FCC SAR Test Report

Report No.	:	**SA120823C14**
Applicant	:	**FUJITSU LIMITED**
Address	:	**1-1, kamikodanaka 4-chome, Nakahara-ku, Kawasaki 211-8588, Japan**
Product	:	**Mobile Phone**
FCC ID	:	**VQK-F03E**
Brand	:	**NTT DOCOMO**
Model No.	:	**F-03E**
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 648474 D01 v01r05** **KDB 941225 D01 v02 / KDB 941225 D03 v01**
Date of Testing	:	**Sep. 21, 2012 ~ Oct. 07, 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.

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Testing Laboratory
2021

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Release Control Record

Issue No.	Reason for Change	Date Issued
R01	Original release	Oct. 09, 2012

1. Summary of Maximum SAR Value

Mode / Band	Test Position	SAR-1g (W/kg)
GSM850	Head	0.771
	Body Worn (1 cm Gap)	0.582
	Hotspot Mode (1 cm Gap)	0.744
GSM1900	Head	0.500
	Body Worn (1 cm Gap)	0.398
	Hotspot Mode (1 cm Gap)	0.530
WCDMA Band V	Head	0.786
	Body Worn (1 cm Gap)	0.598
	Hotspot Mode (1 cm Gap)	0.904
WLAN 2.4GHz	Head	0.301
	Body Worn (1 cm Gap)	0.102
	Hotspot Mode (1 cm Gap)	0.097
WLAN 5GHz	Head	0.175
	Body Worn (1 cm Gap)	0.128
	Hotspot Mode (1 cm Gap)	0.151
Bluetooth	Head	N/A
	Body Worn (1 cm Gap)	N/A
	Hotspot Mode (1 cm Gap)	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 Bluetooth maximum power is less than $2P_{Ref}$, SAR testing for Bluetooth is not required.

2. Description of Equipment Under Test

EUT Type	Mobile Phone
FCC ID	VQK-F03E
Brand Name	NTT DOCOMO
Model Name	F-03E
IMEI Code	353737050010461
HW Version	DVT2
SW Version	LYDV01R13Ge
Tx Frequency Bands (Unit: MHz)	GSM850 : 824 ~ 849 GSM1900 : 1850 ~ 1910 WCDMA Band V : 824 ~ 849 WLAN : 2400 ~ 2483.5, 5150 ~ 5350, 5470 ~ 5725 Bluetooth : 2400 ~ 2483.5
Uplink Modulations	GSM & GPRS : GMSK WCDMA : QPSK 802.11b : DSSS 802.11a/g/n : OFDM Bluetooth : GFSK
Maximum AVG Conducted Power (Unit: dBm)	GSM850 : 33.15 GSM1900 : 30.05 WCDMA Band V : 23.62 802.11b : 14.98 802.11g : 12.23 802.11n HT20 (2.4GHz) : 9.17 802.11a : 8.91 802.11n HT20 (5GHz) : 8.90
Antenna Type	Fixed Internal Antenna
EUT Stage	Identical Prototype

Note:

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

List of Accessory:

Battery	**Brand Name**	FUJITSU
	Model Name	F29
	Power Rating	3.8Vdc, 1810mAh
	Type	Li-ion

3. SAR Measurement System

3.1 Definition of Specific Absorption Rate (SAR)

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

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

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

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 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 form the optical into digital electric signal of the DAE and transfers data to the PC.

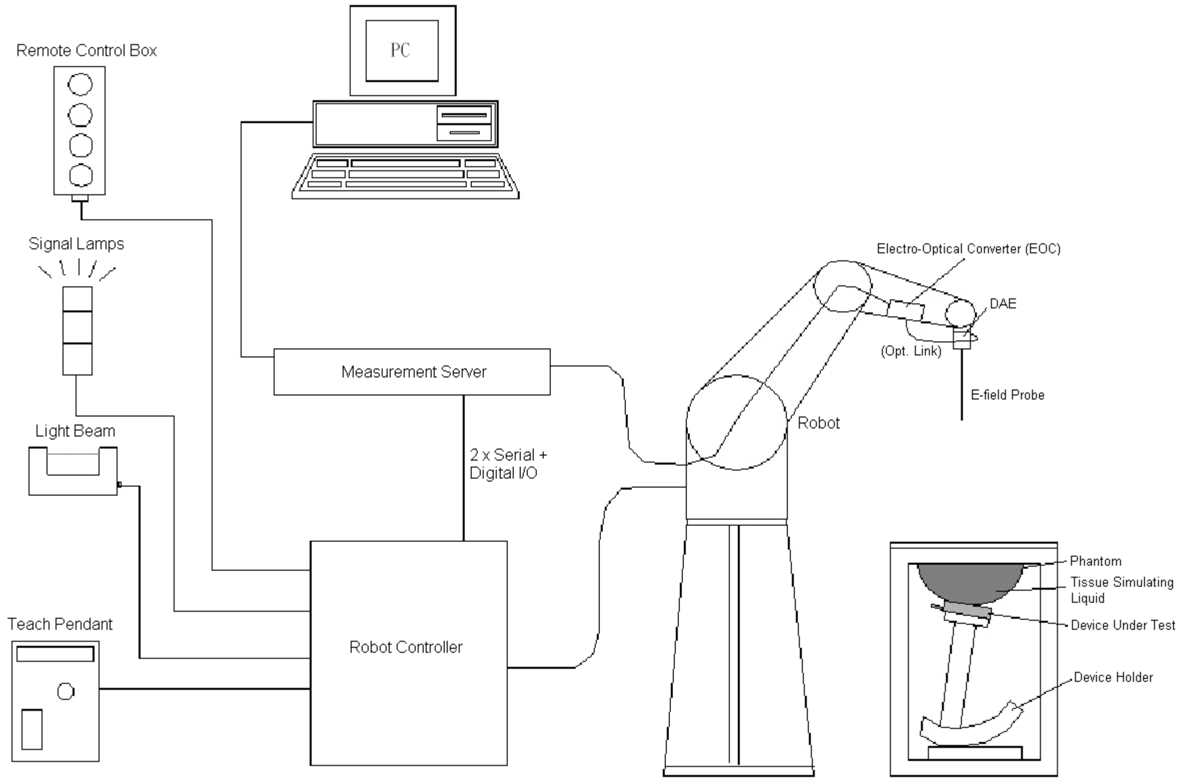


Fig-3.1 DASY System Setup

3.2.1 Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (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)

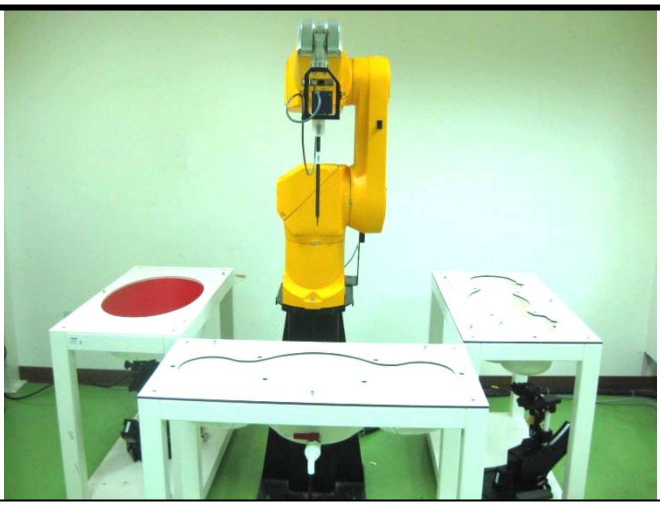


Fig-3.2 DASY4

Fig-3.3 DASY5

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

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	< 5μV (with auto zero)
Input Bias Current	< 50 fA
Dimensions	60 x 60 x 68 mm

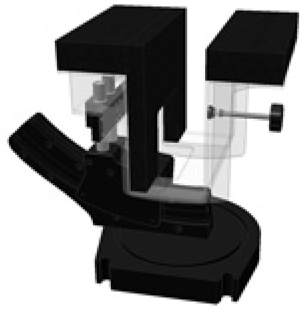
3.2.4 Phantoms

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.

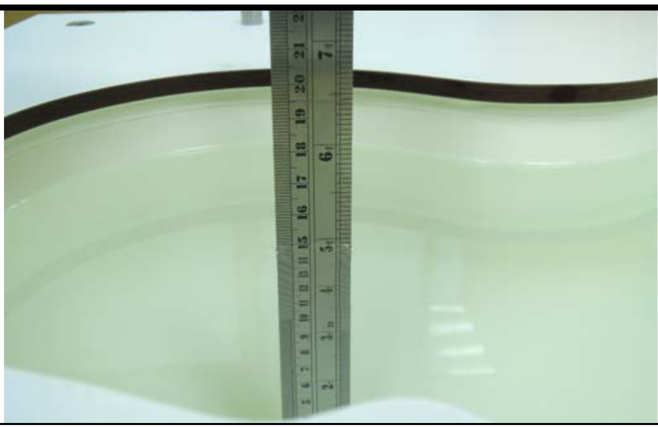


Photo of Liquid Height for Head Position

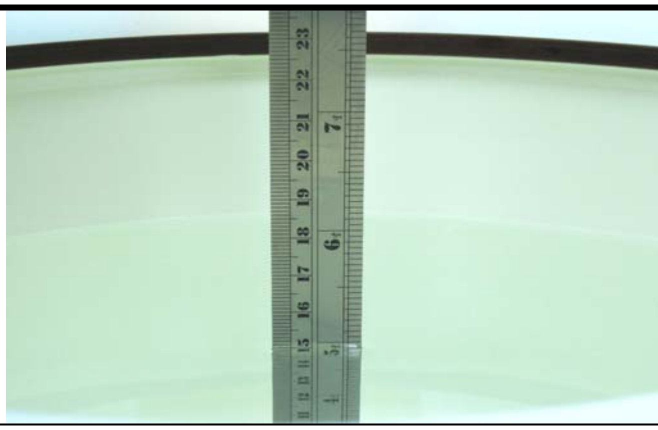


Photo of Liquid Height for Body Position

The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528 and 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 ±5%	Target Conductivity	Range of ±5%
For Head				
835	41.5	39.4 ~ 43.6	0.90	0.86 ~ 0.95
1900	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2450	39.2	37.2 ~ 41.2	1.80	1.71 ~ 1.89
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
For Body				
835	55.2	52.4 ~ 58.0	0.97	0.92 ~ 1.02
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

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
H835	0.2	-	0.2	1.5	57.0	-	41.1	-
H1900	-	44.5	-	0.2	-	-	55.3	-
H2450	-	45.0	-	0.1	-	-	54.9	-
H5G	-	-	-	-	-	17.2	65.5	17.3
B835	0.2	-	0.2	0.9	48.5	-	50.2	-
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.

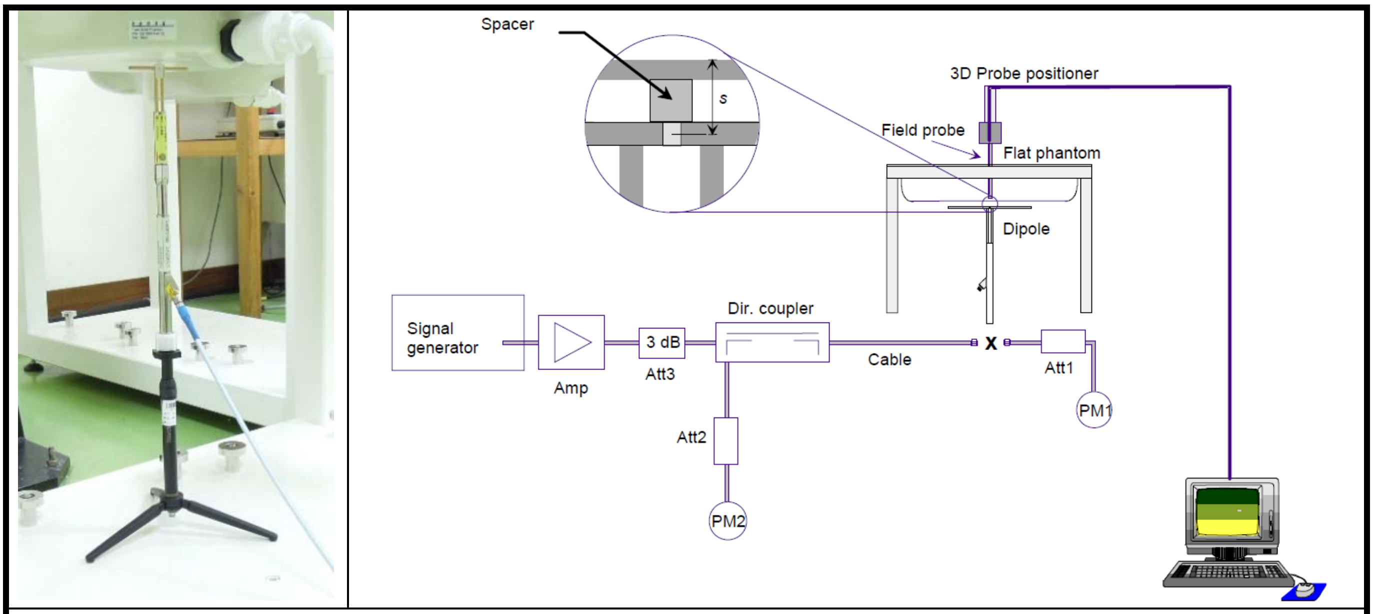


Fig-3.4 System Verification Setup

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 %.

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.

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

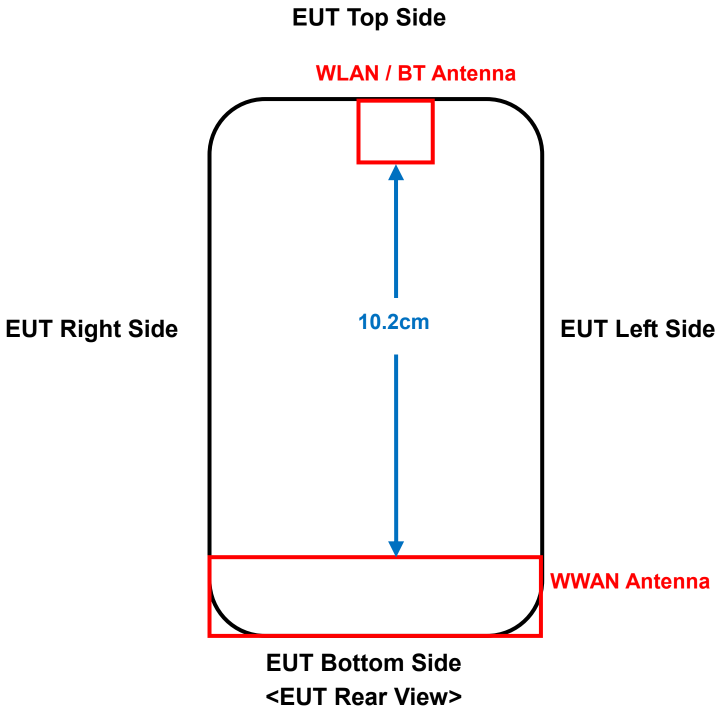
In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard’s method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

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

<Antenna Location>



This device supports WiFi hotspot function, so body SAR was tested under 1 cm for the surfaces / slide edges where a transmitting antenna is within 2.5 cm from the edge. Since the SAR is required for antenna located within 2.5 cm from edge, SAR testing for each antenna is listed as below.

WWAN Antenna : Front Face, Rear Face, Left Side, Right Side, Bottom Side
WLAN / BT Antenna : Front Face, Rear Face, Left Side, Right Side, Top Side

The simultaneous transmission possibilities are listed as below.

Simultaneous TX Combination	Configuration	Head (Voice / VoIP)	Body Worn (Voice / VoIP)	Hotspot (Data)
1	GSM850 (Voice / Data) + WLAN / BT (Data)	Yes	Yes	Yes
2	GSM1900 (Voice / Data) + WLAN / BT (Data)	Yes	Yes	Yes
3	WCDMA V (Voice / Data) + WLAN / BT (Data)	Yes	Yes	Yes

The WLAN and BT cannot transmit simultaneously, so there is no co-location test requirement for WLAN and BT.

For WWAN SAR testing, the EUT was linked and controlled by base station emulator (Agilent E5515C). 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 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 and 6 Mbps for 802.11a due to the highest RF output power.

4.2 EUT Testing Position

This EUT was tested in **Right Cheek**, **Right Tilted**, **Left Cheek**, **Left Tilted**, **Front Face**, **Rear Face**, **Left Side**, **Right Side**, **Top Side**, and **Bottom Side** positions as illustrated 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.

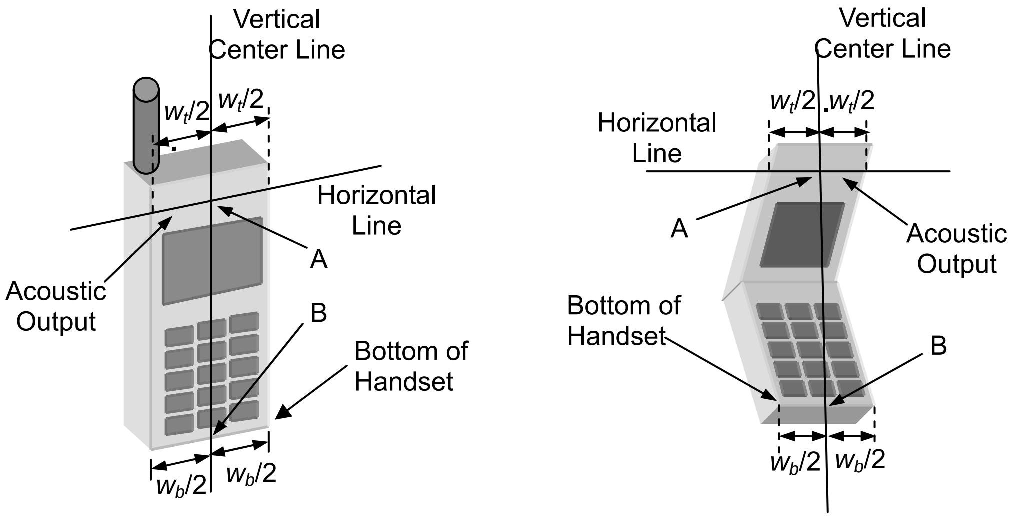


Fig-4.1 Illustration for Handset Vertical and Horizontal Reference Lines

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).

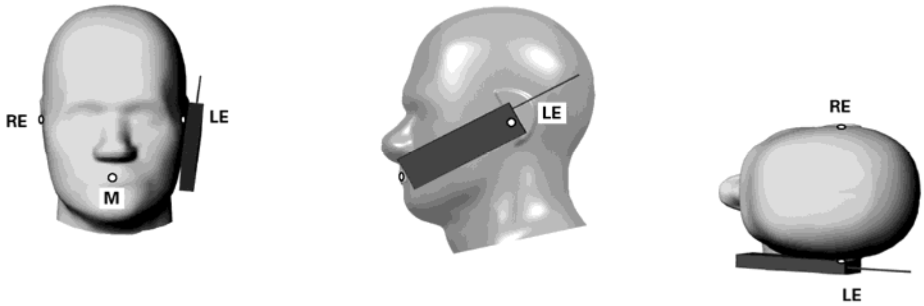


Fig-4.2 Illustration for Cheek Position

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).

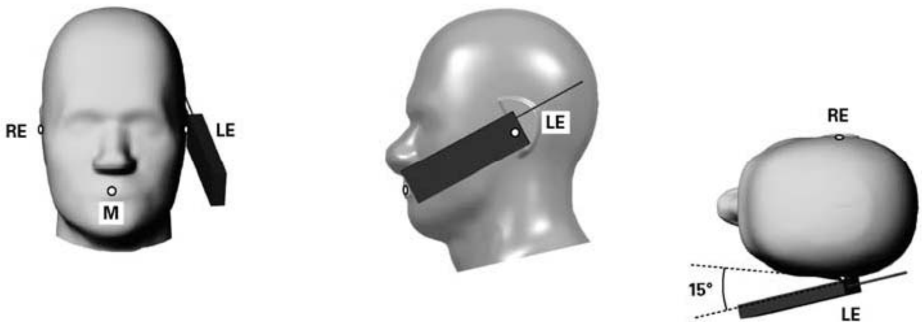


Fig-4.3 Illustration for Tilted Position

4. Body Worn Position

(a) To position the EUT parallel to the phantom surface.

(b) To adjust the EUT parallel to the flat phantom.

(c) To adjust the distance between the EUT surface and the flat phantom to 1.0 cm.

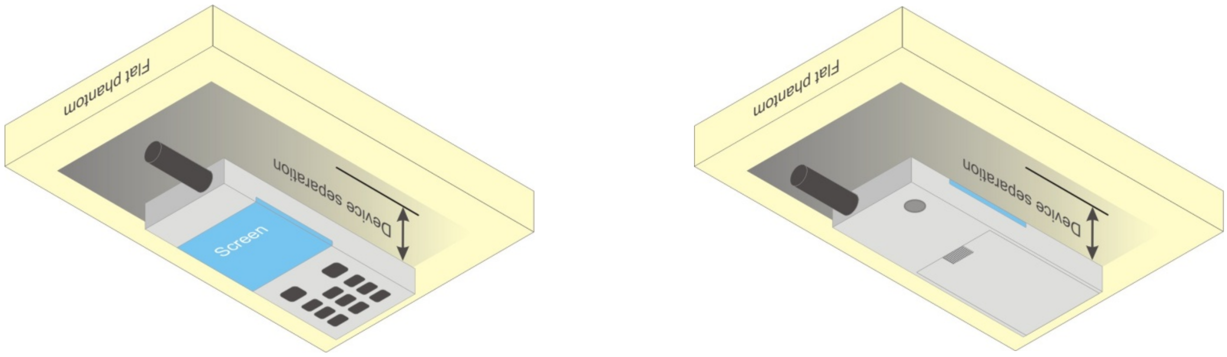


Fig-4.4 Illustration for Body Worn Position

4.3 Tissue Verification

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

Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)	Test Date
H835	835	20.6	0.913	42.52	0.90	41.5	1.44	2.46	Sep. 21, 2012
H1900	1900	20.6	1.441	39.728	1.40	40.0	2.93	-0.68	Sep. 23, 2012
H2450	2450	20.1	1.865	40.552	1.80	39.2	3.61	3.45	Oct. 05, 2012
H5G	5200	20.3	4.688	36.999	4.66	36.0	0.60	2.78	Oct. 07, 2012
H5G	5500	20.3	5.065	36.364	4.96	35.6	2.12	2.15	Oct. 07, 2012
B835	835	20.5	0.98	55.90	0.97	55.2	1.03	1.27	Sep. 24, 2012
B1900	1900	20.3	1.55	52.80	1.52	53.3	1.97	-0.94	Sep. 25, 2012
B2450	2450	21.5	2.016	52.949	1.95	52.7	3.38	0.47	Oct. 07, 2012
B5G	5200	20.2	5.278	48.936	5.30	49.0	-0.42	-0.13	Oct. 04, 2012
B5G	5200	20.4	5.243	49.431	5.30	49.0	-1.08	0.88	Oct. 05, 2012
B5G	5500	20.4	5.693	48.944	5.65	48.6	0.76	0.71	Oct. 05, 2012

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 Verification

The measuring results for system check are shown 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
Sep. 21, 2012	Head	835	9.46	2.38	9.52	0.63	4d021	3864	1277
Sep. 23, 2012	Head	1900	38.90	9.55	38.20	-1.80	5d036	3650	861
Oct. 05, 2012	Head	2450	52.90	13.1	52.40	-0.95	737	3590	579
Oct. 07, 2012	Head	5200	79.60	7.78	77.80	-2.26	1018	3820	1277
Oct. 07, 2012	Head	5500	84.70	8.96	89.60	5.79	1018	3820	1277
Sep. 24, 2012	Body	835	9.60	2.38	9.52	-0.83	4d021	3864	1277
Sep. 25, 2012	Body	1900	38.90	9.43	37.72	-3.03	5d036	3590	579
Oct. 07, 2012	Body	2450	50.00	11.8	47.20	-5.60	737	3820	1277
Oct. 04, 2012	Body	5200	72.70	6.93	69.30	-4.68	1018	3590	579
Oct. 05, 2012	Body	5200	72.70	6.88	68.80	-5.36	1018	3590	579
Oct. 05, 2012	Body	5500	78.30	7.82	78.20	-0.13	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	GSM850			GSM1900		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
Maximum Burst-Averaged Output Power						
GSM (GMSK, 1 Uplink)	32.90	33.13	**33.15**	29.48	29.73	**30.05**
GPRS 8 (GMSK, 1 Uplink)	32.86	33.10	33.10	29.45	29.70	30.03
GPRS 10 (GMSK, 2 Uplink)	30.57	30.92	30.81	27.06	27.07	27.67
GPRS 11 (GMSK, 3 Uplink)	28.56	29.26	28.85	25.01	24.88	25.52
GPRS 12 (GMSK, 4 Uplink)	27.23	27.47	27.41	23.36	23.38	23.93
Maximum Frame-Averaged Output Power						
GSM (GMSK, 1 Uplink)	23.90	24.13	24.15	20.48	20.73	21.05
GPRS 8 (GMSK, 1 Uplink)	23.86	24.10	24.10	20.45	20.70	21.03
GPRS 10 (GMSK, 2 Uplink)	24.57	24.92	24.81	21.06	21.07	**21.67**
GPRS 11 (GMSK, 3 Uplink)	24.30	**25.00**	24.59	20.75	20.62	21.26
GPRS 12 (GMSK, 4 Uplink)	24.23	24.47	24.41	20.36	20.38	20.93

Note:

1. SAR testing for GSM/GPRS/EDGE was performed on the maximum frame-averaged power mode.
2. The frame-averaged power is linearly scaled the maximum burst-averaged power based on time slots. The calculated methods are shown as below:
   Frame-averaged power = Burst-averaged power (1 Uplink) – 9 dBm
   Frame-averaged power = Burst averaged power (2 Uplink) – 6 dBm
   Frame-averaged power = Burst averaged power (3 Uplink) – 4.26 dBm
   Frame-averaged power = Burst averaged power (4 Uplink) – 3 dBm

Band	WCDMA Band V		
Channel	4132	4182	4233
Frequency (MHz)	826.4	836.4	846.6
RMC 12.2K	23.16	22.85	**23.62**
HSDPA Subtest-1	22.16	21.90	22.56
HSDPA Subtest-2	22.19	22.02	22.71
HSDPA Subtest-3	22.22	21.94	22.48
HSDPA Subtest-4	22.09	21.84	22.59
HSUPA Subtest-1	22.20	21.95	22.47
HSUPA Subtest-2	20.06	19.90	20.56
HSUPA Subtest-3	21.25	20.93	21.44
HSUPA Subtest-4	20.11	19.89	20.59
HSUPA Subtest-5	22.12	21.91	22.51

Band	802.11b			802.11g		
Channel	1	6	11	1	6	11
Frequency (MHz)	2412	2437	2462	2412	2437	2462
Average Power	14.51	**14.98**	14.25	11.84	**12.23**	11.55

Band	802.11n (HT20)			-		
Channel	1	6	11	-	-	-
Frequency (MHz)	2412	2437	2462	-	-	-
Average Power	8.27	8.60	**9.17**	-	-	-

Band	802.11a							
Channel	36	40	44	48	52	56	60	64
Frequency (MHz)	5180	5200	5220	5240	5260	5280	5300	5320
Average Power	8.72	8.59	**8.76**	8.65	**8.70**	8.60	8.62	8.57

Band	802.11a							
Channel	100	104	108	112	116	132	136	140
Frequency (MHz)	5500	5520	5540	5560	5580	5660	5680	5700
Average Power	7.71	7.74	7.82	7.90	8.02	8.25	8.31	**8.91**

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	8.44	8.35	**8.47**	8.37	**8.42**	8.30	8.36	8.30

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	7.75	7.72	7.82	8.04	8.06	8.37	8.42	**8.90**

4.6 SAR Testing Results

4.6.1 SAR Results for Head

Plot No.	Band	Mode	Test Position	Channel	SAR-1g (W/kg)
1	GSM850	GSM	Right Cheek	251	**0.771**
2	GSM850	GSM	Right Tilted	251	0.436
3	GSM850	GSM	Left Cheek	251	0.515
4	GSM850	GSM	Left Tilted	251	0.366
9	GSM1900	GSM	Right Cheek	810	0.338
10	GSM1900	GSM	Right Tilted	810	0.153
11	GSM1900	GSM	Left Cheek	810	**0.500**
12	GSM1900	GSM	Left Tilted	810	0.171
5	WCDMA V	RMC12.2K	Right Cheek	4233	**0.786**
6	WCDMA V	RMC12.2K	Right Tilted	4233	0.451
7	WCDMA V	RMC12.2K	Left Cheek	4233	0.593
8	WCDMA V	RMC12.2K	Left Tilted	4233	0.393
113	802.11b	-	Right Cheek	6	**0.301**
114	802.11b	-	Right Tilted	6	0.265
115	802.11b	-	Left Cheek	6	0.215
116	802.11b	-	Left Tilted	6	0.253
117	802.11a	-	Right Cheek	44	0.112
118	802.11a	-	Right Tilted	44	0.148
119	802.11a	-	Left Cheek	44	0.119
120	802.11a	-	Left Tilted	44	**0.175**
121	802.11a	-	Right Cheek	52	0.111
122	802.11a	-	Right Tilted	52	0.161
123	802.11a	-	Left Cheek	52	0.117
124	802.11a	-	Left Tilted	52	0.170
125	802.11a	-	Right Cheek	140	0.064
126	802.11a	-	Right Tilted	140	0.116
127	802.11a	-	Left Cheek	140	0.103
128	802.11a	-	Left Tilted	140	0.145

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.
3. SAR testing for 802.11n is not required because its maximum power is less than 1/4 dB higher than 802.11a.

4.6.2 SAR Results for Body

<Body Worn Mode>

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	SAR-1g (W/kg)
18	GSM850	GSM	Front Face	1	251	**0.582**
19	GSM850	GSM	Rear Face	1	251	0.528
36	GSM1900	GSM	Front Face	1	810	0.377
37	GSM1900	GSM	Rear Face	1	810	**0.398**
25	WCDMA V	RMC12.2K	Front Face	1	4233	0.582
26	WCDMA V	RMC12.2K	Rear Face	1	4233	**0.598**
134	802.11b	-	Front Face	1	6	0.067
135	802.11b	-	Rear Face	1	6	**0.102**
106	802.11a	-	Front Face	1	44	0.011
107	802.11a	-	Rear Face	1	44	0.121
108	802.11a	-	Front Face	1	52	0.010
109	802.11a	-	Rear Face	1	52	**0.128**
110	802.11a	-	Front Face	1	140	0.012
111	802.11a	-	Rear Face	1	140	0.124

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.
3. SAR testing for 802.11n is not required because its maximum power is less than 1/4 dB higher than 802.11a.

<Hotspot Mode>

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	SAR-1g (W/kg)
13	GSM850	GPRS11	Front Face	1	189	0.623
14	GSM850	GPRS11	Rear Face	1	189	0.667
15	GSM850	GPRS11	Left Side	1	189	0.479
16	GSM850	GPRS11	Right Side	1	189	**0.744**
17	GSM850	GPRS11	Bottom Side	1	189	0.280
31	GSM1900	GPRS10	Front Face	1	810	0.415
32	GSM1900	GPRS10	Rear Face	1	810	**0.530**
33	GSM1900	GPRS10	Left Side	1	810	0.281
34	GSM1900	GPRS10	Right Side	1	810	0.161
35	GSM1900	GPRS10	Bottom Side	1	810	0.232
20	WCDMA V	RMC12.2K	Front Face	1	4233	0.853
21	WCDMA V	RMC12.2K	Rear Face	1	4233	0.789
22	WCDMA V	RMC12.2K	Left Side	1	4233	0.587
23	WCDMA V	RMC12.2K	Right Side	1	4233	**0.904**
24	WCDMA V	RMC12.2K	Bottom Side	1	4233	0.394
27	WCDMA V	RMC12.2K	Front Face	1	4132	0.651
28	WCDMA V	RMC12.2K	Front Face	1	4182	0.709
29	WCDMA V	RMC12.2K	Right Side	1	4132	0.651
30	WCDMA V	RMC12.2K	Right Side	1	4182	0.863
129	802.11b	-	Front Face	1	6	0.066
130	802.11b	-	Rear Face	1	6	**0.097**
131	802.11b	-	Left Side	1	6	0.042
132	802.11b	-	Right Side	1	6	0.026
133	802.11b	-	Top Side	1	6	0.095
101	802.11a	-	Front Face	1	44	0.018
102	802.11a	-	Rear Face	1	44	**0.151**
112	802.11a	-	Left Side	1	44	0.001
104	802.11a	-	Right Side	1	44	0.00922
105	802.11a	-	Top Side	1	44	0.146

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.
3. Only WLAN 5G band 1 (5.15~5.25 GHz) support wireless hotspot mode.
4. SAR testing for 802.11n is not required because its maximum power is less than 1/4 dB higher than 802.11a.

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4.6.3 Simultaneous Multi-band Transmission Evaluation

No.	Conditions (SAR1 + SAR2)	Mode	Position	Max. SAR1	Max. SAR2	SAR Summation	SPLSR
1	GSM850 + WLAN	Head	Right Cheek	0.771	0.301	1.072	-
			Right Tilted	0.436	0.265	0.701	-
			Left Cheek	0.515	0.215	0.73	-
			Left Tilted	0.366	0.253	0.619	-
		Body-Worn	Front Face	0.582	0.067	0.649	-
			Rear Face	0.528	0.128	0.656	-
		Hotspot	Front Face	0.623	0.066	0.689	-
			Rear Face	0.667	0.151	0.818	-
			Left Side	0.479	0.042	0.521	-
			Right Side	0.744	0.026	0.77	-
			Top Side	0	0.146	0.146	-
			Bottom Side	0.28	0	0.28	-
2	GSM1900 + WLAN	Head	Right Cheek	0.338	0.301	0.639	-
			Right Tilted	0.153	0.265	0.418	-
			Left Cheek	0.500	0.215	0.715	-
			Left Tilted	0.171	0.253	0.424	-
		Body-Worn	Front Face	0.377	0.067	0.444	-
			Rear Face	0.398	0.128	0.526	-
		Hotspot	Front Face	0.415	0.066	0.481	-
			Rear Face	0.530	0.097	0.627	-
			Left Side	0.281	0.042	0.323	-
			Right Side	0.161	0.026	0.187	-
			Top Side	0	0.095	0.095	-
			Bottom Side	0.232	0	0.232	-
3	WCDMA V + WLAN	Head	Right Cheek	0.786	0.301	1.087	-
			Right Tilted	0.451	0.265	0.716	-
			Left Cheek	0.593	0.215	0.808	-
			Left Tilted	0.393	0.253	0.646	-
		Body-Worn	Front Face	0.582	0.067	0.649	-
			Rear Face	0.598	0.128	0.726	-
		Hotspot	Front Face	0.853	0.066	0.919	-
			Rear Face	0.789	0.097	0.886	-
			Left Side	0.587	0.042	0.629	-
			Right Side	0.904	0.026	0.93	-
			Top Side	0	0.095	0.095	-
			Bottom Side	0.394	0	0.394	-

Note:

1. The maximum SAR summation is calculated based on the same configuration and test position.

Summary:

According to KDB 648474, the simultaneous transmission SAR for WWAN and WLAN was not required, because the SAR summation is less than 1.6 W/kg. The BT standalone SAR and WWAN/BT simultaneous transmission SAR were not required, because the maximum output power of Bluetooth is less than $2P_{Ref}$ and the closest separation distance of these antennas is larger than 5 cm.

5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Kit	SPEAG	D835V2	4d021	Apr. 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
Dosimetric E-Field Probe	SPEAG	ES3DV3	3820	Dec. 16, 2011	Annual
Data Acquisition Electronics	SPEAG	DAE3	579	Apr. 27, 2012	Annual
Data Acquisition Electronics	SPEAG	DAE4	861	Aug. 23, 2012	Annual
Data Acquisition Electronics	SPEAG	DAE4	1277	Jul. 19, 2012	Annual
SAM Phantom	SPEAG	QD000P40CD	TP-1652	N/A	N/A
SAM Phantom	SPEAG	QD000P40CD	TP-1485	N/A	N/A
SAM Phantom	SPEAG	QD000P40CD	TP-1653	N/A	N/A
ELI Phantom	SPEAG	QDOVA001B	TP-1043	N/A	N/A
Radio Communication Tester	Agilent	E5515C	MY50260642	Oct. 25, 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

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:

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