	1	22.63
			75	0	1	22.62
16-QAM			1	0	1	22.73
			1	74	1	22.67
			36	18	2	21.67
			75	0	2	21.65
QPSK	20325	1747.5	1	0	0	23.39
			1	74	0	23.27
			36	18	1	22.41
			75	0	1	22.49
16-QAM			1	0	1	22.49
			1	74	1	22.41
			36	18	2	21.54
			75	0	2	21.46

10. Summary of Test Results for Highest 1g SAR

The test configuration for each body exposure condition (head, body-worn, and body-hotspot) is dependent on the applicable voice or data modes, and antenna selected.

Technology	Frequency (MHz)	Test configuration	Mode	Separation distance (mm)	Highest 1g SAR (W/kg)
LTE Band 4 (Part 27)	1732.5	Head: Right touch	Channel Bandwidth15MHz RB size1, RB offset 74	0	0.588
	1732.5	Body-worn & -hotspot: Rear	Channel Bandwidth15MHz RB size1, RB offset 74	10	1.050

11. Standalone SAR Test Results

11.1. LTE Band 4

Head SAR

(1) Head SAR

Left Hand Side (LHS): 15 MHz BW

Test Position	UL Ch #.	Freq. (MHz)	Mode	RB Size	RB Offset	Avg Pwr (dBm)	MPR	SAR (mW/g)		Note
								1-g	10-g	
Left Touch	20025	1717.5	QPSK	1	0	23.50	0	0.465	0.288	
				1	74	23.50	0	0.555	0.336	
				36	18	22.65	1			1
				75	0	22.70	1			1
			16QAM	1	0	22.81	1	0.396	0.244	
				1	74	22.71	1	0.406	0.248	
				36	18	21.77	2			1
				75	0	21.71	2			1
	20175	1732.5	QPSK	1	0	23.50	0	0.514	0.317	
				1	74	23.50	0	0.521	0.320	
				36	18	22.63	1	0.445	0.274	
				75	0	22.62	1			1
			16QAM	1	0	22.73	1	0.396	0.244	
				1	74	22.67	1	0.389	0.237	
				36	18	21.67	2	0.335	0.205	
				75	0	21.65	2			1
	20325	1747.5	QPSK	1	0	23.39	0			1
				1	74	23.27	0			1
				36	18	22.41	1			1
				75	0	22.49	1			1
			16QAM	1	0	22.49	1			1
				1	74	22.41	1			1
				36	18	21.54	2			1
				75	0	21.46	2			1
Test Position	UL Ch #.	Freq. (MHz)	Mode	RB Size	RB Offset	Avg Pwr (dBm)	MPR	SAR (mW/g)		Note
								1-g	10-g	
Left Tilt	20025	1717.5	QPSK	1	0	23.50	0	0.227	0.138	
				1	74	23.50	0	0.220	0.134	
				36	18	22.65	1			1
				75	0	22.70	1			1
			16QAM	1	0	22.81	1	0.189	0.116	
				1	74	22.71	1	0.183	0.112	
				36	18	21.77	2			1
				75	0	21.71	2			1
	20175	1732.5	QPSK	1	0	23.50	0	0.253	0.154	
				1	74	23.50	0	0.254	0.152	
				36	18	22.63	1	0.220	0.131	
				75	0	22.62	1			1
			16QAM	1	0	22.73	1	0.220	0.132	
				1	74	22.67	1	0.217	0.129	
				36	18	21.67	2	0.185	0.111	
				75	0	21.65	2			1
	20325	1747.5	QPSK	1	0	23.39	0			1
				1	74	23.27	0			1
				36	18	22.41	1			1
				75	0	22.49	1			1
			16QAM	1	0	22.49	1			1
				1	74	22.41	1			1
				36	18	21.54	2			1
				75	0	21.46	2			1

Note(s):

- The test reduction for LTE SAR is based on KDB 941225 D05 SAR for LTE Devices v01.

2. Right Hand Side (RHS): 15 MHz BW

Test Position	UL Ch #.	Freq. (MHz)	Mode	RB Size	RB Offset	Avg Pwr (dBm)	MPR	SAR (mW/g)		Note
								1-g	10-g	
RightTouch	20025	1717.5	QPSK	1	0	23.50	0	0.537	0.344	
				1	74	23.50	0	0.565	0.356	
				36	18	22.65	1			1
				75	0	22.70	1			1
			16QAM	1	0	22.81	1	0.455	0.292	
				1	74	22.71	1	0.390	0.249	
				36	18	21.77	2			1
				75	0	21.71	2			1
	20175	1732.5	QPSK	1	0	23.50	0	0.572	0.364	
				1	74	23.50	0	0.588	0.374	
				36	18	22.63	1	0.493	0.314	
				75	0	22.62	1			1
			16QAM	1	0	22.73	1	0.457	0.288	
				1	74	22.67	1	0.466	0.295	
				36	18	21.67	2	0.394	0.248	
				75	0	21.65	2			1
	20325	1747.5	QPSK	1	0	23.39	0			1
				1	74	23.27	0			1
				36	18	22.41	1			1
				75	0	22.49	1			1
			16QAM	1	0	22.49	1			1
				1	74	22.41	1			1
				36	18	21.54	2			1
				75	0	21.46	2			1
Test Position	UL Ch #.	Freq. (MHz)	Mode	RB Size	RB Offset	Avg Pwr (dBm)	MPR	SAR (mW/g)		Note
								1-g	10-g	
RightTilt	20025	1717.5	QPSK	1	0	23.50	0	0.234	0.152	
				1	74	23.50	0	0.236	0.153	
				36	18	22.65	1			
				75	0	22.70	1			
			16QAM	1	0	22.81	1	0.200	0.129	
				1	74	22.71	1	0.198	0.128	
				36	18	21.77	2			
				75	0	21.71	2			
	20175	1732.5	QPSK	1	0	23.50	0	0.252	0.162	
				1	74	23.50	0	0.178	0.115	
				36	18	22.63	1	0.207	0.134	1
				75	0	22.62	1			
			16QAM	1	0	22.73	1	0.196	0.127	
				1	74	22.67	1	0.132	0.085	
				36	18	21.67	2	0.178	0.117	1
				75	0	21.65	2			
	20325	1747.5	QPSK	1	0	23.39	0			
				1	74	23.27	0			
				36	18	22.41	1			
				75	0	22.49	1			
			16QAM	1	0	22.49	1			
				1	74	22.41	1			
				36	18	21.54	2			
				75	0	21.46	2			

Note(s):

- The test reduction for LTE SAR is based on KDB 941225 D05 SAR for LTE Devices v01.

(2) Body-worn & Body-hotspot SAR 15 MHz BW

Test Position	UL Ch #.	Freq. (MHz)	Mode	RB Size	RB Offset	Avg Pwr (dBm)	MPR	SAR (mW/g)		Note
								1-g	10-g	
Rear	20025	1717.5	QPSK	1	0	23.50	0	1.000	0.615	
				1	74	23.50	0	1.020	0.624	
				36	18	22.65	1			1
				75	0	22.70	1			1
			16QAM	1	0	22.81	1	0.884	0.545	
				1	74	22.71	1	0.861	0.526	
				36	18	21.77	2			1
				75	0	21.71	2			1
	20175	1732.5	QPSK	1	0	23.50	0	1.010	0.631	
				1	74	23.50	0	1.050	0.652	
				1	74	23.50	0	0.917	0.563	2
				36	18	22.63	1	0.784	0.484	
				75	0	22.62	1			1
			16QAM	1	0	22.73	1	0.871	0.539	
				1	74	22.67	1	0.904	0.550	
				36	18	21.67	1	0.753	0.458	
				75	0	21.65	2			1
	20325	1747.5	QPSK	1	0	23.39	0			1
				1	74	23.27	0			1
				36	18	22.41	1			1
				75	0	22.49	1			1
			16QAM	1	0	22.49	1			1
				1	74	22.41	1			1
				36	18	21.54	2			1
				75	0	21.46	2			1
Front	20025	1717.5	QPSK	1	0	23.50	0	0.855	0.519	
				1	74	23.50	0	0.849	0.515	
				36	18	22.65	1			1
				75	0	22.70	1			1
			16QAM	1	0	22.81	1	0.735	0.443	
				1	74	22.71	1	0.727	0.442	
				36	18	21.77	2			1
				75	0	21.71	2			1
	20175	1732.5	QPSK	1	0	23.50	0	0.903	0.549	
				1	74	23.50	0	0.909	0.553	
				36	18	22.63	1	0.792	0.476	
				75	0	22.62	1			1
			16QAM	1	0	22.73	1	0.763	0.465	
				1	74	22.67	1	0.755	0.461	
				36	18	21.67	2	0.630	0.383	
				75	0	21.65	2			1
	20325	1747.5	QPSK	1	0	23.39	0			1
				1	74	23.27	0			1
				36	18	22.41	1			1
				75	0	22.49	1			1
			16QAM	1	0	22.49	1			1
				1	74	22.41	1			1
				36	18	21.54	2			1
				75	0	21.46	2			1

Note(s):

1. The test reduction for LTE SAR is based on KDB 941225 D05 SAR for LTE Devices v01.
2. With headset attached.

Test Position	UL Ch #.	Freq. (MHz)	Mode	RB Size	RB Offset	Avg Pwr (dBm)	MPR	SAR (mW/g)		Note
								1-g	10-g	
Bottom	20025	1717.5	QPSK	1	0	23.50	0	0.497	0.269	
				1	74	23.50	0	0.523	0.278	
				36	18	22.65	1			1
				75	0	22.70	1			1
			16QAM	1	0	22.81	1	0.408	0.224	
				1	74	22.71	1	0.439	0.234	
				36	18	21.77	2			1
				75	0	21.71	2			1
	20175	1732.5	QPSK	1	0	23.50	0	0.530	0.283	
				1	74	23.50	0	0.546	0.286	
				36	18	22.63	1	0.455	0.240	
				75	0	22.62	1			1
			16QAM	1	0	22.73	1	0.436	0.232	
				1	74	22.67	1	0.443	0.234	
				36	18	21.67	2	0.362	0.193	
				75	0	21.65	2			1
	20325	1747.5	QPSK	1	0	23.39	0			1
				1	74	23.27	0			
				36	18	22.41	1			1
				75	0	22.49	1			1
			16QAM	1	0	22.49	1			1
				1	74	22.41	1			1
				36	18	21.54	2			1
				75	0	21.46	2			1
Test Position	UL Ch #.	Freq. (MHz)	Mode	RB Size	RB Offset	Avg Pwr (dBm)	MPR	SAR (mW/g)		Note
								1-g	10-g	
Left	20025	1717.5	QPSK	1	0	23.50	0	0.202	0.124	
				1	74	23.50	0	0.182	0.111	
				36	18	22.65	1			1
				75	0	22.70	1			1
			16QAM	1	0	22.81	1	0.156	0.096	
				1	74	22.71	1	0.158	0.096	
				36	18	21.77	2			1
				75	0	21.71	2			1
	20175	1732.5	QPSK	1	0	23.50	0	0.195	0.119	
				1	74	23.50	0	0.213	0.129	
				36	18	22.63	1	0.178	0.108	
				75	0	22.62	1			1
			16QAM	1	0	22.73	1	0.177	0.106	
				1	74	22.67	1	0.184	0.111	
				36	18	21.67	2	0.121	0.073	
				75	0	21.65	2			1
	20325	1747.5	QPSK	1	0	23.39	0			1
				1	74	23.27	0			1
				36	18	22.41	1			1
				75	0	22.49	1			1
			16QAM	1	0	22.49	1			1
				1	74	22.41	1			1
				36	18	21.54	2			1
				75	0	21.46	2			1

Note(s):

- The test reduction for LTE SAR is based on KDB 941225 D05 SAR for LTE Devices v01.

Test Position	UL Ch #.	Freq. (MHz)	Mode	RB Size	RB Offset	Avg Pwr (dBm)	MPR	SAR (mW/g)		Note
								1-g	10-g	
Right	20025	1717.5	QPSK	1	0	23.50	0	0.263	0.160	
				1	74	23.50	0	0.301	0.181	
				36	18	22.65	1			1
				75	0	22.70	1			1
			16QAM	1	0	22.81	1	0.242	0.146	
				1	74	22.71	1	0.255	0.154	
				36	18	21.77	2			1
				75	0	21.71	2			1
	20175	1732.5	QPSK	1	0	23.50	0	0.361	0.215	
				1	74	23.50	0	0.378	0.225	
				36	18	22.63	1	0.319	0.190	
				75	0	22.62	1			1
			16QAM	1	0	22.73	1	0.312	0.185	
				1	74	22.67	1	0.318	0.189	
				36	18	21.67	2	0.258	0.152	
				75	0	21.65	2			1
	20325	1747.5	QPSK	1	0	23.39	0			1
				1	74	23.27	0			1
				36	18	22.41	1			1
				75	0	22.49	1			1
			16QAM	1	0	22.49	1			1
				1	74	22.41	1			1
				36	18	21.54	2			1
				75	0	21.46	2			1

Note(s):

1. The test reduction for LTE SAR is based on KDB 941225 D05 SAR for LTE Devices v01.

12. Worst-case SAR Plots

12.1. Worst-case SAR Plots for WWAN

Worst-case HEAD SAR Plot for LTE Band 4

Date: 11/9/2011

Test Laboratory: UL CCS SAR Lab C

LTE Band 4_BW15MHz_RHS

Communication System: LTE; Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 1732.5$ MHz; $\sigma = 1.351$ mho/m; $\epsilon_r = 39.754$; $\rho = 1000$ kg/m³
Phantom section: Right Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3772; ConvF(7.4, 7.4, 7.4); Calibrated: 5/3/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1239; Calibrated: 10/18/2011
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP1632
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

RHS_Touch/QPSK_RBs1_RBo74_Mid-Ch/Area Scan (71x111x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (interpolated) = 0.719 mW/g

RHS_Touch/QPSK_RBs1_RBo74_Mid-Ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=8mm, dy=8mm, dz=5mm

Reference Value = 22.939 V/m; Power Drift = -0.01 dB, Peak SAR (extrapolated) = 0.878 W/kg

SAR(1 g) = 0.588 mW/g; SAR(10 g) = 0.374 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.711 mW/g

RHS_Touch/QPSK_RBs1_RBo74_Mid-Ch/Zoom Scan(2nd) (5x5x7)/Cube 0: Measurement

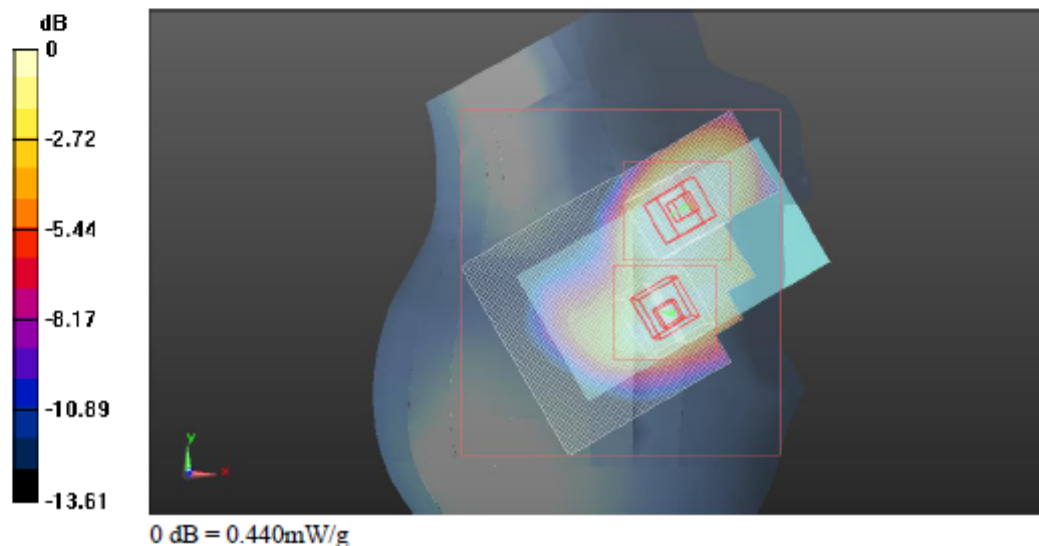
grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 22.939 V/m; Power Drift = -0.01 dB, Peak SAR (extrapolated) = 0.540 W/kg

SAR(1 g) = 0.359 mW/g; SAR(10 g) = 0.234 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.439 mW/g



Worst-case HEAD SAR Plot for LTE Band 4 – Z plot

Date: 11/9/2011

Test Laboratory: UL CCS SAR Lab C

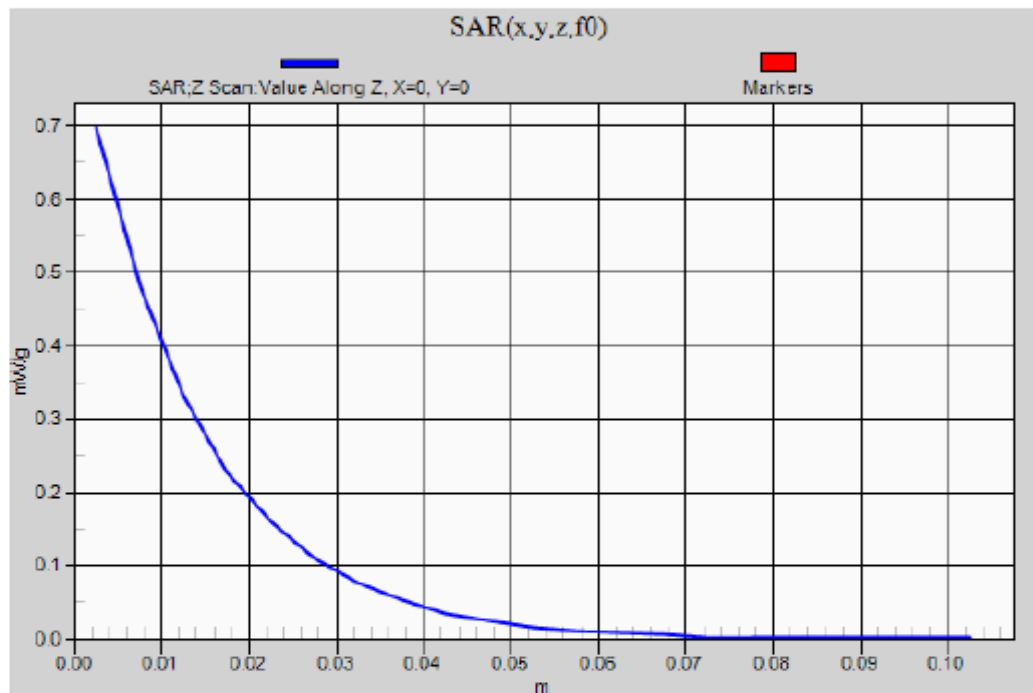
LTE Band 4_BW15MHz_RHS

Communication System: LTE; Frequency: 1732.5 MHz; Duty Cycle: 1:1

RHS_Touch/QPSK_RBs1_RBo74_Mid-Ch/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.697 mW/g



Worst-case Body SAR Plot for LTE Band 4

Date: 11/10/2011

Test Laboratory: UL CCS SAR Lab C

LTE Band 4_BW15MHz_BODY_REAR

Communication System: LTE; Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 1732.5$ MHz; $\sigma = 1.411$ mho/m; $\epsilon_r = 53.32$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 deg. C

DASY5 Configuration:

- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV4 - SN3772; ConvF(7.15, 7.15, 7.15); Calibrated: 5/3/2011
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1239; Calibrated: 10/18/2011
- Phantom: ELI v4.0 (B); Type: QDOVA001BB; Serial: 1121
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

REAR/QPSK_RBs1_RBo74_Mid-Ch/Area Scan (71x121x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (interpolated) = 1.374 mW/g

REAR/QPSK_RBs1_RBo74_Mid-Ch/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm,

dy=8mm, dz=5mm

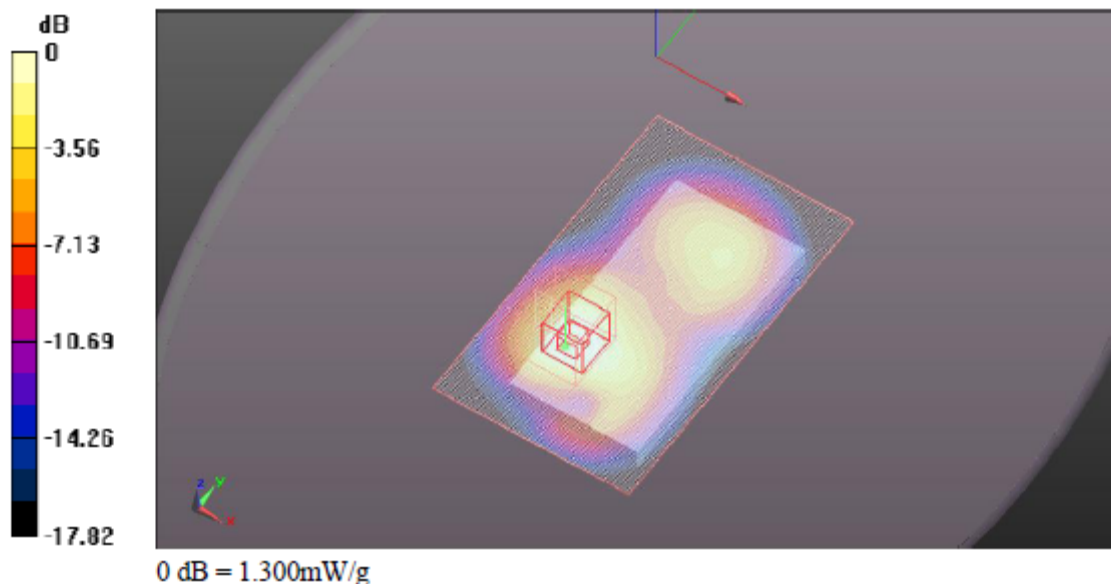
Reference Value = 28.235 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 1.632 W/kg

SAR(1 g) = 1.05 mW/g; SAR(10 g) = 0.652 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 1.296 mW/g



Worst-case Body SAR Plot for LTE Band 4– Z plot

Date: 11/10/2011

Test Laboratory: UL CCS SAR Lab C

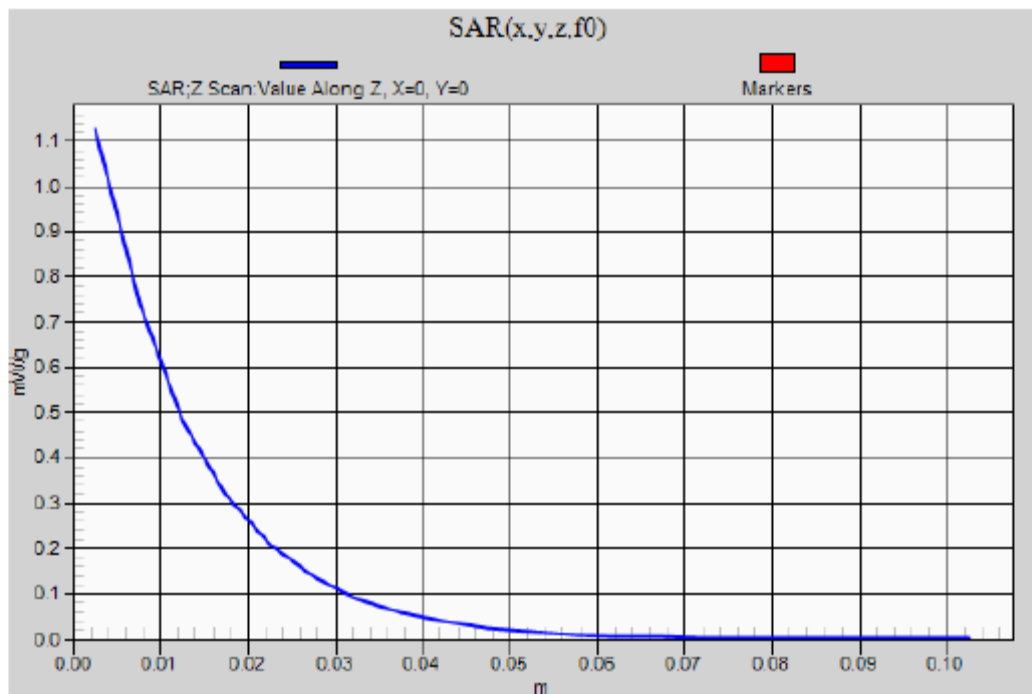
LTE Band 4_BW15MHz_BODY_REAR

Communication System: LTE; Frequency: 1732.5 MHz; Duty Cycle: 1:1

REAR/QPSK_RBs1_RBo74_Mid-Ch/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 1.127 mW/g



4. Simultaneous Transmission SAR Analysis (KDB 648474)

4.1. Head Exposure Condition

Band	Test Position	LTE	Wi-Fi (2.4GHz)	Σ 1-g SAR (W/kg)
LTE Band 4	Left Touch	0.521	0.069	0.590
	Left Tilt	0.254	0.016	0.270
	Right Touch	0.588	0.065	0.653
	Right Tilt	0.252	0.024	0.276

CONCLUSIONS:

- ☒ Simultaneous transmission SAR is not required for WWAN + WiFi or LTE & WiFi because the sum of the 1-g SAR is < 1.6 W/kg
- ☐ Simultaneous transmission SAR is not required for WiFi & WWAN because the SAR to peak location separation ratios is < 0.3 for WiFi and WWAN antenna pairs.

4.2. Body-worn exposure condition

Band	Test Position	LTE	Wi-Fi (2.4GHz)	Σ 1-g SAR (W/kg)
LTE Band 4	Rear	1.050	0.041	1.091
	Front	0.909	0.036	0.945
	Left	0.213	0.036	0.249
	Right	0.378	0.000	0.378
	Bottom	0.546	0.000	0.546
	Top	0.000	0.036	0.036

CONCLUSIONS:

- ☒ Simultaneous transmission SAR is not required for WWAN + WiFi or LTE & WiFi because the sum of the 1-g SAR is < 1.6 W/kg
- ☐ Simultaneous transmission SAR is not required for WWAN + WiFi or LTE & WiFi because the SAR to peak location separation ratios is < 0.3 for WiFi and WWAN antenna pairs.

4.3. Body-hotspot Exposure Condition

Band	Test Position	LTE	Wi-Fi (2.4GHz)	Σ 1-g SAR (W/kg)
LTE Band 4	Rear	1.050	0.041	1.091
	Front	0.909	0.036	0.945
	Left	0.213	0.036	0.249
	Right	0.378	0.000	0.378
	Bottom	0.546	0.000	0.546
	Top	0.000	0.036	0.036

CONCLUSIONS:

- ☒ Simultaneous transmission SAR is not required for WWAN + WiFi or LTE & WiFi because the sum of the 1-g SAR is < 1.6 W/kg
- ☐ Simultaneous transmission SAR is not required for WWAN + WiFi or LTE & WiFi because the SAR to peak location separation ratios is < 0.3 for WiFi and WWAN antenna pairs.

13. Appendixes

Refer to separated files for the following appendixes.

- 13.1. Appendix A: System check plots
- 13.2. Appendix B: SAR test plots for LTE Band 4; 15MHz Head
- 13.3. Appendix C: SAR test plots for LTE Band 4; 15MHz Body
- 13.4. Appendix D: Calibration certificate for E-Field Probe EX3DV4 SN 3686
- 13.5. Appendix E: Calibration certificate for D1750V2 SN 1053

