Variant FCC Test Report

Report No.	:	**SA170220C11D**
Applicant	:	**HTC Corporation**
Address	:	**1F, 6-3 Baoqiang Road, Xindian District, New Taipei City, Taiwan 231**
Product	:	**Smartphone**
FCC ID	:	**NM8HTV33**
Brand	:	**HTC**
Model No.	:	**HTV33**
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 248227 D01 v02r02 KDB 447498 D01 v06, KDB 648474 D04 v01r03, KDB 941225 D01 v03r01 KDB 941225 D05 v02r05, KDB 941225 D05A v01r02, KDB 941225 D06 v02r01**
Sample Received Date	:	**Feb. 20, 2017**
Date of Testing	:	**Mar. 12, 2017 ~ Mar. 17, 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.

This report is issued as a supplementary report to BV CPS report no.: SA170220C11. The difference compared with original report is to enable LTE uplink and downlink CA supported for LTE band 41 only. Hence please refer to original report for complete compliance evaluation, and this report only included LTE CA verified data of LTE band 41 for C2PC application.

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Testing Laboratory
2021

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Release Control Record

Report No.	Reason for Change	Date Issued
SA170220C11D	Initial release	Jul. 05, 2017

1. Summary of Maximum SAR Value

Equipment Class	Mode	Highest SAR-1g Head (W/kg)	Highest SAR-1g Body-worn Tested at 10 mm (W/kg)	Highest SAR-1g Hotspot Tested at 10 mm (W/kg)	Highest SAR-10g Product Specific Tested at 0 mm (W/kg)
PCE	LTE 41	0.52	0.26	0.35	N/A

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	Smartphone
FCC	NM8HTV33
Brand Name	HTC
Model Name	HTV33
Tx Frequency Bands (Unit: MHz)	GSM850 : 824.2 ~ 848.8 GSM1900 : 1850.2 ~ 1909.8 WCDMA Band II : 1852.4 ~ 1907.6 WCDMA Band IV : 1712.4 ~ 1752.6 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 5 : 824.7 ~ 848.3 (1.4M), 825.5 ~ 847.5 (3M), 826.5 ~ 846.5 (5M), 829 ~ 844 (10M) LTE Band 12 : 699.7 ~ 715.3 (1.4M), 700.5 ~ 714.5 (3M), 701.5 ~ 713.5 (5M), 704 ~ 711 (10M) LTE Band 13 : 779.5 ~ 784.5 (5M), 782 (10M) LTE Band 17 : 706.5 ~ 713.5 (5M), 709 ~ 711 (10M) LTE Band 26 : 814.7 ~ 848.3 (1.4M), 815.5 ~ 847.5 (3M), 816.5 ~ 846.5 (5M), 819 ~ 844 (10M), 821.5 ~ 841.5 (15M) LTE Band 41 : 2498.5 ~ 2687.5 (5M), 2501 ~ 2685 (10M), 2503.5 ~ 2682.5 (15M), 2506 ~ 2680 (20M) WLAN : 2412 ~ 2462, 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5700, 5745 ~ 5825 Bluetooth : 2402 ~ 2480 ANT+ : 2402 ~ 2480 NFC : 13.56
Uplink Modulations	GSM & GPRS : GMSK EDGE : 8PSK WCDMA : QPSK LTE : QPSK, 16QAM, 64QAM 802.11b : DSSS 802.11a/g/n/ac : OFDM Bluetooth : GFSK, π/4-DQPSK, 8-DPSK ANT+ : GFSK NFC : ASK
Maximum Tune-up Conducted Power (Unit: dBm)	GSM850 : 33.5 GSM1900 : 30.0 WCDMA Band II : 24.0 WCDMA Band IV : 24.0 WCDMA Band V : 24.0 LTE Band 2 : 23.5 LTE Band 4 : 23.5 LTE Band 5 : 23.5 LTE Band 12 : 24.0 LTE Band 13 : 23.0 LTE Band 17 : 24.0 LTE Band 26 : 23.5 LTE Band 41 : 23.5 WLAN 2.4G : 20.0 WLAN 5.2G : 18.0 WLAN 5.3G : 18.0 WLAN 5.6G : 18.0 WLAN 5.8G : 18.0 Bluetooth : 12.0

Antenna Type	WWAN: Fixed Internal Antenna WLAN/BT/ANT+: PIFA Antenna NFC: Loop Antenna
EUT Stage	Production Unit
Supported Combinations of LTE CA (Carrier Aggregation) in Downlink	**Intra-Band Contiguous CA:** CA_41C **Intra-Band Non-Contiguous CA:** CA_41A-41A
Supported Combinations of LTE CA (Carrier Aggregation) in Uplink	**Intra-Band Contiguous CA:** CA_41C

Note:

1. This report is issued as a supplementary report to BV CPS report no.: SA170220C11. The difference compared with original report is to enable LTE uplink and downlink CA supported for LTE band 41 only. Hence please refer to original report for complete compliance evaluation, and this report only included LTE CA verified data of LTE band 41 for C2PC application.
2. 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.

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:

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

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

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

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

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 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.

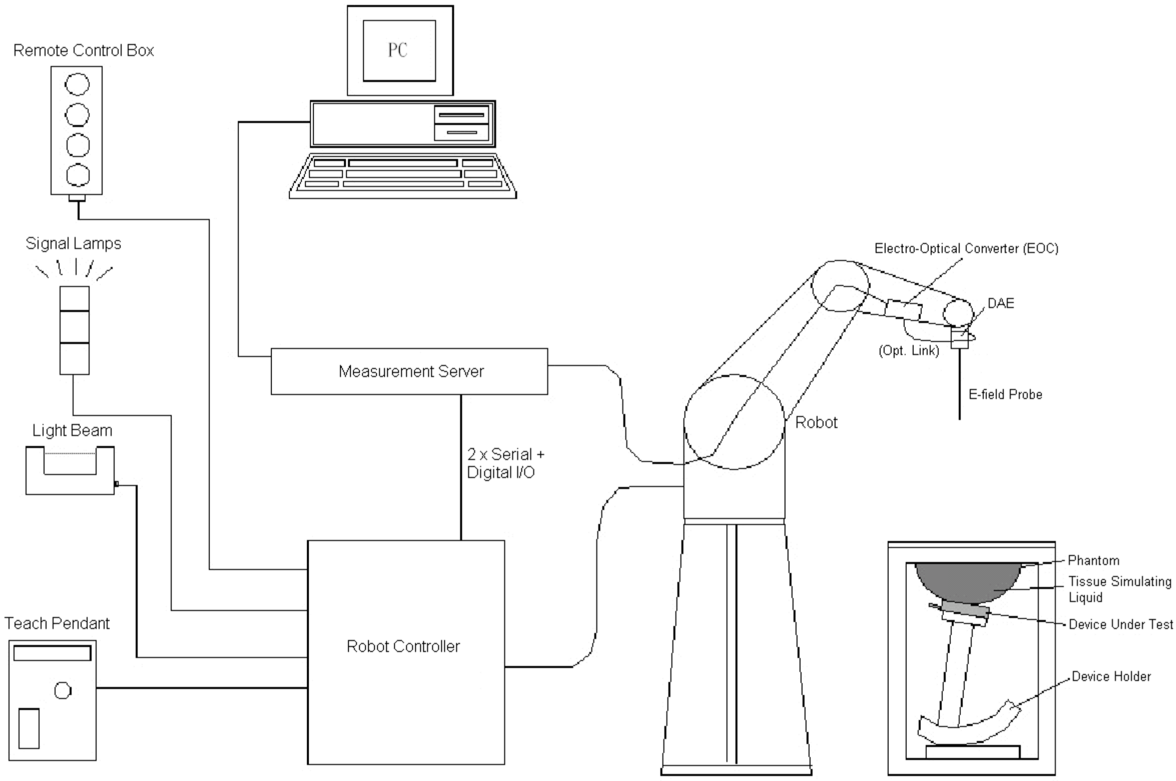


Fig-3.1 SPEAG DASY52 System Setup

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.

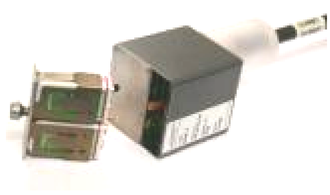
Model	EX3DV4
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue 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.

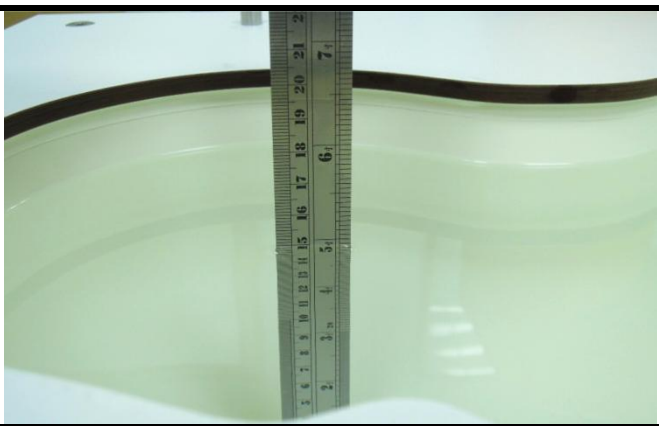


Photo of Liquid Height for Head Position

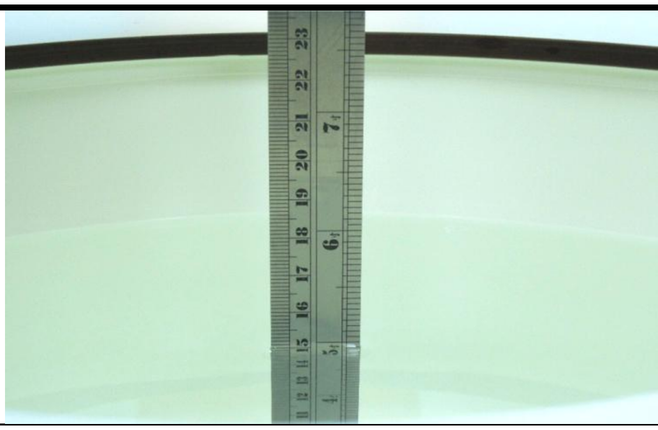


Photo of Liquid Height for Body Position

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.

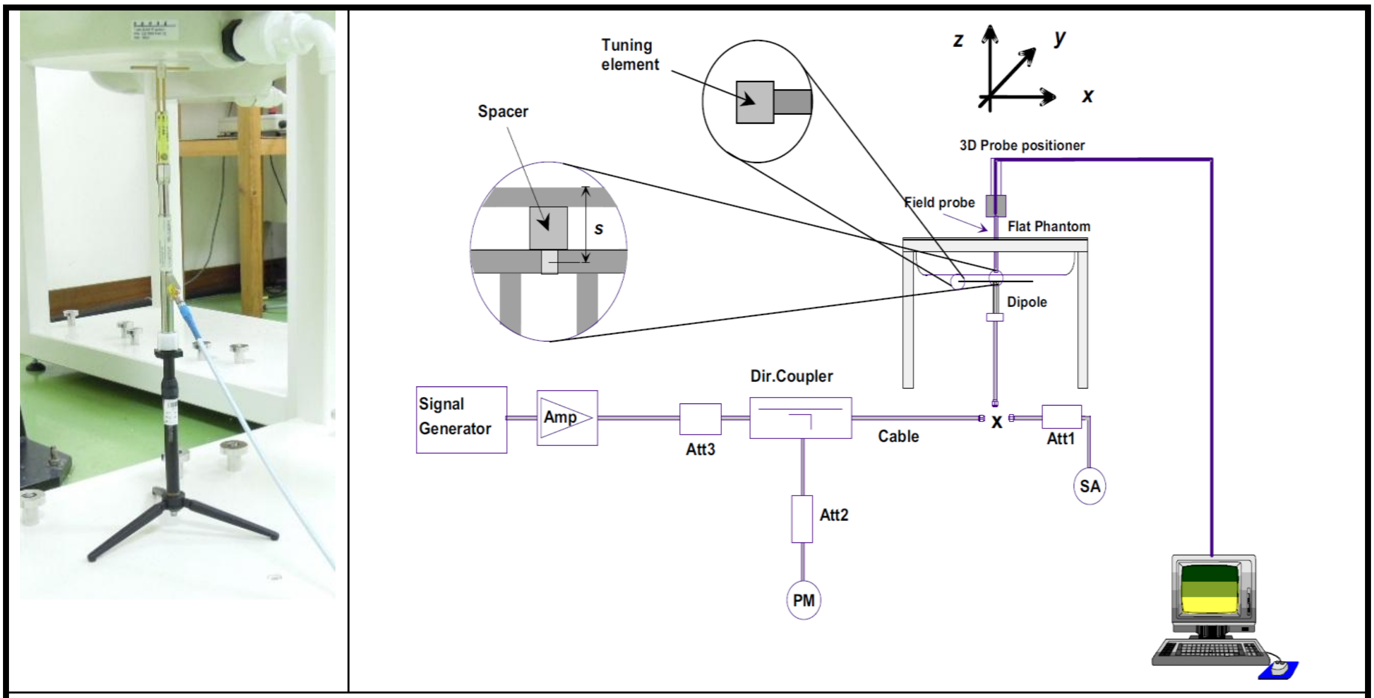


Fig-3.3 System Verification Setup

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 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
5	V	V	V	V		
7			V	V	V	V
12	V	V	V	V		
13			V	V		
17			V	V		
26	V	V	V	V	V	
41			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

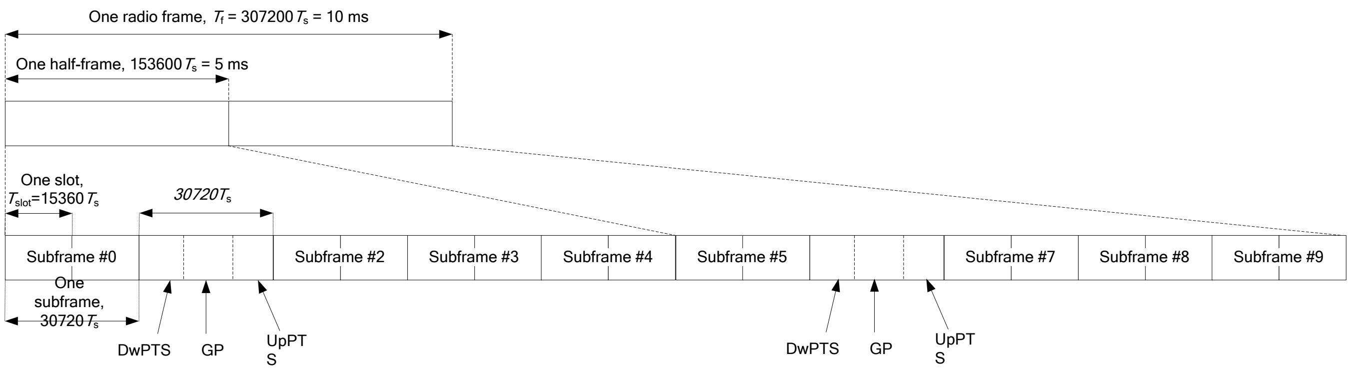
Note: MPR is according to the standard and implemented in the circuit (mandatory).

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.

TDD-LTE Setup Configurations

According to KDB 941225 D05, SAR testing for TDD-LTE device must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP TDD-LTE configurations. The TDD-LTE of this device supports frame structure type 2 defined in 3GPP TS 36.211 section 4.2, and the frame structure configuration can be referred to below.



3GPP TS 36.211 Figure 4.2-1: Frame Structure Type 2

<table>
<tr><th rowspan="3">Special Subframe Configuration</th><th colspan="3">Normal Cyclic Prefix in Downlink</th><th colspan="3">Extended Cyclic Prefix in Downlink</th></tr>
<tr><th rowspan="2">DwPTS</th><th colspan="2">UpPTS</th><th rowspan="2">DwPTS</th><th colspan="2">UpPTS</th></tr>
<tr><th>Normal Cyclic Prefix in Uplink</th><th>Extended Cyclic Prefix in Uplink</th><th>Normal Cyclic Prefix in Uplink</th><th>Extended Cyclic Prefix in Uplink</th></tr>
<tr><td>0</td><td>6592 • Ts</td><td rowspan="5">2192 • Ts</td><td rowspan="5">2560 • Ts</td><td>7680 • Ts</td><td rowspan="4">2192 • Ts</td><td rowspan="4">2560 • Ts</td></tr>
<tr><td>1</td><td>19760 • Ts</td><td>20480 • Ts</td></tr>
<tr><td>2</td><td>21952 • Ts</td><td>23040 • Ts</td></tr>
<tr><td>3</td><td>24144 • Ts</td><td>25600 • Ts</td></tr>
<tr><td>4</td><td>26336 • Ts</td><td>7680 • Ts</td><td rowspan="4">4384 • Ts</td><td rowspan="4">5120 • Ts</td></tr>
<tr><td>5</td><td>6592 • Ts</td><td rowspan="5">4384 • Ts</td><td rowspan="5">5120 • Ts</td><td>20480 • Ts</td></tr>
<tr><td>6</td><td>19760 • Ts</td><td>23040 • Ts</td></tr>
<tr><td>7</td><td>21952 • Ts</td><td>12800 • Ts</td></tr>
<tr><td>8</td><td>24144 • Ts</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>9</td><td>13168 • Ts</td><td>-</td><td>-</td><td>-</td></tr>
</table>

3GPP TS 36.211 Table 4.2-1: Configuration of Special Subframe

Uplink-Downlink Configuration	Downlink-to-Uplink Switch-Point Periodicity	Subframe Number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

3GPP TS 36.211 Table 4.2-2: Uplink-Downlink Configurations

The variety of different TD-LTE uplink-downlink configurations allows a network operator to allocate the network's capacity between uplink and downlink traffic to meet the needs of the network. The uplink duty cycle of these seven configurations can readily be computed and shown in below.

UL-DL Configuration	0	1	2	3	4	5	6
Highest Duty-Cycle	63.33%	43.33%	23.33%	31.67%	21.67%	11.67%	53.33%

Considering the highest transmission duty cycle, TDD-LTE was tested using Uplink-Downlink Configuration 0 with 6 uplink subframe and 2 special subframe. The special subframe was set to special subframe configuration 7 using extended cyclic prefix uplink. Therefore, SAR testing for TDD-LTE was performed at the maximum output power with highest transmission duty cycle of 63.33%.

LTE Downlink Carrier Aggregation (CA) Setup Configurations

LTE Carrier Aggregation (CA) was defined in 3GPP release 10 and higher. The LTE device in CA mode has one Primary Component Carrier (PCC) and one or more Secondary Component Carriers (SCC). PCC acts as the anchor carrier and can optionally cross-schedule data transmission on SCC. The RRC connection is only handled by one cell, the PCC for downlink and uplink communications. After making a data connection to the PCC, the LTE device adds the SCC on the downlink only. All uplink communications and acknowledgements remain identical to release 8 specifications on the PCC. The combinations of downlink carrier aggregation supported by this device are listed in below.

EUT Supported Combinations of Downlink Carrier Aggregation							
Intra-Band Contiguous CA Operating Bands							
CA_41C							
Intra-Band Non-Contiguous CA Operating Bands (with Two Sub-Blocks)							
CA_41A-41A							

LTE Uplink Carrier Aggregation (CA) Setup Configurations

This device supports LTE uplink CA for band 41 only with a maximum of two 20 MHz carrier components in the uplink. The maximum output power for uplink intra-band contiguous CA specified in Table 6.2.2A-1 of 3GPP TS 36.101 is the same as single carrier specified in Table 6.2.2-1 of 3GPP TS 36.101. In Table 6.2.3A-1 of 3GPP TS 36.101, the MPR (maximum power reduction) for several dB is allowed due to modulation and contiguously aggregated transmit bandwidth configuration. All the RF parameters in this device have followed above 3GPP criteria.

EUT Supported Combinations of Uplink Carrier Aggregation							
Intra-Band Contiguous CA Operating Bands							
CA_41C							

This device does not support full CA (Carrier Aggregation) features on 3GPP release 12. Its capability for LTE CA is for LTE band 41 only and supported configuration is shown in above. For network enhancement features, it does not support Wi-Fi Offloading, Enhanced SC-FDMA, Uplink MIMO, CoMP, HetNet, Relay, SON, Cross-Carrier Scheduling, eICIC, Enhanced Downlink MIMO, MBMS, M2M/D2D. All other uplink communications are identical to the LTE Release 8 specifications.

4.2 EUT Testing Position

According to KDB 648474 D04, handsets are tested for SAR compliance in head, body-worn accessory and other use configurations described in the following subsections.

4.2.1 Head Exposure Conditions

Head exposure is limited to next to the ear voice mode operations. Head SAR compliance is tested according to the test positions defined in IEEE Std 1528-2003 using the SAM phantom illustrated as below.

1. Define two imaginary lines on the handset

(a) The vertical centerline passes through two points on the front side of the handset - the midpoint of the width w_t of the handset at the level of the acoustic output, and the midpoint of the width w_b of the bottom of the handset.

(b) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.

(c) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.

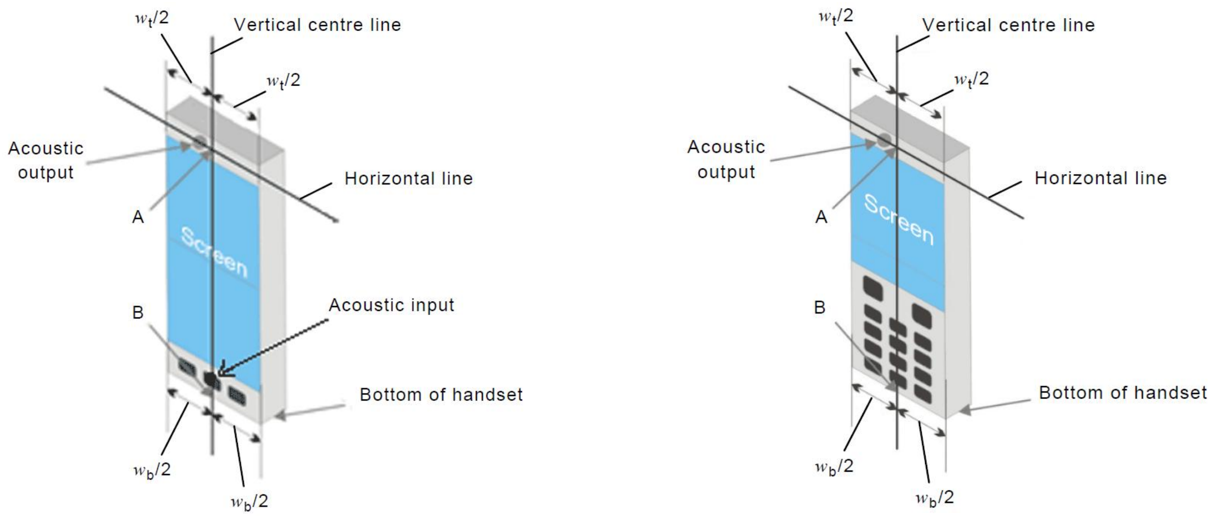


Fig-4.1 Illustration for Handset Vertical and Horizontal Reference Lines

2. Cheek Position

(a) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.

(b) To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see Fig-4.2).

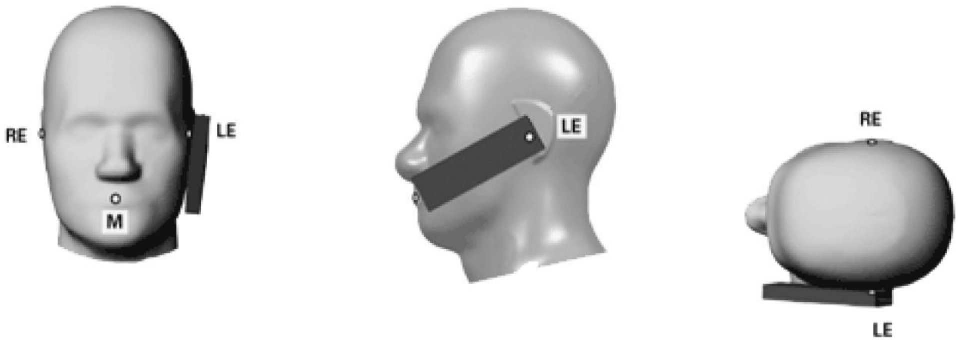


Fig-4.2 Illustration for Cheek Position

3. Tilted Position

(a) To position the device in the "cheek" position described above.

(b) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig-4.3).

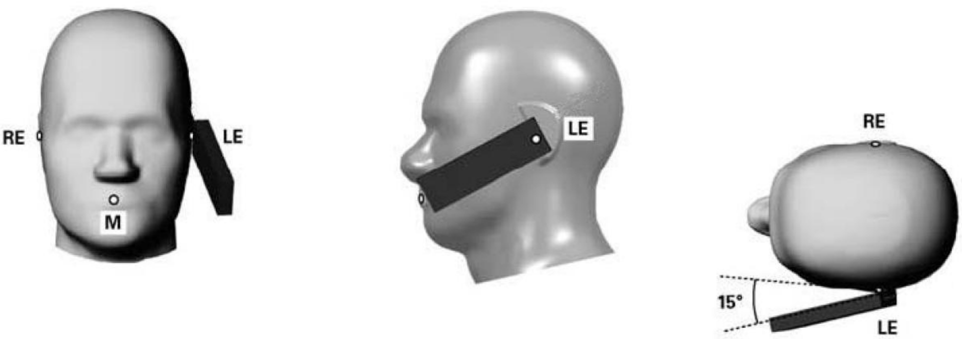


Fig-4.3 Illustration for Tilted Position

4.2.2 Body-worn Accessory Exposure Conditions

Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in KDB 447498 D01 are used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Body-worn accessories that do not contain metallic or conductive components may be tested according to worst-case exposure configurations, typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics. All body-worn accessories containing metallic components are tested in conjunction with the host device.

Body-worn accessory SAR compliance is based on a single minimum test separation distance for all wireless and operating modes applicable to each body-worn accessory used by the host, and according to the relevant voice and/or data mode transmissions and operations. If a body-worn accessory supports voice only operations in its normal and expected use conditions, testing of data mode for body-worn compliance is not required.

A conservative minimum test separation distance for supporting off-the-shelf body-worn accessories that may be acquired by users of consumer handsets is used to test for body-worn accessory SAR compliance. This distance is determined by the handset manufacturer, according to the requirements of Supplement C 01-01. Devices that are designed to operate on the body of users using lanyards and straps, or without requiring additional body-worn accessories, will be tested using a conservative minimum test separation distance <= 5 mm to support compliance.

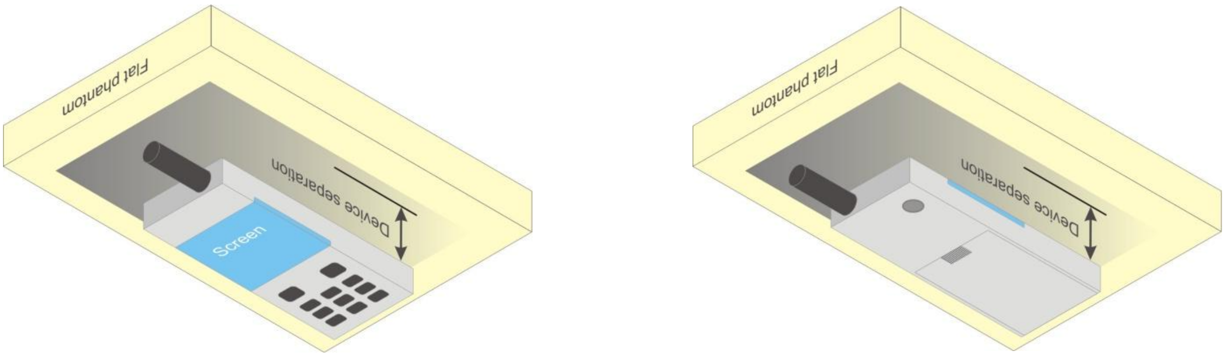
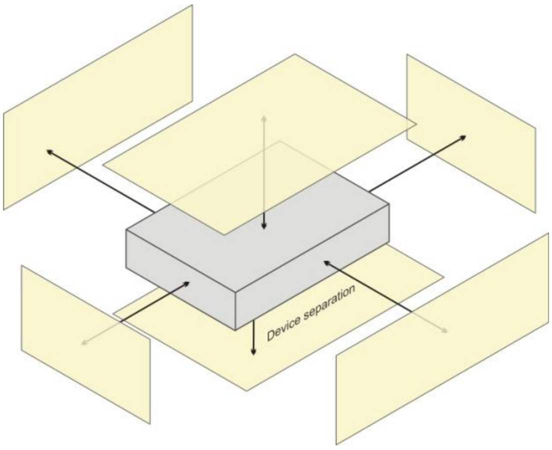


Fig-4.4 Illustration for Body Worn Position

4.2.1 Hotspot Mode Exposure Conditions

For handsets that support hotspot mode operations, with wireless router capabilities and various web browsing functions, the relevant hand and body exposure conditions are tested according to the hotspot SAR procedures in KDB 941225 D06. A test separation distance of 10 mm is required between the phantom and all surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge. When the form factor of a handset is smaller than 9 cm x 5 cm, a test separation distance of 5 mm (instead of 10 mm) is required for testing hotspot mode. When the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, in the same wireless mode and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface).



Based on the antenna location shown on appendix D of this report, the SAR testing required for hotspot mode is listed as below.

Antenna	Front Face	Rear Face	Left Side	Right Side	Top Side	Bottom Side
WWAN Ant-0	V	V	V	V		V
WWAN Ant-1	V	V	V	V	V	
WLAN / BT Ant-0	V	V		V	V	
WLAN Ant-1	V	V		V	V	
WLAN Ant-0+1	V	V		V	V	

4.2.3 Product Specific (Phablet) Exposure Conditions

For smart phones with a display diagonal dimension > 15 cm or an overall diagonal dimension > 16 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance.

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.
2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at <= 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g SAR > 1.2 W/kg. The normal tablet procedures in KDB 616217 are required when the over diagonal dimension of the device is > 20 cm. Hotspot mode SAR is not required when normal tablet procedures are applied. Extremity 10-g SAR is also not required for the front (top) surface of large form factor full size tablets. The more conservative tablet SAR results can be used to support the 10-g extremity SAR for phablet mode.
3. The simultaneous transmission operating configurations applicable to voice and data transmissions for both phone and mini-tablet modes must be taken into consideration separately for 1-g and 10-g SAR to determine the simultaneous transmission SAR test exclusion and measurement requirements for the relevant wireless modes and exposure conditions.

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 (%)
Mar. 12, 2017	Head	2600	23.5	2.050	37.338	1.96	39.0	4.59	-4.26
Mar. 16, 2017	Head	2600	23.5	2.030	37.410	1.96	39.0	3.57	-4.08
Mar. 17, 2017	Head	2600	23.3	2.028	37.423	1.96	39.0	3.47	-4.04
Mar. 17, 2017	Body	2600	23.3	2.221	51.648	2.16	52.5	2.82	-1.62

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
Mar. 12, 2017	3650	Head	2600	2.050	37.338	Pass	Pass	Pass	TDD	PASS	N/A
Mar. 16, 2017	3661	Head	2600	2.030	37.410	Pass	Pass	Pass	TDD	PASS	N/A
Mar. 17, 2017	3661	Head	2600	2.028	37.423	Pass	Pass	Pass	TDD	PASS	N/A
Mar. 17, 2017	3661	Body	2600	2.221	51.648	Pass	Pass	Pass	TDD	PASS	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
Mar. 12, 2017	Head	2600	58.10	15.20	60.80	4.65	1020	3650	579
Mar. 16, 2017	Head	2600	58.10	14.20	56.80	-2.24	1020	3661	1277
Mar. 17, 2017	Head	2600	58.10	15.00	60.00	3.27	1020	3661	1277
Mar. 17, 2017	Body	2600	55.70	13.50	54.00	-3.05	1020	3661	1277

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 Measured Conducted Power Result

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

Mode	LTE 41
QPSK / 16QAM / 64QAM	23.5

4.6.2 Measured Conducted Power Result

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

LTE Band / BW	RB Size	RB Offset	QPSK					3GPP MPR (dB)	16QAM					3GPP MPR (dB)	64QAM					3GPP MPR (dB)
			L-CH 39675 2498.5 MHz	M-CH 40148 2545.8 MHz	M-CH 40620 2593.0 MHz	M-CH 41093 2640.3 MHz	H-CH 41565 2687.5 MHz		L-CH 39675 2498.5 MHz	M-CH 40148 2545.8 MHz	M-CH 40620 2593.0 MHz	M-CH 41093 2640.3 MHz	H-CH 41565 2687.5 MHz		L-CH 39675 2498.5 MHz	M-CH 40148 2545.8 MHz	M-CH 40620 2593.0 MHz	M-CH 41093 2640.3 MHz	H-CH 41565 2687.5 MHz	
41 / 5M	1	0	22.99	22.94	23.02	22.33	22.15	0	22.04	21.98	22.07	21.37	21.20	1	22.01	21.97	22.03	21.33	21.18	2
	1	12	22.82	22.77	22.84	22.20	22.05	0	21.83	21.80	21.88	21.21	21.04	1	21.87	21.84	21.90	21.21	21.12	2
	1	24	22.77	22.66	22.78	22.08	21.89	0	21.80	21.73	21.81	21.11	20.96	1	21.77	21.73	21.80	21.08	20.93	2
	12	0	21.86	21.76	21.89	21.25	21.01	1	20.88	20.77	20.91	20.17	20.02	2	20.67	20.64	20.72	20.03	19.82	3
	12	6	21.78	21.67	21.81	21.09	20.89	1	20.77	20.65	20.84	20.04	19.87	2	20.61	20.56	20.66	19.93	19.80	3
	12	13	21.68	21.56	21.73	20.95	20.88	1	20.71	20.57	20.73	19.92	19.84	2	20.57	20.52	20.61	19.89	19.76	3
	25	0	21.80	21.71	21.86	21.25	20.93	1	20.86	20.70	20.89	20.09	19.95	2	20.77	20.72	20.79	20.01	19.95	3

LTE Band / BW	RB Size	RB Offset	QPSK					3GPP MPR (dB)	16QAM					3GPP MPR (dB)	64QAM					3GPP MPR (dB)
			L-CH 39700 2501.0 MHz	M-CH 40160 2547.0 MHz	M-CH 40620 2593.0 MHz	M-CH 41080 2639.0 MHz	H-CH 41540 2685.0 MHz		L-CH 39700 2501.0 MHz	M-CH 40160 2547.0 MHz	M-CH 40620 2593.0 MHz	M-CH 41080 2639.0 MHz	H-CH 41540 2685.0 MHz		L-CH 39700 2501.0 MHz	M-CH 40160 2547.0 MHz	M-CH 40620 2593.0 MHz	M-CH 41080 2639.0 MHz	H-CH 41540 2685.0 MHz	
41 / 10M	1	0	23.05	23.00	23.07	22.41	22.23	0	22.09	22.05	22.11	21.45	21.28	1	22.06	22.03	22.08	21.39	21.24	2
	1	24	22.88	22.82	22.90	22.30	22.07	0	21.92	21.86	21.96	21.37	21.19	1	21.93	21.91	21.97	21.33	21.17	2
	1	49	22.82	22.77	22.85	22.21	22.00	0	21.88	21.74	21.90	21.16	21.01	1	21.84	21.79	21.86	21.18	20.94	2
	25	0	21.95	21.87	21.96	21.35	21.10	1	20.94	20.87	20.99	20.35	20.06	2	20.76	20.72	20.80	20.12	19.97	3
	25	12	21.88	21.83	21.92	21.24	21.07	1	20.87	20.77	20.91	20.20	19.99	2	20.72	20.70	20.76	20.06	19.93	3
	25	25	21.81	21.68	21.85	21.14	21.04	1	20.79	20.70	20.82	20.12	19.98	2	20.67	20.64	20.71	20.05	19.90	3
	50	0	21.93	21.81	21.95	21.27	21.14	1	20.94	20.85	20.97	20.26	20.03	2	20.84	20.78	20.87	20.24	20.09	3

LTE Band / BW	RB Size	RB Offset	QPSK					3GPP MPR (dB)	16QAM					3GPP MPR (dB)	64QAM					3GPP MPR (dB)
			L-CH 39725 2503.5 MHz	M-CH 40173 2548.3 MHz	M-CH 40620 2593.0 MHz	M-CH 41068 2637.8 MHz	H-CH 41515 2682.5 MHz		L-CH 39725 2503.5 MHz	M-CH 40173 2548.3 MHz	M-CH 40620 2593.0 MHz	M-CH 41068 2637.8 MHz	H-CH 41515 2682.5 MHz		L-CH 39725 2503.5 MHz	M-CH 40173 2548.3 MHz	M-CH 40620 2593.0 MHz	M-CH 41068 2637.8 MHz	H-CH 41515 2682.5 MHz	
41 / 15M	1	0	23.10	23.06	23.12	22.49	22.33	0	22.14	22.09	22.17	21.51	21.34	1	22.11	22.08	22.13	21.49	21.34	2
	1	37	22.94	22.88	22.97	22.34	22.17	0	21.97	21.90	21.99	21.40	21.20	1	22.01	21.95	22.03	21.41	21.26	2
	1	74	22.89	22.84	22.92	22.29	22.13	0	21.91	21.88	21.95	21.28	21.06	1	21.92	21.89	21.94	21.27	21.11	2
	36	0	22.04	22.01	22.07	21.47	21.31	1	21.03	20.98	21.06	20.39	20.27	2	20.89	20.85	20.91	20.34	20.13	3
	36	19	21.99	21.93	22.02	21.38	21.19	1	20.96	20.88	21.00	20.32	20.17	2	20.83	20.82	20.87	20.24	20.08	3
	36	39	21.95	21.90	21.97	21.28	21.17	1	20.90	20.86	20.94	20.24	20.13	2	20.81	20.77	20.83	20.20	20.05	3
	75	0	22.04	21.98	22.05	21.48	21.32	1	21.02	20.92	21.05	20.39	20.18	2	20.97	20.89	20.99	20.38	20.15	3

LTE Band / BW	RB Size	RB Offset	QPSK					3GPP MPR (dB)	16QAM					3GPP MPR (dB)	64QAM					3GPP MPR (dB)
			L-CH 39750 2506.0 MHz	M-CH 40185 2549.5 MHz	M-CH 40620 2593.0 MHz	M-CH 41055 2636.5 MHz	H-CH 41490 2680.0 MHz		L-CH 39750 2506.0 MHz	M-CH 40185 2549.5 MHz	M-CH 40620 2593.0 MHz	M-CH 41055 2636.5 MHz	H-CH 41490 2680.0 MHz		L-CH 39750 2506.0 MHz	M-CH 40185 2549.5 MHz	M-CH 40620 2593.0 MHz	M-CH 41055 2636.5 MHz	H-CH 41490 2680.0 MHz	
41 / 20M	1	0	23.15	23.11	23.17	22.57	22.41	0	22.19	22.15	22.22	21.60	21.44	1	22.16	22.13	22.18	21.56	21.42	2
	1	50	22.99	22.97	23.02	22.48	22.33	0	22.05	22.00	22.06	21.45	21.30	1	22.06	22.02	22.08	21.45	21.34	2
	1	99	22.97	22.86	22.98	22.32	22.21	0	21.98	21.90	22.02	21.37	21.18	1	21.98	21.96	22.00	21.39	21.22	2
	50	0	22.13	22.11	22.16	21.61	21.46	1	21.17	21.10	21.18	20.59	20.38	2	20.99	20.96	21.02	20.44	20.27	3
	50	25	22.09	22.07	22.12	21.52	21.34	1	21.10	21.03	21.13	20.50	20.29	2	20.96	20.93	20.99	20.37	20.23	3
	50	50	22.06	22.02	22.08	21.50	21.32	1	21.04	20.93	21.07	20.46	20.27	2	20.93	20.89	20.96	20.28	20.21	3
	100	0	22.12	22.09	22.15	21.55	21.39	1	21.12	21.05	21.17	20.50	20.41	2	21.05	21.01	21.08	20.48	20.36	3

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 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.

<Power Confirmation for SAR Test Exclusion for LTE Downlink CA>

According to KDB 941225 D05A, the uplink maximum output power below was measured with downlink CA active on the channel with highest measured maximum output power when downlink CA is inactive. The downlink SCC channel was paired with the uplink channel as normal operation. For intra-band contiguous CA, the downlink channel spacing between the component carriers was set to multiple of 300 kHz less than the nominal channel spacing per section 5.4.1A of 3GPP TS36.521. For intra-band non-contiguous CA, the downlink channel spacing between the component carriers was set to maximum separation from PCC and remain fully within the downlink transmission band.

Power Measurements for Intra-Band Contiguous Downlink CA

PCC									SCC				Power		
Band	BW (MHz)	Modulation	RB Size	RB Offset	UL Channel	UL Frequency (MHz)	DL Channel	DL Frequency (MHz)	Band	BW (MHz)	DL Channel	DL Frequency (MHz)	Maximum Tune-up Power (dBm)	Tx Power without CA (dBm)	Tx Power with DL-CA Active (dBm)
41	20	QPSK	1	0	40620	2593.0	40620	2593.0	41	20	40818	2612.8	23.5	23.17	23.05

Power Measurements for Intra-Band Non-Contiguous Downlink CA

PCC									SCC				Power		
Band	BW (MHz)	Modulation	RB Size	RB Offset	UL Channel	UL Frequency (MHz)	DL Channel	DL Frequency (MHz)	Band	BW (MHz)	DL Channel	DL Frequency (MHz)	Maximum Tune-up Power (dBm)	Tx Power without CA (dBm)	Tx Power with DL-CA Active (dBm)
41	20	QPSK	1	0	40620	2593.0	40620	2593.0	41	20	39750	2506.0	23.5	23.17	23.12

Summary for SAR Test Exclusion for LTE Downlink CA

Per power confirmation results in above, the uplink maximum output power with downlink CA active remains within the specified tune-up tolerance and not more than 0.25 dB higher than the maximum output power with downlink CA inactive. According to KDB 941225 D05A, the SAR test exclusion applies to LTE downlink CA operation.

<Power Confirmation for SAR Testing for LTE Uplink CA>

The conducted power for uplink CA active was measured on the highest reported SAR configuration for each exposure condition with both two carrier components was set to largest channel bandwidth.

PCC							SCC							Power		
Band	BW (MHz)	Modulation	RB Size	RB Offset	UL Channel	UL Frequency (MHz)	Band	BW (MHz)	Modulation	RB Size	RB Offset	UL Channel	UL Frequency (MHz)	Maximum Tune-up Power (dBm)	Tx Power without CA (dBm)	Tx Power with UL-CA Active (dBm)
41	20	QPSK	1	0	40620	2593.0	41	20	QPSK	1	0	40818	2612.8	23.5	23.17	23.15

SAR Measurements for Intra-Band Contiguous CA

The SAR testing was performed with the single carrier (uplink CA is inactive) for all test positions for each exposure condition. The LTE uplink CA active was verified with maximum output power on the highest SAR configuration of single carrier for each exposure condition. For intra-band contiguous CA, the SCC channel was set to closest available contiguous channel.

4.7.1 SAR Results for Head Exposure Condition

Uplink Mode	Plot No.	Band	Mode	Test Position	Ch.	Tx Antenna	RB#	RB Offset	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
Single Carrier (CA inactive)		LTE 41	QPSK,20M	Right Cheek	40620	0	1	0	23.5	23.17	1.08	-0.02	0.145	0.16
		LTE 41	QPSK,20M	Right Tilted	40620	0	1	0	23.5	23.17	1.08	0.06	0.039	0.04
		LTE 41	QPSK,20M	Left Cheek	40620	0	1	0	23.5	23.17	1.08	0.13	0.075	0.08
		LTE 41	QPSK,20M	Left Tilted	40620	0	1	0	23.5	23.17	1.08	0.08	0.057	0.06
		LTE 41	QPSK,20M	Right Cheek	40620	0	50	0	22.5	22.16	1.08	-0.04	0.111	0.12
		LTE 41	QPSK,20M	Right Tilted	40620	0	50	0	22.5	22.16	1.08	0.13	0.032	0.03
		LTE 41	QPSK,20M	Left Cheek	40620	0	50	0	22.5	22.16	1.08	0.16	0.052	0.06
		LTE 41	QPSK,20M	Left Tilted	40620	0	50	0	22.5	22.16	1.08	0.10	0.042	0.05
	01	LTE 41	QPSK,20M	Right Cheek	40620	1	1	0	23.5	23.17	1.08	0.14	0.484	0.52
		LTE 41	QPSK,20M	Right Tilted	40620	1	1	0	23.5	23.17	1.08	0.10	0.123	0.13
		LTE 41	QPSK,20M	Left Cheek	40620	1	1	0	23.5	23.17	1.08	-0.02	0.348	0.38
		LTE 41	QPSK,20M	Left Tilted	40620	1	1	0	23.5	23.17	1.08	0.08	0.068	0.07
		LTE 41	QPSK,20M	Right Cheek	40620	1	50	0	22.5	22.16	1.08	0.07	0.357	0.39
		LTE 41	QPSK,20M	Right Tilted	40620	1	50	0	22.5	22.16	1.08	0.02	0.093	0.10
		LTE 41	QPSK,20M	Left Cheek	40620	1	50	0	22.5	22.16	1.08	-0.01	0.275	0.30
		LTE 41	QPSK,20M	Left Tilted	40620	1	50	0	22.5	22.16	1.08	0.14	0.050	0.05
2 CC (CA active)		LTE 41	QPSK,20M	Right Cheek	PCC:40620 SCC:40818	1	PCC:1 SCC:1	PCC:0 SCC:0	23.5	23.15	1.08	0.05	0.479	0.52

4.7.2 SAR Results for Body-worn Exposure Condition (Test Separation Distance is 10 mm)

Uplink Mode	Plot No.	Band	Mode	Test Position	Ch.	Tx Antenna	RB#	RB Offset	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
Single Carrier (CA inactive)	02	LTE 41	QPSK,20M	Front Face	40620	0	1	0	23.5	23.17	1.08	-0.11	0.242	0.26
		LTE 41	QPSK,20M	Rear Face	40620	0	1	0	23.5	23.17	1.08	0.10	0.142	0.15
		LTE 41	QPSK,20M	Front Face	40620	0	50	0	22.5	22.16	1.08	0.02	0.149	0.16
		LTE 41	QPSK,20M	Rear Face	40620	0	50	0	22.5	22.16	1.08	0.04	0.109	0.12
		LTE 41	QPSK,20M	Front Face	40620	1	1	0	23.5	23.17	1.08	-0.04	0.197	0.21
		LTE 41	QPSK,20M	Rear Face	40620	1	1	0	23.5	23.17	1.08	0.06	0.205	0.22
		LTE 41	QPSK,20M	Front Face	40620	1	50	0	22.5	22.16	1.08	0.08	0.142	0.15
		LTE 41	QPSK,20M	Rear Face	40620	1	50	0	22.5	22.16	1.08	0.02	0.157	0.17
2 CC (CA active)		LTE 41	QPSK,20M	Front Face	PCC:40620 SCC:40818	0	PCC:1 SCC:1	PCC:0 SCC:0	23.5	23.15	1.08	0.03	0.238	0.26

4.7.3 SAR Results for Hotspot Exposure Condition (Test Separation Distance is 10 mm)

Uplink Mode	Plot No.	Band	Mode	Test Position	Ch.	Tx Antenna	RB#	RB Offset	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
Single Carrier (CA inactive)		LTE 41	QPSK,20M	Front Face	40620	0	1	0	23.5	23.17	1.08	-0.11	0.242	0.26
		LTE 41	QPSK,20M	Rear Face	40620	0	1	0	23.5	23.17	1.08	0.10	0.142	0.15
		LTE 41	QPSK,20M	Right Side	40620	0	1	0	23.5	23.17	1.08	0.02	0.301	0.32
		LTE 41	QPSK,20M	Left Side	40620	0	1	0	23.5	23.17	1.08	-0.01	0.013	0.01
		LTE 41	QPSK,20M	Bottom Side	40620	0	1	0	23.5	23.17	1.08	0.02	0.09	0.10
		LTE 41	QPSK,20M	Front Face	40620	0	50	0	22.5	22.16	1.08	0.02	0.149	0.16
		LTE 41	QPSK,20M	Rear Face	40620	0	50	0	22.5	22.16	1.08	0.04	0.109	0.12
		LTE 41	QPSK,20M	Right Side	40620	0	50	0	22.5	22.16	1.08	0.10	0.23	0.25
		LTE 41	QPSK,20M	Left Side	40620	0	50	0	22.5	22.16	1.08	-0.03	0.00676	0.01
		LTE 41	QPSK,20M	Bottom Side	40620	0	50	0	22.5	22.16	1.08	0.03	0.066	0.07
		LTE 41	QPSK,20M	Front Face	40620	1	1	0	23.5	23.17	1.08	-0.04	0.197	0.21
		LTE 41	QPSK,20M	Rear Face	40620	1	1	0	23.5	23.17	1.08	0.06	0.205	0.22
		LTE 41	QPSK,20M	Right Side	40620	1	1	0	23.5	23.17	1.08	-0.03	0.00817	0.01
	03	LTE 41	QPSK,20M	Left Side	40620	1	1	0	23.5	23.17	1.08	-0.03	0.328	**0.35**
		LTE 41	QPSK,20M	Top Side	40620	1	1	0	23.5	23.17	1.08	0.06	0.018	0.02
		LTE 41	QPSK,20M	Front Face	40620	1	50	0	22.5	22.16	1.08	0.08	0.142	0.15
		LTE 41	QPSK,20M	Rear Face	40620	1	50	0	22.5	22.16	1.08	0.02	0.157	0.17
		LTE 41	QPSK,20M	Right Side	40620	1	50	0	22.5	22.16	1.08	0.08	0.00357	0.00
		LTE 41	QPSK,20M	Left Side	40620	1	50	0	22.5	22.16	1.08	-0.03	0.254	0.27
		LTE 41	QPSK,20M	Top Side	40620	1	50	0	22.5	22.16	1.08	0.07	0.012	0.01
2 CC (CA active)		LTE 41	QPSK,20M	Left Side	PCC:40620 SCC:40818	1	PCC:1 SCC:1	PCC:0 SCC:0	23.5	23.15	1.08	-0.06	0.326	0.35

Test Engineer： Raymond Wu

5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D2600V2	1020	Aug. 26, 2016	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	3650	Jul. 25, 2016	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	3661	May. 11, 2016	1 Year
Data Acquisition Electronics	SPEAG	DAE3	579	Sep. 05, 2016	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1277	Jul. 22, 2016	1 Year
Radio Communication Analyzer	Anritsu	MT8820C	6201300638	Jul. 14, 2016	1 Year
ENA Series Network Analyzer	Agilent	E5071C	MY46214281	Jun. 13, 2016	1 Year
Spectrum Analyzer	Agilent	N9030A	MY53120770	Jan. 10, 2017	1 Year
MXG Analong Signal Generator	Agilent	N5181A	MY50143868	Jul. 07, 2016	1 Year
Power Meter	Anritsu	ML2495A	1218009	Jul. 06, 2016	1 Year
Power Sensor	Anritsu	MA2411B	1207252	Jul. 06, 2016	1 Year
Thermometer	YFE	YF-160A	150601220	May. 04, 2016	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.

Test Laboratory: Bureau Veritas ADT SAR/HAC Testing Lab Date: 2017/03/12

System Check_H2600_170312

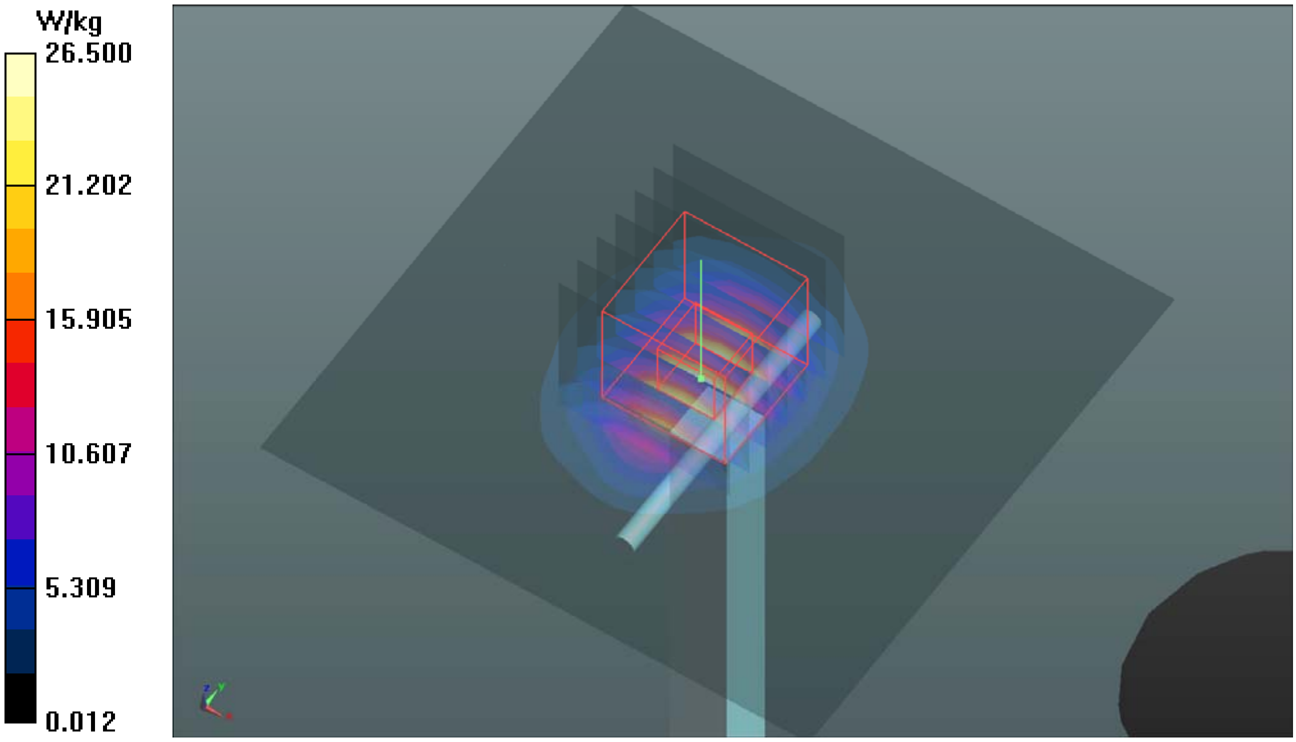
DUT: Dipole 2600 MHz; Type: D2600V2; SN: 1020

Communication System: CW; Frequency: 2600 MHz;Duty Cycle: 1:1
Medium: H19T27N2_0312 Medium parameters used: f = 2600 MHz; σ = 2.05 S/m; ε_r = 37.338; ρ = 1000 kg/m^3
Ambient Temperature：23.7 ℃； Liquid Temperature：23.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3650; ConvF(7.32, 7.32, 7.32); Calibrated: 2016/07/25;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2016/09/05
- Phantom: Twin SAM Phantom_1653; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 26.5 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.4 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 33.9 W/kg
SAR(1 g) = 15.2 W/kg; SAR(10 g) = 6.67 W/kg
Maximum value of SAR (measured) = 26.7 W/kg



System Check_B2600_170317

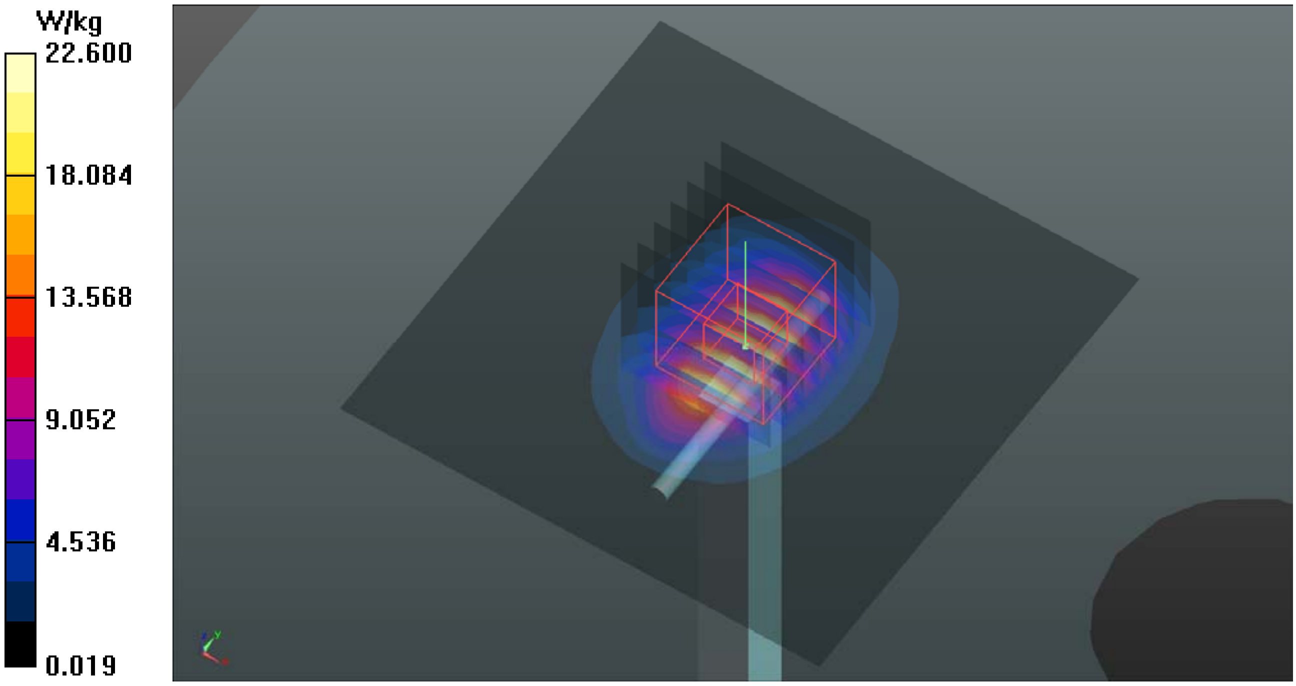
DUT: Dipole 2600 MHz; Type: D2600V2; SN: 1020

Communication System: CW; Frequency: 2600 MHz;Duty Cycle: 1:1
Medium: B19T27N2_0317 Medium parameters used: f = 2600 MHz; σ = 2.221 S/m; ε_r = 51.648; ρ = 1000 kg/m^3
Ambient Temperature：23.8 ℃； Liquid Temperature：23.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3661; ConvF(7.29, 7.29, 7.29); Calibrated: 2016/05/11;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2016/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 22.6 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.1 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 28.2 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.41 W/kg
Maximum value of SAR (measured) = 22.6 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 LTE 41_QPSK,20M_Right Cheek_Ch40620_ANT1_1RB_OS0

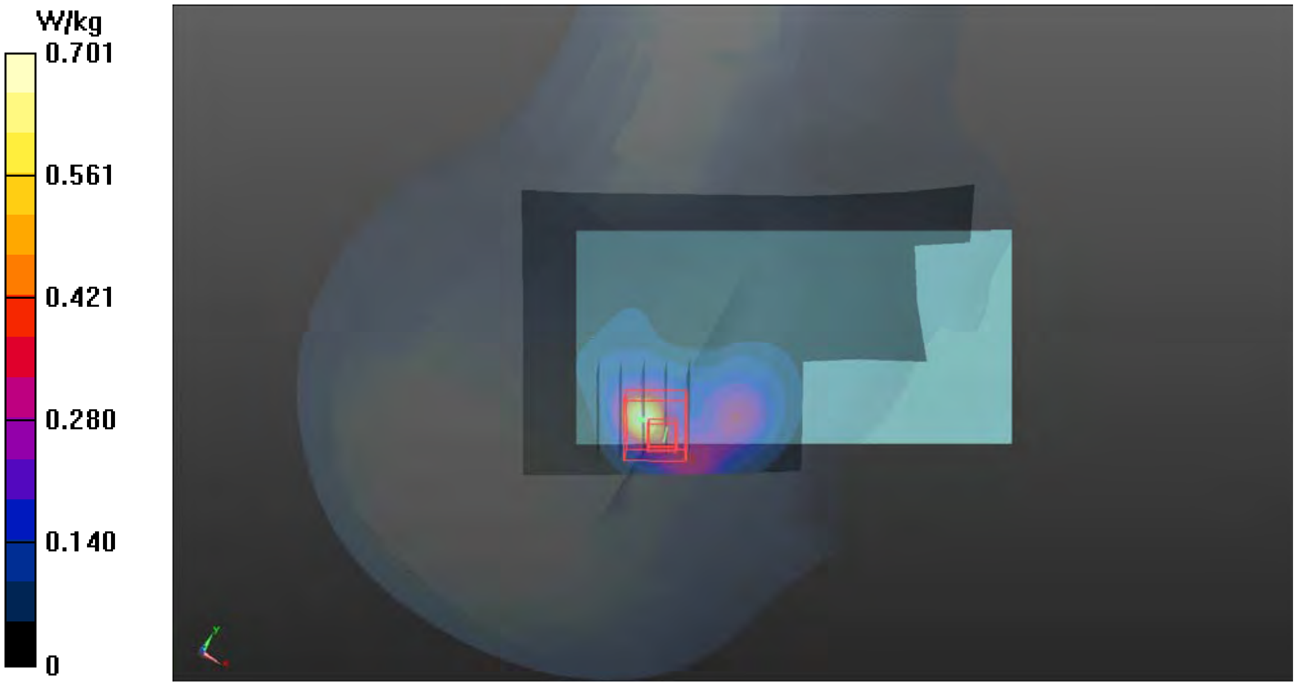
DUT: 170220C11

Communication System: LTE TDD CF0; Frequency: 2593 MHz;Duty Cycle: 1:1.58
Medium: H19T27N2_0316 Medium parameters used: f = 2593 MHz; σ = 2.022 S/m; ε_r = 37.432; ρ = 1000 kg/m^3
Ambient Temperature：23.8 ℃； Liquid Temperature：23.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3661; ConvF(7.17, 7.17, 7.17); Calibrated: 2016/05/11;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2016/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (91x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.701 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.29 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.06 W/kg
SAR(1 g) = 0.484 W/kg; SAR(10 g) = 0.202 W/kg
Maximum value of SAR (measured) = 0.832 W/kg



P02 LTE 41_QPSK,20M_Front Face_10mm_Ch40620_ANT0_1RB_OS0

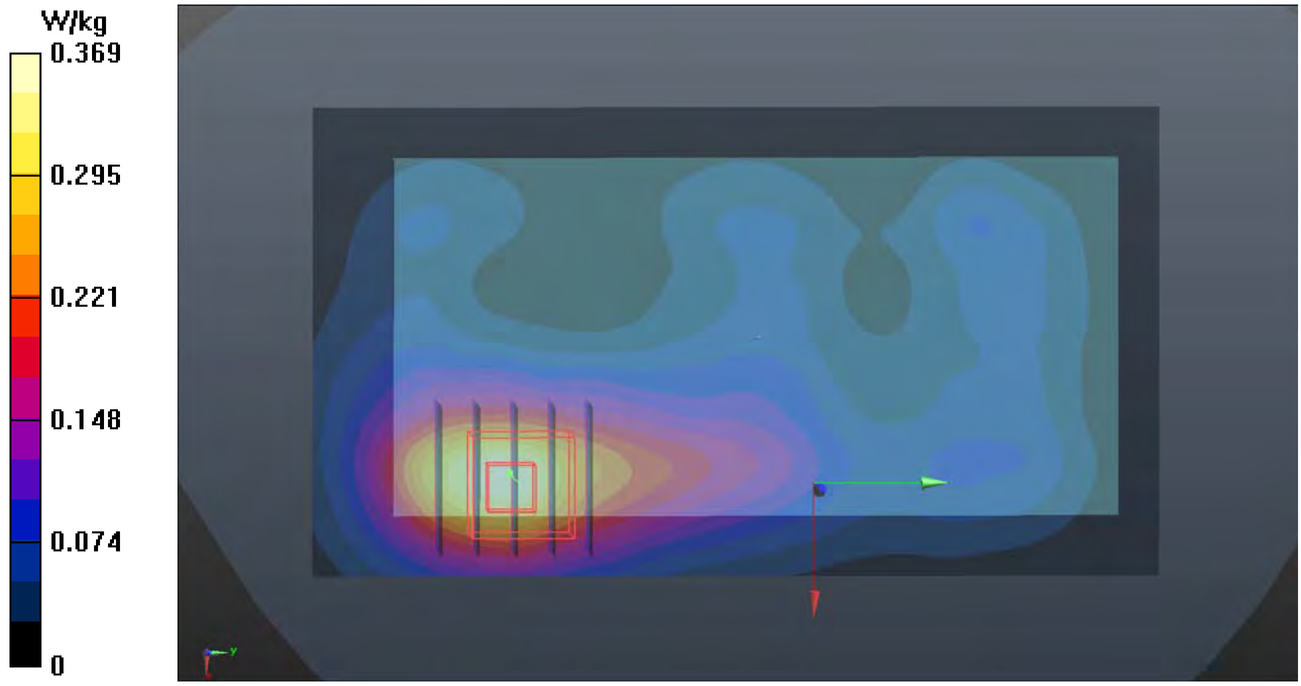
DUT: 170220C11

Communication System: LTE TDD CF0; Frequency: 2593 MHz;Duty Cycle: 1:1.58
Medium: B19T27N2_0317 Medium parameters used: f = 2593 MHz; σ = 2.199 S/m; ε_r = 50.72; ρ = 1000 kg/m^3
Ambient Temperature：23.8 ℃；Liquid Temperature：23.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3661; ConvF(7.29, 7.29, 7.29); Calibrated: 2016/05/11;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2016/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (91x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.369 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.78 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 0.436 W/kg
SAR(1 g) = 0.242 W/kg; SAR(10 g) = 0.130 W/kg
Maximum value of SAR (measured) = 0.358 W/kg



Test Laboratory: Bureau Veritas ADT SAR/HAC Testing Lab Date: 2017/03/17

P03 LTE 41_QPSK,20M_Left Side_10mm_Ch40620_ANT1_1RB_OS0

DUT: 170220C11

Communication System: LTE TDD CF0; Frequency: 2593 MHz;Duty Cycle: 1:1.58
Medium: B19T27N2_0317 Medium parameters used: f = 2593 MHz; σ = 2.199 S/m; ε_r = 50.72; ρ = 1000 kg/m^3
Ambient Temperature：23.8 ℃；Liquid Temperature：23.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3661; ConvF(7.29, 7.29, 7.29); Calibrated: 2016/05/11;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2016/07/22
- Phantom: Twin SAM Phantom_1485; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

- Area Scan (41x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.555 W/kg

- Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.39 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.656 W/kg
SAR(1 g) = 0.328 W/kg; SAR(10 g) = 0.155 W/kg
Maximum value of SAR (measured) = 0.544 W/kg