FCC SAR Test Report

Report No.	:	**SA171102C19**
Applicant	:	**Handheld Group AB**
Address	:	**Kinnegatan 17 A 531 33 Lidköping Sweden**
Product	:	**Rugged Tablet PC**
FCC ID	:	**YY3-1127824**
Brand	:	**Handheld**
Model No.	:	**Algiz 8X**
Standards	:	**FCC 47 CFR Part 2 (2.1093), IEEE C95.1:1992, IEEE Std 1528:2013** **KDB 865664 D01 v01r04, KDB 865664 D02 v01r02** **KDB 447498 D01 v06, KDB 616217 D04 v01r02** **KDB 941225 D01 v03r01, KDB 941225 D05 v02r05**
Sample Received Date	:	**Nov. 02, 2017**
Date of Testing	:	**Dec. 05, 2017 ~ Dec. 11, 2017**
Lab Address	:	**No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan, R.O.C.**
Test Location	:	**No. 19, Hwa Ya 2nd Rd, Wen Hwa Vil, Kwei Shan Dist., Taoyuan City 33383, Taiwan (R.O.C)**

CERTIFICATION: The above equipment have been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch – Lin Kou Laboratories**, 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 TAF or any government agencies.

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Testing Laboratory
2021

FCC Accredited No.: TW0003

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Release Control Record

Report No.	Reason for Change	Date Issued
SA171102C19	Initial release	Dec. 21, 2017

1. Summary of Maximum SAR Value

Equipment Class	Mode	Highest SAR-1g Body Tested at 0 mm (W/kg)
PCB	WCDMA II	0.56
	WCDMA V	0.22
	LTE 2	0.55
	LTE 4	1.12
	LTE 5	0.20
	LTE 13	0.03

Note:

1. The SAR criteria **(Head & Body: SAR-1g 1.6 W/kg, and 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. Description of Equipment Under Test

EUT Type	Rugged Tablet PC
FCC ID	YY3-1127824
Brand Name	Handheld
Model Name	Algiz 8X
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 (BW: 1.4M, 3M, 5M, 10M, 15M, 20M) LTE Band 4 : 1710.7 ~ 1754.3 (BW: 1.4M, 3M, 5M, 10M, 15M, 20M) LTE Band 5 : 824.7 ~ 848.3 (BW: 1.4M, 3M, 5M, 10M) LTE Band 13 : 779.5 ~ 784.5 (BW: 5M, 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	Fixed Internal Antenna
EUT Stage	Identical Prototype

Note:

1. 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:

Battery 1	**Brand Name**	Handheld Group AB
	Model Name	ALG8X-08A
	Power Rating	7.6Vdc, 5200mAh
	Type	Li-ion
Battery 2	**Brand Name**	Handheld Group AB
	Model Name	BH340
	Power Rating	7.4Vdc, 400mAh
	Type	Li-ion

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:

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

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

SAR measurement can be related to the electrical field in the tissue by

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

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 DASY52 System

DASY52 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 DASY52 software defined. The DASY52 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 form the optical into digital electric signal of the DAE and transfers data to the PC.

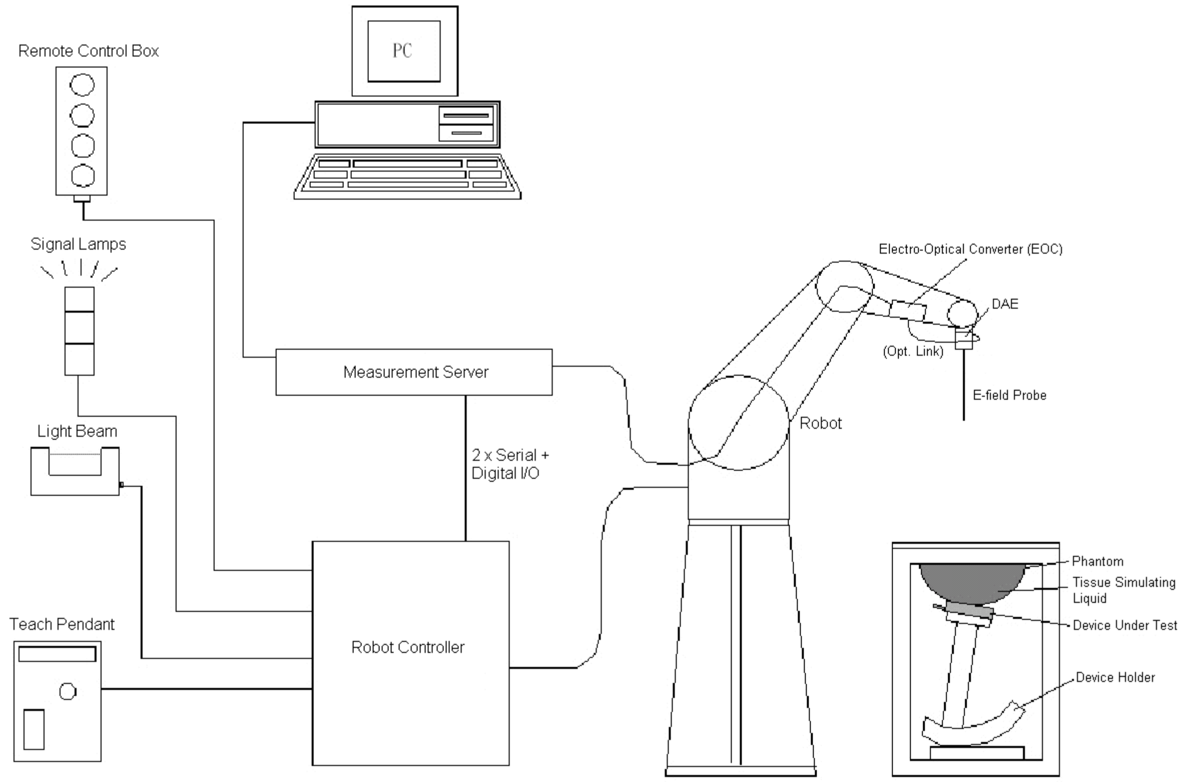


Fig-3.1 SPEAG DASY52 System Setup

3.2.1 Robot

The DASY52 systems use the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version of 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 SPEAG DASY52 System

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.

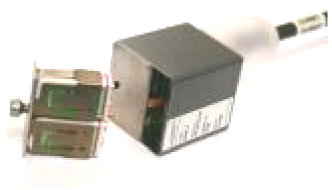
Model	EX3DV4
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/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 µW/g to 100 mW/g Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm

Model	ET3DV6
Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz to 2.3 GHz; Linearity: ± 0.2 dB
Directivity	± 0.2 dB in TSL (rotation around probe axis) ± 0.4 dB in TSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 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	< 5µV (with auto zero)
Input Bias Current	< 50 fA
Dimensions	60 x 60 x 68 mm



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	

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 l/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 < 1GHz), > 40 W (f > 1GHz)	

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.

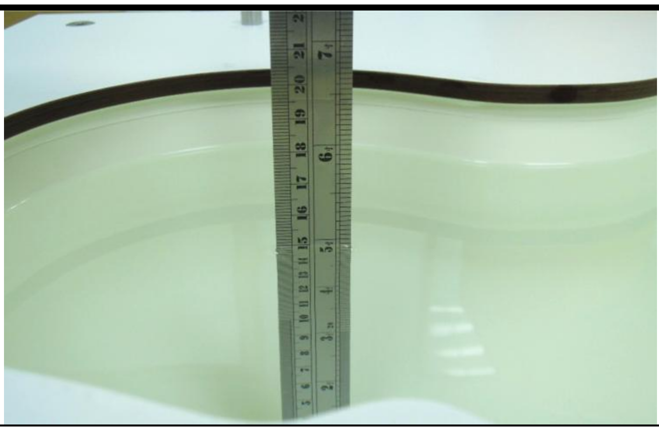
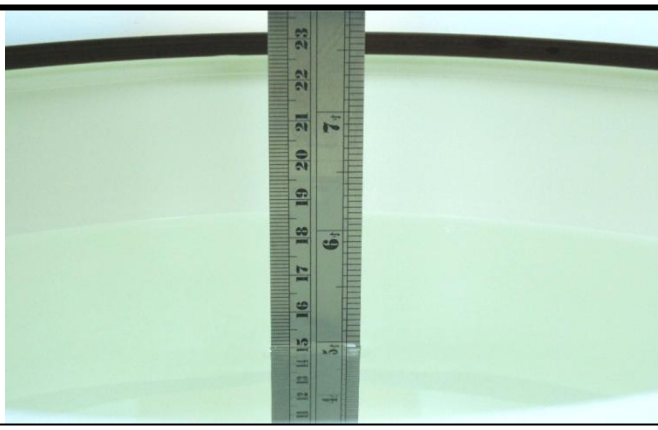
	

Photo of Liquid Height for Head Position	**Photo of Liquid Height for Body Position**

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.

Table-3.1 Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of ±5%	Target Conductivity	Range of ±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

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.

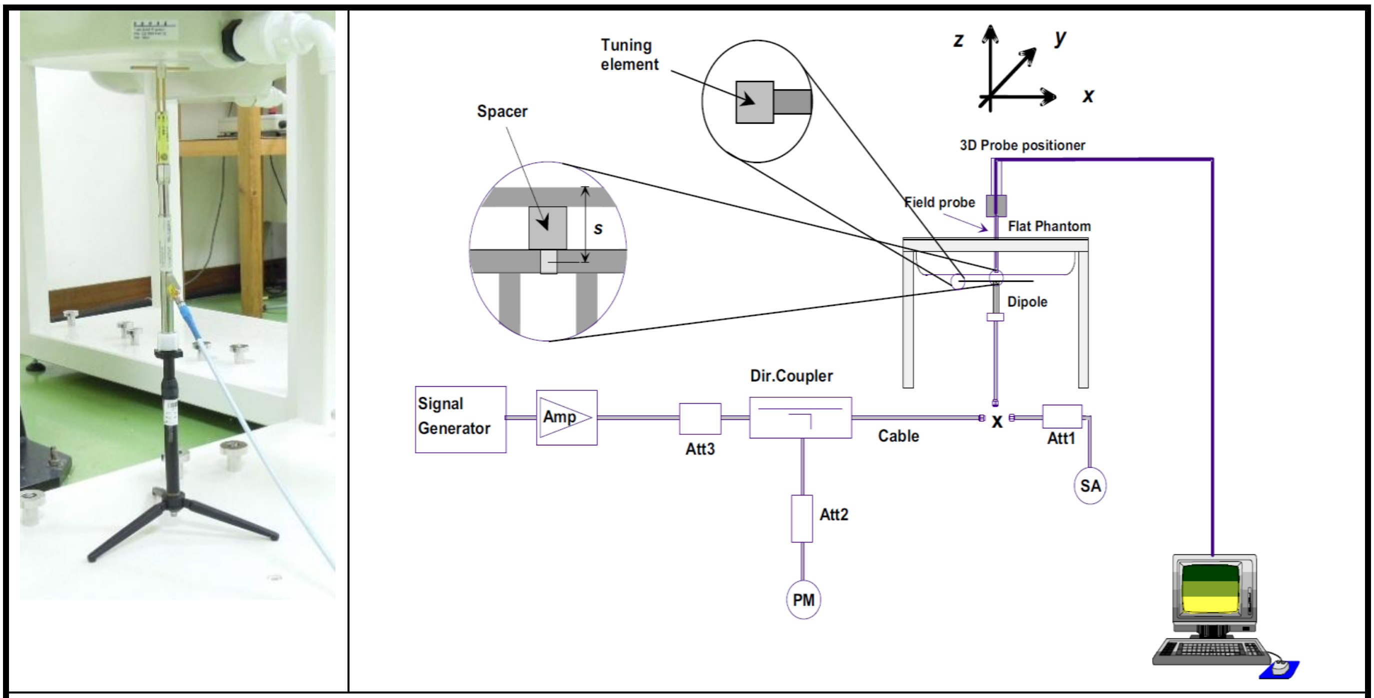


Fig-3.3 System Verification Setup

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 %.

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:
(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

The SAR measurement procedures for each of test conditions are as follows:
(a) Make EUT to transmit maximum output power
(b) Measure conducted output power through RF cable
(c) Place the EUT in the specific position of phantom
(d) Perform SAR testing steps on the DASY system
(e) 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 (Δx, Δy)	<= 15 mm	<= 12 mm	<= 12 mm	<= 10 mm	<= 10 mm
Zoom Scan (Δx, Δy)	<= 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 Δx / Δy (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 form 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. 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 Body-worn SAR

SAR for body-worn 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.

Handsets with Release 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body-worn configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSDPA using the HSDPA body SAR procedures in the “Release 5 HSDPA Data Devices”, for the highest reported SAR body-worn exposure configuration in 12.2 kbps RMC. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

Handsets with Release 6 HSUPA

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body-worn configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures in the “Release 6 HSPA Data Devices”, for the highest reported body-worn exposure SAR configuration in 12.2 kbps RMC. When VOIP is applicable for next to the ear head exposure in HSPA, the 3G SAR test reduction procedure is applied to HSPA with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body-worn measurements is tested for next to the ear head exposure.

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	β_{HS} (1)(2)	CM (3) (dB)	MPR (3) (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (4)	15/15 (4)	64	12/15 (4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{HS} = 30/15 * β_c.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and Δ_{NACK} = 30/15 with β_{HS} = 30/15 * β_c, and Δ_{CQI} = 24/15 with β_{HS} = 24/15 * β_c.

Note 3: CM = 1 for β_c/β_d = 12/15, β_{HS}/β_c = 24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

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	β_{HS} (1)	β_{ec}	β_{ed} (4)(5)	β_{ed} (SF)	β_{ed} (Codes)	CM (2) (dB)	MPR (2)(6) (dB)	AG (5) Index	E-TFCI
1	11/15 (3)	15/15 (3)	64	11/15 (3)	22/15	209/225	1309/225	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_{ed}1: 47/15 β_{ed}2: 47/15	4 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	0	-	-	5/15	5/15	47/15	4	1	1.0	0.0	12	67

Note 1: For sub-test 1 to 4, Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{HS} = 30/15 * β_c. For sub-test 5, Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 5/15 with β_{HS} = 5/15 * β_c.
Note 2: CM = 1 for β_c/β_d = 12/15, β_{HS}/β_c = 24/15. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.
Note 4: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.
Note 5: β_{ed} can not be set directly; it is set by Absolute Grant Value.
Note 6: For subtests 2, 3 and 4, UE may perform E-DPDCH power scaling at max power which could results in slightly smaller MPR values.

<Considerations Related to LTE for Setup and Testing>

This device contains LTE transmitter which follows 3GPP standards, is category 3, supports both QPSK and QAM 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 QAM 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**
5	**V**	**V**	**V**	**V**		
13			**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

For full-size tablet, according to KDB 616217 D04, SAR evaluation is required for back surface and edges of the devices. The back surface and edges of the tablet are tested with the tablet touching the phantom. Exposures from antennas through the front surface of the display section of a tablet are generally limited to the user's hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary. When voice mode is supported on a tablet and it is limited to speaker mode or headset operations only, additional SAR testing for this type of voice use is not required.

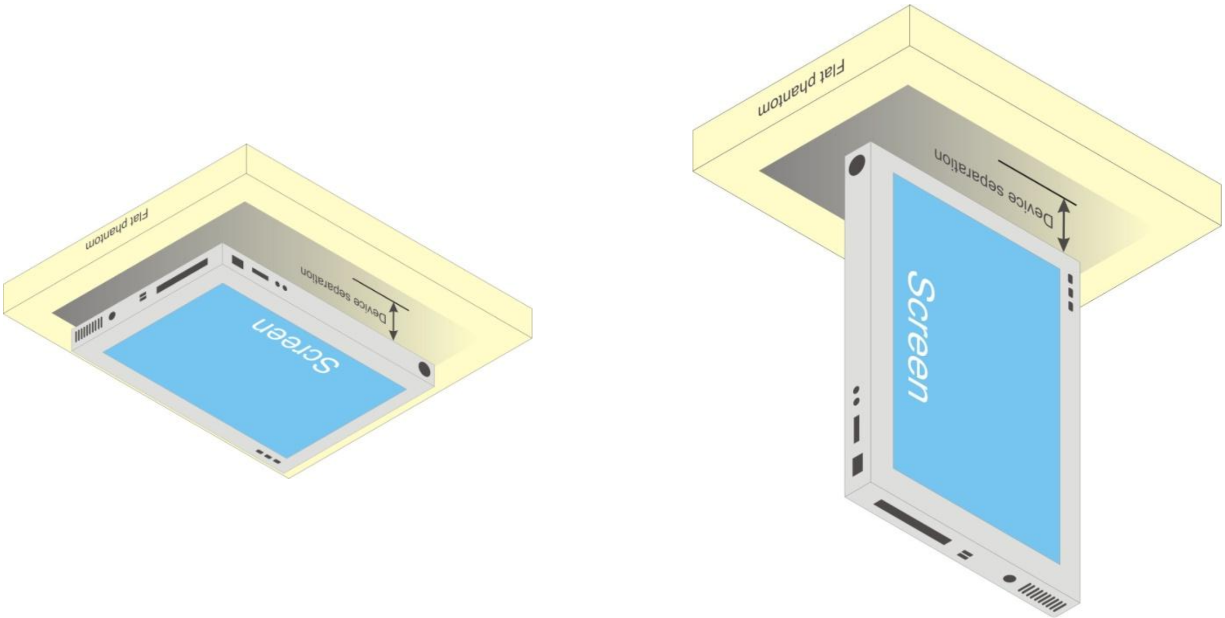


Fig-4.1 Illustration for Tablet Setup

4.2.1 SAR Test Exclusion Evaluations

According to KDB 447498 D01, the SAR test exclusion condition is based on source-based time-averaged maximum conducted output power, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The SAR exclusion threshold is determined by the following formula.

1. For the test separation distance <= 50 mm

$$\frac{\textbf{Max. Tune up Power}_{(\mathrm{mW})}}{\textbf{Min. Test Separation Distance}_{(\mathrm{mm})}} \times \sqrt{\mathrm{f}_{(\mathrm{GHz})}} \leq \textbf{3.0 for SAR-1g}, \leq \textbf{7.5 for SAR-10g}$$

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

2. For the test separation distance > 50 mm, and the frequency at 100 MHz to 1500 MHz

$$\left[(\text{Threshold at 50 mm in Step 1}) + (\text{Test Separation Distance} - 50\ \text{mm}) \times \left(\frac{\mathrm{f}_{(\mathrm{MHz})}}{150}\right)\right]_{(\mathrm{mW})}$$

3. For the test separation distance > 50 mm, and the frequency at > 1500 MHz to 6 GHz

$$[(\text{Threshold at 50 mm in Step 1}) + (\text{Test Separation Distance} - 50\ \text{mm}) \times 10]_{(\mathrm{mW})}$$

Mode	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Rear Face			Top Side			Bottom Side			Left Side			Right Side		
			Ant. to Surface (mm)	Calculated Result	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result	Require SAR Testing?
WCDMA II	21	126	15	11.6	Yes	148	1089 mw	No	5	34.81	Yes	157	1179 mw	No	15	11.6	Yes
WCDMA V	22.5	178	15	10.92	Yes	148	716 mw	No	5	32.76	Yes	157	767 mw	No	15	10.92	Yes
LTE 2	21	126	15	11.61	Yes	148	1089 mw	No	5	34.83	Yes	157	1179 mw	No	15	11.61	Yes
LTE 4	24	251	15	22.17	Yes	148	1093 mw	No	5	66.5	Yes	157	1183 mw	No	15	22.17	Yes
LTE 5	23	200	15	12.29	Yes	148	717 mw	No	5	36.86	Yes	157	768 mw	No	15	12.29	Yes
LTE 13	22	158	15	9.34	Yes	148	683 mw	No	5	28.03	Yes	157	730 mw	No	15	9.34	Yes

Note:

1. When separation distance <= 50 mm and the calculated result shown in above table is <= 3.0 for SAR-1g exposure condition, or <= 7.5 for SAR-10g exposure condition, the SAR testing exclusion is applied.
2. When separation distance > 50 mm and the device output power is less than the calculated result (power threshold, mW) shown in above table, the SAR testing exclusion is applied.

4.3 Tissue Verification

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

Test Date	Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)
Dec. 05, 2017	Body	750	23.2	0.957	55.471	0.96	55.5	-0.31	-0.05
Dec. 11, 2017	Body	750	23.2	0.973	56.01	0.96	55.5	1.35	0.92
Dec. 05, 2017	Body	835	23.3	1.012	56.703	0.97	55.2	4.33	2.72
Dec. 05, 2017	Body	1750	23.4	1.448	52.478	1.49	53.4	-2.82	-1.73
Dec. 05, 2017	Body	1900	23.4	1.584	52.046	1.52	53.3	4.21	-2.35
Dec. 07, 2017	Body	1900	23.3	1.559	52.138	1.52	53.3	2.57	-2.18

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within ±5% of the target values. Liquid temperature during the SAR testing must be within ±2 ℃.

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
Dec. 05, 2017	3971	Body	750	0.957	55.471	Pass	Pass	Pass	N/A	N/A	N/A
Dec. 11, 2017	3650	Body	750	0.973	56.01	Pass	Pass	Pass	N/A	N/A	N/A
Dec. 05, 2017	3971	Body	835	1.012	56.703	Pass	Pass	Pass	N/A	N/A	N/A
Dec. 05, 2017	3971	Body	1750	1.448	52.478	Pass	Pass	Pass	N/A	N/A	N/A
Dec. 05, 2017	3971	Body	1900	1.584	52.046	Pass	Pass	Pass	N/A	N/A	N/A
Dec. 07, 2017	3971	Body	1900	1.559	52.138	Pass	Pass	Pass	N/A	N/A	N/A

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
Dec. 05, 2017	Body	750	8.72	2.20	8.80	0.92	1013	3971	861
Dec. 11, 2017	Body	750	8.72	2.19	8.76	0.46	1013	3650	1431
Dec. 05, 2017	Body	835	9.61	2.26	9.04	-5.93	4d121	3971	861
Dec. 05, 2017	Body	1750	37.10	9.71	38.84	4.69	1055	3971	861
Dec. 05, 2017	Body	1900	40.10	9.94	39.76	-0.85	5d036	3971	861
Dec. 07, 2017	Body	1900	40.10	10.00	40.00	-0.25	5d036	3971	861

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.

4.6 Maximum Output Power

4.6.1 Maximum Target 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	21.0	22.5
HSDPA / HSUPA / DC-HSDPA	20.0	22.0

Mode	LTE 2	LTE 4	LTE 5	LTE 13
Maximum Target Power	21.0	24.0	23.0	22.0

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	20.64	20.72	20.52	22.24	22.09	22.16	-
HSDPA Subtest-1	19.46	19.51	19.47	21.20	21.05	21.12	0
HSDPA Subtest-2	19.48	19.53	19.22	21.16	21.01	21.08	0
HSDPA Subtest-3	18.97	19.02	18.98	20.68	20.53	20.60	0.5
HSDPA Subtest-4	18.96	19.01	18.97	20.64	20.49	20.56	0.5
HSUPA Subtest-1	19.16	19.28	19.20	20.89	20.74	20.81	0
HSUPA Subtest-2	17.83	17.93	17.87	19.92	19.97	19.94	2
HSUPA Subtest-3	18.04	18.16	18.10	19.82	19.67	19.74	1
HSUPA Subtest-4	17.75	17.83	17.99	19.91	19.96	19.93	2
HSUPA Subtest-5	19.50	19.60	19.50	21.27	21.12	21.19	0

LTE Band 2										
BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 18700 1860.0 MHz	Mid CH 18900 1880.0 MHz	High CH 19100 1900.0 MHz	3GPP MPR (dB)	Low CH 18607 1850.7 MHz	Mid CH 18900 1880.0 MHz	High CH 19193 1909.3 MHz	3GPP MPR (dB)
20	1	0	20.40	20.53	20.10	0	19.98	19.91	19.37	1
	1	50	20.43	19.98	20.24	0	19.81	19.32	19.37	1
	1	99	19.91	20.08	20.01	0	18.93	19.34	19.51	1
	50	0	19.38	19.49	19.21	1	18.30	18.23	18.07	2
	50	25	19.26	19.34	19.20	1	18.12	18.21	18.30	2
	50	50	19.21	19.38	19.14	1	18.05	18.18	18.27	2
	100	0	19.23	19.24	19.25	1	18.22	18.14	18.21	2
BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 18675 1857.5 MHz	Mid CH 18900 1880.0 MHz	High CH 19125 1902.5 MHz	3GPP MPR (dB)	Low CH 18675 1857.5 MHz	Mid CH 18900 1880.0 MHz	High CH 19125 1902.5 MHz	3GPP MPR (dB)
15	1	0	20.32	20.45	20.02	0	19.92	19.85	19.31	1
	1	37	20.35	19.90	20.16	0	19.75	19.26	19.31	1
	1	74	19.83	19.93	20.00	0	18.87	19.28	19.45	1
	36	0	19.41	19.30	19.13	1	18.24	18.17	18.01	2
	36	19	19.18	19.26	19.12	1	18.06	18.15	18.24	2
	36	39	19.13	19.30	19.06	1	17.99	18.12	18.21	2
	75	0	19.15	19.16	19.17	1	18.16	18.08	18.15	2
BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 18650 1855.0 MHz	Mid CH 18900 1880.0 MHz	High CH 19150 1905.0 MHz	3GPP MPR (dB)	Low CH 18650 1855.0 MHz	Mid CH 18900 1880.0 MHz	High CH 19150 1905.0 MHz	3GPP MPR (dB)
10	1	0	20.28	20.41	19.98	0	19.85	19.78	19.24	1
	1	24	20.31	19.86	20.12	0	19.68	19.19	19.24	1
	1	49	19.79	19.89	19.96	0	18.80	19.21	19.38	1
	25	0	19.37	19.26	19.09	1	18.17	18.10	17.94	2
	25	12	19.14	19.22	19.08	1	17.99	18.08	18.17	2
	25	25	19.09	19.26	19.02	1	17.92	18.05	18.14	2
	50	0	19.11	19.12	19.13	1	18.09	18.01	18.08	2
BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 18625 1852.5 MHz	Mid CH 18900 1880.0 MHz	High CH 19175 1907.5 MHz	3GPP MPR (dB)	Low CH 18625 1852.5 MHz	Mid CH 18900 1880.0 MHz	High CH 19175 1907.5 MHz	3GPP MPR (dB)
5	1	0	20.23	20.36	19.93	0	19.82	19.75	19.21	1
	1	12	20.26	19.81	20.07	0	19.65	19.16	19.21	1
	1	24	19.74	19.84	19.91	0	18.77	19.18	19.35	1
	12	0	19.32	19.21	19.04	1	18.14	18.07	17.91	2
	12	6	19.09	19.17	19.03	1	17.96	18.05	18.14	2
	12	13	19.04	19.21	18.97	1	17.89	18.02	18.11	2
	25	0	19.06	19.07	19.08	1	18.06	17.98	18.05	2
BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 18615 1851.5 MHz	Mid CH 18900 1880.0 MHz	High CH 19185 1908.5 MHz	3GPP MPR (dB)	Low CH 18615 1851.5 MHz	Mid CH 18900 1880.0 MHz	High CH 19185 1908.5 MHz	3GPP MPR (dB)
3	1	0	20.16	20.29	19.86	0	19.73	19.66	19.12	1
	1	7	20.19	19.74	20.00	0	19.56	19.07	19.12	1
	1	14	19.67	19.77	19.84	0	18.68	19.09	19.26	1
	8	0	19.25	19.14	18.97	1	18.05	17.98	17.82	2
	8	3	19.02	19.10	18.96	1	17.87	17.96	18.05	2
	8	7	18.97	19.14	18.90	1	17.80	17.93	18.02	2
	15	0	18.99	19.00	19.01	1	17.97	17.89	17.96	2
BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 18607 1850.7 MHz	Mid CH 18900 1880.0 MHz	High CH 19193 1909.3 MHz	3GPP MPR (dB)	Low CH 18607 1850.7 MHz	Mid CH 18900 1880.0 MHz	High CH 19193 1909.3 MHz	3GPP MPR (dB)
1.4	1	0	20.16	20.29	19.86	0	19.73	19.66	19.12	1
	1	2	20.19	19.74	20.00	0	19.56	19.07	19.12	1
	1	5	19.67	19.77	19.84	0	18.68	19.09	19.26	1
	3	0	20.25	20.14	19.97	0	19.05	18.98	18.82	1
	3	1	20.02	20.10	19.96	0	18.87	18.96	19.05	1
	3	3	19.97	20.14	19.90	0	18.80	18.93	19.02	1
	6	0	18.99	19.00	19.01	1	17.97	17.89	17.96	2

LTE Band 4

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 20050	Mid CH 20175	High CH 20300	3GPP MPR (dB)	Low CH 20050	Mid CH 20175	High CH 20300	3GPP MPR (dB)
			1720.0 MHz	1732.5 MHz	1745.0 MHz		1720.0 MHz	1732.5 MHz	1745.0 MHz	
20	1	0	23.22	23.17	23.15	0	22.17	22.12	22.10	1
	1	50	23.18	23.13	23.11	0	22.13	22.08	22.06	1
	1	99	23.01	22.96	22.94	0	21.96	21.91	21.89	1
	50	0	22.37	22.32	22.30	1	21.32	21.27	21.25	2
	50	25	22.26	22.21	22.19	1	21.21	21.16	21.14	2
	50	50	22.12	22.07	22.05	1	21.07	21.02	21.00	2
	100	0	22.10	22.05	22.03	1	21.05	21.00	20.98	2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 20025	Mid CH 20175	High CH 20325	3GPP MPR (dB)	Low CH 20025	Mid CH 20175	High CH 20325	3GPP MPR (dB)
			1717.5 MHz	1732.5 MHz	1747.5 MHz		1717.5 MHz	1732.5 MHz	1747.5 MHz	
15	1	0	23.09	23.04	23.02	0	22.04	21.99	21.97	1
	1	37	23.05	23.00	22.98	0	22.00	21.95	21.93	1
	1	74	22.88	22.83	22.81	0	21.83	21.78	21.76	1
	36	0	22.24	22.19	22.17	1	21.19	21.14	21.12	2
	36	19	22.13	22.08	22.06	1	21.08	21.03	21.01	2
	36	39	21.99	21.94	21.92	1	20.94	20.89	20.87	2
	75	0	21.97	21.92	21.90	1	20.92	20.87	20.85	2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 20000	Mid CH 20175	High CH 20350	3GPP MPR (dB)	Low CH 20000	Mid CH 20175	High CH 20350	3GPP MPR (dB)
			1715.0 MHz	1732.5 MHz	1750.0 MHz		1715.0 MHz	1732.5 MHz	1750.0 MHz	
10	1	0	22.98	22.93	22.91	0	21.93	21.88	21.86	1
	1	24	22.94	22.89	22.87	0	21.89	21.84	21.82	1
	1	49	22.77	22.72	22.70	0	21.72	21.67	21.65	1
	25	0	22.13	22.08	22.06	1	21.08	21.03	21.01	2
	25	12	22.02	21.97	21.95	1	20.97	20.92	20.90	2
	25	25	21.88	21.83	21.81	1	20.83	20.78	20.76	2
	50	0	21.86	21.81	21.79	1	20.81	20.76	20.74	2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 19975	Mid CH 20175	High CH 20375	3GPP MPR (dB)	Low CH 19975	Mid CH 20175	High CH 20375	3GPP MPR (dB)
			1712.5 MHz	1732.5 MHz	1752.5 MHz		1712.5 MHz	1732.5 MHz	1752.5 MHz	
5	1	0	22.89	22.84	22.82	0	21.84	21.79	21.77	1
	1	12	22.85	22.80	22.78	0	21.80	21.75	21.73	1
	1	24	22.68	22.63	22.61	0	21.63	21.58	21.56	1
	12	0	22.04	21.99	21.97	1	20.99	20.94	20.92	2
	12	6	21.93	21.88	21.86	1	20.88	20.83	20.81	2
	12	13	21.79	21.74	21.72	1	20.74	20.69	20.67	2
	25	0	21.77	21.72	21.70	1	20.72	20.67	20.65	2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 19965	Mid CH 20175	High CH 20385	3GPP MPR (dB)	Low CH 19965	Mid CH 20175	High CH 20385	3GPP MPR (dB)
			1711.5 MHz	1732.5 MHz	1753.5 MHz		1711.5 MHz	1732.5 MHz	1753.5 MHz	
3	1	0	22.77	22.72	22.70	0	21.72	21.67	21.65	1
	1	7	22.73	22.68	22.66	0	21.68	21.63	21.61	1
	1	14	22.56	22.51	22.49	0	21.51	21.46	21.44	1
	8	0	21.92	21.87	21.85	1	20.87	20.82	20.80	2
	8	3	21.81	21.76	21.74	1	20.76	20.71	20.69	2
	8	7	21.67	21.62	21.60	1	20.62	20.57	20.55	2
	15	0	21.65	21.60	21.58	1	20.60	20.55	20.53	2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 19957	Mid CH 20175	High CH 20393	3GPP MPR (dB)	Low CH 19957	Mid CH 20175	High CH 20393	3GPP MPR (dB)
			1710.7 MHz	1732.5 MHz	1754.3 MHz		1710.7 MHz	1732.5 MHz	1754.3 MHz	
1.4	1	0	22.69	22.64	22.62	0	21.64	21.59	21.57	1
	1	2	22.65	22.60	22.58	0	21.60	21.55	21.53	1
	1	5	22.48	22.43	22.41	0	21.43	21.38	21.36	1
	3	0	22.57	22.52	22.50	0	21.51	21.46	21.44	1
	3	1	22.46	22.41	22.39	0	21.40	21.35	21.33	1
	3	3	22.32	22.27	22.25	0	21.26	21.21	21.19	1
	6	0	21.57	21.52	21.50	1	20.52	20.47	20.45	2

LTE Band 5

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 20450 829.0 MHz	Mid CH 20525 836.5 MHz	High CH 20600 844.0 MHz	3GPP MPR (dB)	Low CH 20450 829.0 MHz	Mid CH 20525 836.5 MHz	High CH 20600 844.0 MHz	3GPP MPR (dB)
10	1	0	22.89	22.79	22.71	0	21.82	21.72	21.64	1
	1	24	22.71	22.61	22.53	0	21.64	21.54	21.46	1
	1	49	22.36	22.26	22.18	0	21.29	21.19	21.11	1
	25	0	21.67	21.57	21.49	1	20.60	20.50	20.42	2
	25	12	21.65	21.55	21.47	1	20.58	20.48	20.40	2
	25	25	21.59	21.49	21.41	1	20.52	20.42	20.34	2
	50	0	21.57	21.47	21.39	1	20.50	20.40	20.32	2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 20425 826.5 MHz	Mid CH 20525 836.5 MHz	High CH 20625 846.5 MHz	3GPP MPR (dB)	Low CH 20425 826.5 MHz	Mid CH 20525 836.5 MHz	High CH 20625 846.5 MHz	3GPP MPR (dB)
5	1	0	22.75	22.65	22.57	0	21.68	21.58	21.50	1
	1	12	22.57	22.47	22.39	0	21.50	21.40	21.32	1
	1	24	22.22	22.12	22.04	0	21.15	21.05	20.97	1
	12	0	21.53	21.43	21.35	1	20.46	20.36	20.28	2
	12	6	21.51	21.41	21.33	1	20.44	20.34	20.26	2
	12	13	21.45	21.35	21.27	1	20.38	20.28	20.20	2
	25	0	21.43	21.33	21.25	1	20.36	20.26	20.18	2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 20415 825.5 MHz	Mid CH 20525 836.5 MHz	High CH 20635 847.5 MHz	3GPP MPR (dB)	Low CH 20415 825.5 MHz	Mid CH 20525 836.5 MHz	High CH 20635 847.5 MHz	3GPP MPR (dB)
3	1	0	22.64	22.54	22.46	0	21.57	21.47	21.39	1
	1	7	22.46	22.36	22.28	0	21.39	21.29	21.21	1
	1	14	22.11	22.01	21.93	0	21.04	20.94	20.86	1
	8	0	21.42	21.32	21.24	1	20.35	20.25	20.17	2
	8	3	21.40	21.30	21.22	1	20.33	20.23	20.15	2
	8	7	21.34	21.24	21.16	1	20.27	20.17	20.09	2
	15	0	21.32	21.22	21.14	1	20.25	20.15	20.07	2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 20407 824.7 MHz	Mid CH 20525 836.5 MHz	High CH 20643 848.3 MHz	3GPP MPR (dB)	Low CH 20407 824.7 MHz	Mid CH 20525 836.5 MHz	High CH 20643 848.3 MHz	3GPP MPR (dB)
1.4	1	0	22.55	22.45	22.37	0	21.48	21.38	21.30	1
	1	2	22.37	22.27	22.19	0	21.30	21.20	21.12	1
	1	5	22.02	21.92	21.84	0	20.95	20.85	20.77	1
	3	0	22.06	21.96	21.88	0	20.98	20.88	20.80	1
	3	1	22.04	21.94	21.86	0	20.96	20.86	20.78	1
	3	3	21.98	21.88	21.80	0	20.90	20.80	20.73	1
	6	0	21.23	21.13	21.05	1	20.16	20.06	19.98	2

LTE Band 13

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
				Mid CH 23230 782.0 MHz		3GPP MPR (dB)		Mid CH 23230 782.0 MHz		3GPP MPR (dB)
10	1	0		21.88		0		20.98		1
	1	24		21.44		0		20.91		1
	1	49		21.47		0		20.53		1
	25	0		20.50		1		19.61		2
	25	12		20.49		1		19.54		2
	25	25		20.47		1		19.59		2
	50	0		20.4		1		19.61		2

BW (MHz)	RB Size	RB Offset	QPSK				16QAM			
			Low CH 23205 779.5 MHz	Mid CH 23230 782.0 MHz	High CH 23255 784.5 MHz	3GPP MPR (dB)	Low CH 23205 779.5 MHz	Mid CH 23230 782.0 MHz	High CH 23255 784.5 MHz	3GPP MPR (dB)
5	1	0	21.43	21.76	21.53	0	20.64	20.93	20.60	1
	1	12	21.36	21.56	21.61	0	20.47	20.86	20.95	1
	1	24	21.38	21.47	21.46	0	20.74	20.60	20.79	1
	12	0	20.51	20.53	20.46	1	19.32	19.53	19.51	2
	12	6	20.46	20.64	20.50	1	19.46	19.53	19.46	2
	12	13	20.39	20.42	20.51	1	19.53	19.51	19.52	2
	25	0	20.55	20.40	20.47	1	19.68	19.42	19.49	2

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 ≤ 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.

4.7.2 SAR Results for Body Exposure Condition (Test Separation Distance is 0 mm)

Plot No.	Band	Mode	Test Position	Ch.	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
	WCDMA II	RMC12.2K	Rear Face	9400	21.0	20.72	1.07	-0.05	0.218	0.23
	WCDMA II	RMC12.2K	Right Side	9400	21.0	20.72	1.07	-0.11	0.164	0.17
01	WCDMA II	RMC12.2K	Bottom Side	9400	21.0	20.72	1.07	-0.13	0.521	0.56
02	WCDMA V	RMC12.2K	Rear Face	4132	22.5	22.24	1.06	-0.09	0.211	0.22
	WCDMA V	RMC12.2K	Right Side	4132	22.5	22.24	1.06	0.08	0.172	0.18
	WCDMA V	RMC12.2K	Bottom Side	4132	22.5	22.24	1.06	0.03	0.153	0.16

Plot No.	Band	Mode	RB#	RB Offset	Test Position	Ch.	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
	LTE 2	QPSK20M	1	0	Rear Face	18900	21.0	20.53	1.11	0.01	0.217	0.24
	LTE 2	QPSK20M	1	0	Right Side	18900	21.0	20.53	1.11	-0.12	0.146	0.16
03	LTE 2	QPSK20M	1	0	Bottom Side	18900	21.0	20.53	1.11	0.03	0.496	0.55
	LTE 2	QPSK20M	50	0	Rear Face	18900	20.0	19.49	1.12	-0.01	0.171	0.19
	LTE 2	QPSK20M	50	0	Right Side	18900	20.0	19.49	1.12	-0.11	0.122	0.14
	LTE 2	QPSK20M	50	0	Bottom Side	18900	20.0	19.49	1.12	-0.15	0.381	0.43
	LTE 4	QPSK20M	1	0	Rear Face	20050	24.0	23.22	1.20	0.03	0.425	0.51
	LTE 4	QPSK20M	1	0	Right Side	20050	24.0	23.22	1.20	0.05	0.542	0.65
	LTE 4	QPSK20M	1	0	Bottom Side	20050	24.0	23.22	1.20	0.01	0.912	1.09
	LTE 4	QPSK20M	50	0	Rear Face	20050	23.0	22.37	1.16	0.18	0.335	0.39
	LTE 4	QPSK20M	50	0	Right Side	20050	23.0	22.37	1.16	0.01	0.356	0.41
	LTE 4	QPSK20M	50	0	Bottom Side	20050	23.0	22.37	1.16	-0.13	0.730	0.84
04	LTE 4	QPSK20M	1	0	Bottom Side	20175	24.0	23.17	1.21	0.17	0.922	1.12
	LTE 4	QPSK20M	1	0	Bottom Side	20300	24.0	23.15	1.22	0.14	0.821	1.00
	LTE 4	QPSK20M	50	0	Bottom Side	20175	23.0	22.32	1.17	0.08	0.713	0.83
	LTE 4	QPSK20M	50	0	Bottom Side	20300	23.0	22.30	1.17	0.06	0.719	0.84
	LTE 4	QPSK20M	100	0	Bottom Side	20050	23.0	22.10	1.23	-0.01	0.717	0.88
	LTE 4	QPSK20M	1	0	Bottom Side	20175	24.0	23.17	1.21	0.13	0.913	1.11
05	LTE 5	QPSK10M	1	0	Rear Face	20450	23.0	22.89	1.03	-0.09	0.196	0.20
	LTE 5	QPSK10M	1	0	Right Side	20450	23.0	22.89	1.03	0.07	0.148	0.15
	LTE 5	QPSK10M	1	0	Bottom Side	20450	23.0	22.89	1.03	0.06	0.130	0.13
	LTE 5	QPSK10M	25	0	Rear Face	20450	22.0	21.67	1.08	0.02	0.167	0.18
	LTE 5	QPSK10M	25	0	Right Side	20450	22.0	21.67	1.08	0.08	0.092	0.10
	LTE 5	QPSK10M	25	0	Bottom Side	20450	22.0	21.67	1.08	0.04	0.116	0.13
	LTE 13	QPSK10M	1	0	Rear Face	23230	22.0	21.88	1.03	0.03	0.001	0.00
	LTE 13	QPSK10M	1	0	Right Side	23230	22.0	21.88	1.03	0.01	0.001	0.00
06	LTE 13	QPSK10M	1	0	Bottom Side	23230	22.0	21.88	1.03	-0.12	0.033	0.03
	LTE 13	QPSK10M	25	0	Rear Face	23230	21.0	20.50	1.12	0	0.001	0.00
	LTE 13	QPSK10M	25	0	Right Side	23230	21.0	20.50	1.12	0	0.001	0.00
	LTE 13	QPSK10M	25	0	Bottom Side	23230	21.0	20.50	1.12	0.06	0.017	0.02

4.7.3 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.

SAR repeated measurement procedure:

1. When the highest measured SAR is < 0.80 W/kg, repeated measurement is not required.
2. When the highest measured SAR is >= 0.80 W/kg, repeat that measurement once.
3. If the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20, or when the original or repeated measurement is >= 1.45 W/kg, perform a second repeated measurement.
4. If the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20, and the original, first or second repeated measurement is >= 1.5 W/kg, perform a third repeated measurement.

Band	Mode	Test Position	Ch.	Original Measured SAR-1g (W/kg)	1st Repeated SAR-1g (W/kg)	L/S Ratio	2nd Repeated SAR-1g (W/kg)	L/S Ratio	3rd Repeated SAR-1g (W/kg)	L/S Ratio
LTE 4	QPSK20M	Bottom Side	20175	0.922	0.913	1.01	N/A	N/A	N/A	N/A

Test Engineer：Sam Onn, and Kevin Yao

5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D750V3	1013	Aug. 21, 2017	1 Year
System Validation Dipole	SPEAG	D835V2	4d121	Aug. 21, 2017	1 Year
System Validation Dipole	SPEAG	D1750V2	1055	Aug. 21, 2017	1 Year
System Validation Dipole	SPEAG	D1900V2	5d036	Jan. 23, 2017	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	3650	Jul. 24, 2017	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	3971	Mar. 24, 2017	1 Year
Data Acquisition Electronics	SPEAG	DAE4	861	May. 22, 2017	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1431	Mar. 20, 2017	1 Year
Radio Communication Analyzer	Anritsu	MT8820C	6201300638	Jul. 11, 2017	1 Year
Universal Radio Communication Tester	R&S	CMW500	152443	Sep. 20, 2017	1 Year
ENA Series Network Analyzer	Agilent	E5071C	MY46214281	Jun. 09, 2017	1 Year
Vector Signal Generator	Anritsu	MG3710A	6201599977	Mar. 27, 2017	1 Year
Power Meter	Anritsu	ML2495A	1218009	Jul. 12, 2017	1 Year
Power Sensor	Anritsu	MA2411B	1207252	Jul. 12, 2017	1 Year
Thermometer	YFE	YF-160A	130504591	Mar. 24, 2017	1 Year

6. Measurement Uncertainty

Source of Uncertainty	Uncertainty (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (± %, 1g)	Standard Uncertainty (± %, 10g)	Vi
Measurement System								
Probe Calibration	6.0	Normal	1	1	1	6.0	6.0	∞
Axial Isotropy	4.7	Rectangular	√3	√0.5	√0.5	1.9	1.9	∞
Hemispherical Isotropy	9.6	Rectangular	√3	√0.5	√0.5	3.9	3.9	∞
Boundary Effect	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Linearity	4.7	Rectangular	√3	1	1	2.7	2.7	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Probe Modulation Response	3.5	Rectangular	√3	1	1	2.0	2.0	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Integration Time	1.7	Rectangular	√3	1	1	1.0	1.0	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	Rectangular	√3	1	1	0.2	0.2	∞
Probe Positioning with Respect to Phantom	2.9	Rectangular	√3	1	1	1.7	1.7	∞
Post-processing	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Test Sample Related								
Test Sample Positioning	3.9 / 2.06	Normal	1	1	1	3.9	2.1	35
Device Holder Uncertainty	2.9 / 4.1	Normal	1	1	1	2.9	4.1	11
Power Drift of Measurement	5.0	Rectangular	√3	1	1	2.9	2.9	∞
Power Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Phantom and Setup								
Phantom Uncertainty (Shape and Thickness Tolerances)	6.1	Rectangular	√3	1	1	3.5	3.5	∞
Liquid Conductivity (Temperature Uncertainty)	3.24	Rectangular	√3	0.78	0.71	1.5	1.3	∞
Liquid Conductivity (Measured)	2.88	Normal	1	0.78	0.71	2.2	2.0	43
Liquid Permittivity (Temperature Uncertainty)	1.13	Rectangular	√3	0.23	0.26	0.2	0.2	∞
Liquid Permittivity (Measured)	2.50	Normal	1	0.23	0.26	0.6	0.7	54
Combined Standard Uncertainty						± 11.4 %	± 11.2 %	
Expanded Uncertainty (K=2)						**± 22.8 %**	**± 22.4 %**	

Head SAR Uncertainty Budget for Frequency Range of 300 MHz to 3 GHz

Source of Uncertainty	Uncertainty (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (± %, 1g)	Standard Uncertainty (± %, 10g)	Vi
Measurement System								
Probe Calibration	6.55	Normal	1	1	1	6.55	6.55	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	3.9	3.9	∞
Boundary Effect	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Linearity	4.7	Rectangular	√3	1	1	2.7	2.7	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Probe Modulation Response	3.5	Rectangular	√3	1	1	2.0	2.0	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Integration Time	1.7	Rectangular	√3	1	1	1.0	1.0	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	Rectangular	√3	1	1	0.2	0.2	∞
Probe Positioning with Respect to Phantom	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Post-processing	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	3.9 / 2.06	Normal	1	1	1	3.9	2.1	35
Device Holder Uncertainty	2.9 / 4.1	Normal	1	1	1	2.9	4.1	11
Power Drift of Measurement	5.0	Rectangular	√3	1	1	2.9	2.9	∞
Power Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Phantom and Setup								
Phantom Uncertainty (Shape and Thickness Tolerances)	6.6	Rectangular	√3	1	1	3.8	3.8	∞
Liquid Conductivity (Temperature Uncertainty)	3.24	Rectangular	√3	0.78	0.71	1.5	1.3	∞
Liquid Conductivity (Measured)	2.88	Normal	1	0.78	0.71	2.2	2.0	43
Liquid Permittivity (Temperature Uncertainty)	1.13	Rectangular	√3	0.23	0.26	0.2	0.2	∞
Liquid Permittivity (Measured)	2.50	Normal	1	0.23	0.26	0.6	0.7	54
Combined Standard Uncertainty						± 12.5 %	± 12.3 %	
Expanded Uncertainty (K=2)						**± 25.0 %**	**± 24.6 %**	

Head SAR Uncertainty Budget for Frequency Range of 3 GHz to 6 GHz

Source of Uncertainty	Uncertainty (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (± %, 1g)	Standard Uncertainty (± %, 10g)	Vi
Measurement System								
Probe Calibration	6.0	Normal	1	1	1	6.0	6.0	∞
Axial Isotropy	4.7	Rectangular	√3	√0.5	√0.5	1.9	1.9	∞
Hemispherical Isotropy	9.6	Rectangular	√3	√0.5	√0.5	3.9	3.9	∞
Boundary Effect	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Linearity	4.7	Rectangular	√3	1	1	2.7	2.7	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Probe Modulation Response	3.5	Rectangular	√3	1	1	2.0	2.0	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Integration Time	1.7	Rectangular	√3	1	1	1.0	1.0	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	Rectangular	√3	1	1	0.2	0.2	∞
Probe Positioning with Respect to Phantom	2.9	Rectangular	√3	1	1	1.7	1.7	∞
Post-processing	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Test Sample Related								
Test Sample Positioning	4.38 / 1.35	Normal	1	1	1	4.4	1.4	29
Device Holder Uncertainty	2.9 / 4.1	Normal	1	1	1	2.9	4.1	11
Power Drift of Measurement	5.0	Rectangular	√3	1	1	2.9	2.9	∞
Power Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Phantom and Setup								
Phantom Uncertainty (Shape and Thickness Tolerances)	7.2	Rectangular	√3	1	1	4.2	4.2	∞
Liquid Conductivity (Temperature Uncertainty)	3.24	Rectangular	√3	0.78	0.71	1.5	1.3	∞
Liquid Conductivity (Measured)	2.88	Normal	1	0.78	0.71	2.2	2.0	43
Liquid Permittivity (Temperature Uncertainty)	1.13	Rectangular	√3	0.23	0.26	0.2	0.2	∞
Liquid Permittivity (Measured)	2.50	Normal	1	0.23	0.26	0.6	0.7	54
Combined Standard Uncertainty						± 11.8 %	± 11.3 %	
Expanded Uncertainty (K=2)						**± 23.6 %**	**± 22.6 %**	

Body SAR Uncertainty Budget for Frequency Range of 300 MHz to 3 GHz

Source of Uncertainty	Uncertainty (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (± %, 1g)	Standard Uncertainty (± %, 10g)	Vi
Measurement System								
Probe Calibration	6.55	Normal	1	1	1	6.55	6.55	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	3.9	3.9	∞
Boundary Effect	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Linearity	4.7	Rectangular	√3	1	1	2.7	2.7	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Probe Modulation Response	3.5	Rectangular	√3	1	1	2.0	2.0	∞
Readout Electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Integration Time	1.7	Rectangular	√3	1	1	1.0	1.0	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	Rectangular	√3	1	1	0.2	0.2	∞
Probe Positioning with Respect to Phantom	6.7	Rectangular	√3	1	1	3.9	3.9	∞
Post-processing	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	4.38 / 1.35	Normal	1	1	1	4.4	1.4	29
Device Holder Uncertainty	2.9 / 4.1	Normal	1	1	1	2.9	4.1	11
Power Drift of Measurement	5.0	Rectangular	√3	1	1	2.9	2.9	∞
Power Scaling	0.0	Rectangular	√3	1	1	0.0	0.0	∞
Phantom and Setup								
Phantom Uncertainty (Shape and Thickness Tolerances)	7.6	Rectangular	√3	1	1	4.4	4.4	∞
Liquid Conductivity (Temperature Uncertainty)	3.24	Rectangular	√3	0.78	0.71	1.5	1.3	∞
Liquid Conductivity (Measured)	2.88	Normal	1	0.78	0.71	2.2	2.0	43
Liquid Permittivity (Temperature Uncertainty)	1.13	Rectangular	√3	0.23	0.26	0.2	0.2	∞
Liquid Permittivity (Measured)	2.50	Normal	1	0.23	0.26	0.6	0.7	54
Combined Standard Uncertainty						± 12.8 %	± 12.4 %	
Expanded Uncertainty (K=2)						**± 25.6 %**	**± 24.8 %**	

Body SAR Uncertainty Budget for Frequency Range of 3 GHz to 6 GHz

7. Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 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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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_B750_171205

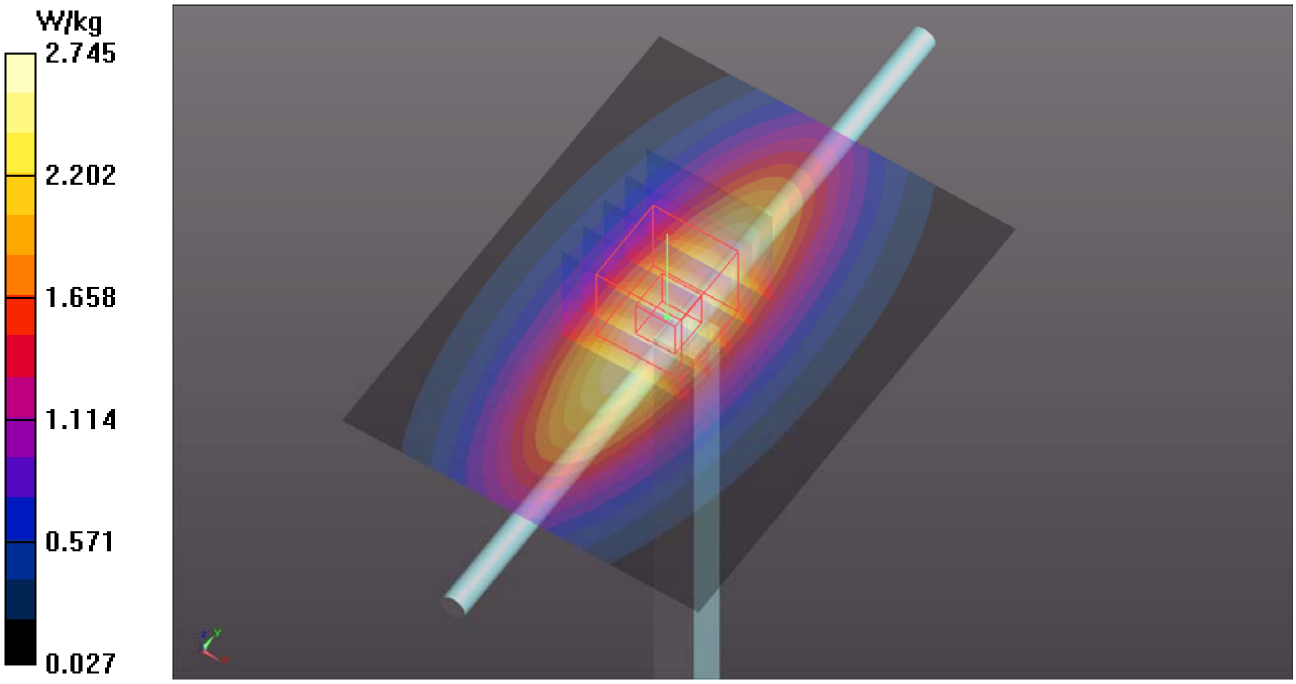
DUT: Dipole 750 MHz; Type: D750V3; SN: 1013

Communication System: CW; Frequency: 750 MHz;Duty Cycle: 1:1
Medium: B06T09N1_1205 Medium parameters used: f = 750 MHz; σ = 0.957 S/m; ε_r = 55.471; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃； Liquid Temperature：23.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(10.61, 10.61, 10.61); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1039; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Pin=250mW/Area Scan (61x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.75 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 54.36 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.17 W/kg
SAR(1 g) = 2.2 W/kg; SAR(10 g) = 1.49 W/kg
Maximum value of SAR (measured) = 2.75 W/kg



System Check_B835_171205

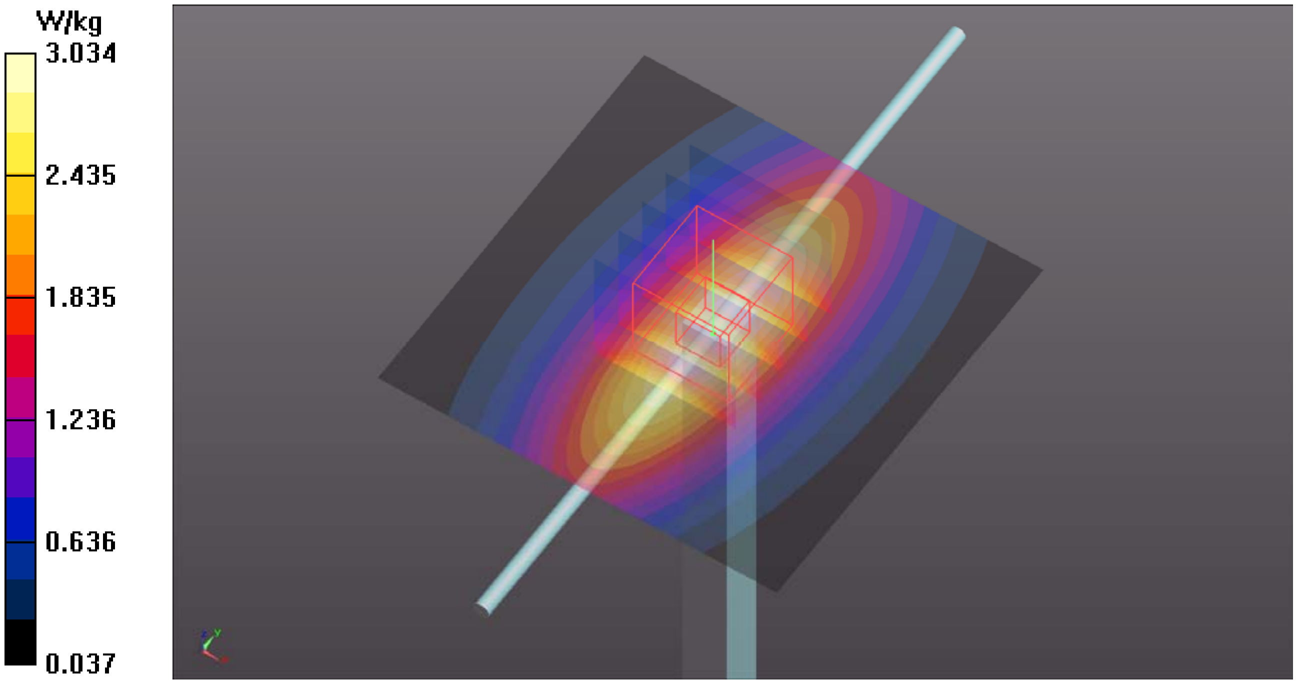
DUT: Dipole 835 MHz; Type: D835V2; SN: 4d121

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: B07T10N1_1205 Medium parameters used: f = 835 MHz; σ = 1.012 S/m; ε_r = 56.703; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃； Liquid Temperature：23.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(10.52, 10.52, 10.52); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1039; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.03 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 50.90 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 3.40 W/kg
SAR(1 g) = 2.26 W/kg; SAR(10 g) = 1.49 W/kg
Maximum value of SAR (measured) = 3.02 W/kg



System Check_B1750_171205

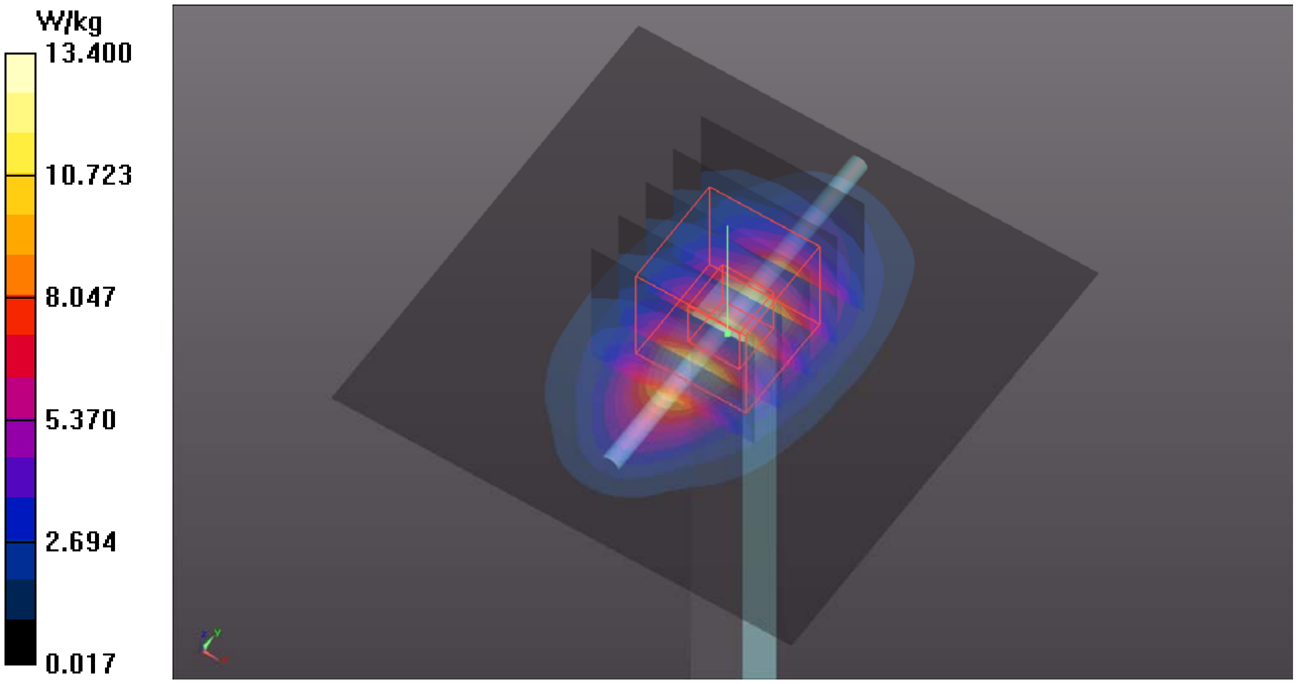
DUT: Dipole 1750 MHz; Type: D1750V2; SN: 1055

Communication System: CW; Frequency: 1750 MHz;Duty Cycle: 1:1
Medium: B16T20N2_1205 Medium parameters used: f = 1750 MHz; σ = 1.448 S/m; ε_r = 52.478; ρ = 1000 kg/m^3
Ambient Temperature：23.7 ℃； Liquid Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(8.51, 8.51, 8.51); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1039; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 13.4 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 104.0 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 17.0 W/kg
SAR(1 g) = 9.71 W/kg; SAR(10 g) = 5.21 W/kg
Maximum value of SAR (measured) = 14.6 W/kg



System Check_B1900_171205

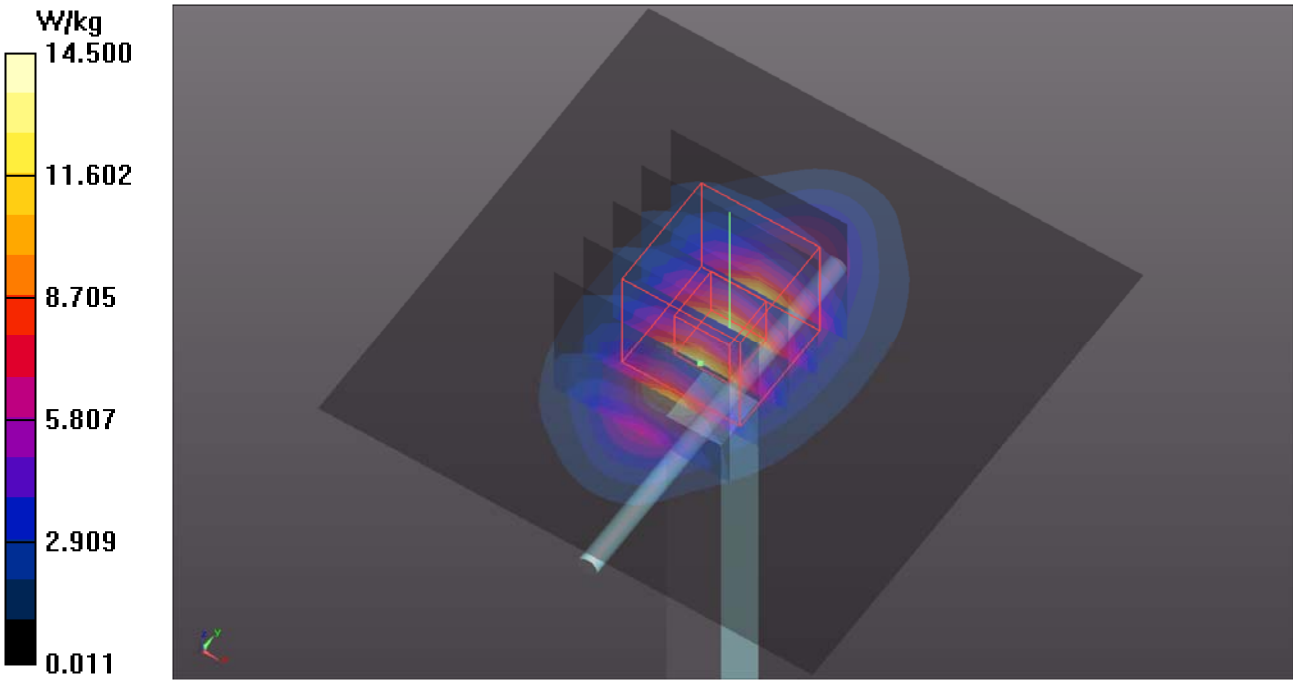
DUT: Dipole 1900 MHz; Type: D1900V2; SN: 5d036

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: B16T20N2_1205 Medium parameters used: f = 1900 MHz; σ = 1.584 S/m; ε_r = 52.046; ρ = 1000 kg/m^3
Ambient Temperature：23.7 ℃； Liquid Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(8.26, 8.26, 8.26); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1039; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 14.5 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 95.66 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 17.7 W/kg
SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.22 W/kg
Maximum value of SAR (measured) = 14.1 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_Bottom Side_0mm_Ch9400

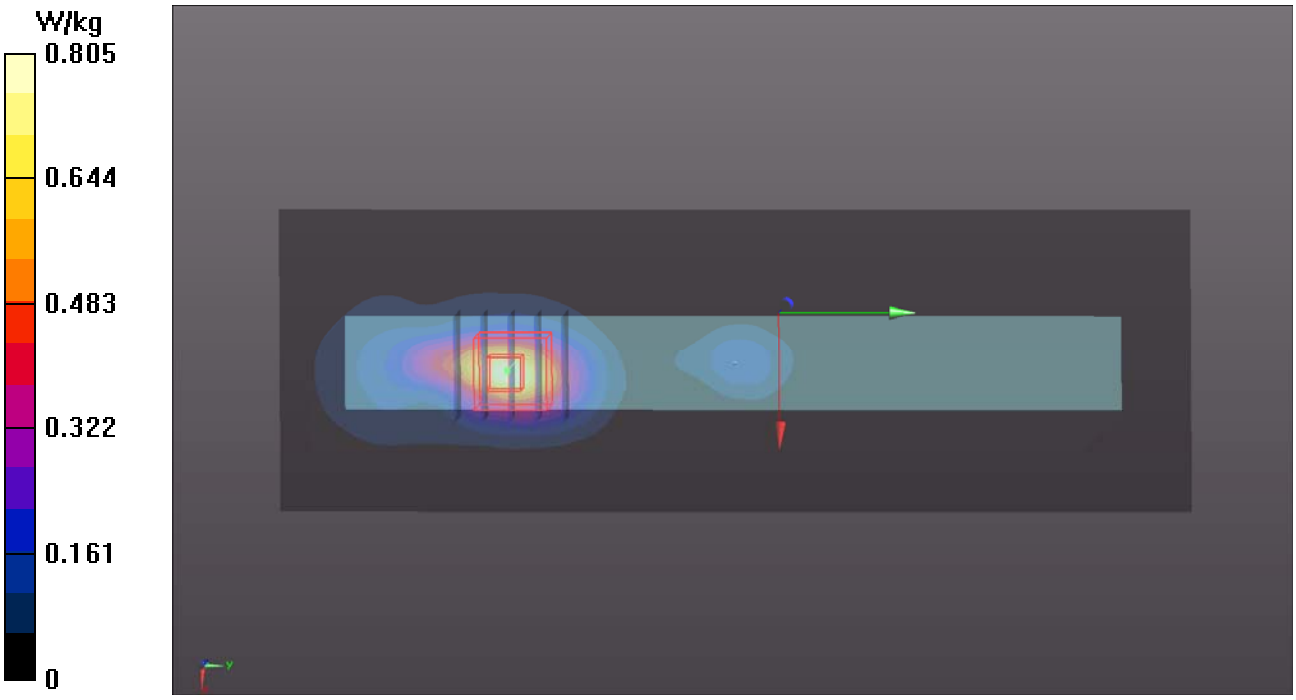
DUT: 171102C19

Communication System: WCDMA; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: B16T20N1_1207 Medium parameters used: f = 1880 MHz; σ = 1.545 S/m; ε_r = 52.159; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃；Liquid Temperature：23.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(8.26, 8.26, 8.26); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1206; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (61x181x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.805 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.75 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 0.990 W/kg
SAR(1 g) = 0.521 W/kg; SAR(10 g) = 0.261 W/kg
Maximum value of SAR (measured) = 0.805 W/kg



P02 WCDMA V_RMC12.2K_Rear Face_0mm_Ch4132

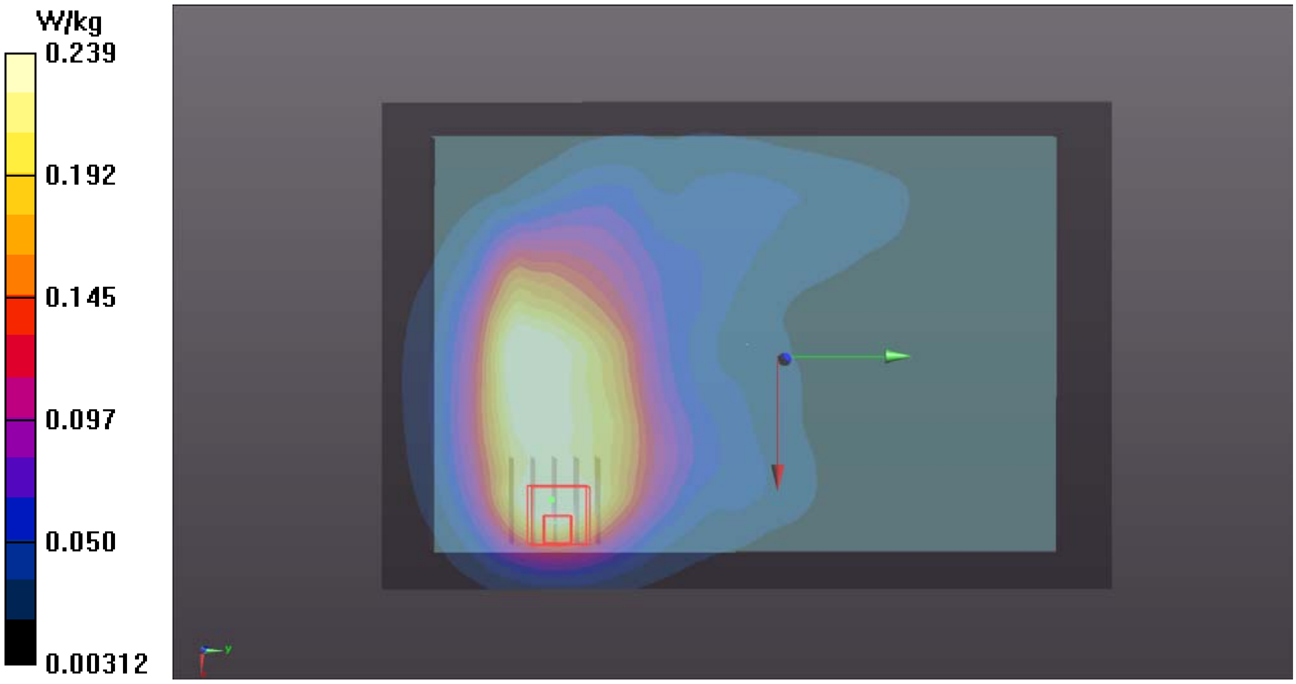
DUT: 171102C19

Communication System: WCDMA; Frequency: 826.4 MHz;Duty Cycle: 1:1
Medium: B07T10N1_1205 Medium parameters used: f = 826.4 MHz; σ = 1.004 S/m; ε_r = 56.758; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃； Liquid Temperature：23.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(10.52, 10.52, 10.52); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1039; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (121x181x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.275 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.68 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.536 W/kg
SAR(1 g) = 0.211 W/kg; SAR(10 g) = 0.073 W/kg
Maximum value of SAR (measured) = 0.239 W/kg



P03 LTE 2_QPSK20M_1RB_OS0_Bottom Side_0mm_Ch18900

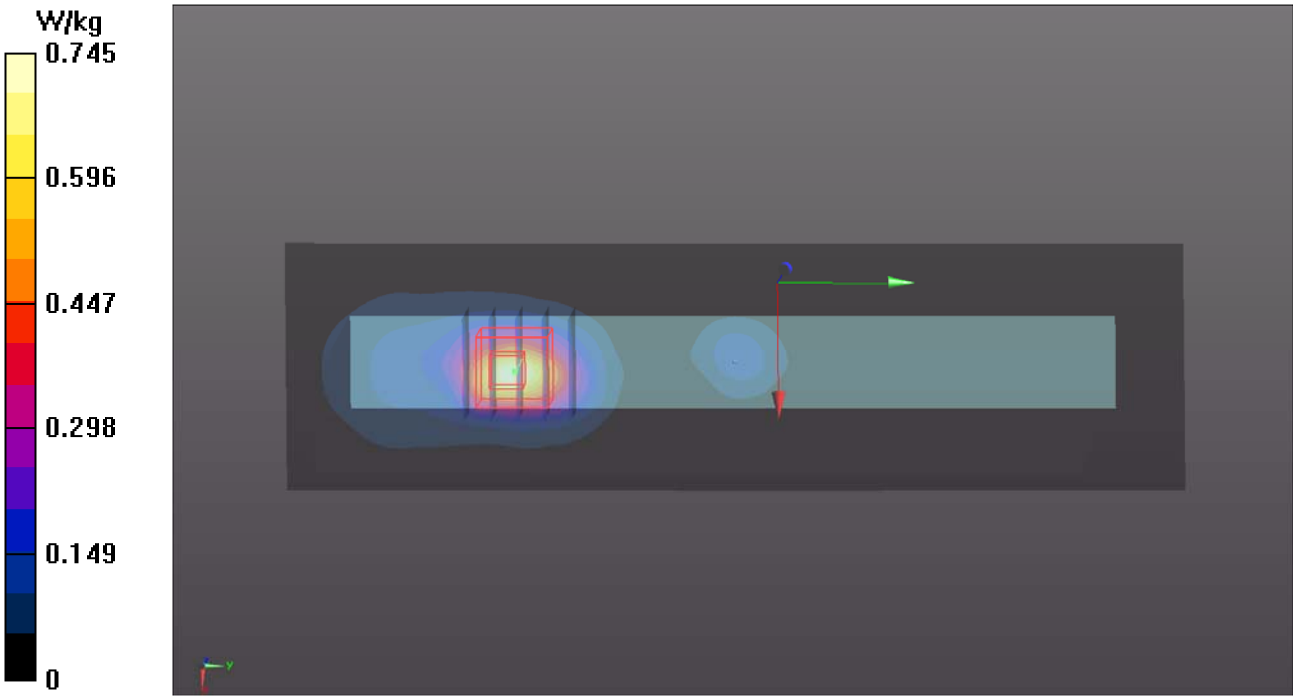
DUT: 171102C19

Communication System: LTE; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: B16T20N1_1207 Medium parameters used: f = 1880 MHz; σ = 1.545 S/m; ε_r = 52.159; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃； Liquid Temperature：23.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(8.26, 8.26, 8.26); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1206; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (51x181x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.745 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.67 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.946 W/kg
SAR(1 g) = 0.496 W/kg; SAR(10 g) = 0.249 W/kg
Maximum value of SAR (measured) = 0.758 W/kg



P04 LTE 4_QPSK20M_1RB_OS0_Bottom Side_0mm_Ch20175

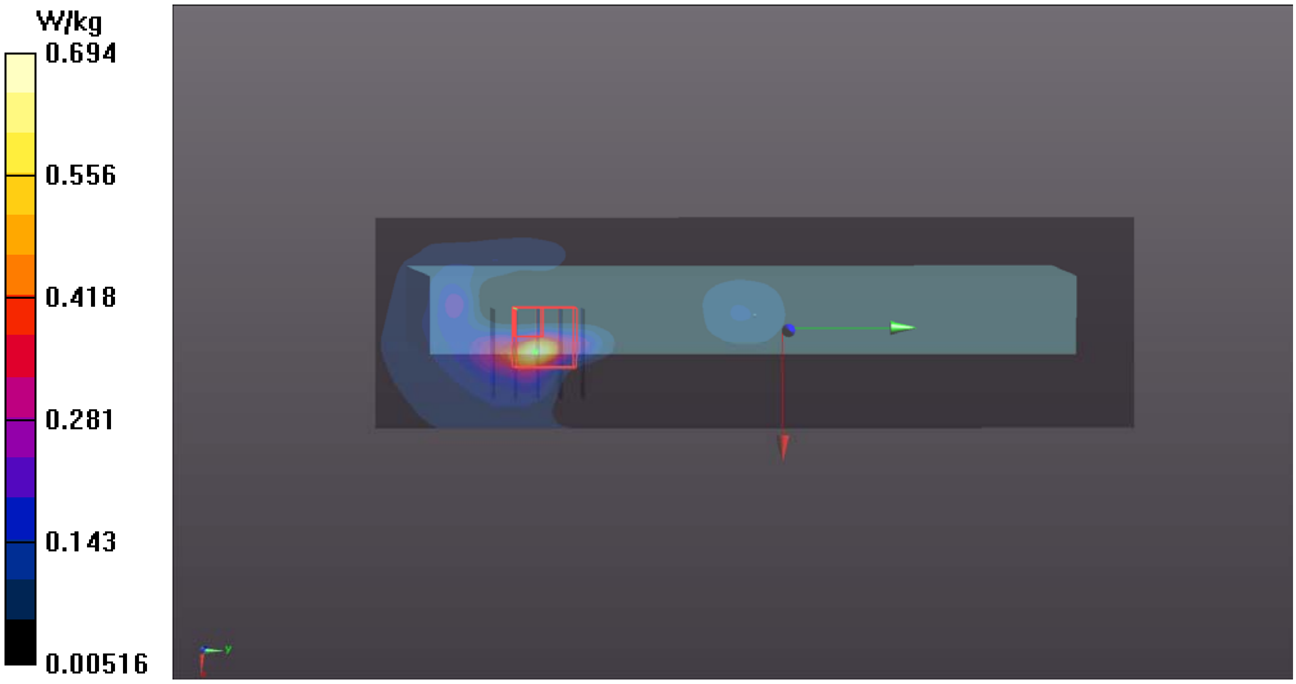
DUT: 171102C19

Communication System: LTE; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium: B16T20N2_1205 Medium parameters used: f = 1732.5 MHz; σ = 1.432 S/m; ε_r = 52.509; ρ = 1000 kg/m^3
Ambient Temperature：23.7 ℃； Liquid Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(8.51, 8.51, 8.51); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1039; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (51x181x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.694 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.61 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 3.58 W/kg
SAR(1 g) = 0.922 W/kg; SAR(10 g) = 0.265 W/kg
Maximum value of SAR (measured) = 0.963 W/kg



P05 LTE 5_QPSK10M_1RB_OS0_Rear Face_0mm_Ch20450

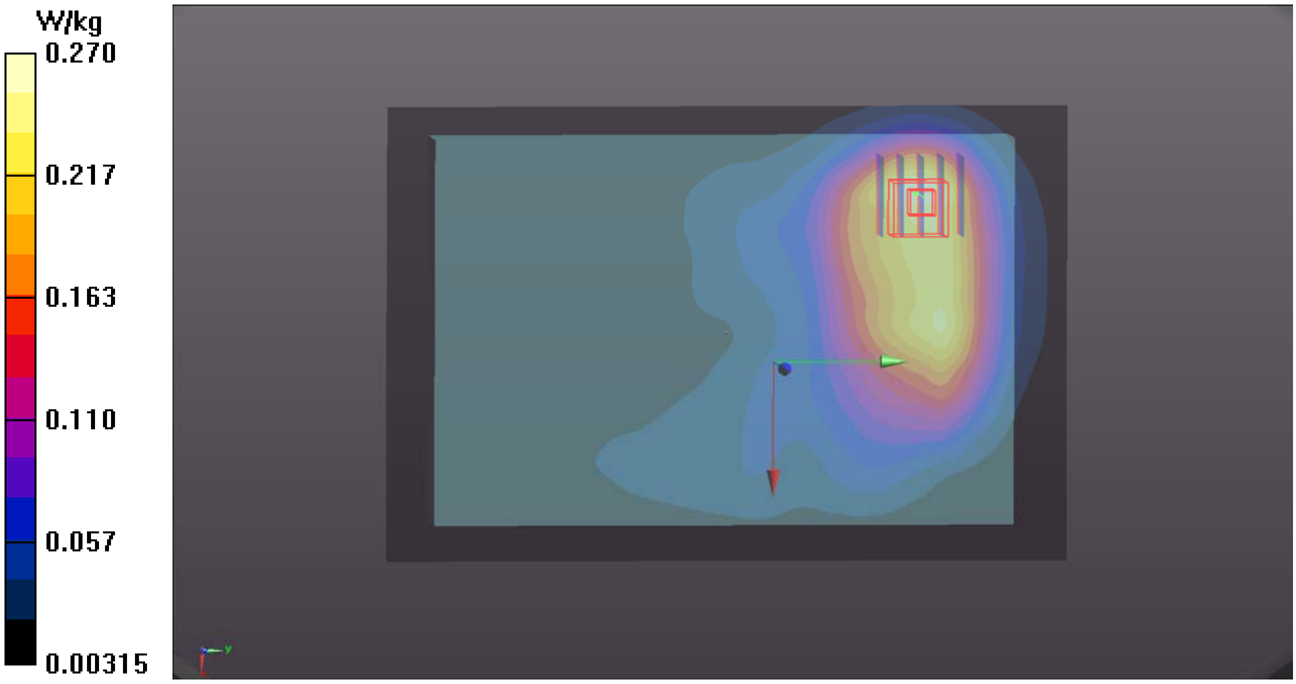
DUT: 171102C19

Communication System: LTE; Frequency: 829 MHz;Duty Cycle: 1:1
Medium: B07T10N1_1205 Medium parameters used: f = 829 MHz; σ = 1.007 S/m; ε_r = 56.738; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃； Liquid Temperature：23.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3971; ConvF(10.52, 10.52, 10.52); Calibrated: 2017/03/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2017/05/22
- Phantom: ELI Phantom_1039; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (121x181x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.270 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.35 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.290 W/kg
SAR(1 g) = 0.196 W/kg; SAR(10 g) = 0.141 W/kg
Maximum value of SAR (measured) = 0.256 W/kg



P06 LTE 13_QPSK10M_1RB_OS0_Bottom Side_0mm_Ch23230

DUT: 171102C19

Communication System: LTE; Frequency: 782 MHz;Duty Cycle: 1:1
Medium: B06T09N1_1211 Medium parameters used: f = 782 MHz; σ = 1.004 S/m; ε_r = 55.71; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃； Liquid Temperature：23.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(9.89, 9.89, 9.89); Calibrated: 2017/07/24;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1431; Calibrated: 2017/03/20
- Phantom: ELI Phantom_1039; Type: QDOVA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (41x171x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0480 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.346 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.0600 W/kg
SAR(1 g) = 0.033 W/kg; SAR(10 g) = 0.013 W/kg
Maximum value of SAR (measured) = 0.0515 W/kg