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FCC SAR Test Report

Report No. : SA120823C20

Applicant : SAMSUNG Electronics Co., LTD.

Address : IT center, 416, Maetan-3dong, Yeongtong-gu, Suwon-city, Gyeonggi-do, Korea

Product : Tablet PC

FCC ID : System FCC ID: A3LXE700T1C-N (for NFC)
Contains FCC ID: A3LEM7700-J (for WWAN Module)
A3L6235ANH (for WLAN Module)

Brand : Samsung

Model No. : XE700T1C

Standards : FCC 47 CFR Part 2 (2.1093) / IEEE C95.1:1991 / IEEE 1528:2003
FCC OET Bulletin 65 Supplement C (Edition 01-01)
KDB 248227 D01 v01r02 / KDB 447498 D01 v04 / KDB 616217 D03 v01
KDB 941225 D01 v02 / KDB 941225 D05 v01

Date of Testing : Aug. 28, 2012 ~ Sep. 20, 2012

CERTIFICATION: The above equipment have been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch - Taiwan HwaYa Lab**, 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.

Prepared By : Ivonne Wu
Ivonne Wu / Senior Specialist

Approved By : Roy Wu
Roy Wu / Manager



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Release Control Record

Issue No.	Reason for Change	Date Issued
R01	Original release	Oct. 03, 2012

1. Summary of Maximum SAR Value

Mode / Band	Test Position	SAR-1g (W/kg)
WCDMA Band II	Body	1.2
WCDMA Band V	Body	0.852
LTE Band 4	Body	0.981
LTE Band 17	Body	1.16
WLAN 2.4GHz	Body	0.615
WLAN 5GHz	Body	0.945
Bluetooth	Body	N/A
NFC	Body	N/A

Note:

1. The SAR limit (**1.6 W/kg**) for general population/uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1991.
2. Since the maximum power of Bluetooth and NFC is less than 60/f, SAR testing for Bluetooth and NFC is not required.

2. Description of Equipment Under Test

EUT Type	Tablet PC
FCC ID	System FCC ID: A3LXE700T1C-N (for NFC) Contains FCC ID: A3LEM7700-J (for WWAN Module) A3L6235ANH (for WLAN Module)
Brand Name	Samsung
Model Name	XE700T1C
Tx Frequency Bands (Unit: MHz)	WCDMA Band II : 1850 ~ 1910 WCDMA Band V : 824 ~ 849 LTE Band 4 : 1710 ~ 1755 LTE Band 17 : 704 ~ 716 WLAN : 2400 ~ 2483.5, 5150 ~ 5350, 5470 ~ 5725, 5725 ~ 5850 Bluetooth : 2400 ~ 2483.5 NFC : 13.56
Uplink Modulations	WCDMA : QPSK 802.11b : DSSS 802.11a/g/n : OFDM Bluetooth : GFSK LTE : QPSK, 16QAM
Maximum AVG Conducted Power (Unit: dBm)	WCDMA Band II : 22.88 WCDMA Band V : 22.88 802.11b : 16.69 802.11g : 16.35 802.11n HT20 (2.4GHz) : 16.36 802.11n HT40 (2.4GHz) : 15.20 802.11a : 16.52 802.11n HT20 (5GHz) : 16.45 802.11n HT40 (5GHz) : 16.49 LTE Band 4 : 22.52 LTE Band 17 : 23
Antenna Type	Fixed Internal Antenna
EUT Stage	Identical Prototype

Note:

- The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.
- NFC (Near Field Communication) controller model number. : PN544, (Brand : NXP)

List of Accessory:

AC Adapter	Brand Name	Samsung
	Model Name	A12-040N1A
	Power Rating	I/P:100-240Vac, 50-60Hz, 1A; O/P: 12Vdc, 3.33A
	DC Power Cord Type	1.8 meter shielded cable with one ferrite core
	AC Power Cable Type	0.9 meter shielded cable without ferrite core
Battery	Brand Name	Samsung
	Model Name	AA-PLZN4NP
	Power Rating	7.5Vdc, 6540mAh
	Type	Li-ion
WWAN Module	Brand Name	Sierra
	Model Name	EM7700
WLAN/BT Module	Brand Name	Intel
	Model Name	6235ANH
LCD Panel	Brand Name	AUO
	Model Name	B116HAN03
Photo Camera	Brand Name	Namuga (Koera)
	Model Name	SA-25AS12572M



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LCD Panel	Brand Name	Namuga (Koera)
	Model Name	SA-25AS12572M

3. SAR Measurement System

3.1 Definition of Specific Absorption Rate (SAR)

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

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

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

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

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

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

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

3.2 SPEAG DASY System

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY4/5 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC.

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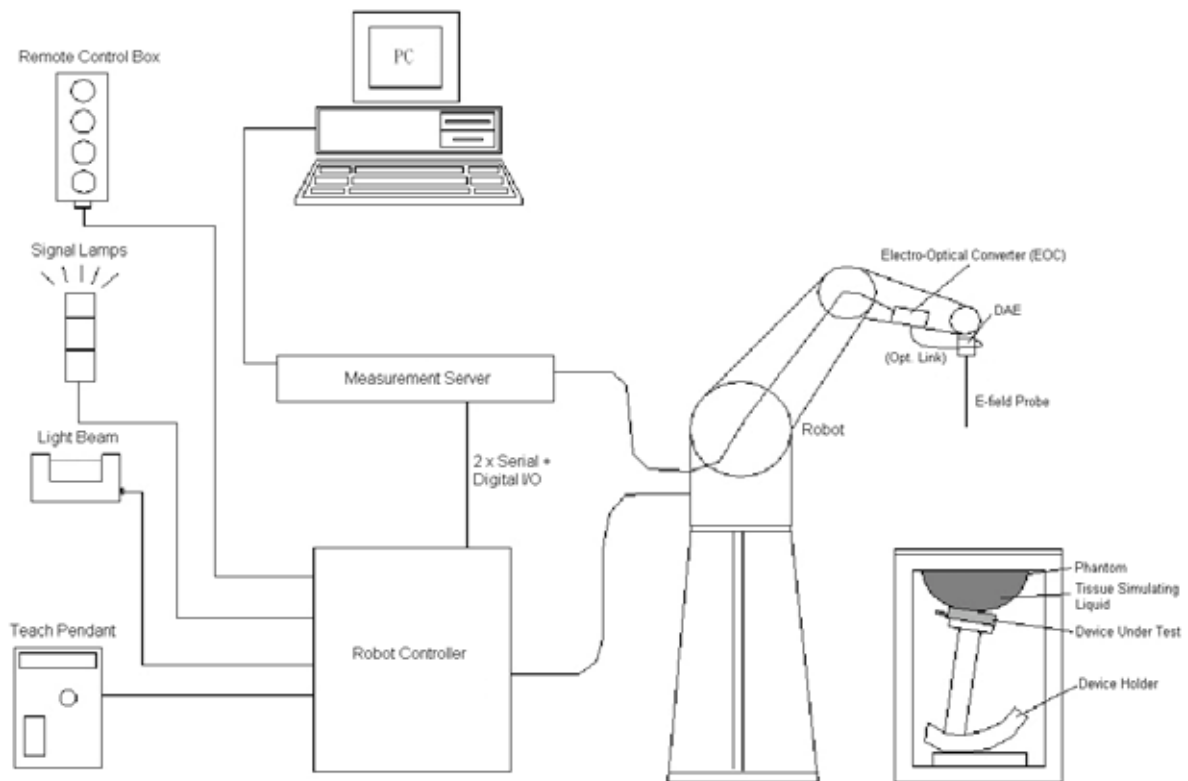


Fig-3.1 DASY System Setup

3.2.1 Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

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



Fig-3.2 DASY4



Fig-3.3 DASY5

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3.2.2 Probes

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

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

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

3.2.3 Data Acquisition Electronics (DAE)

Model	DAE3, DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)	
Input Offset Voltage	< 5 μ V (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

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3.2.4 Phantoms

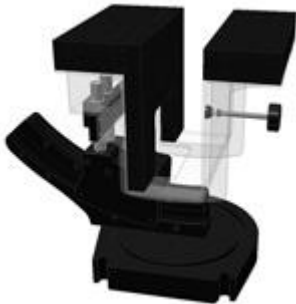
Model	Twin SAM	
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover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

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

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3.2.5 Device Holder

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

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

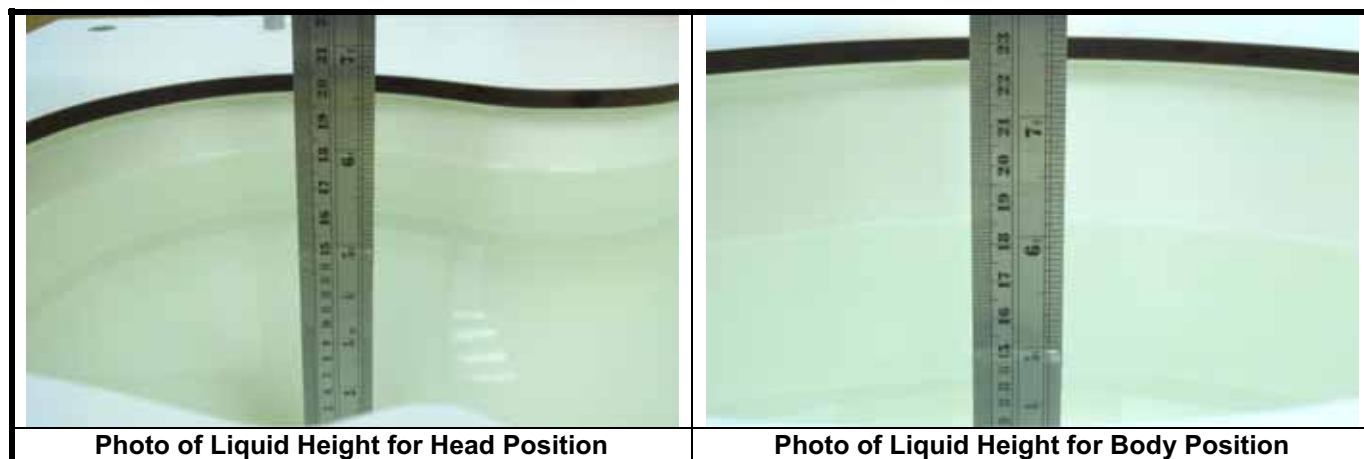
3.2.6 System Validation Dipoles

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

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3.2.7 Tissue Simulating Liquids

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



The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528 and FCC OET 65 Supplement C Appendix C. For the body tissue simulating liquids, the dielectric properties are defined in FCC OET 65 Supplement C Appendix C. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

Table-3.1 Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of $\pm 5\%$	Target Conductivity	Range of $\pm 5\%$
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
1750	53.4	50.7 ~ 56.1	1.49	1.42 ~ 1.56
1900	53.3	50.6 ~ 56.0	1.52	1.44 ~ 1.60
2450	52.7	50.1 ~ 55.3	1.95	1.85 ~ 2.05
5200	49.0	46.6 ~ 51.5	5.30	5.04 ~ 5.57
5300	48.9	46.5 ~ 51.3	5.42	5.15 ~ 5.69
5500	48.6	46.2 ~ 51.0	5.65	5.37 ~ 5.93
5600	48.5	46.1 ~ 50.9	5.77	5.48 ~ 6.06
5800	48.2	45.8 ~ 50.6	6.00	5.70 ~ 6.30

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The following table gives the recipes for tissue simulating liquids.

Table-3.2 Recipes of Tissue Simulating Liquid

Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
B750	0.2	-	0.2	0.8	48.8	-	50.0	-
B835	0.2	-	0.2	0.9	48.5	-	50.2	-
B1750	-	31.0	-	0.2	-	-	68.8	-
B1900	-	29.5	-	0.3	-	-	70.2	-
B2450	-	31.4	-	0.1	-	-	68.5	-
B5G	-	-	-	-	-	10.7	78.6	10.7

3.3 SAR System Verification

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

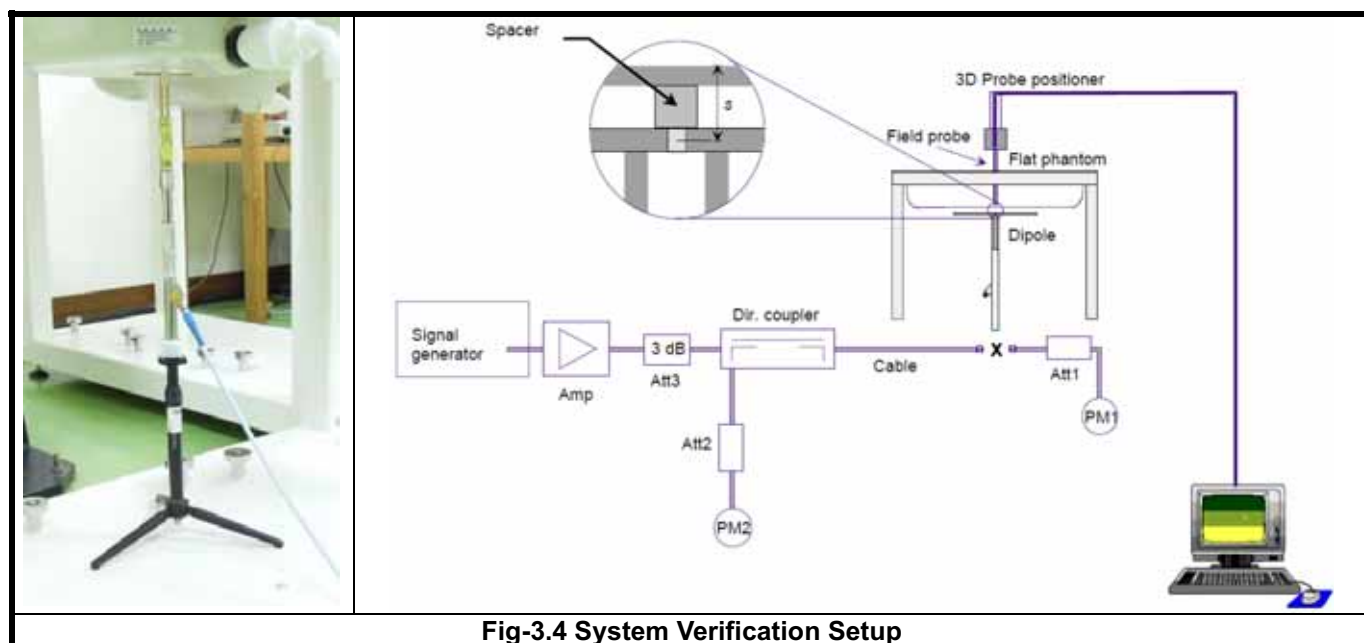


Fig-3.4 System Verification Setup

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The power meter PM1 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 PM2 is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2.

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

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3.4 SAR Measurement Procedure

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

- (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 measures 5x5x7 points with step size 8, 8 and 5 mm for below 3 GHz, and 7x7x9 points with step size 4, 4 and 2.5 mm for above 5 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

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.

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3.4.4 Spatial Peak SAR Evaluation

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

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

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

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

3.4.5 SAR Averaged Methods

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

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

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4. SAR Measurement Evaluation

4.1 EUT Configuration and Setting

The EUT is a data transmitter device that contains one WWAN transmitters. Confirming the LTE transmitter follows 3GPP standards, is category 3, BW 5/10 MHz, band 4/17, supports QPSK / 16QAM modulations, and supports data transmission only. Tested per 3GPP 36.521 maximum transmit procedures for both QPSK / 16QAM.

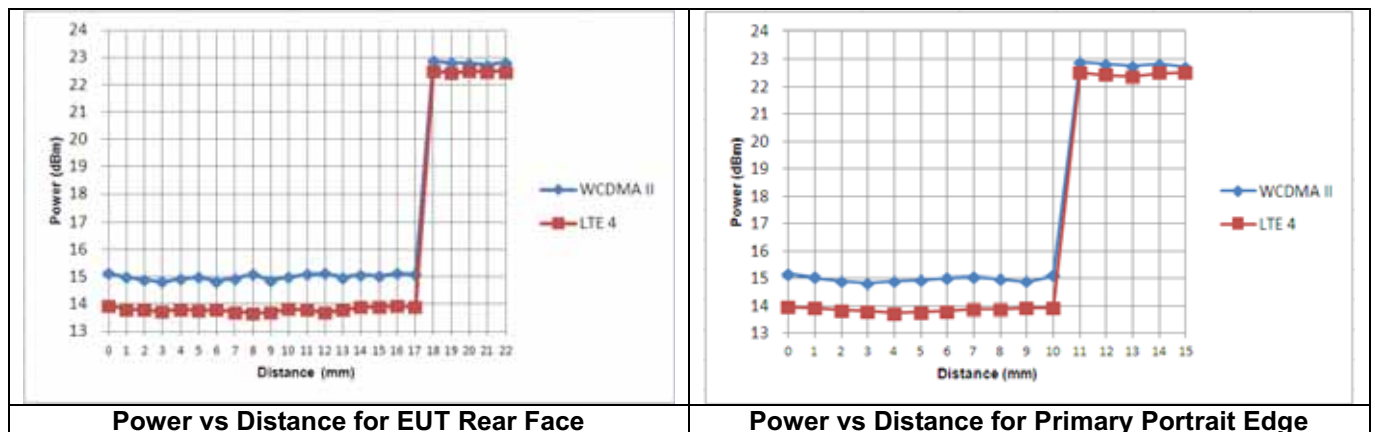
LTE Maximum Power Reduction in accordance with 3GPP 36.101: Power Reduction in accordance to 3GPP is active all times during LTE operation.

Modulation	Channel bandwidth / Transmission bandwidth configuration (RB)		3GPP Requirement (dB)	LTE MPR Setting (dB)
	BW 5 MHz	BW 10 MHz		
QPSK	> 8	> 12	<= 1	1
16QAM	<= 8	<= 12	<= 1	1
16QAM	> 8	> 12	<= 2	2

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

In addition, the device is compliant with A-MPR requirements defined in 36.101 section 6.2.4 that may be required to meet 3GPP Adjacent Channel Leakage Ratio ("ACLR") requirements. A-MPR was disabled for all FCC compliance testing.

The device is tablet PC which supports WWAN, WLAN, Bluetooth and wireless hotspot capabilities. This tablet PC can be used for four display orientations. It is designed with a proximity sensor which can trigger/not trigger power reduction for WCDMA Band II and LTE Band 4 on EUT Rear Face and Primary Portrait orientations. The other RF capabilities (WCDMA Band V / LTE Band 17 / WLAN / BT) have no power reduction. The power vs distance plots for EUT Rear Face and Primary Portrait edge are shown as below.



Based on the separation distance for the sensor triggered / not triggered, we test SAR with power reduction at 0 mm, and test SAR without power reduction at 16 mm for EUT Rear Face, and at 9 mm for EUT Primary Portrait edge.

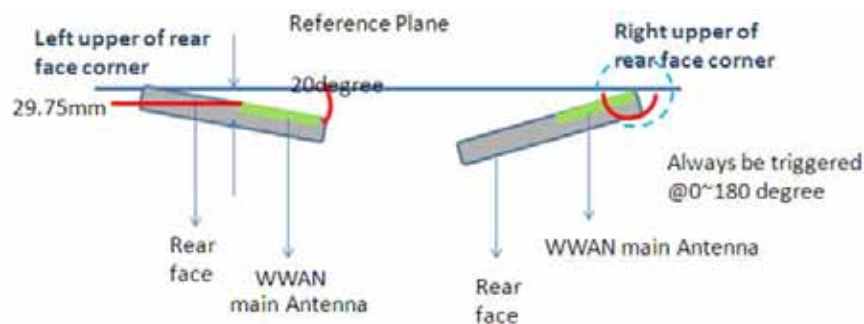
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Since the sensing coverage does not cover the right / left edge contour and the power will resume to normal full power while this tablet is tilted to certain angle, we tilt the tablet and test SAR on the angle with the sensor not triggered.

When the Rear Face of EUT is close to user, the angle of proximity sensor triggered / not triggered at the corner of EUT Rear Face of Top Left and Top Right is listed as below. Based on the angle, we test SAR without power reduction at 20° for Top Edge/Left Rear Corner.

Angle of Top Edge/Right Rear Corner	0° ~ 180°
Proximity Sensor Status	Triggered

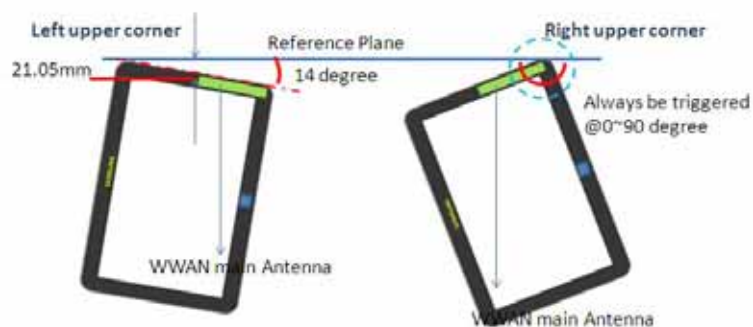
Angle of Top Edge/Left Rear Corner	0° ~ 19°	20°	21°	22°
Proximity Sensor Status	Triggered	Triggered	Not Triggered	Not Triggered



When the edge of Primary Portrait is close to user, the angle of proximity sensor triggered / not triggered at the corner of Top Left and Top Right is listed as below. Based on the angle, we test SAR without power reduction at 14° for Top Edge/Left Corner.

Angle of Top Edge/Right Corner	0° ~ 90°
Proximity Sensor Status	Triggered

Angle of Top Edge/Left Corner	0° ~ 13°	14°	15°	16°
Proximity Sensor Status	Triggered	Triggered	Not Triggered	Not Triggered



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The simultaneous transmission possibilities are listed as below.

Simultaneous Tx Combination	RF Configuration
1	WCDMA Band II (Data) + WLAN (Data)
2	WCDMA Band V (Data) + WLAN (Data)
3	LTE Band 4 (Data) + WLAN (Data)
4	LTE Band 17 (Data) + WLAN (Data)
5	WCDMA Band II (Data) + BT (Data)
6	WCDMA Band V (Data) + BT (Data)
7	LTE Band 4 (Data) + BT (Data)
8	LTE Band 17 (Data) + BT (Data)

Note :

1. This device does not support voice transmission capability.

The power reduction is depends on the proximity sensor input. For a steady SAR test, the power reduction can be enabled/disabled manually by AT commend during SAR testing. The power reduction can be enabled by below command.

<Enable Power Reduction>

at!entercmd="A710"

at!custom="GPIOAREENABLE",1

at!sarstate?

<Disable Power Reduction>

at!entercmd="A710"

at!custom="GPIOAREENABLE",0

at!sarstate?

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

For WCDMA, SAR is tested under 12.2k RMC mode with power control set all up bits. SAR for AMR is not required since its power is less than 1/4 dB higher than RMC. SAR for HSDPA/HSUPA is not required since its power is less than 1/4 dB higher than RMC without HSDPA/HSUPA and SAR for 12.2 kbps RMC is less than 75% of the SAR limit (1.2 W/kg).



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For LTE, set the related parameters of operating band, channel bandwidth, uplink channel number, modulation type, and RB in base station simulator. When the EUT has registered and communicated to base station simulator, set the simulator to make EUT transmitting the maximum radiated power. The steps for system simulator (Anritsu MT8820C) setup are as below.

1. Press the “Std” button to select “LTE 22.20S” function
2. Choose the “Screen Select” item to “Fundamental Measurement”
3. Enter the “Common” item
4. Set the Operating Band
5. Set the Channel Bandwidth
6. Set the UL Channel & Frequency
7. Set the Modulation
8. Set the RB number and RB shift
9. Press “Start Call” button when EUT register to the system simulator
10. Set the TX-1 Max. Power to make the EUT transmit maximum output power

For WLAN SAR testing, the EUT has installed WLAN engineering testing software which can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle. The data rates for WLAN SAR testing were set in 1 Mbps for 802.11b, 6 Mbps for 802.11a, MCS0 for 802.11n 1Tx, and MCS8 for 802.11n 2Tx due to the highest RF output power.



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4.2 EUT Testing Position

The proximity sensor is only active for WCDMA II and LTE 4 on EUT Rear Face and Primary Portrait edge. According to KDB 447498, the SAR is required for antenna located within 5 cm from edge. Based on the antenna location shown on Appendix D of this report, SAR testing condition for each antenna is listed as below.

Mode	Testing Position	Power Reduction	Separation Distance (mm)	SAR Testing
WCDMA Band II	Rear Face	Yes	0	Yes
	Rear Face	No	16	Yes
	Primary Portrait	Yes	0	Yes
	Primary Portrait	No	9	Yes
	Secondary Portrait	No	0	No
	Primary Landscape	No	0	Yes
	Secondary Landscape	No	0	No
WCDMA Band V	Rear Face	No	0	Yes
	Primary Portrait	No	0	Yes
	Secondary Portrait	No	0	No
	Primary Landscape	No	0	Yes
	Secondary Landscape	No	0	No
LTE Band 4	Rear Face	Yes	0	Yes
	Rear Face	No	16	Yes
	Primary Portrait	Yes	0	Yes
	Primary Portrait	No	9	Yes
	Secondary Portrait	No	0	No
	Primary Landscape	No	0	Yes
	Secondary Landscape	No	0	No
LTE Band 17	Rear Face	No	0	Yes
	Primary Portrait	No	0	Yes
	Secondary Portrait	No	0	No
	Primary Landscape	No	0	Yes
	Secondary Landscape	No	0	No
WLAN	Rear Face	No	0	Yes
	Primary Portrait	No	0	Yes
	Secondary Portrait	No	0	Yes
	Primary Landscape	No	0	Yes
	Secondary Landscape	No	0	Yes

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4.3 Tissue Verification

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

Tissue Type	Frequency (MHz)	Liquid Temp. (°C)	Measured Conductivity (σ)	Measured Permittivity (ϵ_r)	Target Conductivity (σ)	Target Permittivity (ϵ_r)	Conductivity Deviation (%)	Permittivity Deviation (%)	Test Date
B750	750	20.6	0.967	55.252	0.96	55.5	0.73	-0.45	Sep. 04, 2012
B835	835	20.5	0.973	55.20	0.97	55.2	0.31	0.00	Aug. 28, 2012
B1750	1750	20.6	1.468	53.825	1.49	53.4	-1.48	0.80	Aug. 31, 2012
B1750	1750	20.7	1.471	53.784	1.49	53.4	-1.28	0.72	Sep. 03, 2012
B1900	1900	20.3	1.54	52.90	1.52	53.3	1.32	-0.75	Aug. 29, 2012
B1900	1900	20.6	1.551	52.998	1.52	53.3	2.04	-0.57	Sep. 05, 2012
B2450	2450	20.6	1.999	52.351	1.95	52.7	2.51	-0.66	Sep. 20, 2012
B5G	5200	20.6	5.244	49.381	5.30	49.0	-1.06	0.78	Sep. 18, 2012
B5G	5200	20.5	5.185	50.911	5.30	49.0	-2.17	3.90	Sep. 19, 2012
B5G	5200	20.2	5.27	49.057	5.30	49.0	-0.57	0.12	Sep. 20, 2012
B5G	5500	20.5	5.686	50.476	5.65	48.6	0.64	3.86	Sep. 19, 2012
B5G	5500	20.2	5.714	48.566	5.65	48.6	1.13	-0.07	Sep. 20, 2012
B5G	5800	20.3	6.127	47.81	6.00	48.2	2.12	-0.81	Sep. 15, 2012
B5G	5800	20.5	6.153	49.738	6.00	48.2	2.55	3.19	Sep. 19, 2012
B5G	5800	20.2	6.127	47.81	6.00	48.2	2.12	-0.81	Sep. 20, 2012

Note:

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

4.4 System Verification

The measuring results for system check are shown as below.

Test Date	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
Sep. 04, 2012	750	8.76	2.31	9.24	5.48	1013	3650	910
Aug. 28, 2012	835	9.60	2.35	9.40	-2.08	4d021	3864	1277
Aug. 31, 2012	1750	37.00	9.48	37.92	2.49	1023	3864	1277
Sep. 03, 2012	1750	37.00	9.23	36.92	-0.22	1023	3650	910
Aug. 29, 2012	1900	38.90	9.71	38.84	-0.15	5d036	3864	1277
Sep. 05, 2012	1900	38.90	9.95	39.80	2.31	5d036	3650	910
Sep. 20, 2012	2450	50.00	13.4	53.60	7.20	737	3590	579
Sep. 18, 2012	5200	72.70	6.88	68.80	-5.36	1018	3590	579
Sep. 19, 2012	5200	72.70	7.1	71.00	-2.34	1018	3590	579
Sep. 20, 2012	5200	72.70	6.92	69.20	-4.81	1018	3590	579
Sep. 19, 2012	5500	78.30	7.81	78.10	-0.26	1018	3590	579
Sep. 20, 2012	5500	78.30	7.85	78.50	0.26	1018	3590	579
Sep. 15, 2012	5800	73.40	6.92	69.20	-5.72	1018	3590	579
Sep. 19, 2012	5800	73.40	6.93	69.30	-5.59	1018	3590	579
Sep. 20, 2012	5800	73.40	7.71	77.10	5.04	1018	3590	579

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.

4.5 Conducted Power Results

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

Band Channel Frequency (MHz)	WCDMA II (P-Sensor Not Triggered)			Power Reduction (dB)	WCDMA II (P-Sensor Triggered)		
	9262 1852.4	9400 1880.0	9538 1907.6		9262 1852.4	9400 1880.0	9538 1907.6
RMC 12.2K	22.84	22.82	22.88	8	14.90	15.02	15.14
HSDPA Subtest-1	22.16	22.18	22.11	8	14.21	14.29	14.41
HSDPA Subtest-2	21.31	21.39	21.34	8	13.53	14.15	14.27
HSDPA Subtest-3	21.27	21.34	21.24	8	13.35	13.57	13.31
HSDPA Subtest-4	21.16	21.25	21.21	8	13.18	13.50	13.42
HSUPA Subtest-1	21.95	22.02	21.90	8	13.99	14.03	14.28
HSUPA Subtest-2	21.21	21.32	21.26	8	13.40	14.02	14.14
HSUPA Subtest-3	22.15	22.24	22.19	8	14.17	14.28	14.29
HSUPA Subtest-4	22.35	22.22	22.34	8	14.40	14.32	14.44
HSUPA Subtest-5	21.86	22.01	21.90	8	13.95	14.03	14.12

Band Channel Frequency (MHz)	WCDMA Band V		
	4132 826.4	4182 836.4	4233 846.6
RMC 12.2K	22.88	22.69	22.75
HSDPA Subtest-1	22.33	22.27	22.32
HSDPA Subtest-2	21.48	21.34	21.33
HSDPA Subtest-3	21.31	21.26	21.24
HSDPA Subtest-4	21.27	21.19	21.14
HSUPA Subtest-1	21.93	21.91	21.89
HSUPA Subtest-2	21.39	21.20	21.21
HSUPA Subtest-3	22.37	22.32	22.24
HSUPA Subtest-4	22.51	22.47	22.36
HSUPA Subtest-5	21.86	21.83	21.76

Note : Power reduction is not implemented on WCDMA band V.



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LTE Band 4										
BW	Modulation	CH	Frequency (MHz)	RB	RB Offset	Target Power	MPR	Measured Power (P-Sensor Not Triggered)	Power Reduction (dB)	Measured Power (P-Sensor Triggered)
5 MHz	QPSK	19975	1712.5	1	0	22.80	0	22.37	9	13.75
		20175	1732.5	1	0	22.80	0	22.49	9	13.84
		20375	1752.5	1	0	22.80	0	22.36	9	13.44
		19975	1712.5	1	24	22.80	0	22.46	9	13.69
		20175	1732.5	1	24	22.80	0	22.48	9	13.87
		20375	1752.5	1	24	22.80	0	22.34	9	13.72
		19975	1712.5	12	6	22.80	1	21.72	9	12.94
		20175	1732.5	12	6	22.80	1	21.77	9	13.07
		20375	1752.5	12	6	22.80	1	21.63	9	12.76
		19975	1712.5	25	0	22.80	1	21.71	9	12.97
	16QAM	20175	1732.5	25	0	22.80	1	21.74	9	13.08
		20375	1752.5	25	0	22.80	1	21.66	9	12.88
		19975	1712.5	1	0	22.80	1	21.85	9	13.19
		20175	1732.5	1	0	22.80	1	21.93	9	13.22
		20375	1752.5	1	0	22.80	1	21.86	9	13.01
		19975	1712.5	1	24	22.80	1	21.88	9	13.34
		20175	1732.5	1	24	22.80	1	21.91	9	13.39
		20375	1752.5	1	24	22.80	1	21.82	9	13.25
		19975	1712.5	12	6	22.80	2	20.67	9	12.10
		20175	1732.5	12	6	22.80	2	20.73	9	12.13
		20375	1752.5	12	6	22.80	2	20.64	9	12.03
10 MHz	QPSK	19975	1712.5	25	0	22.80	2	20.68	9	12.04
		20175	1732.5	25	0	22.80	2	20.69	9	12.07
		20375	1752.5	25	0	22.80	2	20.67	9	12.02
	16QAM	20000	1715	1	0	22.80	0	22.40	9	13.79
		20175	1732.5	1	0	22.80	0	22.52	9	13.95
		20350	1750	1	0	22.80	0	22.39	9	13.64
		20000	1715	1	49	22.80	0	22.44	9	13.76
		20175	1732.5	1	49	22.80	0	22.46	9	13.89
		20350	1750	1	49	22.80	0	22.32	9	13.73
		20000	1715	25	12	22.80	1	21.90	9	13.08
		20175	1732.5	25	12	22.80	1	21.95	9	13.45
		20350	1750	25	12	22.80	1	21.81	9	12.90
		20000	1715	50	0	22.80	1	21.84	9	13.28
		20175	1732.5	50	0	22.80	1	21.87	9	13.30
		20350	1750	50	0	22.80	1	21.79	9	13.22
	16QAM	20000	1715	1	0	22.80	1	21.96	9	13.34
		20175	1732.5	1	0	22.80	1	22.04	9	13.44
		20350	1750	1	0	22.80	1	21.97	9	13.11
		20000	1715	1	49	22.80	1	21.94	9	13.21
		20175	1732.5	1	49	22.80	1	21.97	9	13.31
		20350	1750	1	49	22.80	1	21.88	9	13.16
		20000	1715	25	12	22.80	2	21.17	9	12.56
		20175	1732.5	25	12	22.80	2	21.23	9	12.60
		20350	1750	25	12	22.80	2	21.14	9	12.18
		20000	1715	50	0	22.80	2	20.92	9	12.09
		20175	1732.5	50	0	22.80	2	20.93	9	12.34
		20350	1750	50	0	22.80	2	20.91	9	11.94



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LTE Band 17								
BW	Modulation	CH	Frequency (MHz)	RB	RB Offset	Target Power	MPR	Measured Power
5 MHz	QPSK	23755	706.5	1	0	23.00	0	22.80
		23790	710	1	0	23.00	0	22.82
		23825	713.5	1	0	23.00	0	22.89
		23755	706.5	1	24	23.00	0	22.81
		23790	710	1	24	23.00	0	22.83
		23825	713.5	1	24	23.00	0	22.84
		23755	706.5	12	6	23.00	1	21.96
		23790	710	12	6	23.00	1	22.00
		23825	713.5	12	6	23.00	1	22.06
		23755	706.5	25	0	23.00	1	22.01
		23790	710	25	0	23.00	1	22.04
		23825	713.5	25	0	23.00	1	22.08
	16QAM	23755	706.5	1	0	23.00	1	21.90
		23790	710	1	0	23.00	1	21.92
		23825	713.5	1	0	23.00	1	21.96
		23755	706.5	1	24	23.00	1	22.06
		23790	710	1	24	23.00	1	22.05
		23825	713.5	1	24	23.00	1	22.66
		23755	706.5	12	6	23.00	2	21.04
		23790	710	12	6	23.00	2	21.06
		23825	713.5	12	6	23.00	2	21.14
		23755	706.5	25	0	23.00	2	21.37
10 MHz	QPSK	23790	710	25	0	23.00	2	21.46
		23825	713.5	25	0	23.00	2	21.48
	16QAM	23780	709	1	0	23.00	0	22.47
		23790	710	1	0	23.00	0	22.58
		23800	711	1	0	23.00	0	22.69
		23780	709	1	49	23.00	0	22.43
		23790	710	1	49	23.00	0	22.85
		23800	711	1	49	23.00	0	23.00
		23780	709	25	12	23.00	1	21.44
		23790	710	25	12	23.00	1	21.45
		23800	711	25	12	23.00	1	21.46
		23780	709	50	0	23.00	1	21.38
	16QAM	23790	710	50	0	23.00	1	21.39
		23800	711	50	0	23.00	1	21.49
		23780	709	1	0	23.00	1	21.58
		23790	710	1	0	23.00	1	21.68
		23800	711	1	0	23.00	1	21.76
		23780	709	1	49	23.00	1	21.71
		23790	710	1	49	23.00	1	22.14
		23800	711	1	49	23.00	1	22.21
		23780	709	25	12	23.00	2	20.65
		23790	710	25	12	23.00	2	20.69
		23800	711	25	12	23.00	2	20.77
		23780	709	50	0	23.00	2	20.33
		23790	710	50	0	23.00	2	20.35
		23800	711	50	0	23.00	2	20.39

Note : Power reduction is not implemented on WWAN LTE band 17.

Band	802.11b			802.11g		
Channel	1	6	11	1	6	11
Frequency (MHz)	2412	2437	2462	2412	2437	2462
Average Power (Ant 0)	16.69	16.46	16.42	13.74	16.24	13.75
Average Power (Ant 1)	16.54	14.66	15.75	13.64	16.35	13.21



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Band	802.11n (HT20)			802.11n (HT40)		
Channel	1	6	11	3	6	9
Frequency (MHz)	2412	2437	2462	2422	2437	2452
Average Power (Ant 0)	12.82	16.36	12.45	10.40	13.16	9.67
Average Power (Ant 1)	12.27	16.23	12.18	8.86	12.49	9.79
Average Power (Ant 0+1)	14.59	15.94	13.57	10.01	15.20	9.33

Band	802.11a							
Channel	36	40	44	48	52	56	60	64
Frequency (MHz)	5180	5200	5220	5240	5260	5280	5300	5320
Average Power (Ant 0)	16.01	15.93	15.66	15.76	15.72	15.47	15.87	16.12
Average Power (Ant 1)	15.65	15.61	15.40	15.41	14.91	15.07	15.00	15.61

Band	802.11a							
Channel	100	104	108	112	116	132	136	140
Frequency (MHz)	5500	5520	5540	5560	5580	5660	5680	5700
Average Power (Ant 0)	16.21	16.22	16.11	16.23	16.14	16.34	16.34	16.16
Average Power (Ant 1)	15.33	15.12	15.24	15.43	15.44	15.46	15.35	15.26

Band	802.11a							
Channel	149	153	157	161	165	-	-	-
Frequency (MHz)	5745	5765	5785	5805	5825	-	-	-
Average Power (Ant 0)	16.34	16.27	16.20	16.13	16.24	-	-	-
Average Power (Ant 1)	16.52	16.46	16.41	16.43	16.46	-	-	-

Band	802.11n (HT20)							
Channel	36	40	44	48	52	56	60	64
Frequency (MHz)	5180	5200	5220	5240	5260	5280	5300	5320
Average Power (Ant 0)	15.73	16.37	16.35	16.24	15.85	15.65	16.36	16.24
Average Power (Ant 1)	15.73	16.37	15.74	16.24	15.11	14.87	14.87	15.45
Average Power (Ant 0+1)	16.05	16.08	15.84	15.56	15.34	15.45	15.52	15.72

Band	802.11n (HT20)							
Channel	100	104	108	112	116	132	136	140
Frequency (MHz)	5500	5520	5540	5560	5580	5660	5680	5700
Average Power (Ant 0)	16.05	16.10	16.10	16.18	16.27	15.93	15.99	16.20
Average Power (Ant 1)	15.55	15.41	15.51	15.34	15.59	15.33	15.49	15.48
Average Power (Ant 0+1)	15.63	15.62	15.77	15.81	15.84	15.64	15.09	15.29

Band	802.11n (HT20)							
Channel	149	153	157	161	165	-	-	-
Frequency (MHz)	5745	5765	5785	5805	5825	-	-	-
Average Power (Ant 0)	16.25	16.18	16.12	16.06	16.21	-	-	-
Average Power (Ant 1)	16.45	16.45	16.32	16.27	16.42	-	-	-
Average Power (Ant 0+1)	12.99	12.82	12.91	13.17	13.12	-	-	-

Band	802.11n (HT40)							
Channel	38	46	54	62	102	134	151	159
Frequency (MHz)	5190	5230	5270	5310	5510	5670	5755	5795
Average Power (Ant 0)	12.61	16.06	15.91	11.48	15.94	16.26	16.05	16.30
Average Power (Ant 1)	12.65	15.63	15.01	12.28	14.38	15.57	16.43	16.49
Average Power (Ant 0+1)	13.14	16.09	15.21	15.16	15.62	15.40	15.56	15.28

Note : Power reduction is not implemented on WLAN.

4.6 SAR Testing Results

4.6.1 SAR Results for Body

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	P-Sensor Status	Output Power	Power Reduction (dB)	SAR-1g (W/kg)	Power Drift (dB)
4	WCDMA II	RMC12.2K	Rear Face	0	9538	Triggered	15.14	8	0.429	-0.08
5	WCDMA II	RMC12.2K	Primary Portrait	0	9538	Triggered	15.14	8	0.535	-0.17
6	WCDMA II	RMC12.2K	Rear Face	1.6	9538	Not Triggered	22.88	w/o	0.533	0.163
7	WCDMA II	RMC12.2K	Rear Face (Top Edge/Left Rear Corner at 20°)	0	9538	Not Triggered	22.88	w/o	0.188	-0.05
9	WCDMA II	RMC12.2K	Primary Portrait	0.9	9538	Not Triggered	22.88	w/o	1.2	-0.15
10	WCDMA II	RMC12.2K	Primary Portrait (Top Edge/Left Corner at 14°)	0	9538	Not Triggered	22.88	w/o	0.205	0.037
12	WCDMA II	RMC12.2K	Primary Landscape	0	9538	Not Triggered	22.88	w/o	0.743	0.162
16	WCDMA II	RMC12.2K	Primary Portrait	0.9	9262	Not Triggered	22.84	w/o	1.02	-0.054
17	WCDMA II	RMC12.2K	Primary Portrait	0.9	9400	Not Triggered	22.82	w/o	1.03	-0.197
1	WCDMA V	RMC12.2K	Rear Face	0	4132	Not Triggered	22.88	w/o	0.852	0.165
2	WCDMA V	RMC12.2K	Primary Portrait	0	4132	Not Triggered	22.88	w/o	0.693	-0.101
3	WCDMA V	RMC12.2K	Primary Landscape	0	4132	Not Triggered	22.88	w/o	0.139	0.146
15	WCDMA V	RMC12.2K	Rear Face	0	4182	Not Triggered	22.69	w/o	0.608	-0.126
14	WCDMA V	RMC12.2K	Rear Face	0	4233	Not Triggered	22.75	w/o	0.584	0.132

Note:

- According to KDB 941225, the SAR testing for HSPA is not required because the maximum power of HSPA is less than 1/4 dB higher than RMC 12.2K.



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Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	RB	RB Offset	P-Sensor Status	Output Power	Power Reduction (dB)	SAR-1g (W/kg)	Power Drift (dB)
213	LTE 4	QPSK_10M	Rear Face	0	20175	25	12	Triggered	13.45	9	0.509	0.129
215	LTE 4	QPSK_10M	Rear Face	0	20175	1	0	Triggered	13.95	9	0.484	0.137
217	LTE 4	QPSK_10M	Rear Face	0	20175	1	49	Triggered	13.89	9	0.48	0.043
214	LTE 4	QPSK_10M	Primary Portrait	0	20175	25	12	Triggered	13.45	9	0.541	0.04
216	LTE 4	QPSK_10M	Primary Portrait	0	20175	1	0	Triggered	13.95	9	0.574	0.08
218	LTE 4	QPSK_10M	Primary Portrait	0	20175	1	49	Triggered	13.89	9	0.526	0.03
219	LTE 4	16QAM_10M	Primary Portrait	0	20175	25	12	Triggered	12.60	9	0.539	-0.02
220	LTE 4	16QAM_10M	Primary Portrait	0	20175	1	0	Triggered	13.44	9	0.526	-0.06
221	LTE 4	16QAM_10M	Primary Portrait	0	20175	1	49	Triggered	13.31	9	0.488	-0.129
222	LTE 4	QPSK_10M	Rear Face	1.6	20175	25	12	Not Triggered	21.95	w/o	0.312	-0.06
229	LTE 4	QPSK_10M	Rear Face	1.6	20175	1	0	Not Triggered	22.52	w/o	0.388	-0.01
236	LTE 4	QPSK_10M	Rear Face	1.6	20175	1	49	Not Triggered	22.46	w/o	0.392	0.04
223	LTE 4	QPSK_10M	Rear Face (Top Edge/Left Rear Corner at 20°)	0	20175	25	12	Not Triggered	21.95	w/o	0.183	-0.14
230	LTE 4	QPSK_10M	Rear Face (Top Edge/Left Rear Corner at 20°)	0	20175	1	0	Not Triggered	22.52	w/o	0.183	0.076
237	LTE 4	QPSK_10M	Rear Face (Top Edge/Left Rear Corner at 20°)	0	20175	1	49	Not Triggered	22.46	w/o	0.182	0.086
225	LTE 4	QPSK_10M	Primary Portrait	0.9	20175	25	12	Not Triggered	21.95	w/o	0.791	-0.04
232	LTE 4	QPSK_10M	Primary Portrait	0.9	20175	1	0	Not Triggered	22.52	w/o	0.975	-0.12
239	LTE 4	QPSK_10M	Primary Portrait	0.9	20175	1	49	Not Triggered	22.46	w/o	0.981	-0.13
226	LTE 4	QPSK_10M	Primary Portrait (Top Edge/Left Corner at 14°)	0	20175	25	12	Not Triggered	21.95	w/o	0.134	-0.034
233	LTE 4	QPSK_10M	Primary Portrait (Top Edge/Left Corner at 14°)	0	20175	1	0	Not Triggered	22.52	w/o	0.166	-0.03
240	LTE 4	QPSK_10M	Primary Portrait (Top Edge/Left Corner at 14°)	0	20175	1	49	Not Triggered	22.46	w/o	0.177	-0.15
228	LTE 4	QPSK_10M	Primary Landscape	0	20175	25	12	Not Triggered	21.95	w/o	0.488	0.18
235	LTE 4	QPSK_10M	Primary Landscape	0	20175	1	0	Not Triggered	22.52	w/o	0.605	0.16
242	LTE 4	QPSK_10M	Primary Landscape	0	20175	1	49	Not Triggered	22.46	w/o	0.620	0.05
243	LTE 4	16QAM_10M	Primary Portrait	0.9	20175	25	12	Not Triggered	21.23	w/o	0.636	-0.131
244	LTE 4	16QAM_10M	Primary Portrait	0.9	20175	1	0	Not Triggered	22.04	w/o	0.756	-0.031
245	LTE 4	16QAM_10M	Primary Portrait	0.9	20175	1	49	Not Triggered	21.97	w/o	0.755	-0.15

Note:

1. According to KDB 941225, the SAR testing for 100% RB is not required since the maximum SAR of 50% RB is less than 1.45 W/kg.
2. According to KDB 941225, the SAR testing was performed on largest channel bandwidth, and SAR for other channel bandwidths is not required since the maximum power of smaller channel bandwidth is within 1/2 dB higher or lower of measured for the largest channel bandwidth and maximum SAR of largest channel bandwidth is less than 1.45 W/kg.

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Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	RB	Offset	Output Power	SAR-1g (W/kg)	Power Drift (dB)
201	LTE 17	QPSK_10M	Rear Face	0	23800	25	12	21.46	0.601	0.09
204	LTE 17	QPSK_10M	Rear Face	0	23800	1	0	22.69	0.761	-0.16
207	LTE 17	QPSK_10M	Rear Face	0	23800	1	49	23.00	0.74	0.08
202	LTE 17	QPSK_10M	Primary Portrait	0	23800	25	12	21.46	0.91	-0.13
205	LTE 17	QPSK_10M	Primary Portrait	0	23800	1	0	22.69	1.16	-0.07
208	LTE 17	QPSK_10M	Primary Portrait	0	23800	1	49	23.00	1.15	-0.03
203	LTE 17	QPSK_10M	Primary Landscape	0	23800	25	12	21.46	0.07	-0.02
206	LTE 17	QPSK_10M	Primary Landscape	0	23800	1	0	22.69	0.109	0.16
209	LTE 17	QPSK_10M	Primary Landscape	0	23800	1	49	23.00	0.089	0.13
246	LTE 17	QPSK_10M	Primary Portrait	0	23780	25	12	21.44	0.905	-0.1
247	LTE 17	QPSK_10M	Primary Portrait	0	23790	25	12	21.45	0.914	-0.09
210	LTE 17	16QAM_10M	Primary Portrait	0	23800	25	12	20.77	0.79	-0.18
211	LTE 17	16QAM_10M	Primary Portrait	0	23800	1	0	21.76	0.999	-0.16
212	LTE 17	16QAM_10M	Primary Portrait	0	23800	1	49	22.21	0.967	-0.12

Note:

1. According to KDB 941225, the SAR testing for 100% RB is not required since the maximum SAR of 50% RB is less than 1.45 W/kg.
2. According to KDB 941225, the SAR testing was performed on largest channel bandwidth, and SAR for other channel bandwidths is not required since the maximum power of smaller channel bandwidth is within 1/2 dB higher or lower of measured for the largest channel bandwidth and maximum SAR of largest channel bandwidth is less than 1.45 W/kg.

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	Tx Antenna	Output Power	SAR-1g (W/kg)	Power Drift (dB)
101	802.11b	-	Rear Face	0	1	0	16.69	0.615	0.12
102	802.11b	-	Primary Portrait	0	1	0	16.69	0.461	-0.17
103	802.11b	-	Secondary Landscape	0	1	0	16.69	0.196	0.18
104	802.11b	-	Rear Face	0	1	1	16.54	0.508	0.02
105	802.11b	-	Secondary Portrait	0	1	1	16.54	0.335	0.04
106	802.11b	-	Primary Landscape	0	1	1	16.54	0.49	0.15
107	802.11n	HT20	Rear Face	0	6	0+1	15.94	0.229	0.15
109	802.11n	HT20	Primary Portrait	0	6	0+1	15.94	0.162	0.16
108	802.11n	HT20	Secondary Portrait	0	6	0+1	15.94	0.097	-0.06
111	802.11n	HT20	Primary Landscape	0	6	0+1	15.94	0.127	0.17
110	802.11n	HT20	Secondary Landscape	0	6	0+1	15.94	0.063	0.15

Note:

1. SAR is performed on the highest power channel. When the SAR value of highest power channel is less than 0.8 W/kg, SAR testing for optional channel is not required.
2. SAR testing for 802.11g/n is not required because its maximum power is less than 1/4 dB higher than 802.11b.



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Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	Tx Antenna	Output Power	SAR-1g (W/kg)	Power Drift (dB)
112	802.11n	HT20	Rear Face	0	40	0	16.37	0.046	0.13
113	802.11n	HT20	Primary Portrait	0	40	0	16.37	0.134	-0.09
114	802.11n	HT20	Secondary Landscape	0	40	0	16.37	0.028	-0.03
147	802.11n	HT20	Rear Face	0	40	1	16.37	0.789	0.03
148	802.11n	HT20	Secondary Portrait	0	40	1	16.37	0.406	0.1
149	802.11n	HT20	Primary Landscape	0	40	1	16.37	0.209	0.03
126	802.11n	HT40	Rear Face	0	46	0+1	16.09	0.241	0.11
128	802.11n	HT40	Primary Portrait	0	46	0+1	16.09	0.047	0.03
127	802.11n	HT40	Secondary Portrait	0	46	0+1	16.09	0.117	0.01
130	802.11n	HT40	Primary Landscape	0	46	0+1	16.09	0.042	0.07
129	802.11n	HT40	Secondary Landscape	0	46	0+1	16.09	N/A	-
115	802.11n	HT20	Rear Face	0	60	0	16.36	0.016	0.16
116	802.11n	HT20	Primary Portrait	0	60	0	16.36	0.155	-0.02
117	802.11n	HT20	Secondary Landscape	0	60	0	16.36	0.023	0
150	802.11a	-	Rear Face	0	64	1	15.61	0.358	-0.05
151	802.11a	-	Secondary Portrait	0	64	1	15.61	0.361	0.07
152	802.11a	-	Primary Landscape	0	64	1	15.61	0.081	0.12
131	802.11n	HT20	Rear Face	0	64	0+1	15.72	0.115	0.15
133	802.11n	HT20	Primary Portrait	0	64	0+1	15.72	0.052	0.08
132	802.11n	HT20	Secondary Portrait	0	64	0+1	15.72	0.168	0.02
135	802.11n	HT20	Primary Landscape	0	64	0+1	15.72	0.026	0.04
134	802.11n	HT20	Secondary Landscape	0	64	0+1	15.72	0.000441	0.01
119	802.11a	-	Rear Face	0	136	0	16.34	0.127	0.14
120	802.11a	-	Primary Portrait	0	136	0	16.34	0.785	-0.05
121	802.11a	-	Secondary Landscape	0	136	0	16.34	0.084	0.11
153	802.11n	HT20	Rear Face	0	116	1	15.59	0.496	0.06
154	802.11n	HT20	Secondary Portrait	0	116	1	15.59	0.92	0.06
155	802.11n	HT20	Primary Landscape	0	116	1	15.59	0.244	-0.1
159	802.11n	HT20	Secondary Portrait	0	100	1	15.55	0.945	0.04
160	802.11n	HT20	Secondary Portrait	0	136	1	15.49	0.699	0.07
136	802.11n	HT20	Rear Face	0	116	0+1	15.64	0.214	0.12
138	802.11n	HT20	Primary Portrait	0	116	0+1	15.64	0.24	-0.06
137	802.11n	HT20	Secondary Portrait	0	116	0+1	15.64	0.452	0.05
140	802.11n	HT20	Primary Landscape	0	116	0+1	15.64	0.087	0.04
139	802.11n	HT20	Secondary Landscape	0	116	0+1	15.64	N/A	-
122	802.11a	-	Rear Face	0	149	0	16.34	0.117	0
123	802.11a	-	Primary Portrait	0	149	0	16.34	0.623	-0.11
124	802.11a	-	Secondary Landscape	0	149	0	16.34	0.089	0
156	802.11a	-	Rear Face	0	149	1	16.52	0.447	0.09
157	802.11a	-	Secondary Portrait	0	149	1	16.52	0.863	0.04
158	802.11a	-	Primary Landscape	0	149	1	16.52	0.226	-0.08
161	802.11a	-	Secondary Portrait	0	153	1	16.46	0.826	0.03
162	802.11a	-	Secondary Portrait	0	165	1	16.46	0.712	0.06
141	802.11n	HT40	Rear Face	0	151	0+1	15.56	0.093	0.12
143	802.11n	HT40	Primary Portrait	0	151	0+1	15.56	0.139	0.12
142	802.11n	HT40	Secondary Portrait	0	151	0+1	15.56	0.207	0.16
145	802.11n	HT40	Primary Landscape	0	151	0+1	15.56	0.06	0.15
144	802.11n	HT40	Secondary Landscape	0	151	0+1	15.56	N/A	-

Note:

1. SAR is performed on the highest power channel. When the SAR value of highest power channel is less than 0.8 W/kg, SAR testing for optional channel is not required.
2. SAR testing for WLAN 5G is performed on the maximum power mode.
3. The "N/A" means there is no SAR value or the SAR is too low to be measured.

Test Engineer : Morrison Huang, Isaac Liao, and Mars Chang

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4.6.2 Simultaneous Multi-band Transmission Evaluation

No.	Conditions (SAR1 + SAR2)	Position	P-Sensor Status	Max. SAR1	Max. SAR2	Max. SAR Summation	SPLSR
1	WCDMA II + WLAN 2.4G	Rear Face	Triggered	0.429	0.615	1.148	-
			Not Triggered	0.533			
		Primary Portrait	Triggered	0.535	0.461	1.661	0.149
			Not Triggered	1.2			
		Secondary Portrait	N/A	0	0.335	0.335	-
		Primary Landscape	N/A	0.743	0.49	1.233	-
		Secondary Landscape	N/A	0	0.196	0.196	-
	WCDMA II + WLAN 5G	Rear Face	Triggered	0.429	0.789	1.322	-
			Not Triggered	0.533			
		Primary Portrait	Triggered	0.535	0.785	1.985	0.169
			Not Triggered	1.2			
		Secondary Portrait	N/A	0	0.945	0.945	-
		Primary Landscape	N/A	0.743	0.244	0.987	-
		Secondary Landscape	N/A	0	0.089	0.089	-
2	WCDMA V + WLAN 2.4G	Rear Face	N/A	0.852	0.615	1.467	-
		Primary Portrait	N/A	0.693	0.461	1.154	-
		Secondary Portrait	N/A	0	0.335	0.335	-
		Primary Landscape	N/A	0.139	0.49	0.629	-
		Secondary Landscape	N/A	0	0.196	0.196	-
	WCDMA V + WLAN 5G	Rear Face	N/A	0.852	0.789	1.641	0.054
		Primary Portrait	N/A	0.693	0.785	1.478	-
		Secondary Portrait	N/A	0	0.945	0.945	-
		Primary Landscape	N/A	0.139	0.244	0.383	-
		Secondary Landscape	N/A	0	0.089	0.089	-
3	LTE 4 + WLAN 2.4G	Rear Face	Triggered	0.509	0.615	1.124	-
			Not Triggered	0.392			
		Primary Portrait	Triggered	0.574	0.461	1.442	-
			Not Triggered	0.981			
		Secondary Portrait	Triggered	0	0.335	0.335	-
		Primary Landscape	N/A	0.62	0.49	1.11	-
		Secondary Landscape	N/A	0	0.196	0.196	-
	LTE 4 + WLAN 5G	Rear Face	Triggered	0.509	0.789	1.298	-
			Not Triggered	0.392			
		Primary Portrait	Triggered	0.574	0.785	1.766	0.158
			Not Triggered	0.981			
		Secondary Portrait	Triggered	0	0.945	0.945	-
		Primary Landscape	N/A	0.62	0.244	0.864	-
		Secondary Landscape	N/A	0	0.089	0.089	-
4	LTE 17+ WLAN 2.4G	Rear Face	N/A	0.761	0.615	1.376	-
		Primary Portrait	N/A	1.16	0.461	1.621	0.255
		Secondary Portrait	N/A	0	0.335	0.335	-
		Primary Landscape	N/A	0.109	0.49	0.599	-
		Secondary Landscape	N/A	0	0.196	0.196	-
	LTE 17 + WLAN 5G	Rear Face	N/A	0.761	0.789	1.55	-
		Primary Portrait	N/A	1.16	0.785	1.945	0.279
		Secondary Portrait	N/A	0	0.945	0.945	-
		Primary Landscape	N/A	0.109	0.244	0.353	-
		Secondary Landscape	N/A	0	0.089	0.089	-

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Note:

1. The maximum SAR summation is calculated based on the same configuration and test position.
2. The calculation of SPLSR is as follows.

<SPLSR calculation procedure>

- 1) Use DASY software to open SAR data file with zoom scan results.
- 2) Export data file to SEMCAD using 'Field Data Export' function.
- 3) Search for highest SAR based on the imported measured/interpolated data and identify the X, Y, and Z coordinates. Per the SAR system manufacture, DASY stores the individual coordinates of each measurement point in the measurement file where the, center coordinate (x=0, y=0) is always the Grid Reference Point as set in DASY for a phantom section.
- 4) Calculate the peak SAR separation distances using the Pythagoras' theorem where
Peak Location Separation = $\text{Sqrt}[(X_1 - X_2)^2 + (Y_1 - Y_2)^2 + (Z_1 - Z_2)^2]$
- 5) Calculate SPLSR = (SAR1 + SAR2) / Peak SAR separation distance.
- 6) The SPLSR calculation plots shown in test report are for reference only as the images were generated in a separate software program to add the antenna and arrow references. The distance information in the calculations below each plot is derived from the DASY SAR zoom scan data as specified in this procedure.

The calculation of SPLSR for (WCDMA Band II + WLAN 2.4G, Primary Portrait) is as below:

Coordinate of Peak SAR Location (X, Y, Z) :

WCDMA Band II (-0.24, 6.48, -17.93)

WLAN 2.4G (0.16, -4.68, -18.07)

Peak Location Spacing = 11.2 cm

SPLSR (SAR to Peak Location Spacing Ratio) = $(1.2 + 0.461) / 11.2 = 0.149$

The calculation of SPLSR for (WCDMA Band II + WLAN 5G, Primary Portrait) is as below:

Coordinate of Peak SAR Location (X, Y, Z) :

WCDMA Band II (-0.24, 6.48, -17.93)

WLAN 5G (0.24, -5.28, -17.97)

Peak Location Spacing = 11.8 cm

SPLSR (SAR to Peak Location Spacing Ratio) = $(1.2 + 0.785) / 11.8 = 0.169$

The calculation of SPLSR for (WCDMA Band V + WLAN 5G, Rear Face) is as below:

Coordinate of Peak SAR Location (X, Y, Z) :

WCDMA Band V (-0.59, 15.72, -17.83)

WLAN 5G (-8.24, -13.96, -17.77)

Peak Location Spacing = 30.7 cm

SPLSR (SAR to Peak Location Spacing Ratio) = $(0.852 + 0.789) / 30.7 = 0.054$

The calculation of SPLSR for (LTE Band 4 + WLAN 5G, Primary Portrait) is as below:

Coordinate of Peak SAR Location (X, Y, Z) :

LTE Band 4 (-0.24, 5.88, -18.06)

WLAN 5G (0.24, -5.28, -17.97)

Peak Location Spacing = 11.2 cm

SPLSR (SAR to Peak Location Spacing Ratio) = $(0.981 + 0.785) / 11.2 = 0.158$

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The calculation of SPLSR for (LTE Band 17 + WLAN 2.4G, Primary Portrait) is as below:

Coordinate of Peak SAR Location (X, Y, Z) :

LTE Band 17 (0, 1.68, -18.07)

WLAN 2.4G (0.16, -4.68, -18.07)

Peak Location Spacing = 6.4 cm

SPLSR (SAR to Peak Location Spacing Ratio) = $(1.16 + 0.461) / 6.4 = 0.255$

The calculation of SPLSR for (LTE Band 17 + WLAN 5G, Primary Portrait) is as below:

Coordinate of Peak SAR Location (X, Y, Z) :

LTE Band 17 (0, 1.68, -18.07)

WLAN 5G (0.24, -5.28, -17.97)

Peak Location Spacing = 7.0 cm

SPLSR (SAR to Peak Location Spacing Ratio) = $(1.16 + 0.785) / 7.0 = 0.279$

Summary:

According to KDB 447498, the simultaneous transmission SAR for WWAN and WLAN was not required because the SAR summation is less than 1.6 W/kg or SPLSR is less than 0.3. The Bluetooth standalone SAR and simultaneous transmission SAR for WWAN and Bluetooth were not required because the output power of Bluetooth is less than 60/f. The WLAN and Bluetooth cannot transmit simultaneously, so there is no co-location test requirement for WLAN and Bluetooth.



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5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Kit	SPEAG	D750V3	1013	Apr. 25, 2012	Annual
System Validation Kit	SPEAG	D835V2	4d021	Apr. 20, 2012	Annual
System Validation Kit	SPEAG	D1750V2	1023	Jun. 20, 2012	Annual
System Validation Kit	SPEAG	D1900V2	5d036	Jan. 26, 2012	Annual
System Validation Kit	SPEAG	D2450V2	737	Jan. 24, 2012	Annual
System Validation Kit	SPEAG	D5GHzV2	1018	Jan. 18, 2012	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3590	Feb. 23, 2012	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3650	Oct. 26, 2011	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3864	Jul. 19, 2012	Annual
Data Acquisition Electronics	SPEAG	DAE3	579	Apr. 27, 2012	Annual
Data Acquisition Electronics	SPEAG	DAE4	910	Dec. 07, 2011	Annual
Data Acquisition Electronics	SPEAG	DAE4	1277	Jul. 19, 2012	Annual
ELI Phantom	SPEAG	QDOVA001B	TP-1039	N/A	N/A
ELI Phantom	SPEAG	QDOVA001B	TP-1043	N/A	N/A
Radio Communication Tester	Agilent	E5515C	MY50260642	Oct. 25, 2011	Biennial
Radio Communication Analyzer	Anritsu	MT8820C	6201010284	Aug. 01, 2011	Biennial
ENA Series Network Analyzer	Agilent	E5071C	MY46214281	May 14, 2012	Annual
MXG Analog Signal Generator	Agilent	N5181A	MY50143868	May 06, 2012	Annual
Power Meter	Anritsu	ML2495A	1218009	May 07, 2012	Annual
Power Sensor	Anritsu	MA2411B	1207252	May 07, 2012	Annual
EXA Spectrum Analyzer	Agilent	N9010A	MY52100136	Apr. 23, 2012	Annual
Dielectric Probe Kit	Agilent	85070D	E2-020018	May 14, 2012	Annual
Thermometer	YFE	YF-160A	110600361	Feb. 21, 2012	Annual
Directional Coupler	Woken	0110A05602O-10	11122702	Apr. 19, 2012	Annual
Power Amplifier	AR	5S1G4	0339656	Apr. 23, 2012	Annual
Power Amplifier	Mini-Circuit	ZVE-8G	001000422	Apr. 23, 2012	Annual
Attenuator	Woken	00800A1G01L-03	N/A	Apr. 19, 2012	Annual

6. Measurement Uncertainty

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (1g)	Vi
Measurement System						
Probe Calibration	6.0	Normal	1	1	± 6.0 %	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	± 3.9 %	∞
Boundary Effects	1.0	Rectangular	√3	1	± 0.6 %	∞
Linearity	4.7	Rectangular	√3	1	± 2.7 %	∞
System Detection Limits	1.0	Rectangular	√3	1	± 0.6 %	∞
Readout Electronics	0.6	Normal	1	1	± 0.6 %	∞
Response Time	0.0	Rectangular	√3	1	± 0.0 %	∞
Integration Time	1.7	Rectangular	√3	1	± 1.0 %	∞
RF Ambient Noise	3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Reflections	3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	0.5	Rectangular	√3	1	± 0.3 %	∞
Probe Positioning	2.9	Rectangular	√3	1	± 1.7 %	∞
Max. SAR Eval.	2.3	Rectangular	√3	1	± 1.3 %	∞
Test Sample Related						
Device Positioning	3.9	Normal	1	1	± 3.9 %	31
Device Holder	2.7	Normal	1	1	± 2.7 %	19
Power Drift	5.0	Rectangular	√3	1	± 2.9 %	∞
Phantom and Setup						
Phantom Uncertainty	4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	± 1.8 %	∞
Liquid Conductivity (Meas.)	5.0	Normal	1	0.64	± 3.2 %	29
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	± 1.7 %	∞
Liquid Permittivity (Meas.)	5.0	Normal	1	0.6	± 3.0 %	29
Combined Standard Uncertainty					± 11.7 %	
Expanded Uncertainty (K=2)					± 23.4 %	

Uncertainty budget for frequency range 300 MHz to 3 GHz



FCC SAR Test Report

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (1g)	Vi
Measurement System						
Probe Calibration	6.55	Normal	1	1	± 6.55 %	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	± 3.9 %	∞
Boundary Effects	2.0	Rectangular	√3	1	± 1.2 %	∞
Linearity	4.7	Rectangular	√3	1	± 2.7 %	∞
System Detection Limits	1.0	Rectangular	√3	1	± 0.6 %	∞
Readout Electronics	0.3	Normal	1	1	± 0.3 %	∞
Response Time	0.8	Rectangular	√3	1	± 0.5 %	∞
Integration Time	2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Noise	3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Reflections	3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	0.8	Rectangular	√3	1	± 0.5 %	∞
Probe Positioning	9.9	Rectangular	√3	1	± 5.7 %	∞
Max. SAR Eval.	4.0	Rectangular	√3	1	± 2.3 %	∞
Test Sample Related						
Device Positioning	3.9	Normal	1	1	± 3.9 %	31
Device Holder	2.7	Normal	1	1	± 2.7 %	19
Power Drift	5.0	Rectangular	√3	1	± 2.9 %	∞
Phantom and Setup						
Phantom Uncertainty	4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	± 1.8 %	∞
Liquid Conductivity (Meas.)	5.0	Normal	1	0.64	± 3.2 %	30
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	± 1.7 %	∞
Liquid Permittivity (Meas.)	5.0	Normal	1	0.6	± 3.0 %	30
Combined Standard Uncertainty					± 13.4 %	
Expanded Uncertainty (K=2)					± 26.8 %	

Uncertainty budget for frequency range 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.

Copies of accreditation and authorization certificates of our laboratories obtained from approval agencies can be downloaded from our web site. If you have any comments, please feel free to contact us at the following:

Taiwan HwaYa EMC/RF/Safety/Telecom Lab:

Add: No. 19, Hwa Ya 2nd Rd, Wen Hwa Vil., Kwei Shan Hsiang, Taoyuan Hsien 333, Taiwan, R.O.C.

Tel: 886-3-318-3232

Fax: 886-3-327-0892

Taiwan LinKo EMC/RF Lab:

Add: No. 47, 14th Ling, Chia Pau Vil., Linkou Dist., New Taipei City 244, Taiwan, R.O.C.

Tel: 886-2-2605-2180

Fax: 886-2-2605-1924

Taiwan HsinChu EMC/RF Lab:

Add: No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Vil., Chiung Lin Township, Hsinchu County 307, Taiwan, R.O.C.

Tel: 886-3-593-5343

Fax: 886-3-593-5342

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

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

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