

FCC SAR Test Report

Report No. : SA190626W002

Applicant : ShadowTrack Technologies, Inc.

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70433, USA

Product : ShadoWatch

FCC ID : 2ARH7-SG-001-18

Brand : Shadowtrack

Model No. : SG-001-18

Standards : FCC 47 CFR Part 2 (2.1093) / IEEE C95.1:1992 / IEEE 1528:2013
KDB 865664 D01 v01r04 / KDB 865664 D02 v01r02
/ KDB 447498 D01 v06 / KDB 941225 D01 v03r01 / KDB 941225 D05 v02r05

Sample Received Date : Aug. 04, 2019

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CERTIFICATION: The above equipment have been tested by **BV 7LAYERS COMMUNICATIONS TECHNOLOGY (SHENZHEN) CO. LTD.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by A2LA or any government agencies.

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Release Control Record

Report No.	Reason for Change	Date Issued
SA190626W002	Initial release	Sep. 06, 2019

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1. Summary of Maximum SAR Value

Equipment Class	Mode	Highest Reported Face SAR _{1g} (1.0 cm Gap) (W/kg)	Highest Reported Extremity SAR _{10g} (0 cm Gap) (W/kg)
PCB	WCDMA II	0.33	0.30
	WCDMA V	0.10	0.79
	LTE 2	0.55	0.30
	LTE 4	0.31	0.36
	LTE 12	0.19	0.17

Note:

1. The SAR limit (Head & Body: SAR_{1g} 1.6 W/kg, Extremity: SAR_{10g} 4.0 W/kg) for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.
2. 2.4G WLAN only support RX, and no simultaneous TX configuration;

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2. Description of Equipment Under Test

EUT Type	ShadoWatch
FCC ID	2ARH7-SG-001-18
Brand Name	Shadowtrack
Model Name	SG-001-18
IMEI Code	N/A
HW Version	4G_MT2503MB_V1.1
SW Version	A03190531V01
Tx Frequency Bands (Unit: MHz)	WCDMA Band II : 1852.4 ~ 1907.6 WCDMA Band V : 826.4 ~ 846.6 LTE Band 2 : 1850.7 ~ 1909.3 (1.4M), 1851.5 ~ 1908.5 (3M), 1852.5 ~ 1907.5 (5M), 1855 ~ 1905 (10M), 1857.5 ~ 1902.5 (15M), 1860 ~ 1900 (20M) LTE Band 4 : 1710.7 ~ 1754.3 (1.4M), 1711.5 ~ 1753.5 (3M), 1712.5 ~ 1752.5 (5M), 1715 ~ 1750 (10M), 1717.5 ~ 1747.5 (15M), 1720 ~ 1745 (20M) LTE Band 12 : 699.7 ~ 715.3 (1.4M), 700.5 ~ 714.5 (3M), 701.5 ~ 713.5 (5M), 704 ~ 711 (10M)
Uplink Modulations	WCDMA : QPSK LTE : QPSK, 16QAM
Maximum Tune-up Conducted Power (Unit: dBm)	Please refer to section 4.6.1 of this report.
Antenna Type	WLAN: Fixed Internal Antenna WWAN: Fixed Internal Antenna
EUT Stage	Production Unit

Note:

- The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

List of Accessory:

wireless charger	Brand Name	SHADOWTRACK
	Model Name	ShadoWatch WLC00119
	Power Rating	I/P: 5Vdc, 2A; O/P: 5W
Battery	Brand Name	SHENZHEN HUAYOU
	Model Name	603048
	Power Rating	3.7Vdc, 800mAh
LCD Panel	Type	Li-ion
	Brand Name	SHENZHEN LIJING
	Model Name	LD-1.54TFT-16PIN

3. SAR Measurement System

3.1 Definition of Specific Absorption Rate (SAR)

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.

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 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.

3.2 SPEAG DASY System

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY5 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC.

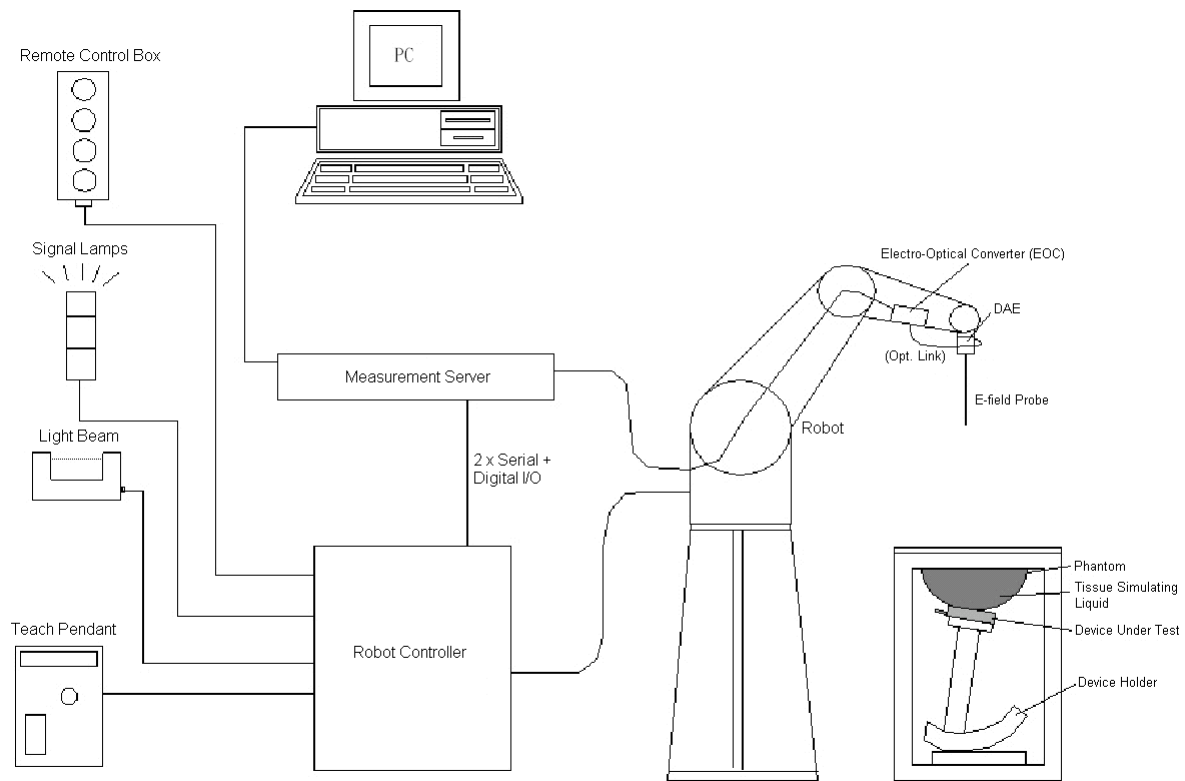


Fig-3.1 DASY System Setup

3.2.1 Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ± 0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)



Fig-3.2 DASY5

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3.2.2 Probes

The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

Model	EX3DV4	
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

Model	ES3DV3	
Construction	Symmetrical design with triangular core. Interleaved sensors. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	5 μ W/g to 100 mW/g Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	

3.2.3 Data Acquisition Electronics (DAE)

Model	DAE3, DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)	
Input Offset Voltage	< 5 μ V (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

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3.2.4 Phantoms

Model	Twin SAM	
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	

Model	ELI	
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	

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3.2.5 Device Holder

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

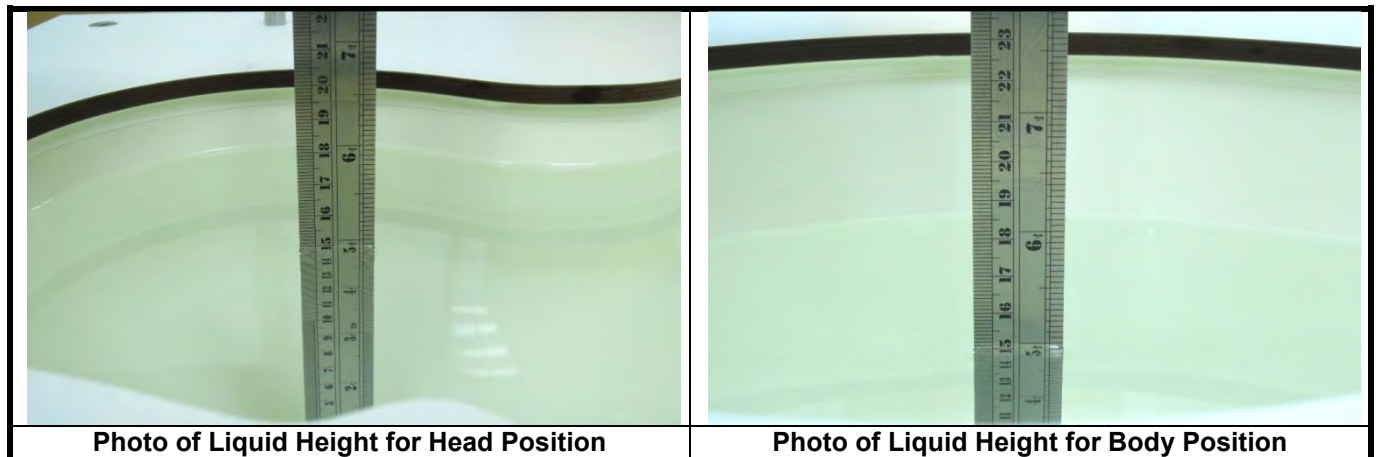
Model	Laptop Extensions Kit	
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.	
Material	POM, Acrylic glass, Foam	

3.2.6 System Validation Dipoles

Model	D-Serial	
Construction	Symmetrical dipole with 1/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.	
Frequency	750 MHz to 5800 MHz	
Return Loss	> 20 dB	
Power Capability	> 100 W ($f < 1\text{GHz}$), > 40 W ($f > 1\text{GHz}$)	

3.2.7 Tissue Simulating Liquids

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in Table-3.1.



The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528, and KDB 865664 D01 Appendix A. For the body tissue simulating liquids, the dielectric properties are defined in KDB 865664 D01 Appendix A. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using a dielectric assessment kit and a network analyzer.

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Table-3.1 Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of $\pm 5\%$	Target Conductivity	Range of $\pm 5\%$
For Head				
750	41.9	39.8 ~ 44.0	0.89	0.85 ~ 0.93
835	41.5	39.4 ~ 43.6	0.90	0.86 ~ 0.95
900	41.5	39.4 ~ 43.6	0.97	0.92 ~ 1.02
1450	40.5	38.5 ~ 42.5	1.20	1.14 ~ 1.26
1640	40.3	38.3 ~ 42.3	1.29	1.23 ~ 1.35
1750	40.1	38.1 ~ 42.1	1.37	1.30 ~ 1.44
1800	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
1900	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2000	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2300	39.5	37.5 ~ 41.5	1.67	1.59 ~ 1.75
2450	39.2	37.2 ~ 41.2	1.80	1.71 ~ 1.89
2600	39.0	37.1 ~ 41.0	1.96	1.86 ~ 2.06
3500	37.9	36.0 ~ 39.8	2.91	2.76 ~ 3.06
5200	36.0	34.2 ~ 37.8	4.66	4.43 ~ 4.89
5300	35.9	34.1 ~ 37.7	4.76	4.52 ~ 5.00
5500	35.6	33.8 ~ 37.4	4.96	4.71 ~ 5.21
5600	35.5	33.7 ~ 37.3	5.07	4.82 ~ 5.32
5800	35.3	33.5 ~ 37.1	5.27	5.01 ~ 5.53
For Body				
750	55.5	52.7 ~ 58.3	0.96	0.91 ~ 1.01
835	55.2	52.4 ~ 58.0	0.97	0.92 ~ 1.02
900	55.0	52.3 ~ 57.8	1.05	1.00 ~ 1.10
1450	54.0	51.3 ~ 56.7	1.30	1.24 ~ 1.37
1640	53.8	51.1 ~ 56.5	1.40	1.33 ~ 1.47
1750	53.4	50.7 ~ 56.1	1.49	1.42 ~ 1.56
1800	53.3	50.6 ~ 56.0	1.52	1.44 ~ 1.60
1900	53.3	50.6 ~ 56.0	1.52	1.44 ~ 1.60
2000	53.3	50.6 ~ 56.0	1.52	1.44 ~ 1.60
2300	52.9	50.3 ~ 55.5	1.81	1.72 ~ 1.90
2450	52.7	50.1 ~ 55.3	1.95	1.85 ~ 2.05
2600	52.5	49.9 ~ 55.1	2.16	2.05 ~ 2.27
3500	51.3	48.7 ~ 53.9	3.31	3.14 ~ 3.48
5200	49.0	46.6 ~ 51.5	5.30	5.04 ~ 5.57
5300	48.9	46.5 ~ 51.3	5.42	5.15 ~ 5.69
5500	48.6	46.2 ~ 51.0	5.65	5.37 ~ 5.93
5600	48.5	46.1 ~ 50.9	5.77	5.48 ~ 6.06
5800	48.2	45.8 ~ 50.6	6.00	5.70 ~ 6.30

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The following table gives the recipes for tissue simulating liquids.

Table-3.2 Recipes of Tissue Simulating Liquid

Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
H750	0.2	-	0.2	1.5	56.0	-	42.1	-
H835	0.2	-	0.2	1.5	57.0	-	41.1	-
H900	0.2	-	0.2	1.4	58.0	-	40.2	-
H1450	-	43.3	-	0.6	-	-	56.1	-
H1640	-	45.8	-	0.5	-	-	53.7	-
H1750	-	47.0	-	0.4	-	-	52.6	-
H1800	-	44.5	-	0.3	-	-	55.2	-
H1900	-	44.5	-	0.2	-	-	55.3	-
H2000	-	44.5	-	0.1	-	-	55.4	-
H2300	-	44.9	-	0.1	-	-	55.0	-
H2450	-	45.0	-	0.1	-	-	54.9	-
H2600	-	45.1	-	0.1	-	-	54.8	-
H3500	-	8.0	-	0.2	-	20.0	71.8	-
H5G	-	-	-	-	-	17.2	65.5	17.3
B750	0.2	-	0.2	0.8	48.8	-	50.0	-
B835	0.2	-	0.2	0.9	48.5	-	50.2	-
B900	0.2	-	0.2	0.9	48.2	-	50.5	-
B1450	-	34.0	-	0.3	-	-	65.7	-
B1640	-	32.5	-	0.3	-	-	67.2	-
B1750	-	31.0	-	0.2	-	-	68.8	-
B1800	-	29.5	-	0.4	-	-	70.1	-
B1900	-	29.5	-	0.3	-	-	70.2	-
B2000	-	30.0	-	0.2	-	-	69.8	-
B2300	-	31.0	-	0.1	-	-	68.9	-
B2450	-	31.4	-	0.1	-	-	68.5	-
B2600	-	31.8	-	0.1	-	-	68.1	-
B3500	-	28.8	-	0.1	-	-	71.1	-
B5G	-	-	-	-	-	10.7	78.6	10.7

3.3 SAR System Verification

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.

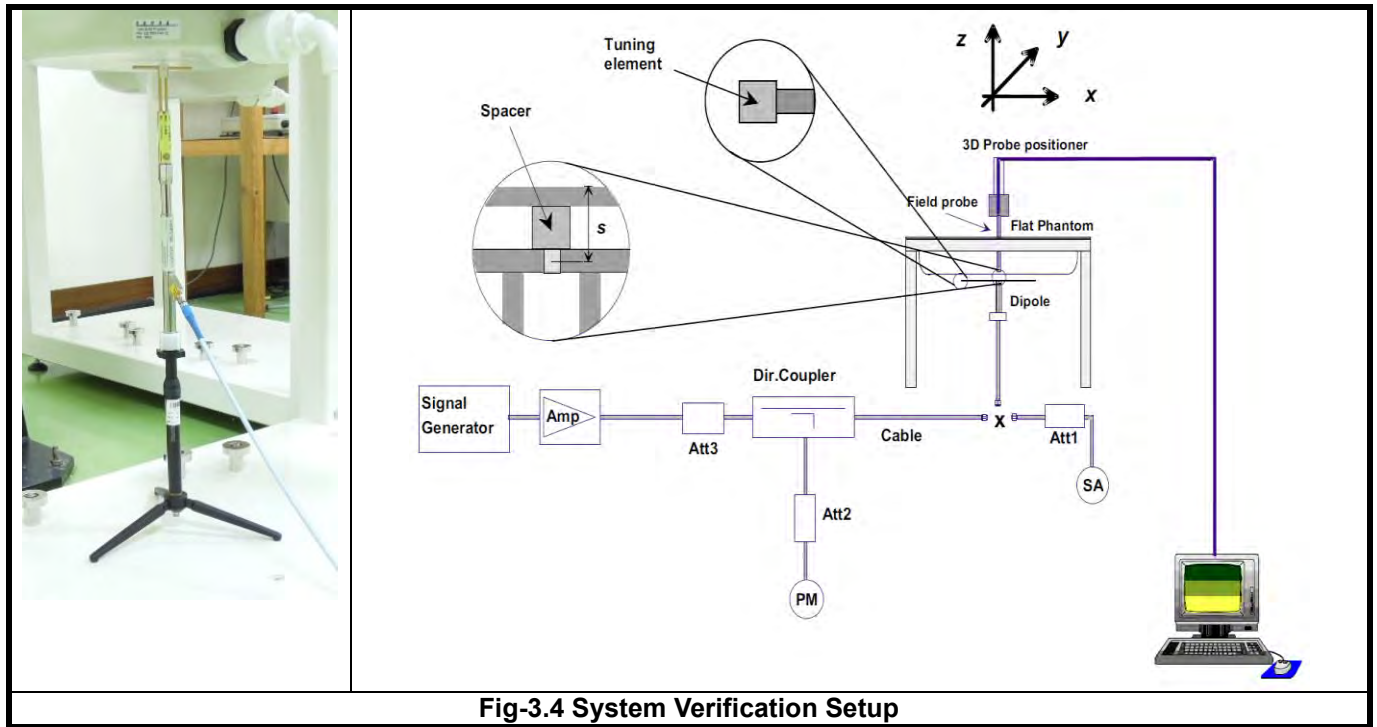


Fig-3.4 System Verification Setup

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The spectrum analyzer measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power (250 mW is used for 700 MHz to 3 GHz, 100 mW is used for 3.5 GHz to 6 GHz) at the dipole connector and the power meter is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter.

After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

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3.4 SAR Measurement Procedure

According to the SAR test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Area scan
- Zoom scan
- Power drift measurement

The SAR measurement procedures for each of test conditions are as follows:

- Make EUT to transmit maximum output power
- Measure conducted output power through RF cable
- Place the EUT in the specific position of phantom
- Perform SAR testing steps on the DASY system
- Record the SAR value

3.4.1 Area & Zoom Scan Procedure

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. According to KDB 865664 D01, the resolution for Area and Zoom scan is specified in the table below.

Items	<= 2 GHz	2-3 GHz	3-4 GHz	4-5 GHz	5-6 GHz
Area Scan ($\Delta x, \Delta y$)	<= 15 mm	<= 12 mm	<= 12 mm	<= 10 mm	<= 10 mm
Zoom Scan ($\Delta x, \Delta y$)	<= 8 mm	<= 5 mm	<= 5 mm	<= 4 mm	<= 4 mm
Zoom Scan (Δz)	<= 5 mm	<= 5 mm	<= 4 mm	<= 3 mm	<= 2 mm
Zoom Scan Volume	>= 30 mm	>= 30 mm	>= 28 mm	>= 25 mm	>= 22 mm

Note:

When zoom scan is required and report SAR is <= 1.4 W/kg, the zoom scan resolution of $\Delta x / \Delta y$ (2-3GHz: <= 8 mm, 3-4GHz: <= 7 mm, 4-6GHz: <= 5 mm) may be applied.

3.4.2 Volume Scan Procedure

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

3.4.3 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.

3.4.4 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

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 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g

3.4.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

4. SAR Measurement Evaluation

4.1 EUT Configuration and Setting

<Connections between EUT and System Simulator>

For WWAN SAR testing, the EUT was linked and controlled by base station emulator (Agilent E5515C is used for GSM/WCDMA/CDMA, and Anritsu MT8820C is used for LTE). Communication between the EUT and the emulator was established by air link. The distance between the EUT and the communicating antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT. The EUT was set from the emulator to radiate maximum output power during SAR testing.

<Considerations Related to WCDMA for Setup and Testing>

WCDMA Handsets Head SAR

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode.

WCDMA Handsets Body SAR

SAR for body configurations is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCH_n configurations supported by the handset with 12.2 kbps RMC as the primary mode.

Release 5 HSDPA Data Devices

The 3G SAR test reduction procedure is applied to body SAR with 12.2 kbps RMC as the primary mode. Otherwise, body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, for the highest reported SAR configuration in 12.2 kbps RMC without HSDPA. HSDPA is configured according to the applicable UE category of a test device. The number of HS-DSCH / HS-PDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4 ms and a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors (β_c , β_d), and HS-DPCCH power offset parameters (Δ_{ACK} , Δ_{NACK} , Δ_{CQI}) are set according to values indicated in below. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the H-set.

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

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs} / \beta_c = 30 / 15 \Leftrightarrow \beta_{hs} = 30 / 15 * \beta_c$.
Note 2: CM = 1 for $\beta_c / \beta_d = 12 / 15$, $\beta_{hs} / \beta_c = 24 / 15$.
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 $\beta_c = 11 / 15$ and $\beta_d = 15 / 15$.

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Release 6 HSUPA Data Devices

The 3G SAR test reduction procedure is applied to body SAR with 12.2 kbps RMC as the primary mode. Otherwise, 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 and power control algorithm 2, according to the highest reported body SAR configuration in 12.2 kbps RMC without HSPA. When VOIP applies to head exposure, the 3G SAR test reduction procedure is applied with 12.2 kbps RMC as the primary mode. Otherwise, the same HSPA configuration used for body SAR measurements are applied to head exposure testing. Due to inner loop power control requirements in HSPA, a communication test set is required for output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA are configured according to the β values indicated in below.

Sub-test	β_c	β_d	β_d (SF)	β_c / β_d	$\beta_{hs}^{(1)}$	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 $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs} / \beta_c = 30 / 15 \Leftrightarrow \beta_{hs} = 30 / 15 * \beta_c$.

Note 2: CM = 1 for $\beta_c / \beta_d = 12 / 15$, $\beta_{hs} / \beta_c = 24 / 15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c / β_d ratio of 11 / 15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10 / 15$ and $\beta_d = 15 / 15$.

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 $\beta_c = 14 / 15$ and $\beta_d = 15 / 15$.

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} cannot be set directly; it is set by Absolute Grant Value.

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<Considerations Related to LTE for Setup and Testing>

This device contains LTE transmitter which follows 3GPP standards, is category 3, supports both QPSK and 16QAM modulations, and supported LTE band and channel bandwidth is listed in below. The output power was tested per 3GPP TS 36.521-1 maximum transmit procedures for both QPSK and 16QAM modulation. The results please refer to section 4.6 of this report.

EUT Supported LTE Band and Channel Bandwidth						
LTE Band	BW 1.4 MHz	BW 3 MHz	BW 5 MHz	BW 10 MHz	BW 15 MHz	BW 20 MHz
2	V	V	V	V	V	V
4	V	V	V	V	V	V
12	V	V	V	V		

The LTE maximum power reduction (MPR) in accordance with 3GPP TS 36.101 is active all times during LTE operation. The allowed MPR for the maximum output power is specified in below.

Modulation	Channel Bandwidth / RB Configurations						LTE MPR Setting (dB)
	BW 1.4 MHz	BW 3 MHz	BW 5 MHz	BW 10 MHz	BW 15 MHz	BW 20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1
16QAM	<= 5	<= 4	<= 8	<= 12	<= 16	<= 18	1
16QAM	> 5	> 4	> 8	> 12	> 16	> 18	2

Note: MPR is according to the standard and implemented in the circuit (mandatory).

In addition, the device is compliant with additional maximum power reduction (A-MPR) requirements defined in 3GPP TS 36.101 section 6.2.4 that was disabled for all FCC compliance testing.

During LTE SAR testing, the related parameters of operating band, channel bandwidth, uplink channel number, modulation type, and RB was set in base station simulator. When the EUT has registered and communicated to base station simulator, the simulator set to make EUT transmitting the maximum radiated power.

4.2 EUT Testing Position

Transmitters that are built-in within a wrist watch or similar wrist-worn devices typically operate in speaker mode for voice communication, with the device worn on the wrist and positioned next to the mouth. Next to the mouth exposure requires 1-g SAR, and the wrist-worn condition requires 10-g extremity SAR. The 10-g extremity and 1-g SAR test exclusions may be applied to the wrist and face exposure conditions. When SAR evaluation is required, next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. The wrist bands should be strapped together to represent normal use conditions. SAR for wrist exposure is evaluated with the back of the devices positioned in direct contact against a flat phantom fill with body tissue-equivalent medium. The wrist bands should be unstrapped and touching the phantom. The space introduced by the watch or wrist bands and the phantom must be representative of actual use conditions.

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4.3 Tissue Verification

The measuring results for tissue simulating liquid are shown as below.

Test Date	Tissue Type	Frequency (MHz)	Liquid Temp. (°C)	Measured Conductivity (σ)	Measured Permittivity (ϵ_r)	Target Conductivity (σ)	Target Permittivity (ϵ_r)	Conductivity Deviation (%)	Permittivity Deviation (%)
2019.08.06	Head	750	22.1	0.890	40.774	0.89	41.90	0.00	-2.69
2019.08.06	Head	835	21.8	0.898	43.088	0.90	41.50	-0.22	3.83
2019.08.06	Head	1750	21.6	1.333	39.259	1.37	40.10	-2.70	-2.10
2019.08.06	Head	1900	21.9	1.426	40.610	1.40	40.00	1.86	1.53
2019.08.09	Body	750	21.7	0.963	53.779	0.96	55.50	0.31	-3.10
2019.08.09	Body	835	21.8	0.954	57.264	0.97	55.20	-1.65	3.74
2019.08.09	Body	1750	22.8	1.482	52.500	1.49	53.40	-0.54	-1.69
2019.08.09	Body	1900	21.9	1.526	51.959	1.52	53.30	0.39	-2.52

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within $\pm 5\%$ of the target values. Liquid temperature during the SAR testing must be within $\pm 2^\circ\text{C}$.

4.4 System Validation

The SAR measurement system was validated according to procedures in KDB 865664 D01. The validation status in tabulated summary is as below.

Test Date	Probe S/N	Calibration Point		Measured Conductivity (σ)	Measured Permittivity (ϵ_r)	Validation for CW			Validation for Modulation		
						Sensitivity Range	Probe Linearity	Probe Isotropy	Modulation Type	Duty Factor	PAR
Aug. 06, 2019	3873	Head	750	0.890	40.774	Pass	Pass	Pass	N/A	N/A	N/A
Aug. 06, 2019	3873	Head	835	0.898	43.088	Pass	Pass	Pass	GMSK	Pass	N/A
Aug. 06, 2019	3873	Head	1750	1.333	39.259	Pass	Pass	Pass	N/A	N/A	N/A
Aug. 06, 2019	3873	Head	1900	1.426	40.610	Pass	Pass	Pass	GMSK	Pass	N/A
Aug. 09, 2019	3873	Body	750	0.963	53.779	Pass	Pass	Pass	N/A	N/A	N/A
Aug. 09, 2019	3873	Body	835	0.954	57.264	Pass	Pass	Pass	GMSK	Pass	N/A
Aug. 09, 2019	3873	Body	1750	1.482	52.500	Pass	Pass	Pass	N/A	N/A	N/A
Aug. 09, 2019	3873	Body	1900	1.526	51.959	Pass	Pass	Pass	GMSK	Pass	N/A

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4.5 System Verification

The measuring result for system verification is tabulated as below.

Test Date	Mode	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
2019.08.06	Head	750	8.51	2.04	8.16	-4.11	1067	3873	1341
2019.08.06	Head	835	9.51	2.45	9.80	3.05	4d139	3873	1341
2019.08.06	Head	1750	36.80	9.52	38.08	3.48	1071	3873	1341
2019.08.06	Head	1900	39.80	10.20	40.80	2.51	5d159	3873	1341
2019.08.09	Body	750	8.80	2.27	9.08	3.18	1067	3873	1341
2019.08.09	Body	835	9.70	2.55	10.20	5.15	4d139	3873	1341
2019.08.09	Body	1750	38.00	10.20	40.80	7.37	1071	3873	1341
2019.08.09	Body	1900	40.20	10.50	42.00	4.48	5d159	3873	1341

Note:

Comparing to the reference SAR value provided by SPEAG, the validation data should be within its specification of 10 %. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

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4.6 Maximum Output Power

4.6.1 Maximum Conducted Power

The maximum conducted average power (Unit: dBm) including tune-up tolerance is shown as below.

Mode	WCDMA Band II	WCDMA Band V
RMC 12.2K	23.5	25.0
HSDPA	22.5	24.0
HSUPA	22.0	24.0

Mode	LTE 2	LTE 4	LTE 12
QPSK / 16QAM	24.0/23.0	24.5/23.5	24.5/23.5

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4.6.2 Measured Conducted Power Result

The measuring conducted average power (Unit: dBm) is shown as below.

Band	WCDMA Band II			WCDMA Band V			3GPP MPR (dB)
Channel	9262	9400	9538	4132	4182	4233	
Frequency (MHz)	1852.4	1880.0	1907.6	826.4	836.4	846.6	
RMC 12.2K	23.06	23.02	22.43	24.55	24.58	24.52	-
HSDPA Subtest-1	22.15	22.11	21.52	23.64	23.67	23.61	0
HSDPA Subtest-2	22.07	22.03	21.44	23.56	23.59	23.53	0
HSDPA Subtest-3	21.51	21.47	20.88	23.00	23.03	22.97	0.5
HSDPA Subtest-4	21.44	21.40	20.81	22.93	22.96	22.90	0.5
HSUPA Subtest-1	22.06	22.02	21.43	23.55	23.58	23.52	0
HSUPA Subtest-2	20.02	19.98	19.39	21.51	21.54	21.48	2
HSUPA Subtest-3	21.10	21.06	20.47	22.59	22.62	22.56	1
HSUPA Subtest-4	20.06	20.02	19.43	21.55	21.58	21.52	2
HSUPA Subtest-5	21.95	21.91	21.32	23.44	23.47	23.41	0

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LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 18607	Mid CH 18900	High CH 19193		Low CH 18607	Mid CH 18900	High CH 19193	
			1850.7 MHz	1880.0 MHz	1909.3 MHz		1850.7 MHz	1880.0 MHz	1909.3 MHz	
2 / 1.4M	1	0	23.24	22.78	22.95	0	22.26	21.80	21.97	1
	1	2	23.00	22.54	22.71	0	22.20	21.74	21.91	1
	1	5	22.89	22.43	22.60	0	21.45	20.99	21.16	1
	3	0	23.23	22.77	22.94	0	22.24	21.78	21.95	1
	3	1	22.99	22.53	22.70	0	22.18	21.72	21.89	1
	3	3	22.88	22.42	22.59	0	21.43	20.97	21.14	1
	6	0	22.18	21.72	21.89	1	20.23	19.98	20.17	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 18615	Mid CH 18900	High CH 19185		Low CH 18615	Mid CH 18900	High CH 19185	
			1851.5 MHz	1880.0 MHz	1908.5 MHz		1851.5 MHz	1880.0 MHz	1908.5 MHz	
2 / 3M	1	0	23.27	22.81	22.98	0	22.29	21.83	22.00	1
	1	7	23.03	22.57	22.74	0	22.23	21.77	21.94	1
	1	14	22.92	22.46	22.63	0	21.48	21.02	21.19	1
	8	0	22.45	21.99	22.16	1	21.50	21.04	21.21	2
	8	3	22.17	21.71	21.88	1	21.06	20.60	20.77	2
	8	7	21.84	21.38	21.55	1	21.17	20.71	20.88	2
	15	0	22.21	21.75	21.92	1	21.14	20.68	20.84	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 18625	Mid CH 18900	High CH 19175		Low CH 18625	Mid CH 18900	High CH 19175	
			1852.5 MHz	1880.0 MHz	1907.5 MHz		1852.5 MHz	1880.0 MHz	1907.5 MHz	
2 / 5M	1	0	23.30	22.84	23.01	0	22.32	21.86	22.03	1
	1	12	23.06	22.60	22.77	0	22.26	21.80	21.97	1
	1	24	22.95	22.49	22.66	0	21.51	21.05	21.22	1
	12	0	22.48	22.02	22.19	1	21.53	21.07	21.24	2
	12	6	22.20	21.74	21.91	1	21.09	20.63	20.80	2
	12	13	21.87	21.41	21.58	1	21.20	20.74	20.91	2
	25	0	22.24	21.78	21.95	1	21.12	20.54	20.65	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 18650	Mid CH 18900	High CH 19150		Low CH 18650	Mid CH 18900	High CH 19150	
			1855.0 MHz	1880.0 MHz	1905.0 MHz		1855.0 MHz	1880.0 MHz	1905.0 MHz	
2 / 10M	1	0	23.32	22.86	23.03	0	22.34	21.88	22.05	1
	1	24	23.08	22.62	22.79	0	22.28	21.82	21.99	1
	1	49	22.97	22.51	22.68	0	21.53	21.07	21.24	1
	25	0	22.50	22.04	22.21	1	21.55	21.09	21.26	2
	25	12	22.22	21.76	21.93	1	21.11	20.65	20.82	2
	25	25	21.89	21.43	21.60	1	21.22	20.76	20.93	2
	50	0	22.26	21.80	21.97	1	21.21	20.71	20.90	2

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LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 18675	Mid CH 18900	High CH 19125		Low CH 18675	Mid CH 18900	High CH 19125	
			1857.5 MHz	1880.0 MHz	1902.5 MHz		1857.5 MHz	1880.0 MHz	1902.5 MHz	
2 / 15M	1	0	23.35	22.89	23.06	0	22.37	21.91	22.08	1
	1	37	23.11	22.65	22.82	0	22.31	21.85	22.02	1
	1	74	23.00	22.54	22.71	0	21.56	21.10	21.27	1
	36	0	22.53	22.07	22.24	1	21.58	21.12	21.29	2
	36	19	22.25	21.79	21.96	1	21.14	20.68	20.85	2
	36	39	21.92	21.46	21.63	1	21.25	20.79	20.96	2
	54	0	22.29	21.83	22.00	1	NA	NA	NA	NA

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 18700	Mid CH 18900	High CH 19100		Low CH 18700	Mid CH 18900	High CH 19100	
			1860.0 MHz	1880.0 MHz	1900.0 MHz		1860.0 MHz	1880.0 MHz	1900.0 MHz	
2 / 20M	1	0	23.40	22.94	23.11	0	22.42	21.96	22.13	1
	1	50	23.16	22.70	22.87	0	22.36	21.90	22.07	1
	1	99	23.05	22.59	22.76	0	21.61	21.15	21.32	1
	50	0	22.58	22.12	22.29	1	21.63	21.17	21.34	2
	50	25	22.30	21.84	22.01	1	21.19	20.73	20.90	2
	50	50	21.97	21.51	21.68	1	21.30	20.84	21.01	2
	54	0	22.34	21.88	22.05	1	NA	NA	NA	NA

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 19957	Mid CH 20175	High CH 20393		Low CH 19957	Mid CH 20175	High CH 20393	
			1710.7 MHz	1732.5 MHz	1754.3 MHz		1710.7 MHz	1732.5 MHz	1754.3 MHz	
4 / 1.4M	1	0	22.94	23.67	23.43	0	21.51	22.24	22.00	1
	1	2	22.57	23.30	23.06	0	21.53	22.26	22.02	1
	1	5	22.38	23.11	22.87	0	21.31	22.04	21.80	1
	3	0	22.92	23.65	23.41	0	21.50	22.23	21.99	1
	3	1	22.55	23.28	23.04	0	21.52	22.25	22.01	1
	3	3	22.36	23.09	22.85	0	21.30	22.03	21.79	1
	6	0	21.48	22.21	21.97	1	20.20	21.05	20.72	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 19965	Mid CH 20175	High CH 20385		Low CH 19965	Mid CH 20175	High CH 20385	
			1711.5 MHz	1732.5 MHz	1753.5 MHz		1711.5 MHz	1732.5 MHz	1753.5 MHz	
4 / 3M	1	0	22.95	23.68	23.44	0	21.52	22.25	22.01	1
	1	7	22.58	23.31	23.07	0	21.54	22.27	22.03	1
	1	14	22.39	23.12	22.88	0	21.32	22.05	21.81	1
	8	0	21.57	22.30	22.06	1	20.61	21.34	21.10	2
	8	3	21.53	22.26	22.02	1	20.68	21.41	21.17	2
	8	7	21.47	22.20	21.96	1	20.48	21.21	20.97	2
	15	0	21.49	22.22	21.98	1	20.32	21.12	20.43	2

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LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 19975	Mid CH 20175	High CH 20375		Low CH 19975	Mid CH 20175	High CH 20375	
			1712.5 MHz	1732.5 MHz	1752.5 MHz		1712.5 MHz	1732.5 MHz	1752.5 MHz	
4 / 5M	1	0	22.98	23.71	23.47	0	21.55	22.28	22.04	1
	1	12	22.61	23.34	23.10	0	21.57	22.30	22.06	1
	1	24	22.42	23.15	22.91	0	21.35	22.08	21.84	1
	12	0	21.60	22.33	22.09	1	20.64	21.37	21.13	2
	12	6	21.56	22.29	22.05	1	20.71	21.44	21.20	2
	12	13	21.50	22.23	21.99	1	20.51	21.24	21.00	2
	25	0	21.52	22.25	22.01	1	20.32	21.12	21.09	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 20000	Mid CH 20175	High CH 20350		Low CH 20000	Mid CH 20175	High CH 20350	
			1715.0 MHz	1732.5 MHz	1750.0 MHz		1715.0 MHz	1732.5 MHz	1750.0 MHz	
4 / 10M	1	0	23.02	23.75	23.51	0	21.59	22.32	22.08	1
	1	24	22.65	23.38	23.14	0	21.61	22.34	22.10	1
	1	49	22.46	23.19	22.95	0	21.39	22.12	21.88	1
	25	0	21.64	22.37	22.13	1	20.68	21.41	21.17	2
	25	12	21.60	22.33	22.09	1	20.75	21.48	21.24	2
	25	25	21.54	22.27	22.03	1	20.55	21.28	21.04	2
	50	0	21.56	22.29	22.05	1	20.43	21.15	21.01	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 20025	Mid CH 20175	High CH 20325		Low CH 20025	Mid CH 20175	High CH 20325	
			1717.5 MHz	1732.5 MHz	1747.5 MHz		1717.5 MHz	1732.5 MHz	1747.5 MHz	
4 / 15M	1	0	23.08	23.81	23.57	0	21.65	22.38	22.14	1
	1	37	22.71	23.44	23.20	0	21.67	22.40	22.16	1
	1	74	22.52	23.25	23.01	0	21.45	22.18	21.94	1
	36	0	21.70	22.43	22.19	1	20.74	21.47	21.23	2
	36	19	21.66	22.39	22.15	1	20.81	21.54	21.30	2
	36	39	21.60	22.33	22.09	1	20.61	21.34	21.10	2
	54	0	21.62	22.35	22.11	1	NA	NA	NA	NA

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 20050	Mid CH 20175	High CH 20300		Low CH 20050	Mid CH 20175	High CH 20300	
			1720.0 MHz	1732.5 MHz	1745.0 MHz		1720.0 MHz	1732.5 MHz	1745.0 MHz	
4 / 20M	1	0	23.11	23.84	23.60	0	21.68	22.41	22.17	1
	1	50	22.74	23.47	23.23	0	21.70	22.43	22.19	1
	1	99	22.55	23.28	23.04	0	21.48	22.21	21.97	1
	50	0	21.73	22.46	22.22	1	20.77	21.50	21.26	2
	50	25	21.69	22.42	22.18	1	20.84	21.57	21.33	2
	50	50	21.63	22.36	22.12	1	20.64	21.37	21.13	2
	54	0	21.65	22.38	22.14	1	NA	NA	NA	NA

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LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 23017	Mid CH 23095	High CH 23173		Low CH 23017	Mid CH 23095	High CH 23173	
			699.7 MHz	707.5 MHz	715.3 MHz		699.7 MHz	707.5 MHz	715.3 MHz	
12 / 1.4M	1	0	23.17	23.34	23.19	0	22.11	22.28	22.13	1
	1	2	23.41	23.58	23.43	0	22.14	22.31	22.16	1
	1	5	23.29	23.46	23.31	0	22.07	22.24	22.09	1
	3	0	23.15	23.32	23.17	0	22.10	22.27	22.12	1
	3	1	23.39	23.56	23.41	0	22.13	22.30	22.15	1
	3	3	23.27	23.44	23.29	0	22.06	22.23	22.08	1
	6	0	22.20	22.37	22.22	1	21.17	21.34	21.19	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 23025	Mid CH 23095	High CH 23165		Low CH 23025	Mid CH 23095	High CH 23165	
			700.5 MHz	707.5 MHz	714.5 MHz		700.5 MHz	707.5 MHz	714.5 MHz	
12 / 3M	1	0	23.21	23.38	23.23	0	22.15	22.32	22.17	1
	1	7	23.45	23.62	23.47	0	22.18	22.35	22.20	1
	1	14	23.33	23.50	23.35	0	22.11	22.28	22.13	1
	8	0	22.27	22.44	22.29	1	21.05	21.22	21.07	2
	8	3	22.38	22.55	22.40	1	21.44	21.61	21.46	2
	8	7	22.32	22.49	22.34	1	21.43	21.60	21.45	2
	15	0	22.24	22.41	22.26	1	21.21	21.38	21.23	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 23035	Mid CH 23095	High CH 23155		Low CH 23035	Mid CH 23095	High CH 23155	
			701.5 MHz	707.5 MHz	713.5 MHz		701.5 MHz	707.5 MHz	713.5 MHz	
12 / 5M	1	0	23.27	23.44	23.29	0	22.21	22.38	22.23	1
	1	12	23.51	23.68	23.53	0	22.24	22.41	22.26	1
	1	24	23.39	23.56	23.41	0	22.17	22.34	22.19	1
	12	0	22.33	22.50	22.35	1	21.11	21.28	21.13	2
	12	6	22.44	22.61	22.46	1	21.50	21.67	21.52	2
	12	13	22.38	22.55	22.40	1	21.49	21.66	21.51	2
	25	0	22.30	22.47	22.32	1	21.27	21.44	21.29	2

LTE Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low CH 23060	Mid CH 23095	High CH 23130		Low CH 23060	Mid CH 23095	High CH 23130	
			704.0 MHz	707.5 MHz	711.0 MHz		704.0 MHz	707.5 MHz	711.0 MHz	
12 / 5M	1	0	23.30	23.47	23.32	0	22.24	22.41	22.26	1
	1	24	23.54	23.71	23.56	0	22.27	22.44	22.29	1
	1	49	23.42	23.59	23.44	0	22.20	22.37	22.22	1
	25	0	22.36	22.53	22.38	1	21.14	21.31	21.16	2
	25	12	22.47	22.64	22.49	1	21.53	21.70	21.55	2
	25	25	22.41	22.58	22.43	1	21.52	21.69	21.54	2
	50	0	22.33	22.50	22.35	1	21.30	21.47	21.32	2

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4.7 SAR Testing Results

4.7.1 SAR Test Reduction Considerations

<KDB 447498 D01, General RF Exposure Guidance>

Testing of other required channels within the operating mode of a frequency band is not required when the reported SAR for the mid-band or highest output power channel is:

- (1) ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- (2) ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- (3) ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

<KDB 941225 D01, 3G SAR Measurement Procedures>

The mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is $\leq 1/4$ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

<KDB 941225 D05, SAR Evaluation Considerations for LTE Devices>

- (1) QPSK with 1 RB and 50% RB allocation

Start with the largest channel bandwidth and measure SAR, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.

- (2) QPSK with 100% RB allocation

SAR is not required when the highest maximum output power for 100% RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.

- (3) Higher order modulations

SAR is required only when the highest maximum output power for the configuration in the higher order modulation is $> 1/2$ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.

- (4) Other channel bandwidth

SAR is required when the highest maximum output power of the smaller channel bandwidth is $> 1/2$ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

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4.7.2 SAR Results for Face Exposure Condition (Separation Distance is 1.0 cm Gap)

Plot No.	Band	Mode	Test Position	Ch.	RB#	RB Offset	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaling Factor	Scaled SAR-1g (W/kg)
1	WCDMA II	RMC12.2K	Front Face	9262	-	-	23.5	23.06	0.16	0.302	1.11	0.33
2	WCDMA V	RMC12.2K	Front Face	4182	-	-	25.0	24.58	0.02	0.092	1.10	0.10
3	LTE 2	QPSK20M	Front Face	18700	1	0	24.0	23.40	0.04	0.479	1.15	0.55
4	LTE 4	QPSK20M	Front Face	20175	1	0	24.5	23.84	0.12	0.269	1.16	0.31
5	LTE 12	QPSK10M	Front Face	23095	1	24	24.5	23.71	-0.02	0.16	1.20	0.19

4.7.3 SAR Results for Extremity Exposure Condition (Separation Distance is 0 cm Gap)

Plot No.	Band	Mode	Test Position	Ch.	RB#	RB Offset	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-10g (W/kg)	Scaling Factor	Scaled SAR-10g (W/kg)
6	WCDMA II	RMC12.2K	Rear Face	9262	-	-	23.5	23.06	-0.06	0.267	1.11	0.30
7	WCDMA V	RMC12.2K	Rear Face	4182	-	-	25.0	24.58	0.01	0.721	1.10	0.79
8	LTE 2	QPSK20M	Rear Face	18700	1	0	24.0	23.40	-0.19	0.263	1.15	0.30
9	LTE 4	QPSK20M	Rear Face	20175	1	0	24.5	23.84	-0.02	0.31	1.16	0.36
10	LTE 12	QPSK10M	Rear Face	23095	1	24	24.5	23.71	-0.03	0.143	1.20	0.17

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4.7.4 SAR Measurement Variability

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10 , the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

Since all the measured SAR are less than 0.8 W/kg, the repeated measurement is not required.

Test Engineer : York Liu / Engineer

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5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D750V3	1067	Sep. 05, 2018	1 Year
System Validation Dipole	SPEAG	D835V2	4d139	Sep. 06, 2018	1 Year
System Validation Dipole	SPEAG	D1750V2	1071	Sep. 13, 2018	1 Year
System Validation Dipole	SPEAG	D1900V2	5d159	Sep. 11, 2018	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	3873	Aug. 31, 2018	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1341	Aug. 28, 2018	1 Year
Radio Communication Analyzer	ANRITSU	MT8820C	6201300717	Jun. 24, 2019	1 Year
Wireless Communication Test Set	Agilent	E5515C	MY50260600	Feb. 26, 2019	1 Year
ENA Series Network Analyzer	Agilent	E5071C	MY46214638	Jun. 24, 2019	1 Year
Spectrum Analyzer	KEYSIGHT	N9010A	MY54510355	Feb. 26, 2019	1 Year
MXG Analog Signal Generator	KEYSIGHT	N5183A	MY50143024	Mar. 27, 2019	1 Year
Power Meter	Agilent	N1914A	MY52180044	Oct. 10, 2018	2 Years
Power Sensor	Agilent	E9304A H18	MY52050011	Jan. 21, 2019	1 Year
Power Meter	ANRITSU	ML2495A	1506002	Feb. 26, 2019	1 Year
Power Sensor	ANRITSU	MA2411B	1339353	Feb. 26, 2019	1 Year
Temp. & Humi. Recorder	CLOCK	HTC-1	157248	Jun. 27, 2019	1 Year
Electronic Thermometer	YONGFA	YF-160A	120100323	Sep. 14, 2018	1 Year
Coupler	Woken	0110A056020-10	COM27RW1A3	Sep. 14, 2018	1 Year

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6. Measurement Uncertainty

Source of Uncertainty	Tolerance ($\pm$ %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty ($\pm$ %, 1g)	Standard Uncertainty ($\pm$ %, 10g)	Vi
Measurement System								
Probe Calibration	6.0	Normal	1	1	1	6.0	6.0	∞
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.707	0.707	3.9	3.9	∞
Boundary Effect	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	∞
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	2.7	2.7	∞
System Detection Limits	0.25	Rectangular	$\sqrt{3}$	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	0.0	Rectangular	$\sqrt{3}$	1	1	0.0	0.0	∞
Integration Time	1.7	Rectangular	$\sqrt{3}$	1	1	1.0	1.0	∞
RF Ambient Conditions - Noise	3.0	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	3.0	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	Rectangular	$\sqrt{3}$	1	1	0.2	0.2	∞
Probe Positioning with Respect to Phantom Shell	2.9	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	2.0	Rectangular	$\sqrt{3}$	1	1	1.2	1.2	∞
Test Sample Related								
Test Sample Positioning	1.5 / 0.7	Normal	1	1	1	1.5	0.7	32
Device Holder Uncertainty	4.2 / 1.8	Normal	1	1	1	4.2	1.8	32
Output Power Variation - SAR Drift Measurement	5.0	Rectangular	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and Tissue Parameters								
Phantom Uncertainty (Shape and Thickness Tolerances)	7.2	Rectangular	$\sqrt{3}$	1	1	4.2	4.2	∞
Liquid Conductivity - Deviation from Target Values	5.0	Rectangular	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - Measurement Uncertainty	1.0	Normal	1	0.64	0.43	0.6	0.4	25
Liquid Permittivity - Deviation from Target Values	5.0	Rectangular	$\sqrt{3}$	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - Measurement Uncertainty	0.5	Normal	1	0.60	0.49	0.3	0.2	25
Combined Standard Uncertainty						± 11.2 %	± 10.4 %	
Expanded Uncertainty (K=2)						± 22.4 %	± 20.8 %	

Uncertainty budget for frequency range 300 MHz to 3 GHz

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Source of Uncertainty	Tolerance ($\pm$ %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty ($\pm$ %, 1g)	Standard Uncertainty ($\pm$ %, 10g)	Vi
Measurement System								
Probe Calibration	6.55	Normal	1	1	1	6.55	6.55	∞
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.707	0.707	3.9	3.9	∞
Boundary Effect	2.0	Rectangular	$\sqrt{3}$	1	1	1.2	1.2	∞
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	2.7	2.7	∞
System Detection Limits	0.25	Rectangular	$\sqrt{3}$	1	1	0.14	0.14	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	0.0	Rectangular	$\sqrt{3}$	1	1	0.0	0.0	∞
Integration Time	1.7	Rectangular	$\sqrt{3}$	1	1	1.0	1.0	∞
RF Ambient Conditions - Noise	3.0	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	3.0	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	Rectangular	$\sqrt{3}$	1	1	0.2	0.2	∞
Probe Positioning with Respect to Phantom Shell	6.7	Rectangular	$\sqrt{3}$	1	1	3.9	3.9	∞
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	4.0	Rectangular	$\sqrt{3}$	1	1	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	1.5 / 0.7	Normal	1	1	1	1.5	0.7	32
Device Holder Uncertainty	4.2 / 1.8	Normal	1	1	1	4.2	1.8	32
Output Power Variation - SAR Drift Measurement	5.0	Rectangular	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and Tissue Parameters								
Phantom Uncertainty (Shape and Thickness Tolerances)	7.6	Rectangular	$\sqrt{3}$	1	1	4.4	4.4	∞
Liquid Conductivity - Deviation from Target Values	5.0	Rectangular	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - Measurement Uncertainty	1.0	Normal	1	0.64	0.43	0.6	0.4	25
Liquid Permittivity - Deviation from Target Values	5.0	Rectangular	$\sqrt{3}$	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - Measurement Uncertainty	0.5	Normal	1	0.60	0.49	0.3	0.2	25
Combined Standard Uncertainty						± 12.3 %	± 11.5 %	
Expanded Uncertainty (K=2)						± 24.6 %	± 23.0 %	

Uncertainty budget for frequency range 3 GHz to 6 GHz

7. Information on the Testing Laboratories

We, BV 7LAYERS COMMUNICATIONS TECHNOLOGY (SHENZHEN) CO. LTD., were founded in 2015 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Web Site: www.bureauveritas.com

The road map of all our labs can be found in our web site also.

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Appendix A. SAR Plots of System Verification

The plots for system verification with largest deviation for each SAR system combination are shown as follows.

System Check_HSL750_190806**DUT: Dipole:750 MHz;Type:D750V3;SN:1067**

Communication System: CW; Frequency: 750 MHz;Duty Cycle: 1:1

Medium: HSL750_0806 Medium parameters used: $f = 750$ MHz; $\sigma = 0.89$ S/m; $\epsilon_r = 40.774$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.0°C; Liquid Temperature : 22.1°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(10.15, 10.15, 10.15); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Left Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1722
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (71x131x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.66 W/kg

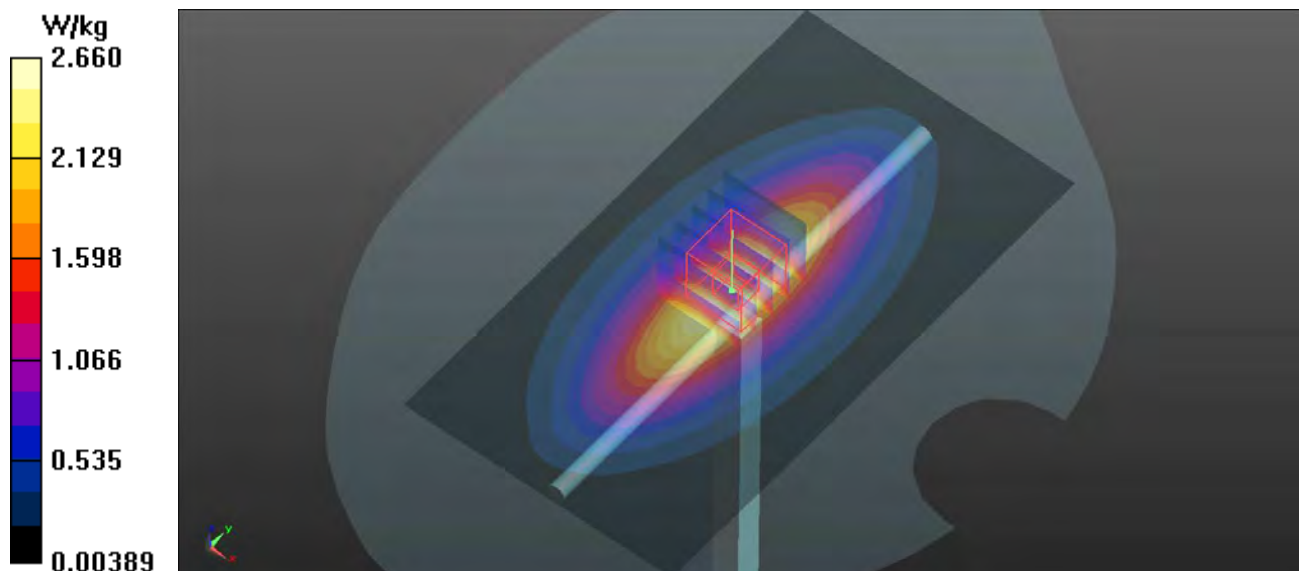
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 54.47 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.03 W/kg

SAR(1 g) = 2.04 W/kg; SAR(10 g) = 1.35 W/kg

Maximum value of SAR (measured) = 2.71 W/kg



System Check_HSL835_190806**DUT: Dipole:835 MHz;Type:D835V2; SN:4d139**

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1

Medium: HSL835_0806 Medium parameters used: $f = 835$ MHz; $\sigma = 0.898$ S/m; $\epsilon_r = 43.088$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.9°C; Liquid Temperature : 21.8°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(9.69, 9.69, 9.69); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Left Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1722
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 3.22 W/kg

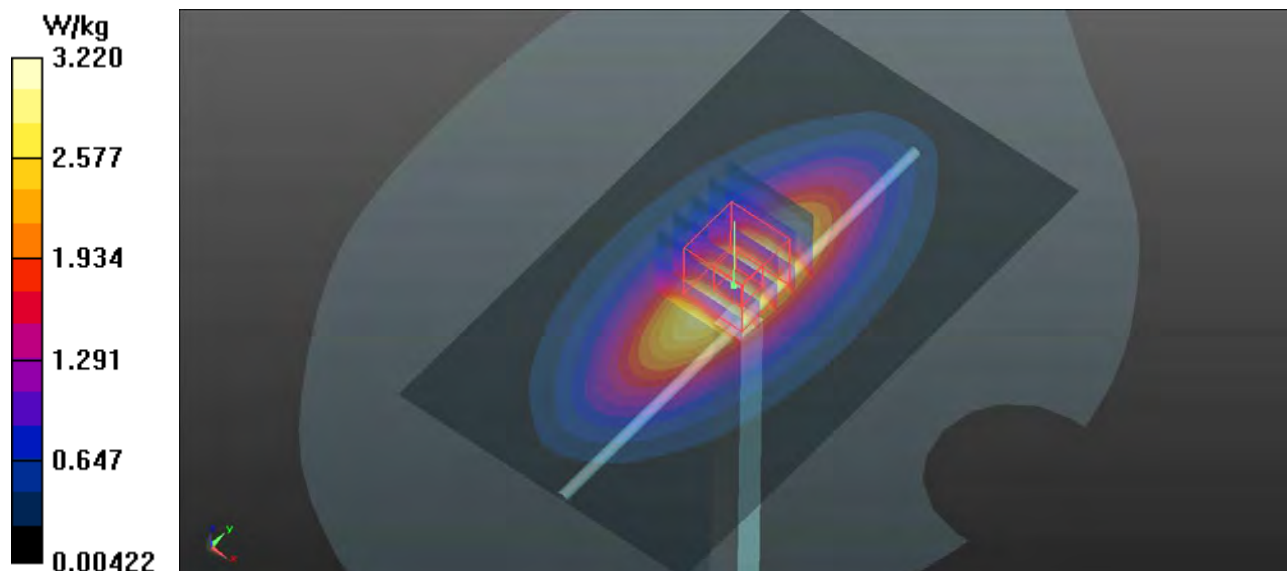
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 59.43 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 3.65 W/kg

SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.6 W/kg

Maximum value of SAR (measured) = 3.26 W/kg



System Check_HSL1750_190806**DUT: Dipole:1750 MHz;Type:D1750V2; SN:1071**

Communication System: CW; Frequency: 1750 MHz;Duty Cycle: 1:1

Medium: HSL1750_0806 Medium parameters used: $f = 1750$ MHz; $\sigma = 1.333$ S/m; $\epsilon_r = 39.259$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.7°C; Liquid Temperature : 21.6°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(8.39, 8.39, 8.39); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (71x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 14.3 W/kg

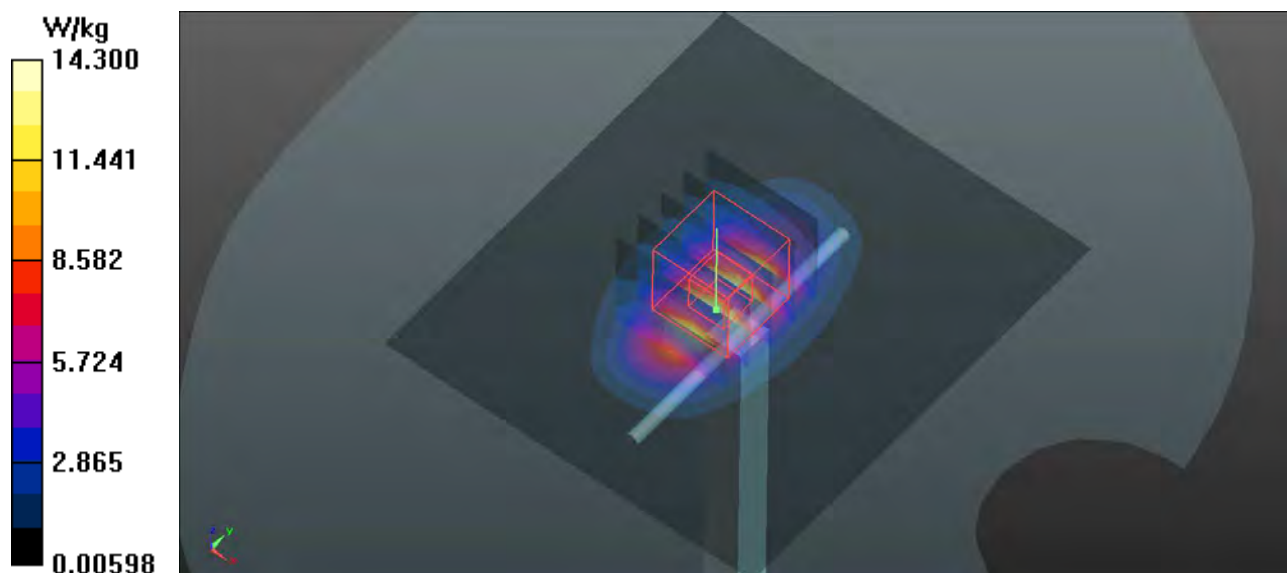
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 103.3 V/m; Power Drift = 0.19 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.52 W/kg; SAR(10 g) = 5.14 W/kg

Maximum value of SAR (measured) = 14.4 W/kg



System Check_HSL1900_190806**DUT: Dipole:1900MHz;Type:D1900V2; SN:5d159**

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1

Medium: HSL1900_0806 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.426$ S/m; $\epsilon_r = 40.61$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1°C; Liquid Temperature : 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(8.12, 8.12, 8.12); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (71x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 16.0 W/kg

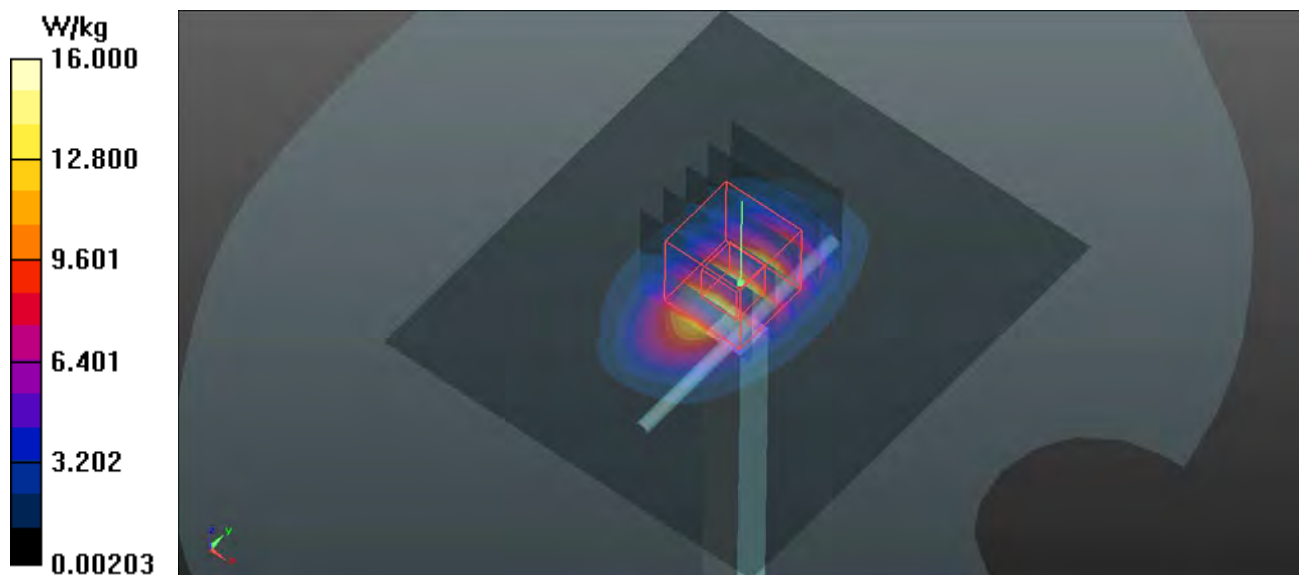
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 102.0 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 19.6 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.16 W/kg

Maximum value of SAR (measured) = 16.2 W/kg



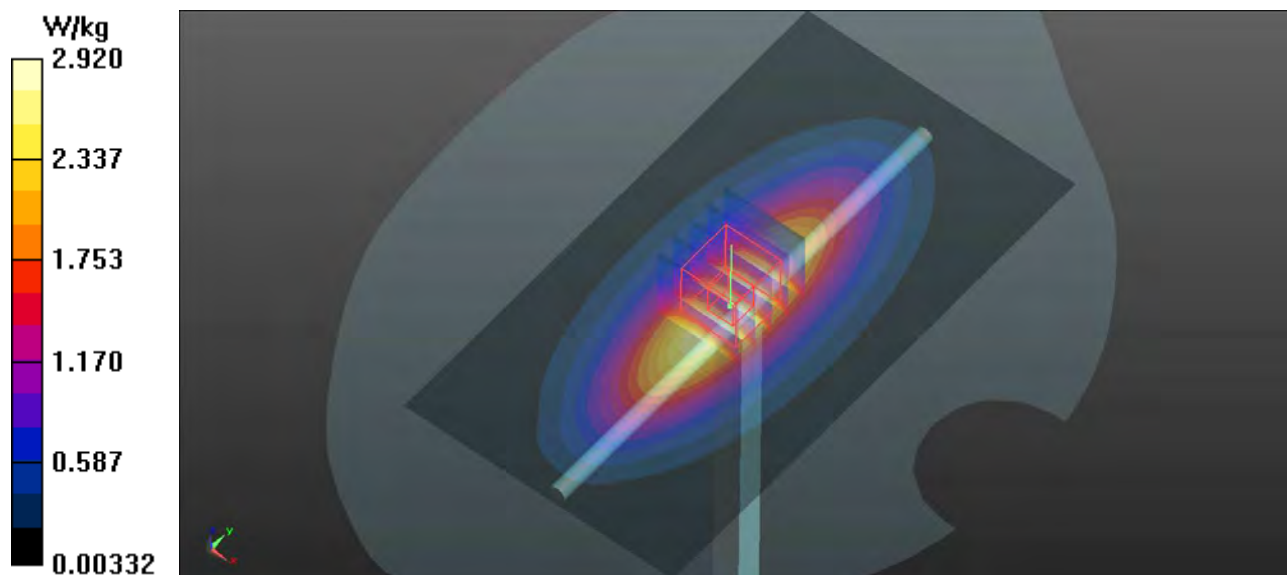
System Check_MSL750_190809**DUT: Dipole:750 MHz;Type:D750V3;SN:1067**

Communication System: CW; Frequency: 750 MHz;Duty Cycle: 1:1

Medium: MSL750_0809 Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.963 \text{ S/m}$; $\epsilon_r = 53.779$; $\rho = 1000 \text{ kg/m}^3$ Ambient Temperature : 22.8°C ; Liquid Temperature : 21.7°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(9.67, 9.67, 9.67); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Left Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1722
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (71x131x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$ Maximum value of SAR (interpolated) = 2.92 W/kg **Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$ Reference Value = 54.94 V/m ; Power Drift = 0.00 dB Peak SAR (extrapolated) = 3.37 W/kg **SAR(1 g) = 2.27 W/kg ; SAR(10 g) = 1.52 W/kg** Maximum value of SAR (measured) = 3.00 W/kg 

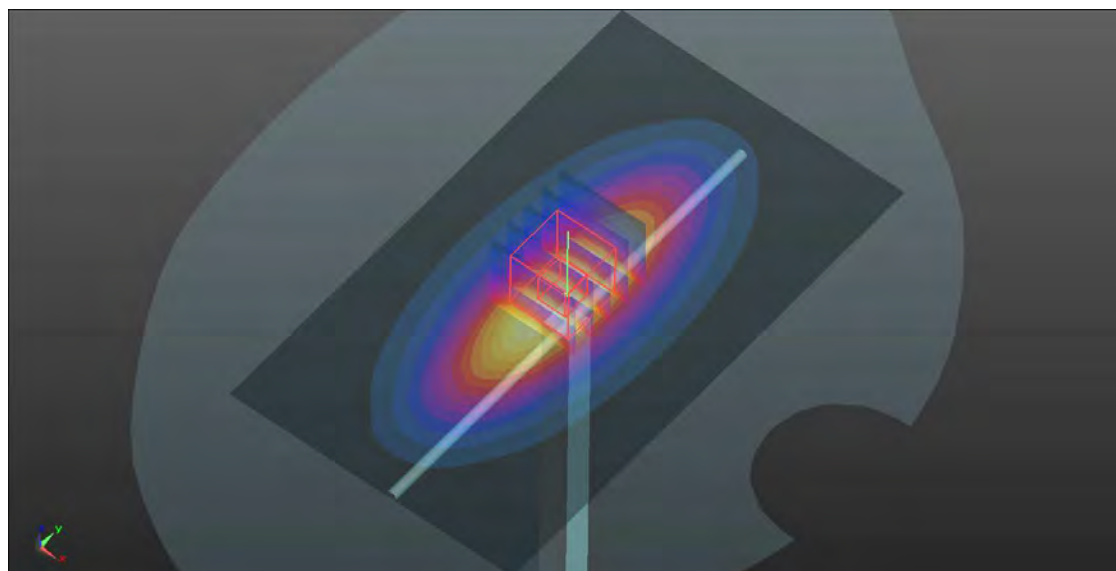
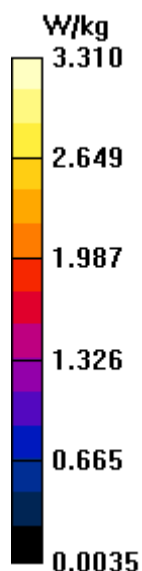
System Check_MSL835_190809**DUT: Dipole:835 MHz;Type:D835V2; SN:4d139**

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1

Medium: MSL835_0809 Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.954 \text{ S/m}$; $\epsilon_r = 57.264$; $\rho = 1000 \text{ kg/m}^3$ Ambient Temperature : 22.7°C ; Liquid Temperature : 21.8°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(9.49, 9.49, 9.49); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Left Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1722
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (71x121x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$ Maximum value of SAR (interpolated) = 3.31 W/kg **Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$ Reference Value = 59.25 V/m ; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.75 W/kg **SAR(1 g) = 2.55 W/kg ; SAR(10 g) = 1.69 W/kg** Maximum value of SAR (measured) = 3.37 W/kg 

System Check_MSL1750_190809**DUT: Dipole:1750 MHz;Type:D1750V2; SN:1071**

Communication System: CW; Frequency: 1750 MHz;Duty Cycle: 1:1

Medium: MSL1750_0809 Medium parameters used: $f = 1750$ MHz; $\sigma = 1.482$ S/m; $\epsilon_r = 52.5$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1°C; Liquid Temperature : 22.8°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(7.8, 7.8, 7.8); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 14.9 W/kg

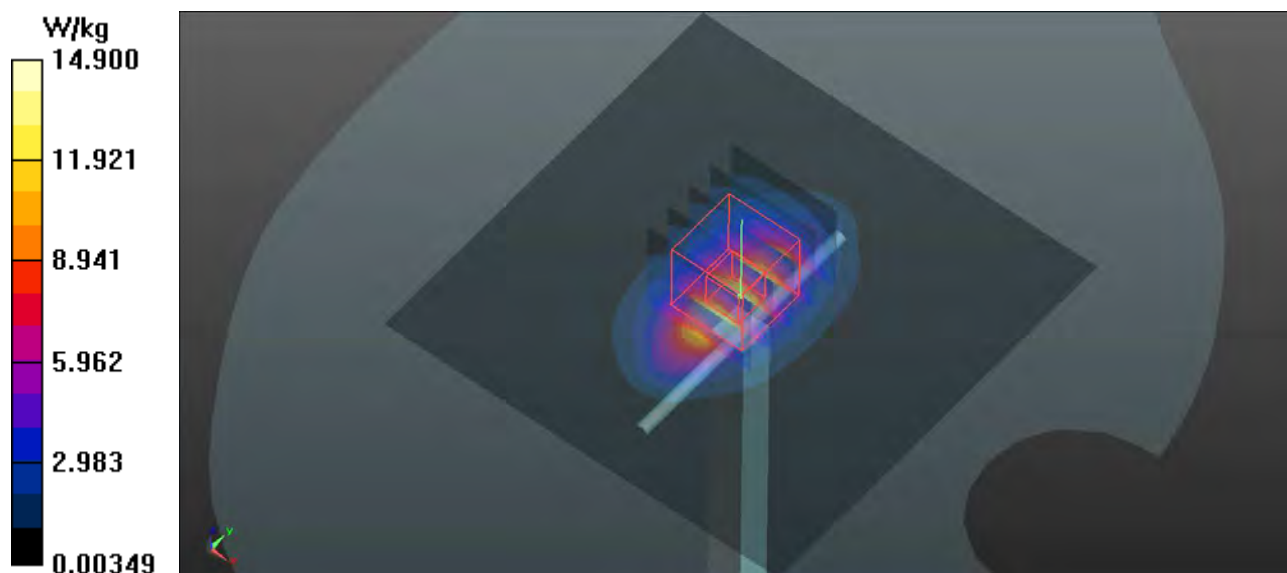
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 103.9 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 17.2 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.58 W/kg

Maximum value of SAR (measured) = 14.9 W/kg



System Check_MSL1900_190809**DUT: Dipole:1900MHz;Type:D1900V2; SN:5d159**

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1

Medium: MSL1900_0809 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.526$ S/m; $\epsilon_r = 51.959$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.9°C; Liquid Temperature : 22.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(7.61, 7.61, 7.61); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 15.7 W/kg

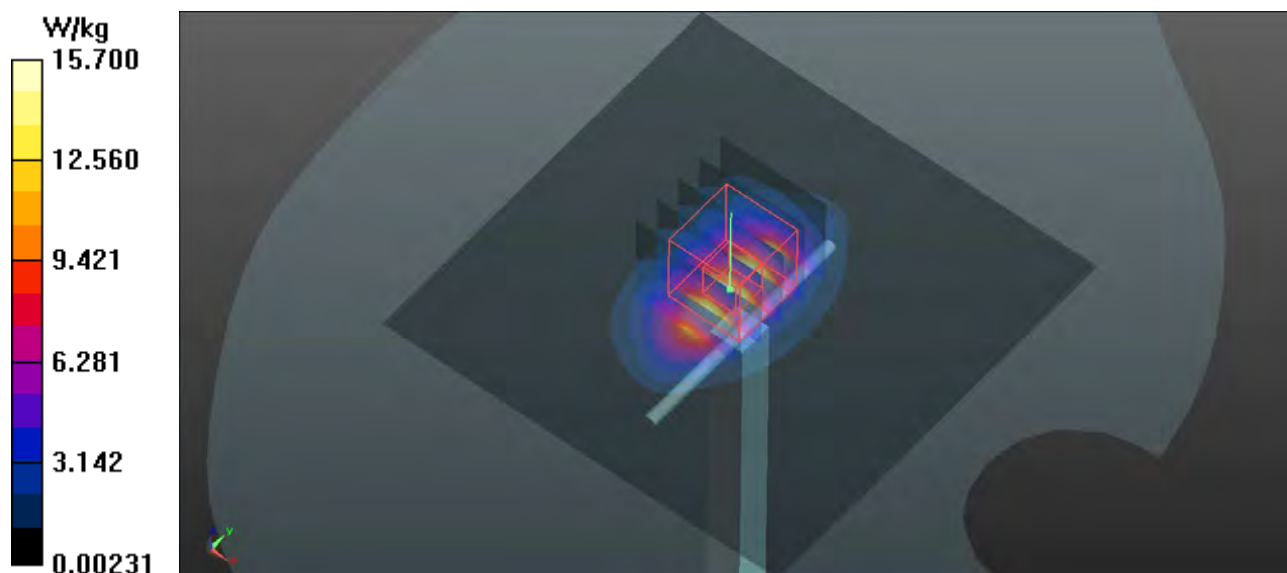
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 97.05 V/m; Power Drift = 0.19 dB

Peak SAR (extrapolated) = 19.0 W/kg

SAR(1 g) = 10.5 W/kg; SAR(10 g) = 5.52 W/kg

Maximum value of SAR (measured) = 16.4 W/kg



Appendix B. SAR Plots of SAR Measurement

The SAR plots for highest measured SAR in each exposure configuration, wireless mode and frequency band combination, and measured SAR > 1.5 W/kg are shown as follows.

P01 WCDMA II_RMC12.2K_Front Face_1cm_Ch9262**DUT: 190626W002**

Communication System: WCDMA; Frequency: 1852.4 MHz; Duty Cycle: 1:1

Medium: HSL1900_0806 Medium parameters used: $f = 1852.4$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 40.814$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1°C; Liquid Temperature : 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(8.12, 8.12, 8.12); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.420 W/kg

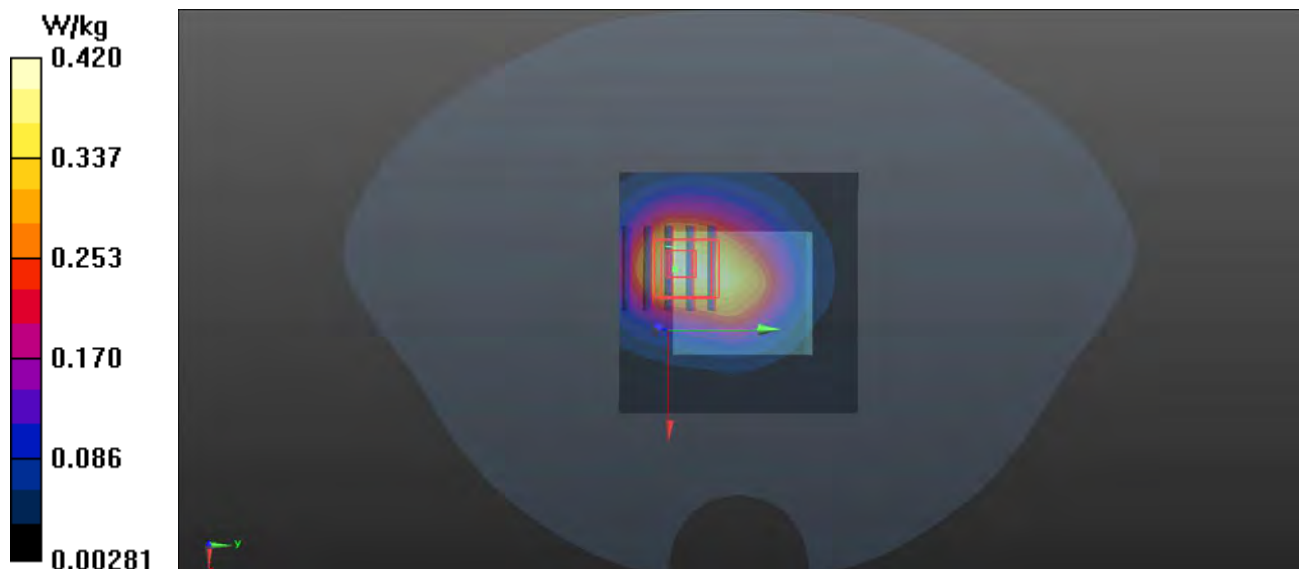
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.31 V/m; Power Drift = 0.16 dB

Peak SAR (extrapolated) = 0.465 W/kg

SAR(1 g) = 0.302 W/kg; SAR(10 g) = 0.202 W/kg

Maximum value of SAR (measured) = 0.399 W/kg



P02 WCDMA V_RMC12.2K_Front_1cm_Ch4182**DUT: 190626W002**

Communication System: WCDMA; Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: HSL835_0806 Medium parameters used: $f = 836.4$ MHz; $\sigma = 0.899$ S/m; $\epsilon_r = 43.072$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.9°C; Liquid Temperature : 21.8°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(9.69, 9.69, 9.69); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Left Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1722
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.120 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.572 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.136 W/kg

SAR(1 g) = 0.092 W/kg; SAR(10 g) = 0.061 W/kg

Maximum value of SAR (measured) = 0.120 W/kg

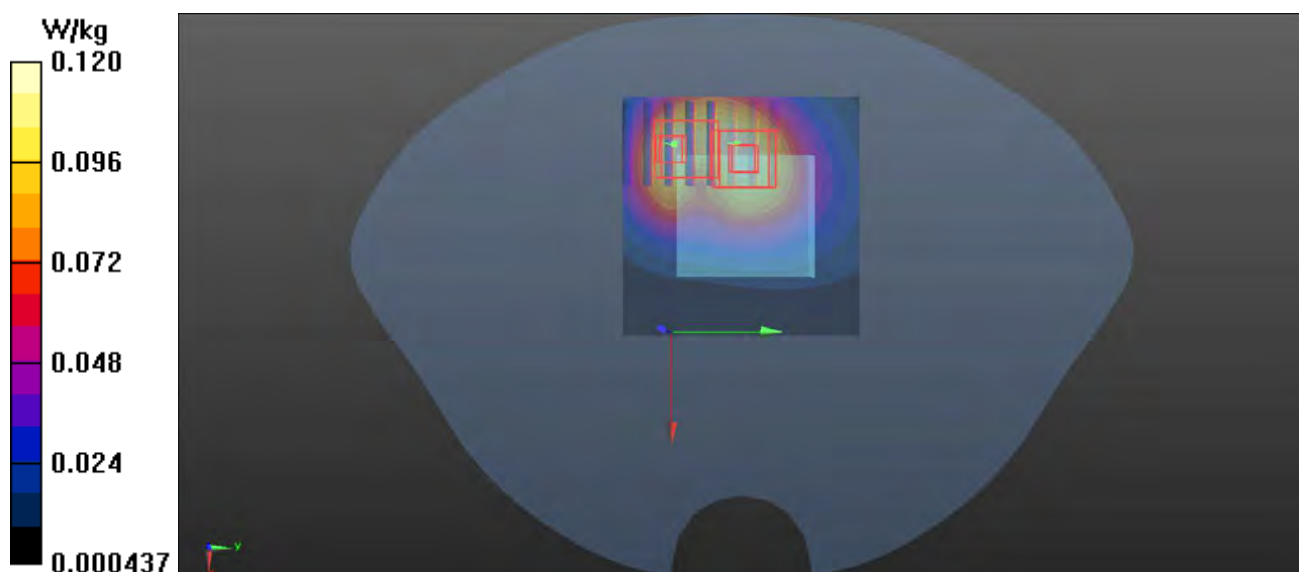
- Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.572 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.131 W/kg

SAR(1 g) = 0.079 W/kg; SAR(10 g) = 0.051 W/kg

Maximum value of SAR (measured) = 0.112 W/kg



P03 LTE 2_QPSK20M_Front Face_1cm_Ch18700_1RB_OS0**DUT: 190626W002**

Communication System: LTE ; Frequency: 1860 MHz;Duty Cycle: 1:1

Medium: HSL1900_0806 Medium parameters used: $f = 1860$ MHz; $\sigma = 1.387$ S/m; $\epsilon_r = 40.782$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1°C; Liquid Temperature : 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(8.12, 8.12, 8.12); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.642 W/kg

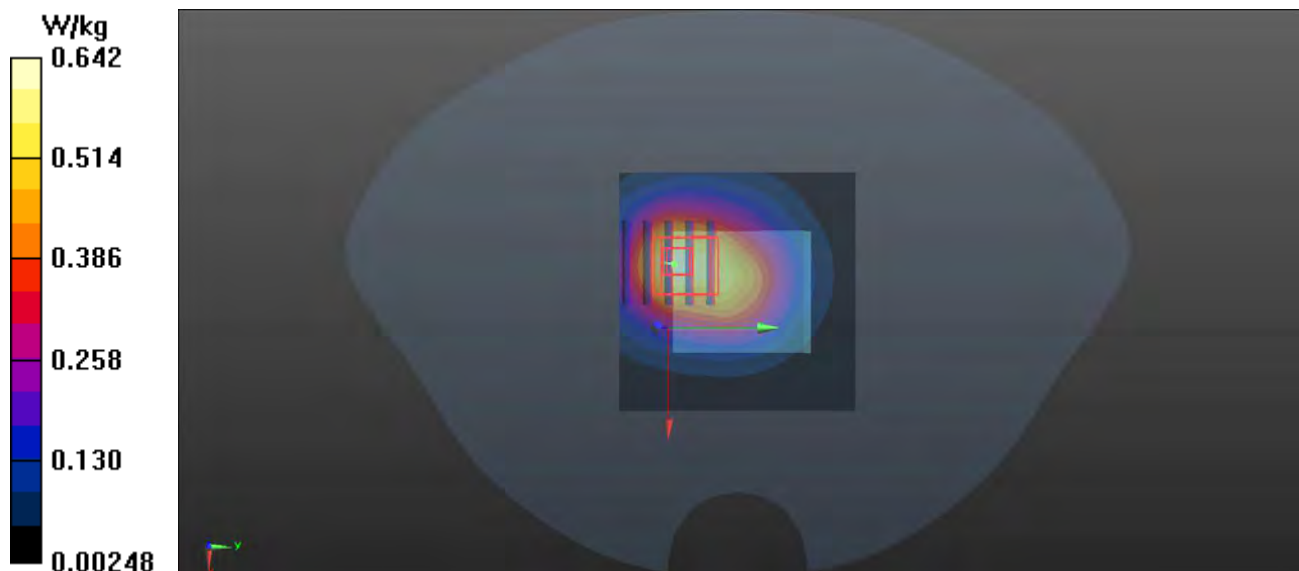
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 16.46 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.739 W/kg

SAR(1 g) = 0.479 W/kg; SAR(10 g) = 0.314 W/kg

Maximum value of SAR (measured) = 0.633 W/kg



P04 LTE 4_QPSK20M_Front Face_1cm_Ch20175_1RB_OS0**DUT: 190626W002**

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

Medium: HSL1750_0806 Medium parameters used: $f = 1732.5$ MHz; $\sigma = 1.315$ S/m; $\epsilon_r = 39.349$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.7°C; Liquid Temperature : 21.6°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(8.39, 8.39, 8.39); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.390 W/kg

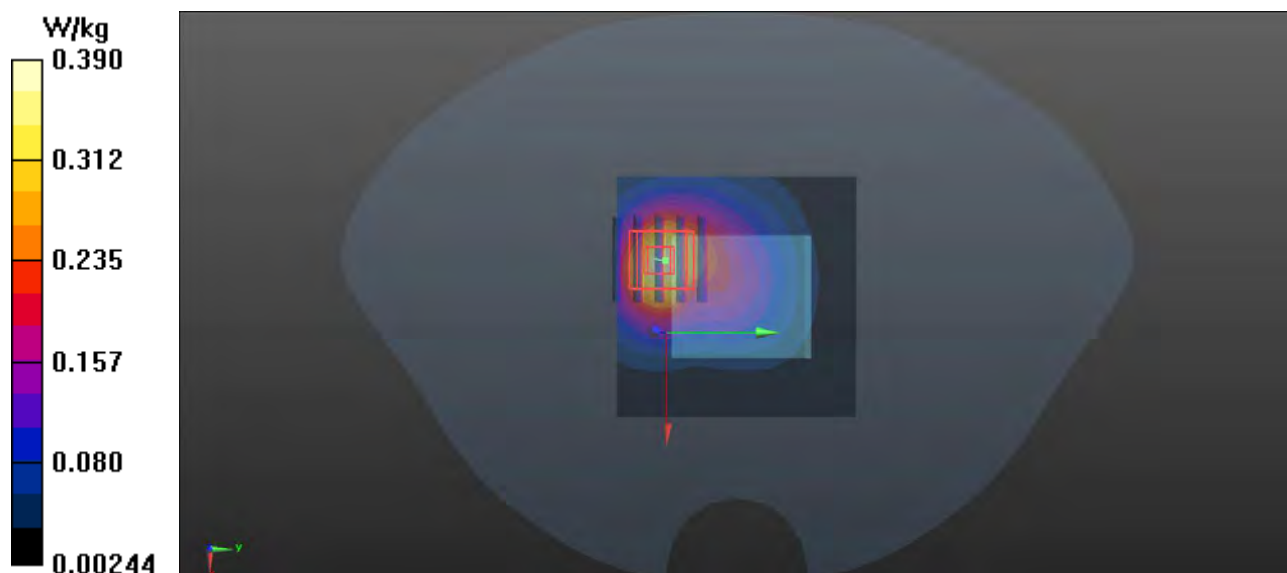
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.12 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.429 W/kg

SAR(1 g) = 0.269 W/kg; SAR(10 g) = 0.166 W/kg

Maximum value of SAR (measured) = 0.366 W/kg



P05 LTE 12_QPSK10M_Front_1cm_Ch23095_1RB_OS24**DUT: 190626W002**

Communication System: LTE; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: HSL750_0806 Medium parameters used: $f = 707.5$ MHz; $\sigma = 0.856$ S/m; $\epsilon_r = 41.219$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.0°C; Liquid Temperature : 22.1°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(10.15, 10.15, 10.15); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Left Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1722
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.198 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.302 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.229 W/kg

SAR(1 g) = 0.160 W/kg; SAR(10 g) = 0.110 W/kg

Maximum value of SAR (measured) = 0.206 W/kg

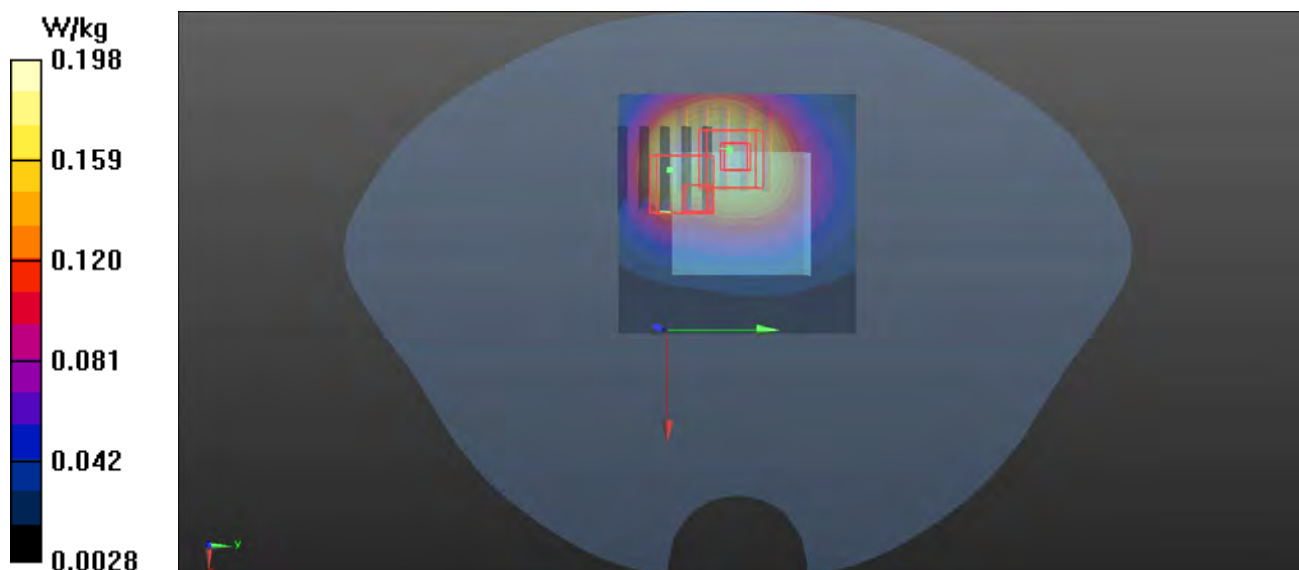
- Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.302 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.135 W/kg

SAR(1 g) = 0.00866 W/kg; SAR(10 g) = 0.00525 W/kg

Maximum value of SAR (measured) = 0.127 W/kg



P06 WCDMA II_RMC12.2K_Rear Face_0cm_Ch9262**DUT: 190626W002**

Communication System: WCDMA ; Frequency: 1852.4 MHz; Duty Cycle: 1:1

Medium: MSL1900_0809 Medium parameters used: $f = 1852.4$ MHz; $\sigma = 1.468$ S/m; $\epsilon_r = 52.121$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.9°C; Liquid Temperature : 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(7.61, 7.61, 7.61); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.20 W/kg

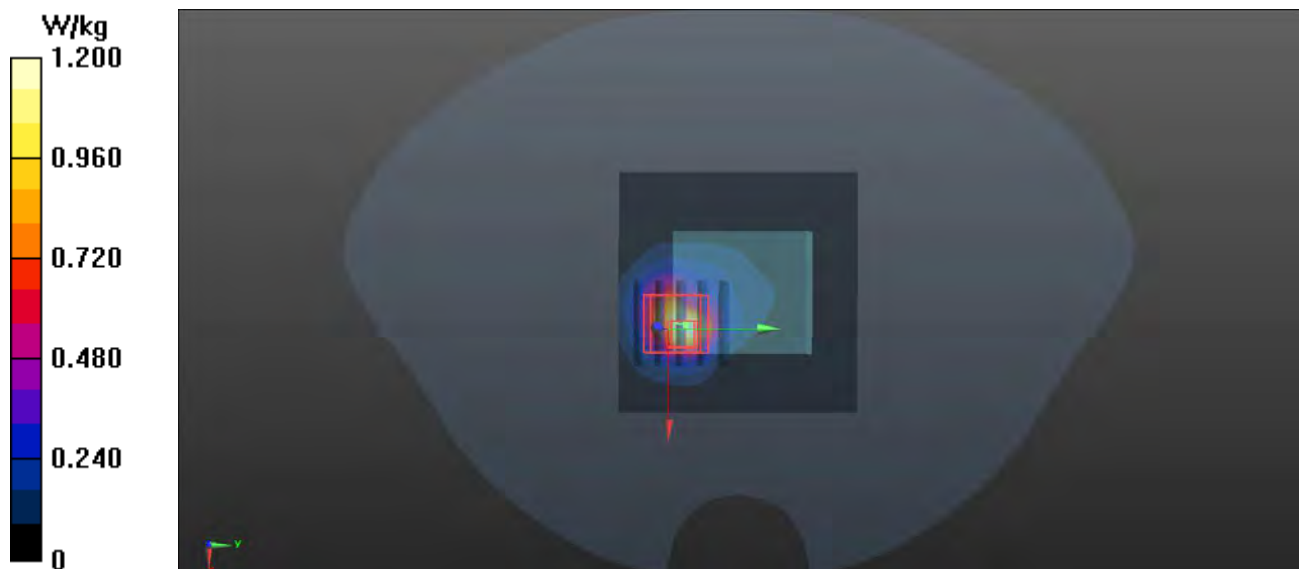
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.911 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 1.21 W/kg

SAR(1 g) = 0.532 W/kg; SAR(10 g) = 0.267 W/kg

Maximum value of SAR (measured) = 0.824 W/kg



P07 WCDMA V_RMC12.2K_Rear Face_0cm_Ch4182**DUT: 190626W002**

Communication System: WCDMA; Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL835_0809 Medium parameters used: $f = 836.4$ MHz; $\sigma = 0.956$ S/m; $\epsilon_r = 57.253$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.7°C; Liquid Temperature : 21.8°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(9.49, 9.49, 9.49); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Left Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1722
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.79 W/kg

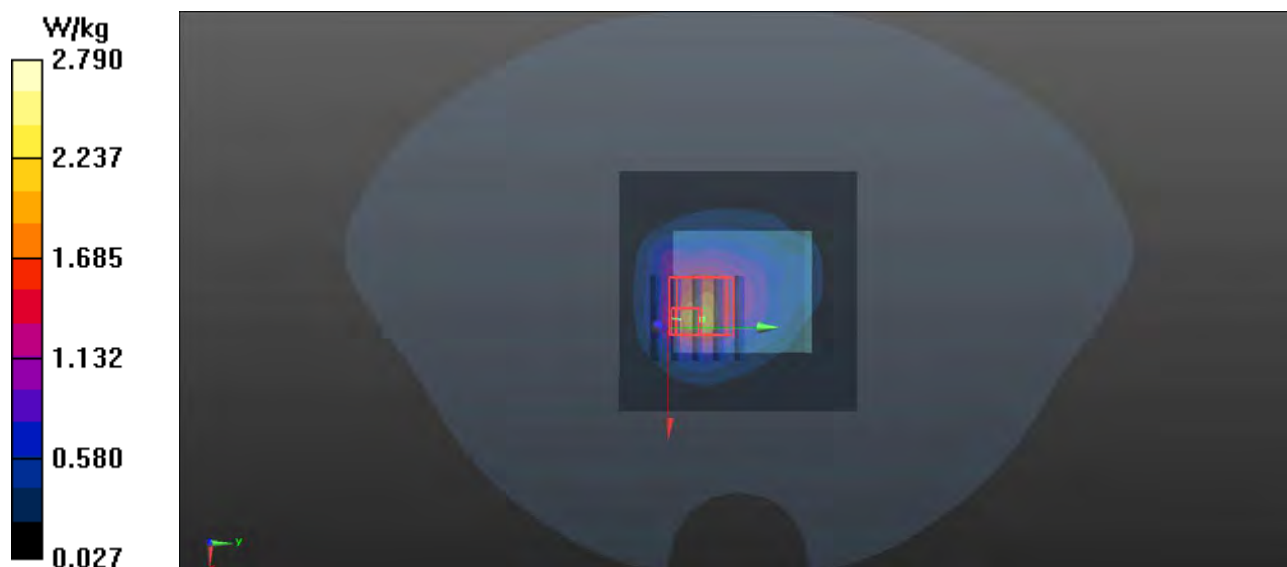
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.39 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.83 W/kg

SAR(1 g) = 1.37 W/kg; SAR(10 g) = 0.721 W/kg

Maximum value of SAR (measured) = 2.79 W/kg



P08 LTE 2_QPSK20M_Rear Face_0cm_Ch18700_1RB_OS0**DUT: 190626W002**

Communication System: LTE ; Frequency: 1860 MHz;Duty Cycle: 1:1

Medium: MSL1900_0809 Medium parameters used: $f = 1860$ MHz; $\sigma = 1.477$ S/m; $\epsilon_r = 52.096$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.9°C; Liquid Temperature : 21.9°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(7.61, 7.61, 7.61); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.17 W/kg

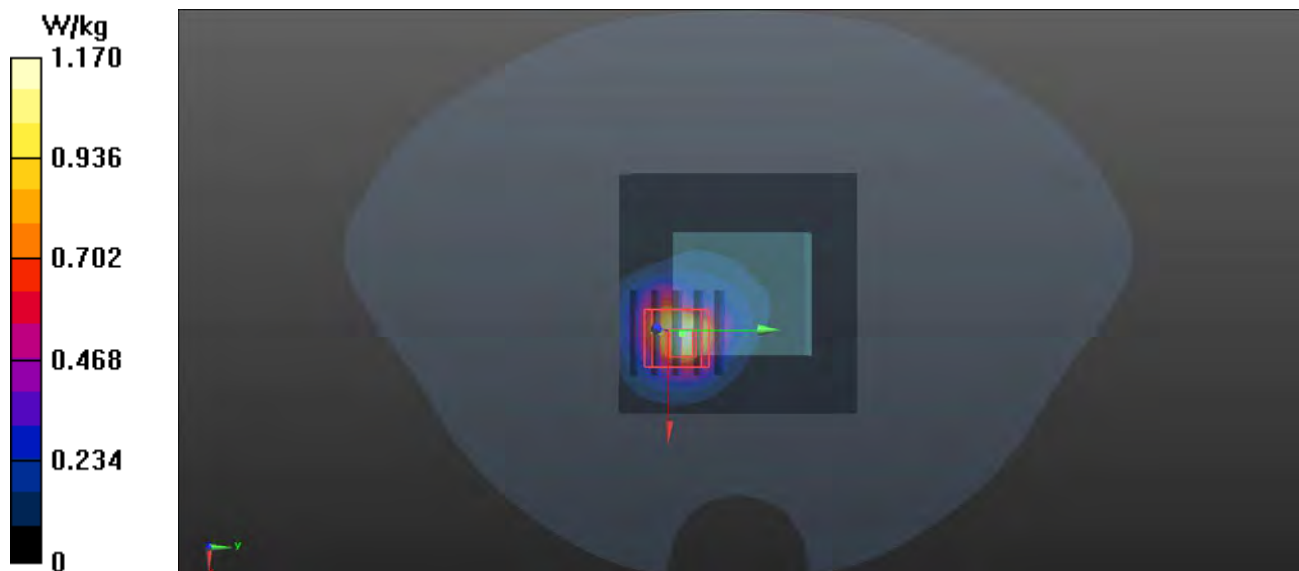
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.34 V/m; Power Drift = -0.19 dB

Peak SAR (extrapolated) = 1.26 W/kg

SAR(1 g) = 0.541 W/kg; SAR(10 g) = 0.263 W/kg

Maximum value of SAR (measured) = 0.880 W/kg



P09 LTE 4_QPSK20M_Rear Face_0cm_Ch20175_1RB_OS0**DUT: 190626W002**

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

Medium: MSL1750_0809 Medium parameters used: $f = 1732.5$ MHz; $\sigma = 1.462$ S/m; $\epsilon_r = 52.554$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1°C; Liquid Temperature : 22.8°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(7.8, 7.8, 7.8); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Front Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1695
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.41 W/kg

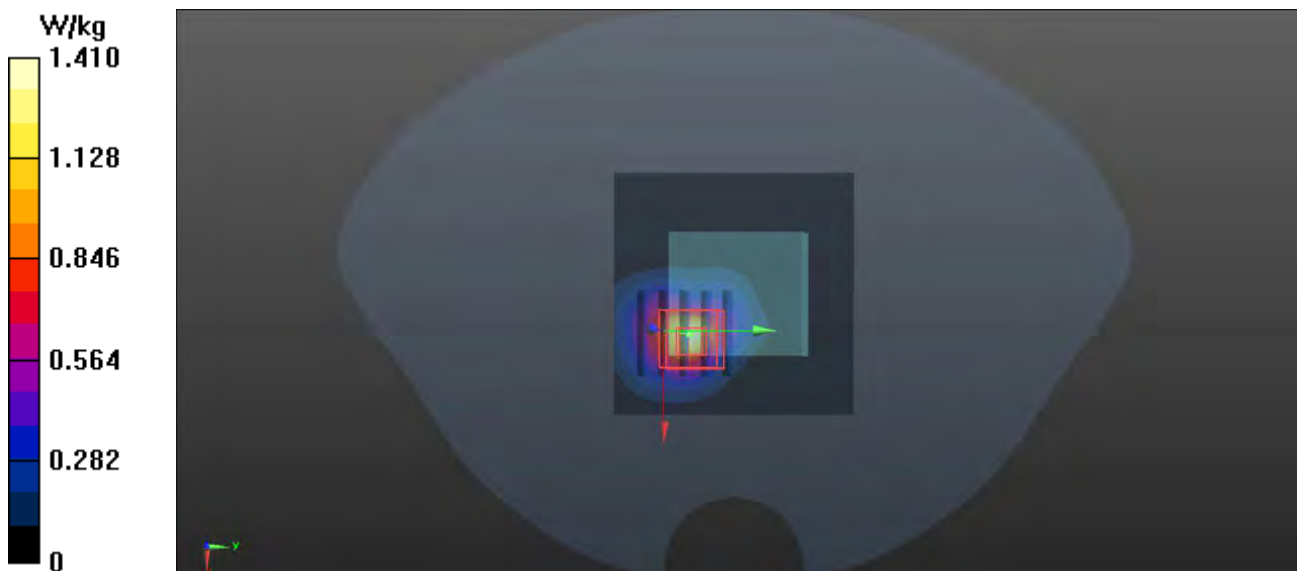
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.68 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.82 W/kg

SAR(1 g) = 0.680 W/kg; SAR(10 g) = 0.310 W/kg

Maximum value of SAR (measured) = 1.37 W/kg



P10 LTE 12_QPSK10M_Rear Face_0cm_Ch23095_1RB_OS24**DUT: 190626W002**

Communication System: LTE; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: MSL750_0809 Medium parameters used: $f = 707.5$ MHz; $\sigma = 0.919$ S/m; $\epsilon_r = 54.277$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.8°C; Liquid Temperature : 21.7°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3873; ConvF(9.67, 9.67, 9.67); Calibrated: 2018/08/31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 2018/08/28
- Phantom: Left Phantom with CRP v5.0; Type: QD000P40CD; Serial: TP:1722
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

- Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.447 W/kg

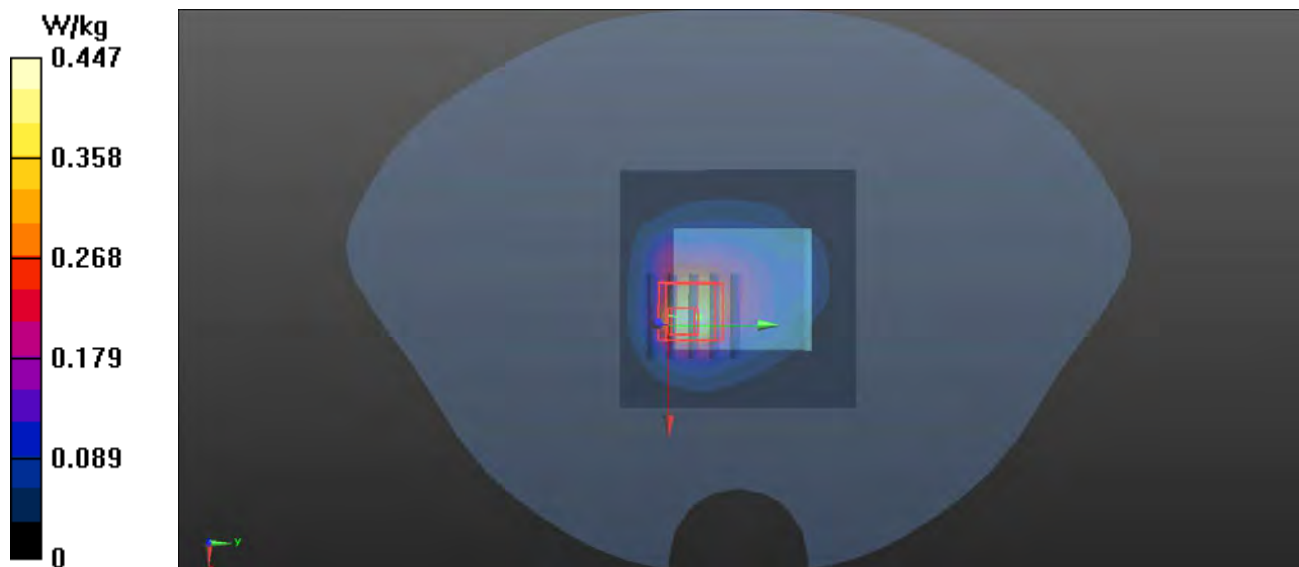
- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.18 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.00 W/kg

SAR(1 g) = 0.310 W/kg; SAR(10 g) = 0.143 W/kg

Maximum value of SAR (measured) = 0.687 W/kg



Appendix C. Calibration Certificate for Probe and Dipole

The SPEAG calibration certificates are shown as follows.



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CALIBRATION
CNAS L0570

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E-mail: cttl@chinattl.com http://www.chinattl.cn

Client

ADT_CN

Certificate No: Z18-60310

CALIBRATION CERTIFICATE

Object

D750V3 - SN: 1067

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

September 5, 2018

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Sep-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: September 8, 2018

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http://www.chinattl.cn

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM _{x,y,z}
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor $k=2$, which for a normal distribution Corresponds to a coverage probability of approximately 95%.



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Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.10.1.1476
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	43.1 $\pm$ 6 %	0.87 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.07 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	8.51 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.40 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.72 mW / g $\pm$ 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	56.8 $\pm$ 6 %	0.93 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.14 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	8.80 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	5.97 mW / g $\pm$ 18.7 % (k=2)



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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω - 2.03j Ω
Return Loss	- 27.8dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.7 Ω - 3.79j Ω
Return Loss	- 27.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	0.897 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

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DASY5 Validation Report for Head TSL

Date: 09.05.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1067

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.866 \text{ S/m}$; $\epsilon_r = 43.13$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.57, 10.57, 10.57) @ 750 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

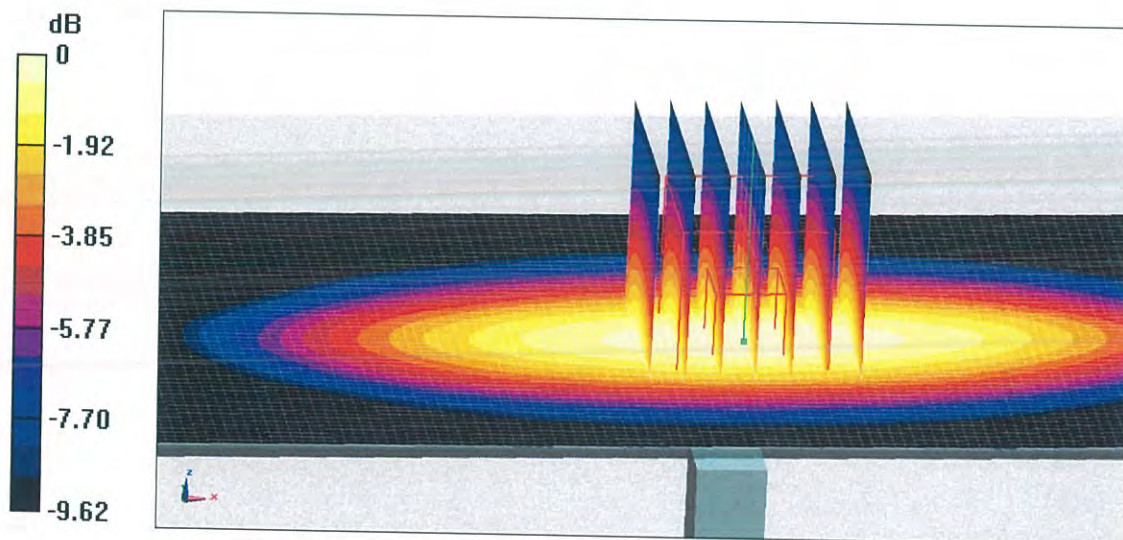
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 55.01 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.05 W/kg

SAR(1 g) = 2.07 W/kg; SAR(10 g) = 1.4 W/kg

Maximum value of SAR (measured) = 2.73 W/kg



0 dB = 2.73 W/kg = 4.36 dBW/kg

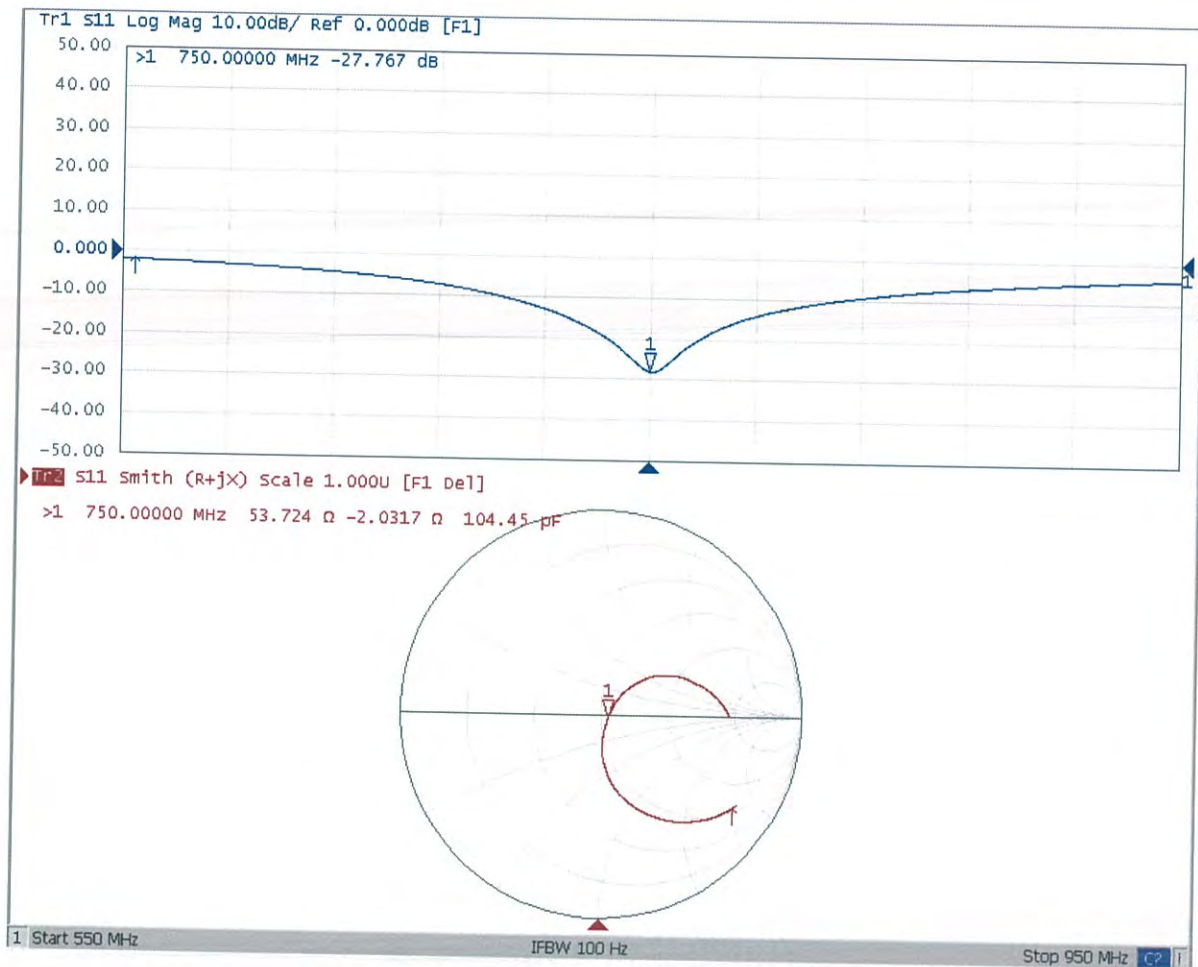


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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 09.05.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1067

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 750$ MHz; $\sigma = 0.932$ S/m; $\epsilon_r = 56.82$; $\rho = 1000$ kg/m³

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.63, 10.63, 10.63) @ 750 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

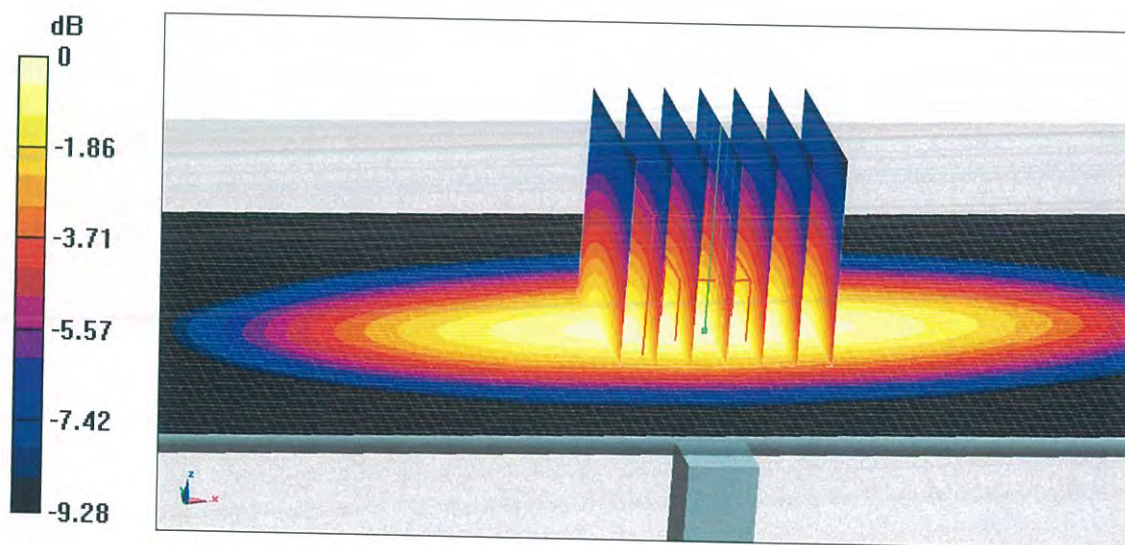
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.11 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.06 W/kg

SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.46 W/kg

Maximum value of SAR (measured) = 2.76 W/kg

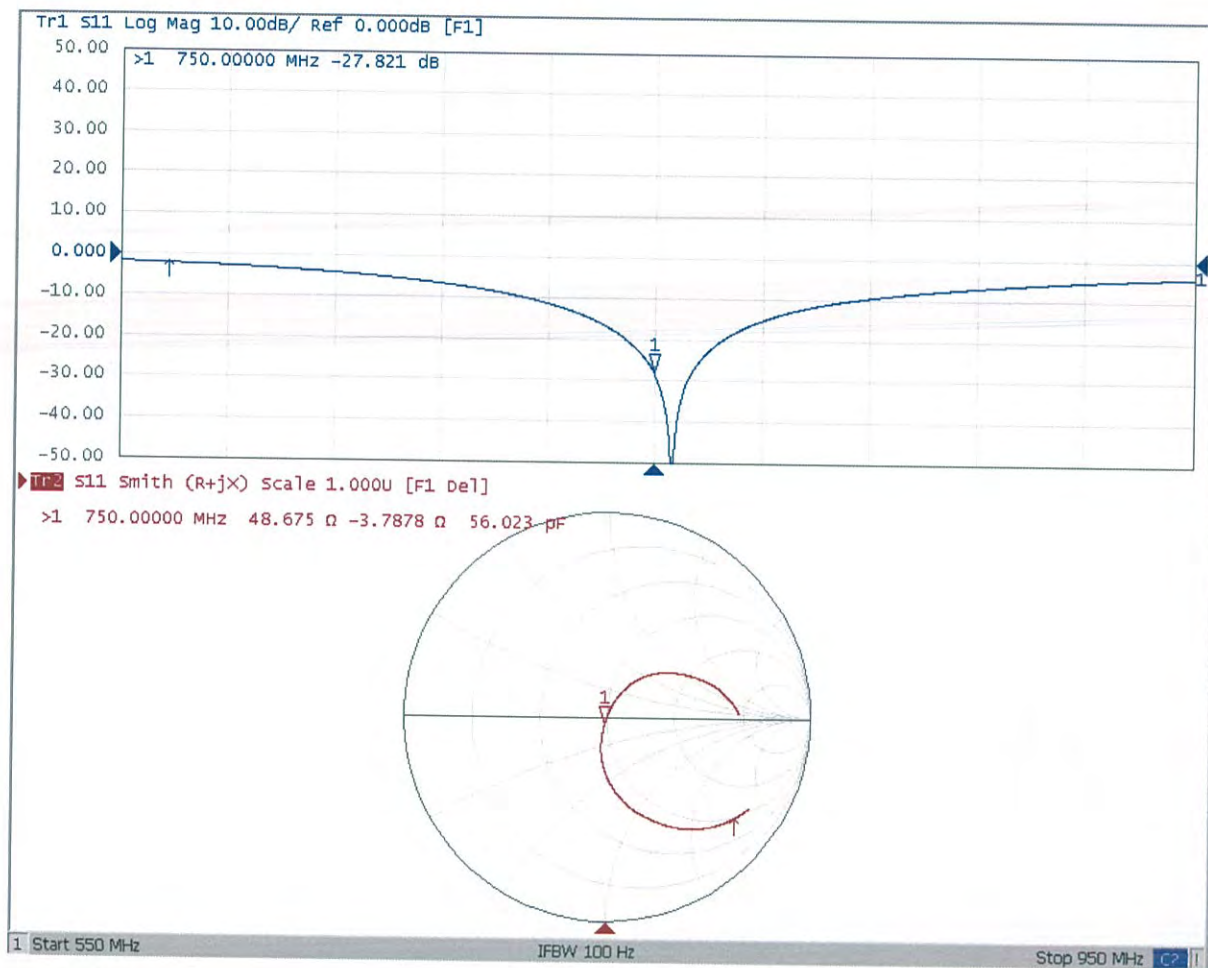


0 dB = 2.76 W/kg = 4.41 dBW/kg



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Impedance Measurement Plot for Body TSL





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Client

ADT_CN

Certificate No: Z18-60311

CALIBRATION CERTIFICATE

Object

D835V2 - SN: 4d139

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

September 6, 2018

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Sep-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: September 9, 2018

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM _{x,y,z}
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor $k=2$, which for a normal distribution Corresponds to a coverage probability of approximately 95%.



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Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.10.1.1476
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	42.7 $\pm$ 6 %	0.90 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.37 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.51 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.56 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.25 mW / g $\pm$ 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	56.0 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.70 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.65 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.50 mW / g $\pm$ 18.7 % (k=2)



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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.5Ω- 3.46jΩ
Return Loss	- 28.6dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3Ω- 4.75jΩ
Return Loss	- 25.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.256 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 09.04.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d139

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.904 \text{ S/m}$; $\epsilon_r = 42.71$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.28, 10.28, 10.28) @ 835 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

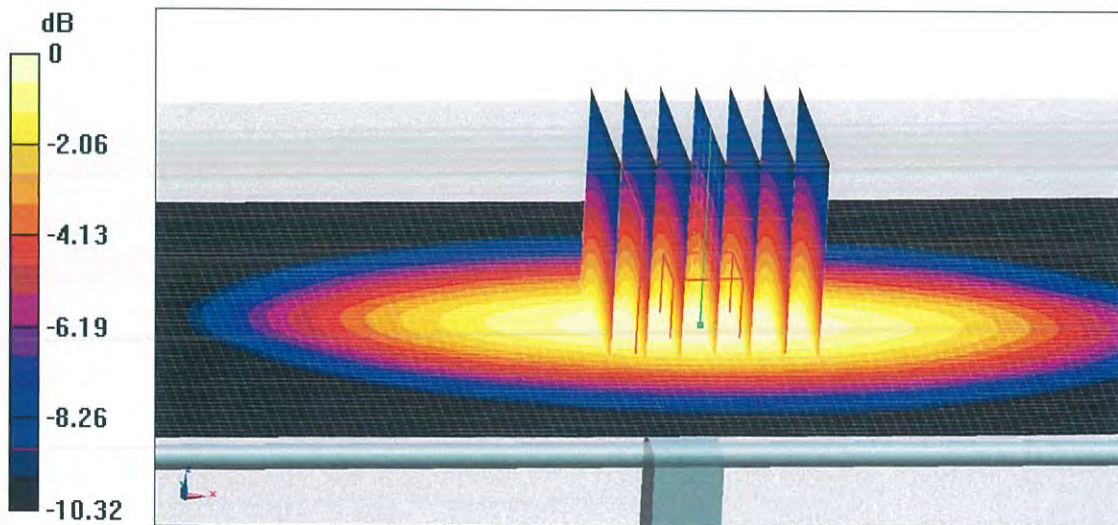
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 58.15 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 3.58 W/kg

SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 3.18 W/kg



0 dB = 3.18 W/kg = 5.02 dBW/kg