SAR TEST REPORT
(WLAN)

REPORT NO.: SA110705C18-3

MODEL NO.: PH98100

FCC ID: NM8PH98100

RECEIVED: Jun. 27, 2011

TESTED: Jul. 07 ~ Jul. 09, 2011
Aug. 09, 2011

ISSUED: Aug. 11, 2011

APPLICANT: HTC Corporation

ADDRESS: 6-3, Baoquang Rd., Xindian City, Taipei County, Taiwan

ISSUED BY: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

LAB ADDRESS: No. 47, 14th Ling, Chia Pau Tsuen, Lin Kou Hsiang, Taipei Hsien 244, Taiwan, R.O.C.

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Testing Laboratory
2021

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
Original release	NA	Aug. 11, 2011

1. CERTIFICATION

PRODUCT:	Smartphone
MODEL NO.:	PH98100
FCC ID:	NM8PH98100
BRAND:	hTC
APPLICANT:	HTC Corporation
TESTED:	Jul. 07 ~ Jul. 09, 2011 Aug. 09, 2011
STANDARDS:	**FCC Part 2 (Section 2.1093)** **FCC OET Bulletin 65 Supplement C (01-01)** **IEEE 1528-2003** **RSS-102 Issue 4 (2010-03)**

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, 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.

PREPARED BY : Pettie Chen , **DATE:** Aug. 11, 2011

Pettie Chen / Specialist

APPROVED BY : Gary Chang , **DATE:** Aug. 11, 2011

Gary Chang / Technical Manager

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

EUT	Smartphone
MODEL NO.	PH98100
FCC ID	NM8PH98100
MODULATION TYPE	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
MODULATION TECHNOLOGY	DSSS, OFDM
TRANSFER RATE	802.11b:11.0/ 5.5/ 2.0/ 1.0Mbps 802.11g: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0Mbps 802.11a: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0Mbps 802.11n (20MHz): up to 150.0Mbps
OPERATING FREQUENCY	**2.4GHz:** 2412 ~ 2462 MHz **5.0GHz:** 5180 ~ 5320 MHz, 5500 ~ 5700 MHz, 5745 ~ 5805 MHz
ANTENNA TYPE	**2.4GHz:** PIFA antenna with -2dBi gain **5.0GHz:** PIFA antenna with -3dBi gain
ANTENNA CONNECTOR	NA
I/O PORTS	Refer to users' manual
DATA CABLE	Refer to Note as below
ACCESSORY DEVICES	Refer to Note as below

NOTE:

1. The EUT provides one completed transmitter and one receiver.

MODULATION MODE	TX FUNCTION
802.11b	1TX
802.11g	1TX
802.11a	1TX
802.11n (20MHz)	1TX

2. The EUT were powered by the following adapters, battery & accessories:

NO.	PRODUCT	BRAND	MODEL	DESCRIPTION
1	Power Adapter	hTC	TC U250	I/P: 100-240Vac, 50-60Hz, 200mA O/P: 5Vdc, 1A Manufacturer: Emerson
2			TC U250	I/P: 100-240Vac, 50-60Hz, 200mA O/P: 5Vdc, 1A Manufacturer: Delta
3	Battery 1	hTC	BH98100, BTR6425B	Rating: 3.8Vdc, 1620mAh, 6.15Whr
4	Extend Battery 2	hTC	BG05200, BTE6425B	Rating: 3.7Vdc, 2750mAh, 10.17Whr
5	USB cable	hTC	DC T500	1.25m shielded cable without core
6	Earphone	hTC	RC E160	1.25m shielded cable without core
7	beats earphone	hTC	RC E180	1.30m shielded cable without core

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

2.2 SUMMARY OF PEAK SAR RESULTS

STANDALONE SAR		
Band	**Position**	**SAR_{1g} (W/kg)**
802.11a/b/g/n	**Head**	**0.314**
	Body (Body Worn)	**0.503**
	Body (Hotspot)	**0.596**
Bluetooth	**Head**	**N/A**
	Body (Body Worn)	**N/A**
	Body (Hotspot)	**N/A**

SIMULTANEOUS TRANSMISSION SAR			
Band	**Test Position**	**Channel**	**Multi-Band SAR_{1g} (W/kg)**
CDMA2000 BC0 EVDO	**Body (Left Edge)**	**777**	**1.4**
CDMA2000 BC1 1x		**600**	
802.11b		**6**	

2.3 TEST CONFIGURATION

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

This device supports WiFi hotspot function, so body SAR was tested under 1 cm separation distance for all 6 faces.

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

2.4 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to the specifications of the manufacturer, this product must comply with the requirements of the following standards:

FCC Part 2 (2.1093)
FCC OET Bulletin 65, Supplement C (01- 01)
RSS-102 Issue 4 (2010-03)
IEEE 1528-2003
FCC KDB 248227 D01 v01r02
FCC KDB 648474 D01 v01r05
FCC KDB 941225 D06 v01

All test items have been performed and recorded as per the above standards.

2.5 GENERAL INOFRMATION OF THE SAR SYSTEM

DASY5 (**Software DASY52, Version 52.6**) consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY5 software defined. The DASY5 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.

EX3DV4 ISOTROPIC E-FIELD PROBE

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 > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
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: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
APPLICATION	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

NOTE

1. The Probe parameters have been calibrated by the SPEAG. Please reference “APPENDIX D” for the Calibration Certification Report.

TWIN SAM V4.0

CONSTRUCTION	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, EN 62209-1 and IEC 62209. 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 manually teaching three points with the robot.
SHELL THICKNESS	2 ± 0.2mm
FILLING VOLUME	Approx. 25liters
DIMENSIONS	Height: 810mm; Length: 1000mm; Width: 500mm

SYSTEM VALIDATION KITS:

CONSTRUCTION	Symmetrical dipole with l/4 balun enables measurement of feedpoint impedance with NWA matched for use near flat phantoms filled with brain simulating solutions. Includes distance holder and tripod adaptor
CALIBRATION	Calibrated SAR value for specified position and input power at the flat phantom in brain simulating solutions
FREQUENCY	2450MHz, 5800MHz
RETURN LOSS	> 20dB at specified validation position
POWER CAPABILITY	> 100W (f < 1GHz); > 40W (f > 1GHz)
OPTIONS	Dipoles for other frequencies or solutions and other calibration conditions upon request

DEVICE HOLDER FOR SAM TWIN PHANTOM

CONSTRUCTION

The device holder for the mobile phone device is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity ε =3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered. The device holder for the portable device makes up of the polyethylene foam. The dielectric parameters of material close to the dielectric parameters of the air.

DATA ACQUISITION ELECTRONICS

CONSTRUCTION

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplex, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe is mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE3 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

2.6 TEST EQUIPMENT

FOR SAR MEASURENENT

ITEM	NAME	BRAND	TYPE	SERIES NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
1	SAM Phantom	S & P	QD000 P40 CA	TP-1485	NA	NA
2	Signal Generator	Agilent	E8257C	MY43320668	Dec. 27, 2010	Dec. 26, 2011
3	E-Field Probe	S & P	EX3DV4	3650	Jan. 24, 2011	Jan. 23, 2012
4	DAE	S & P	DAE 3	510	Oct. 04, 2010	Oct. 03, 2011
5	Robot Positioner	Staubli Unimation	NA	NA	NA	NA
6	Validation Dipole	S & P	D2450V2	716	Jan. 26, 2011	Jan. 25, 2012
7	Validation Dipole	S & P	D5GHzV2	1019	Jan. 25, 2011	Jan. 24, 2012

NOTE: Before starting the measurement, all test equipment shall be warmed up for 30min.

FOR TISSUE PROPERTY

ITEM	NAME	BRAND	TYPE	SERIES NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
1	Network Analyzer	Agilent	E8358A	US41480538	Dec. 30, 2010	Dec. 29, 2011
2	Dielectric Probe	Agilent	85070D	US01440176	NA	NA

NOTE:

1. Before starting, all test equipment shall be warmed up for 30min.
2. The tolerance (k=1) specified by Agilent for general dielectric measurements, deriving from inaccuracies in the calibration data, analyzer drift, and random errors, are usually ±2.5% and ±5% for measured permittivity and conductivity, respectively. However, the tolerances for the conductivity is smaller for material with large loss tangents, i.e., less than ±2.5% (k=1). It can be substantially smaller if more accurate methods are applied.

2.7 GENERAL DESCRIPTION OF THE SPATIAL PEAK SAR EVALUATION

The DASY5 post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the micro-volt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters:	- Frequency	F
	- Crest factor	Cf
Media parameters:	- Conductivity	σ
	- Density	ρ

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \bullet \frac{cf}{dcp_i}$$

V_i	=compensated signal of channel i	(i = x, y, z)
U_i	=input signal of channel I	(i = x, y, z)
Cf	=crest factor of exciting field	(DASY parameter)
dcp_i	=diode compression point	(DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E-fieldprobes: } E_i = \sqrt{\frac{V_1}{Norm_i \cdot ConvF}}$$

$$\text{H-fieldprobes: } H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

V_i	=compensated signal of channel I	(i = x, y, z)
$Norm_i$	=sensor sensitivity of channel i µV/(V/m)2 for E-field Probes	(i = x, y, z)
ConvF	= sensitivity enhancement in solution	
a_{ij}	= sensor sensitivity factors for H-field probes	
F	= carrier frequency [GHz]	
E_i	= electric field strength of channel i in V/m	
H_i	= magnetic field strength of channel i in A/m	

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

SAR	= local specific absorption rate in mW/g
E_{tot}	= total field strength in V/m
σ	= conductivity in [mho/m] or [Siemens/m]
ρ	= equivalent tissue density in g/cm3

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid. 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:

1. The extraction of the measured data (grid and values) from the Zoom Scan
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1g and 10g.

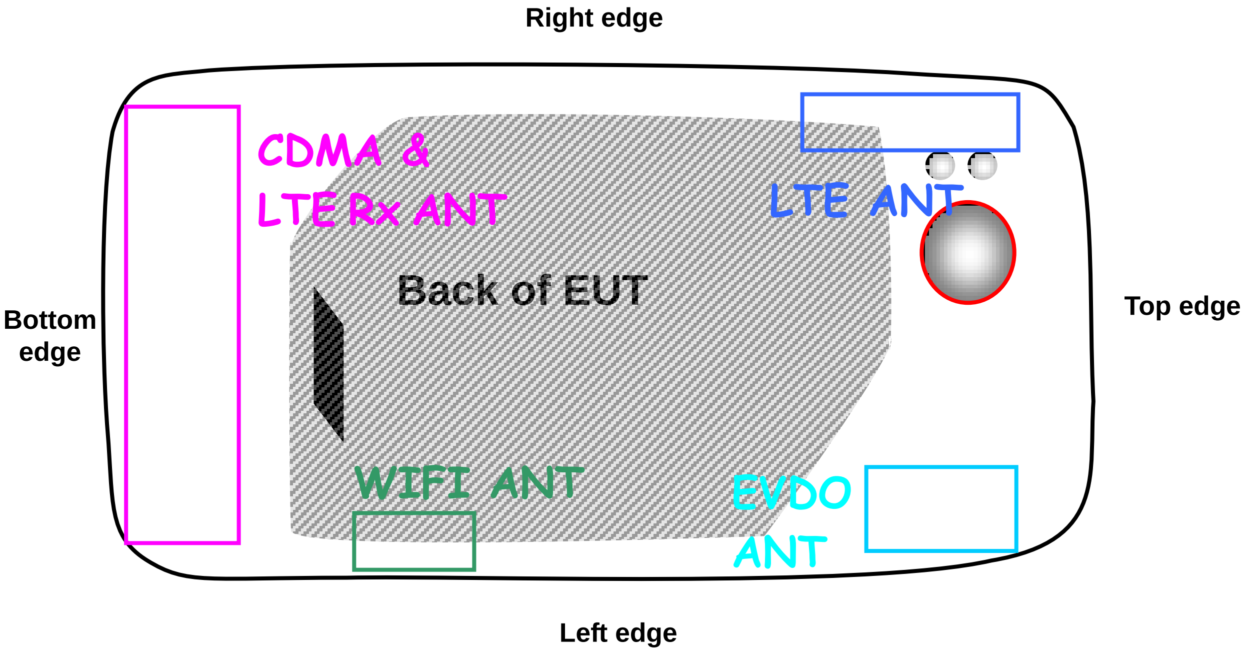
The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz, and 7x7x9 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The routines are verified and optimized for the grid dimensions used in these cube measurements. The first procedure is an extrapolation (incl. boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

2.8 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit.

3. DESCRIPTION OF ANTENNA LOCATION

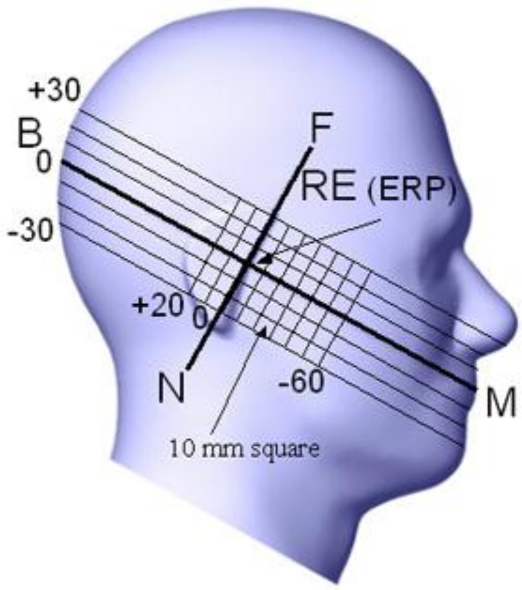


<Evaluation for Hotspot SAR>

Top edge & Right edge are not tested since the distance between antenna and Top edge & Right edge are > 2.5 cm.

4. DESCRIPTION OF TEST POSITION

4.1. DESCRIPTION OF TEST POSITION



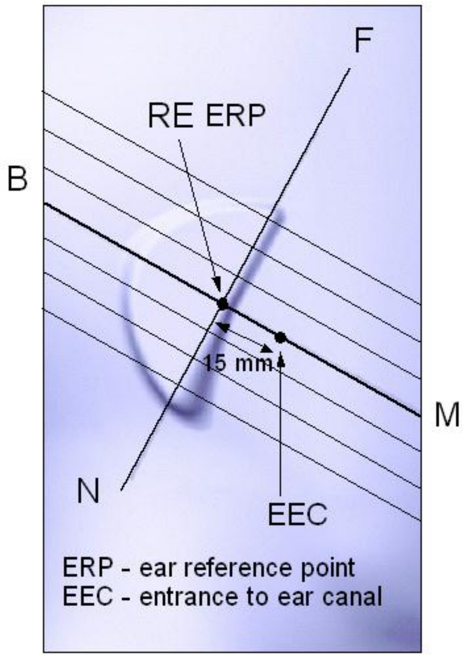
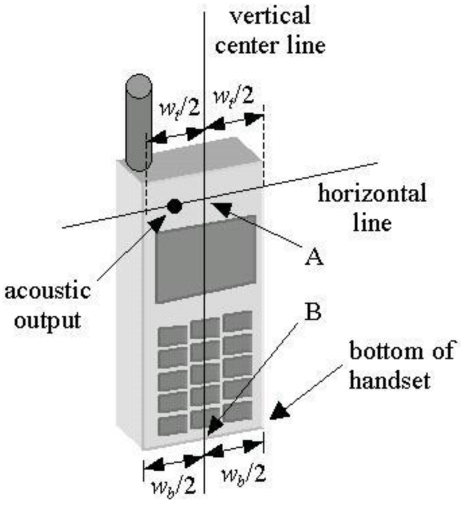


FIGURE 3.1



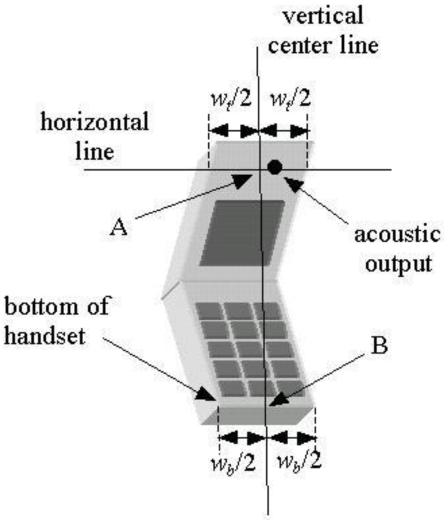
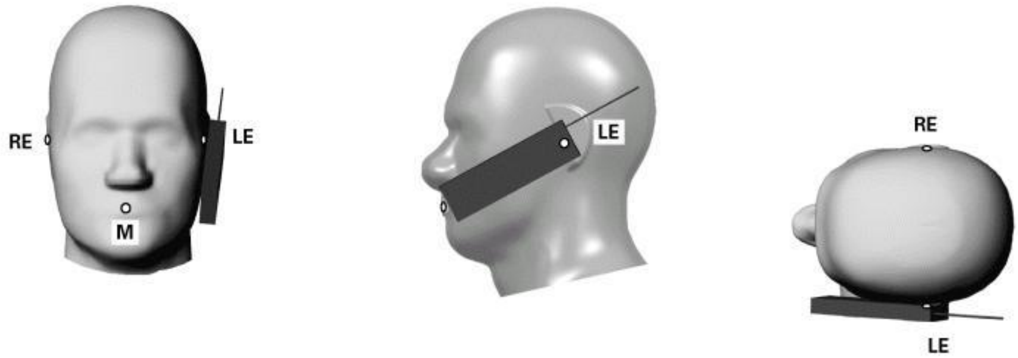


FIGURE 3.1a

FIGURE 3.1b

4.1.1 TOUCH/CHEEK TEST POSITION

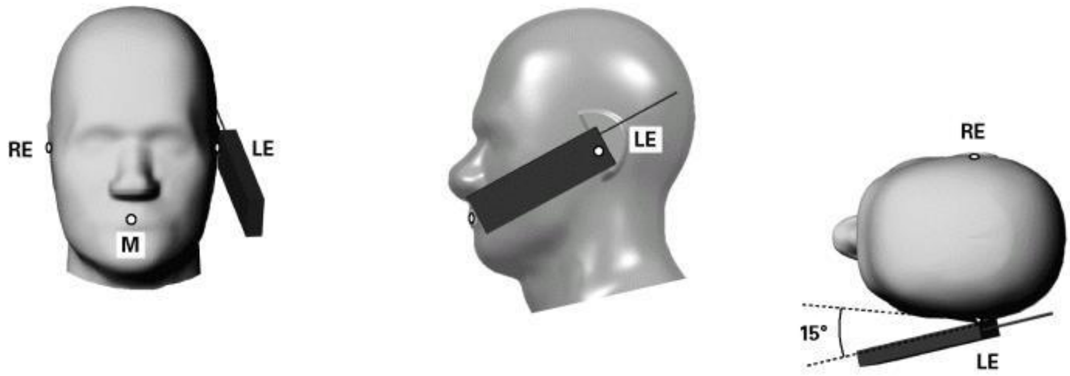
The head position in Figure 3.1, the ear reference points ERP are 15mm above entrance to ear canal along the B-M line. The line N-F (Neck-Front) is perpendicular to the B-M (Back Mouth) line. The handset device in Figure 3.1a and 3.1b, The vertical centerline pass through two points on the front side of handset: the midpoint of the width wt of the handset at the level of the acoustic output (point A) and the midpoint of the width Wb of the bottom of the handset (point B). The vertical centerline is perpendicular to the horizontal line and pass through the center of the acoustic output. The point A touches the ERP and the vertical centerline of the handset is parallel to the B-M line. While maintaining the point A contact with the ear(ERP), rotate the handset about the line NF until any point on handset is in contact with the cheek of the phantom



TOUCH/CHEEK POSITION FIGURE

4.1.2 TILT TEST POSITION

Adjust the device in the cheek position. While maintaining a point of the handset contact in the ear, move the bottom of the handset away from the mouth by an angle of 15 degrees.



TILT POSITION FIGURE

4.1.3 BODY-WORN CONFIGURATION

The handset device attached the belt clip or the holster. The keypad face of the handset is against with the bottom of the flat phantom face and the bottom of the keypad face contact to the bottom of the flat phantom.

When multiple accessories that do not contain metallic components are supplied with the device, the device may be tested with only the accessory that dictates the closest spacing to the body. When multiple accessories that contain metallic components are supplied with the device, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (e.g., the same metallic belt-clip used with different holsters with no other metallic components), only accessory that dictates the closest spacing to the body must be tested.

If the device supports WiFi hotspot function, the body SAR will test under 1 cm for the surfaces/slide edges where a transmitting antenna is within 2.5 cm from the edge.

5. RECIPES FOR TISSUE SIMULATING LIQUIDS

For the measurement of the field distribution inside the SAM phantom, the phantom must be filled with 25 litters of tissue simulation liquid.

The following is a short description of some typical ingredients used in the Simulating Liquids ：

• **WATER-**	Deionized water (pure H20), resistivity _16 M - as basis for the liquid
• **SUGAR-**	Refined sugar in crystals, as available in food shops - to reduce relative permittivity
• **SALT-**	Pure NaCl - to increase conductivity
• **CELLULOSE-**	Hydroxyethyl-cellulose, medium viscosity (75-125mPa.s, 2% in water, 20_C), CAS # 54290 - to increase viscosity and to keep sugar in solution
• **PRESERVATIVE-**	Preventol D-7 Bayer AG, D-51368 Leverkusen, CAS # 55965-84-9 - to prevent the spread of bacteria and molds
• **DGMBE-**	Diethylenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH, CAS # 112-34-5 - to reduce relative permittivity

THE RECIPES FOR 2450MHz SIMULATING LIQUID TABLE

INGREDIENT	HEAD SIMULATING LIQUID 2450MHz (HSL-2450)	MUSCLE SIMULATING LIQUID 2450MHz (MSL-2450)
Water	45%	69.83%
DGMBE	55%	30.17%
Salt	NA	NA
Dielectric Parameters at 22℃	f= 2450MHz ε= 39.2 ± 5% σ= 1.80 ± 5% S/m	f= 2450MHz ε= 52.7 ± 5% σ= 1.95 ± 5% S/m

THE INFORMATION FOR 5GHz SIMULATING LIQUID

The 5GHz liquids was purchased from SPEAG.

Body liquid model: HSL 5800, P/N: SL AAH 5800 AA

Head liquid model: M 5800, P/N: SL AAM 580 AD

5GHz liquids contain the following ingredients:

Water 64 - 78%

Mineral Oil 11 - 18%

Emulsifiers 9 - 15%

Additives and Salt 2 - 3%

Testing the liquids using the Agilent Network Analyzer E8358A and Agilent Dielectric Probe Kit 85070D.The testing procedure is following as

1. Turn Network Analyzer on and allow at least 30min. warm up.
2. Mount dielectric probe kit so that interconnecting cable to Network Analyzer will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature (±1°).
4. Set water temperature in Agilent-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with >8mm thickness ε'=10.0, ε''=0.0). If measured parameters do not fit within tolerance, repeat calibration (±0.2 for ε': ±0.1 for ε'').
7. Conductivity can be calculated from ε'' by $\sigma = \omega \varepsilon_0 \varepsilon'' = \varepsilon'' f \text{ [GHz]} / 18$.
8. Measure liquid shortly after calibration. Repeat calibration every hour.
9. Stir the liquid to be measured. Take a sample (~ 50ml) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY5 for the frequencies necessary for the measurements (‘Setup Config’, select medium (e.g. Brain 900MHz) and press ‘Option’-button.
14. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 900MHz).

LIQUID TYPE	HSL-2450			
SIMULATING LIQUID TEMP.	21.6			
TEST DATE	Jul. 07, 2011			
TESTED BY	Morrison Huang			
FREQ. (MHz)	LIQUID PARAMETER	STANDARD VALUE	MEASUREMENT VALUE	ERROR PERCENTAGE (%)
2437	Permittivity (ε)	39.22	40.16	2.40
2450		39.20	40.01	2.07
2437	Conductivity (σ) S/m	1.79	1.81	1.12
2450		1.80	1.85	2.78

LIQUID TYPE	HSL-2450			
SIMULATING LIQUID TEMP.	22.7			
TEST DATE	Aug. 09, 2011			
TESTED BY	Morrison Huang			
FREQ. (MHz)	LIQUID PARAMETER	STANDARD VALUE	MEASUREMENT VALUE	ERROR PERCENTAGE (%)
2437	Permittivity (ε)	39.22	41.05	4.67
2450		39.20	39.45	0.64
2437	Conductivity (σ) S/m	1.79	1.71	-4.47
2450		1.80	1.79	-0.56

LIQUID TYPE		HSL-5G		
SIMULATING LIQUID TEMP.		22.1		
TEST DATE		Jul. 08, 2011		
TESTED BY		Morrison Huang		
FREQ. (MHz)	**LIQUID PARAMETER**	**STANDARD VALUE**	**MEASUREMENT VALUE**	**ERROR PERCENTAGE (%)**
5200	Permittivity (ε)	35.99	37.21	3.39
5240		35.94	37.16	3.39
5260		35.92	37.13	3.37
5500		35.64	36.76	3.14
5580		35.55	36.59	2.93
5745		35.36	36.31	2.69
5800		35.30	36.22	2.61
5200	Conductivity (σ) S/m	4.66	4.53	-2.79
5240		4.70	4.58	-2.55
5260		4.72	4.60	-2.54
5500		4.96	4.89	-1.41
5580		5.04	4.99	-0.99
5745		5.21	5.18	-0.58
5800		5.27	5.26	-0.19

LIQUID TYPE		MSL-2450		
SIMULATING LIQUID TEMP.		21.4		
TEST DATE		Jul. 07, 2011		
TESTED BY		Morrison Huang		
FREQ. (MHz)	**LIQUID PARAMETER**	**STANDARD VALUE**	**MEASUREMENT VALUE**	**ERROR PERCENTAGE (%)**
2437	Permittivity (ε)	52.72	54.05	2.52
2450		52.70	53.93	2.33
2437	Conductivity (σ) S/m	1.94	1.95	0.52
2450		1.95	1.98	1.54

LIQUID TYPE		MSL-2450		
SIMULATING LIQUID TEMP.		22.4		
TEST DATE		Aug. 09, 2011		
TESTED BY		Morrison Huang		
FREQ. (MHz)	**LIQUID PARAMETER**	**STANDARD VALUE**	**MEASUREMENT VALUE**	**ERROR PERCENTAGE (%)**
2437	Permittivity (ε)	52.72	53.85	2.14
2450		52.70	53.41	1.35
2437	Conductivity (σ) S/m	1.94	1.84	-5.15
2450		1.95	1.86	-4.62

LIQUID TYPE		MSL-5G		
SIMULATING LIQUID TEMP.		21.8		
TEST DATE		Jul. 09, 2011		
TESTED BY		Morrison Huang		
FREQ. (MHz)	**LIQUID PARAMETER**	**STANDARD VALUE**	**MEASUREMENT VALUE**	**ERROR PERCENTAGE (%)**
5200	Permittivity (ε)	49.01	50.66	3.37
5240		48.96	50.55	3.25
5260		48.93	50.53	3.27
5500		48.61	50.09	3.04
5580		48.50	49.95	2.99
5745		48.22	49.58	2.82
5800		48.20	49.47	2.63
5200	Conductivity (σ) S/m	5.30	5.32	0.38
5240		5.35	5.38	0.56
5260		5.37	5.49	2.23
5500		5.65	5.76	1.95
5580		5.74	5.89	2.61
5745		5.98	6.14	2.68
5800		6.00	6.21	3.50

6. SYSTEM VALIDATION

The system validation was performed in the flat phantom with equipment listed in the following table. Since the SAR value is calculated from the measured electric field, dielectric constant and conductivity of the body tissue and the SAR is proportional to the square of the electric field. So, the SAR value will be also proportional to the RF power input to the system validation dipole under the same test environment. In our system validation test, 250mW RF input power was used.

6.1 TEST PROCEDURE

Before the system performance check, we need only to tell the system which components (probe, medium, and device) are used for the system performance check; the system will take care of all parameters. The dipole must be placed beneath the flat section of the SAM Twin Phantom with the correct distance holder in place. The distance holder should touch the phantom surface with a light pressure at the reference marking (little cross) and be oriented parallel to the long side of the phantom. Accurate positioning is not necessary, since the system will search for the peak SAR location, except that the dipole arms should be parallel to the surface. The device holder for mobile phones can be left in place but should be rotated away from the dipole.

1. The "Power Reference Measurement" and "Power Drift Measurement" jobs are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the amplifier output power. If it is too high (above ±0.1 dB), the system performance check should be repeated; some amplifiers have very high drift during warm-up. A stable amplifier gives drift results in the DASY system below ±0.02dB.

2. The "Surface Check" job tests the optical surface detection system of the DASY system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ±0.1mm). In that case it is better to abort the system performance check and stir the liquid.

3. The ”Area Scan” job measures the SAR above the dipole on a plane parallel to the surface. It is used to locate the approximate location of the peak SAR. The proposed scan uses large grid spacing for faster measurement; due to the symmetric field, the peak detection is reliable. If a finer graphic is desired, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result.

4. The ”Zoom Scan” job measures the field in a volume around the peak SAR value assessed in the previous ”Area Scan” job (for more information see the application note on SAR evaluation).

About the validation dipole positioning uncertainty, the constant and low loss dielectric spacer is used to establish the correct distance between the top surface of the dipole and the bottom surface of the phantom, the error component introduced by the uncertainty of the distance between the liquid (i.e., phantom shell) and the validation dipole in the DASY5 system is less than ±0.1mm.

$$SAR_{tolerance}[\%] = 100 \times (\frac{(a+d)^2}{a^2} - 1)$$

As the closest distance is 10mm, the resulting tolerance $SAR_{tolerance}[\%]$ is <2%.

6.2 VALIDATION RESULTS

SYSTEM VALIDATION TEST OF SIMULATING LIQUID					
FREQUENCY (MHz)	**REQUIRED SAR1g (mW/g)**	**MEASURED SAR1g (mW/g)**	**DEVIATION (%)**	**SEPARATION DISTANCE**	**TESTED DATE**
HSL 2450	54.80	55.2	0.73	10mm	Jul. 07, 2011
HSL 2450	54.80	56.4	2.92	10mm	Aug. 09, 2011
MSL 2450	53.30	49.6	-6.94	10mm	Jul. 07, 2011
MSL 2450	53.30	56.4	5.82	10mm	Aug. 09, 2011
HSL 5G (5200)	81.8	85.3	4.28	10mm	Jul. 08, 2011
MSL5G (5200)	77.1	76.2	-1.17	10mm	Jul. 09, 2011
HSL5G (5500)	88.9	91.2	2.59	10mm	Jul. 08, 2011
MSL5G (5500)	82.4	86.1	4.49	10mm	Jul. 09, 2011
HSL 5G (5800)	83.2	88.7	6.61	10mm	Jul. 08, 2011
MSL 5G (5800)	73.4	76.4	4.09	10mm	Jul. 09, 2011
TESTED BY	Morrison Huang				

NOTE:

1. Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 %. Above table shows the target SAR and measured SAR after normalized to 1W input power.

2. Please see Appendix for the photo of system validation test.

6.3 SYSTEM VALIDATION UNCERTAINTIES

In the table below, the system validation uncertainty with respect to the analytically assessed SAR value of a dipole source as given in the IEEE 1528 standard is given. This uncertainty is smaller than the expected uncertainty for mobile phone measurements due to the simplified setup and the symmetric field distribution.

Error Description	Tolerance (±%)	Probability Distribution	Divisor	(C_i)		Standard Uncertainty (±%)		(v_i)
				(1g)	(10g)	(1g)	(10g)	
Measurement System								
Probe Calibration	6.55	Normal	1	1	1	6.55	6.55	∞
Axial Isotropy	0.25	Rectangular	$\sqrt{3}$	0.7	0.7	0.10	0.10	∞
Hemispherical Isotropy	1.30	Rectangular	$\sqrt{3}$	0.7	0.7	0.53	0.53	∞
Boundary effects	1.00	Rectangular	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	0.30	Rectangular	$\sqrt{3}$	1	1	0.17	0.17	∞
System Detection Limits	1.00	Rectangular	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	0.30	Normal	1	1	1	0.30	0.30	∞
Response Time	0.80	Rectangular	$\sqrt{3}$	1	1	0.46	0.46	∞
Integration Time	2.60	Rectangular	$\sqrt{3}$	1	1	1.50	1.50	∞
RF Ambient Noise	3.00	Rectangular	$\sqrt{3}$	1	1	1.73	1.73	9
RF Ambient Reflections	3.00	Rectangular	$\sqrt{3}$	1	1	1.73	1.73	9
Probe Positioner	0.40	Rectangular	$\sqrt{3}$	1	1	0.23	0.23	∞
Probe Positioning	2.90	Rectangular	$\sqrt{3}$	1	1	1.67	1.67	∞
Max. SAR Eval.	1.00	Rectangular	$\sqrt{3}$	1	1	0.58	0.58	∞
Test sample related								
Sample positioning	1.90	Normal	1	1	1	1.90	1.90	4
Device holder uncertainty	2.80	Normal	1	1	1	2.80	2.80	4
Output power variation-SAR drift measurement	4.50	Rectangular	$\sqrt{3}$	1	1	2.60	2.60	1
Dipole Related								
Dipole Axis to Liquid Distance	1.60	Rectangular	$\sqrt{3}$	1	1	0.92	0.92	4
Input Power Drift	3.04	Rectangular	$\sqrt{3}$	1	1	1.75	1.75	1
Phantom and Tissue parameters								
Phantom Uncertainty	4.00	Rectangular	$\sqrt{3}$	1	1	2.31	2.31	∞
Liquid Conductivity (target)	5.00	Rectangular	$\sqrt{3}$	0.64	0.43	1.85	1.24	∞
Liquid Conductivity (measurement)	3.50	Normal	1	0.64	0.43	2.24	1.51	9
Liquid Permittivity (target)	5.00	Rectangular	$\sqrt{3}$	0.6	0.49	1.73	1.41	∞
Liquid Permittivity (measurement)	3.39	Normal	1	0.6	0.49	2.03	1.66	9
Combined Standard Uncertainty						**9.93**	**9.57**	
Coverage Factor for 95%						**Kp=2**		
Expanded Uncertainty (K=2)						**19.87**	**19.15**	

7. TEST RESULTS

7.1 TEST PROCEDURES

Use the software to control the EUT channel and transmission power. Then record the conducted power before the testing. Place the EUT to the specific test location. After the testing, must writing down the conducted power of the EUT into the report. The SAR value was calculated via the 3D spline interpolation algorithm that has been implemented in the software of DASY5 SAR measurement system manufactured and calibrated by SPEAG. According to the IEEE 1528 standards, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Verification of the power reference measurement
- Area scan
- Zoom scan
- Power reference measurement

The area scan was performed for the highest spatial SAR location. The zoom scan was performed for SAR value averaged over 1g and 10g spatial volumes.

In the zoom scan, the distance between the measurement point at the probe sensor location (geometric center behind the probe tip) and the phantom surface is 3mm and maintained at a constant distance of ±0.5mm during a zoom scan to determine peak SAR locations. The distance is 2mm between the first measurement point and the bottom surface of the phantom.

The measurement time is 0.5s at each point of the zoom scan. The probe boundary effect compensation shall be applied during the SAR test. Because of the tip of the probe to the Phantom surface separated distances are longer than half a tip probe diameter.

In the area scan, the separation distance is 2mm between the each measurement point and the phantom surface. The scan size shall be included the transmission portion of the EUT. The measurement time is the same as the zoom scan. At last the reference power drift shall be less than ±5%.

7.2 DESCRIPTION OF TEST CONDITION

TEST DATE	TISSUE TYPE / FREQ.	TEMPERATURE(°C)		HUMIDITY (%RH)	TESTED BY
		AIMBENT	LIQUID		
Jul. 07, 2011	HSL 2450	22.5	21.6	61	Morrison Huang
Aug. 09, 2011	HSL 2450	22.2	22.7	59	Morrison Huang
Jul. 07, 2011	MSL 2450	22.7	21.4	60	Morrison Huang
Aug. 09, 2011	MSL 2450	22.0	22.4	60	Morrison Huang
Jul. 08, 2011	HSL 5G	23.2	22.1	58	Morrison Huang
Jul. 09, 2011	MSL 5G	22.9	21.8	57	Morrison Huang

7.3 MEASURED CONDUCTED POWER OF DUT

Band	802.11b			802.11g		
Channel	1	6	11	1	6	11
Frequency (MHz)	2412	2437	2462	2412	2437	2462
Peak Power	21.30	21.70	21.50	21.70	22.30	22.20
Average Power	18.10	18.50	18.30	13.20	13.70	13.40

Band	802.11n (BW 20MHz)			-		
Channel	1	6	11	-	-	-
Frequency (MHz)	2412	2437	2462	-	-	-
Peak Power	21.00	21.70	21.50	-	-	-
Average Power	12.20	12.60	12.40	-	-	-

Band	802.11a						
Channel	36	40	44	48	52	56	60
Frequency (MHz)	5180	5200	5220	5240	5260	5280	5300
Peak Power	-	-	-	-	-	-	-
Average Power	10.80	10.80	10.70	10.90	10.40	10.00	10.20

Band	802.11a						
Channel	64	100	104	108	112	116	120
Frequency (MHz)	5320	5500	5520	5540	5560	5580	5600
Peak Power	-	-	-	-	-	-	-
Average Power	10.40	10.10	10.30	10.20	10.40	10.80	10.20

Band	802.11a						
Channel	124	128	132	136	140	149	153
Frequency (MHz)	5620	5640	5660	5680	5700	5745	5765
Peak Power	-	-	-	-	-	20.40	-
Average Power	10.40	10.10	10.30	10.50	10.30	10.30	10.20

Band	802.11a						
Channel	157	161	165	-	-	-	-
Frequency (MHz)	5785	5805	5825	-	-	-	-
Peak Power	20.30	20.10	-	-	-	-	-
Average Power	10.20	10.20	10.30	-	-	-	-

Band	802.11n (BW 20MHz)						
Channel	36	40	44	48	52	56	60
Frequency (MHz)	5180	5200	5220	5240	5260	5280	5300
Peak Power	-	-	-	-	-	-	-
Average Power	10.50	10.40	10.30	10.60	10.10	10.00	10.00

Band	802.11n (BW 20MHz)						
Channel	64	100	104	108	112	116	120
Frequency (MHz)	5320	5500	5520	5540	5560	5580	5600
Peak Power	-	-	-	-	-	-	-
Average Power	10.10	10.00	10.20	10.10	10.20	10.50	10.10

Band	802.11n (BW 20MHz)						
Channel	124	128	132	136	140	149	153
Frequency (MHz)	5620	5640	5660	5680	5700	5745	5765
Peak Power	-	-	-	-	-	20.10	-
Average Power	10.20	10.10	10.20	10.30	10.10	10.20	10.00

Band	802.11n (BW 20MHz)						
Channel	157	161	165	-	-	-	-
Frequency (MHz)	5785	5805	5825	-	-	-	-
Peak Power	20.10	20.00	-	-	-	-	-
Average Power	10.10	10.00	10.00	-	-	-	-

7.4 MEASURED SAR RESULTS

<Head SAR>

Plot No.	Band	Test Position	Channel	Battery	SAR_{1g} (W/kg)
138	802.11b	Right Cheek	6	1	0.104
139	802.11b	Right Tilted	6	1	0.049
140	**802.11b**	**Left Cheek**	**6**	**1**	**0.314**
141	802.11b	Left Tilted	6	1	0.034
146	802.11b	Left Cheek	6	2	0.296
112	802.11a	Right Cheek	48	1	0.057
113	802.11a	Right Cheek	52	1	0.072
114	802.11a	Right Cheek	116	1	0.049
148	802.11a	Right Cheek	149	1	0.057
115	802.11a	Right Tilted	48	1	0.000252
116	802.11a	Right Tilted	52	1	0.014
117	802.11a	Right Tilted	116	1	0.00229
149	802.11a	Right Tilted	149	1	0.011
118	802.11a	Left Cheek	48	1	0.087
119	802.11a	Left Cheek	52	1	0.092
120	**802.11a**	**Left Cheek**	**116**	**1**	**0.103**
150	802.11a	Left Cheek	149	1	0.049
121	802.11a	Left Tilted	48	1	0.027
122	802.11a	Left Tilted	52	1	0.023
123	802.11a	Left Tilted	116	1	0.035
151	802.11a	Left Tilted	149	1	0.027
136	802.11a	Left Cheek	116	2	0.075
156	802.11a	Right Cheek	149	2	0.036
-	Bluetooth	Right Cheek	39	1	N/A

Note: The separation distance between BT and EVDO antennas is less than 2.5 cm and the EVDO is larger than 1.2 mW/g. Therefore, the BT SAR was tested on Right Cheek. The BT SAR is too small and it cannot take any SAR value.

<Body SAR: Body Worn Mode>

Plot No.	Band	Test Position	Separation Distance (cm)	Channel	Battery	SAR_{1g} (W/kg)
142	802.11b	Front Face	1.0	6	1	0.123
143	**802.11b**	**Back Face**	**1.0**	**6**	**1**	**0.503**
124	802.11a	Front Face	1.0	48	1	0.103
125	802.11a	Front Face	1.0	52	1	0.11
126	**802.11a**	**Front Face**	**1.0**	**116**	**1**	**0.129**
152	802.11a	Front Face	1.0	149	1	0.1
127	802.11a	Back Face	1.0	48	1	0.078
128	802.11a	Back Face	1.0	52	1	0.081
129	802.11a	Back Face	1.0	116	1	0.078
153	802.11a	Back Face	1.0	149	1	0.043

<Body SAR: Hotspot Mode>

Plot No.	Band	Test Position	Separation Distance (cm)	Channel	Battery	SAR_{1g} (W/kg)
142	802.11b	Front Face	1.0	6	1	0.123
143	802.11b	Back Face	1.0	6	1	0.503
144	**802.11b**	**Left Side**	**1.0**	**6**	**1**	**0.596**
145	802.11b	Bottom Side	1.0	6	1	0.075
147	802.11b	Left Side	1.0	6	2	0.531
124	802.11a	Front Face	1.0	48	1	0.103
125	802.11a	Front Face	1.0	52	1	0.11
126	**802.11a**	**Front Face**	**1.0**	**116**	**1**	**0.129**
152	802.11a	Front Face	1.0	149	1	0.1
127	802.11a	Back Face	1.0	48	1	0.078
128	802.11a	Back Face	1.0	52	1	0.081
129	802.11a	Back Face	1.0	116	1	0.078
153	802.11a	Back Face	1.0	149	1	0.043
130	802.11a	Left Side	1.0	48	1	0.077
131	802.11a	Left Side	1.0	52	1	0.073
132	802.11a	Left Side	1.0	116	1	0.062
154	802.11a	Left Side	1.0	149	1	0.038
133	802.11a	Bottom Side	1.0	48	1	0.031
134	802.11a	Bottom Side	1.0	52	1	0.058
135	802.11a	Bottom Side	1.0	116	1	0.035
155	802.11a	Bottom Side	1.0	149	1	0.034
137	802.11a	Back Face	1.0	116	2	0.103
157	802.11a	Back Face	1.0	149	2	0.085

Note:
The details of WWAN standalone SAR result can be referred to BVADT SAR report number SA110705C18-1 dated Aug. 11, 2011.

7.5 SIMULTANEOUS TRANSMISSION EVALUATION

The simultaneous transmission SAR for this handset has been addressed in the WWAN SAR report (BVADT Report No. SA110705C18-1).

<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

   $$\text{Peak SAR separation distance} = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2 + (Z_1 - Z_2)^2}$$
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.

Table 7.1 Co-located Simultaneous Transmission Analysis for CDMA850 Voice + DO850 Data + WLAN

Position	Transmitter 1 CDMA 850 Voice	Transmitter 2 DO 850 Data	Transmitter 3 WLAN	All 3 SAR Summation	SPLSR T1&T2	SPLSR T1&T3	SPLSR T2&T3	Note
Head-Right Cheek	0.447	1.25	0.104	**1.801**	0.278	0.104	0.212	All SPLSR<0.3, Simul-TX SAR not required
Head-Right Tilted	0.219	0.669	0.049	0.937	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Cheek	0.518	0.868	0.314	**1.7**	0.283	0.287	0.179	All SPLSR<0.3, Simul-TX SAR not required
Head-Left Tilted	0.301	0.424	0.035	0.76	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Front Face	0.408	0.388	0.129	0.925	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Back Face	0.553	1.01	0.503	**2.066**	0.163	0.285	0.213	All SPLSR<0.3, Simul-TX SAR not required
Body-Bottom Side	0.056	0	0.075	0.131	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Top Side	0	0.031	0	0.031	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Left Side	0.196	1.12	0.596	**1.912**	0.269	0.283	0.291	All SPLSR<0.3, Simul-TX SAR not required
Body-Right Side	0.427	0	0	0.427	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required

Note: The calculation of SPLSR is as follows.

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0635, -0.274, -0.176), T2(0.0462, -0.332, -0.174)
Peak Location Spacing = 6.1 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.447 + 1.25) / 6.1 = 0.278

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0635, -0.274, -0.176), T3(0.103, -0.306, -0.16)
Peak Location Spacing = 5.3 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.447 + 0.104) / 5.3 = 0.104

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(0.0462, -0.332, -0.174), T3(0.103, -0.306, -0.16)
Peak Location Spacing = 6.4 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.25 + 0.104) / 6.4 = 0.212

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.063, 0.262, -0.175), T2(0.0169, 0.277, -0.171)
Peak Location Spacing = 4.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.518 + 0.868) / 4.9 = 0.283

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.063, 0.262, -0.175), T3(0.0658, 0.233, -0.172)
Peak Location Spacing = 2.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.518 + 0.314) / 2.9 = 0.287

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(0.0169, 0.277, -0.171), T3(0.0658, 0.233, -0.172)
Peak Location Spacing = 6.6 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.868 + 0.314) / 6.6 = 0.179

The calculation of SAR to peak location separation ratio for (Body-Back Face, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.013, -0.0453, -0.207), T2(-0.0538, -0.0419, -0.206)
Peak Location Spacing = 9.6 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.553 + 1.01) / 9.6 = 0.163

The calculation of SAR to peak location separation ratio for (Body-Back Face, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.013, 0.0453, -0.207), T3(-0.0455, 0.0282, -0.207)
Peak Location Spacing = 3.7 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.553 + 0.503) / 3.7 = 0.285

The calculation of SAR to peak location separation ratio for (Body-Back Face, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(-0.0538, -0.0419, -0.206), T3(-0.0455, 0.0282, -0.207)
Peak Location Spacing = 7.1 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.01 + 0.503) / 7.1 = 0.213

The calculation of SAR to peak location separation ratio for (Body-Left Edge, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.0365, 0.018, -0.206), T2(-0.0181, -0.0271, -0.207)
Peak Location Spacing = 4.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.196 + 1.12) / 4.9 = 0.269

The calculation of SAR to peak location separation ratio for (Body-Left Edge, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.0365, 0.018, -0.206), T3(-0.012, 0.0313, -0.207)
Peak Location Spacing = 2.8 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.196 + 0.596) / 2.8 = 0.283

The calculation of SAR to peak location separation ratio for (Body-Left Edge, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(-0.0181, -0.0271, -0.207), T3(-0.012, 0.0313, -0.207)
Peak Location Spacing = 5.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.12 + 0.596) / 5.9 = 0.291

Table 7.2 Co-located Simultaneous Transmission Analysis for CDMA850 Voice + DO1900 Data + WLAN

Position	Transmitter 1 CDMA 850 Voice	Transmitter 2 DO 1900 Data	Transmitter 3 WLAN	All 3 SAR Summation	SPLSR T1&T2	SPLSR T1&T3	SPLSR T2&T3	Note
Head-Right Cheek	0.447	0.605	0.104	1.156	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Right Tilted	0.219	0.322	0.049	0.59	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Cheek	0.518	0.358	0.314	1.19	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Tilted	0.301	0.296	0.035	0.632	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Front Face	0.408	0.179	0.129	0.716	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Back Face	0.553	0.27	0.503	1.326	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Bottom Side	0.056	0	0.075	0.131	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Top Side	0	0.079	0	0.079	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Left Side	0.196	0.547	0.596	1.339	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Right Side	0.427	0	0	0.427	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required

Table 7.3 Co-located Simultaneous Transmission Analysis for CDMA850 Voice + LTE700 Data + WLAN

Position	Transmitter 1 CDMA 850 Voice	Transmitter 2 LTE 700 Data	Transmitter 3 WLAN	All 3 SAR Summation	SPLSR T1&T2	SPLSR T1&T3	SPLSR T2&T3	Note
Head-Right Cheek	0.447	0.352	0.104	0.903	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Right Tilted	0.219	0.345	0.049	0.613	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Cheek	0.518	0.756	0.314	1.588	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Tilted	0.301	0.642	0.035	0.978	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Front Face	0.408	0.444	0.129	0.981	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Back Face	0.553	0.615	0.503	**1.671**	0.209	0.285	0.238	All SPLSR<0.3, Simul-TX SAR not required
Body-Bottom Side	0.056	0	0.075	0.131	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Top Side	0	0.455	0	0.455	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Left Side	0.196	0	0.596	0.792	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Right Side	0.427	0.644	0	1.071	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required

Note: The calculation of SPLSR is as follows.

The calculation of SAR to peak location separation ratio for (Body-Back Face, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.013, 0.0453, -0.207), T2(-0.0185, -0.0106, -0.207)
Peak Location Spacing = 5.6 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.553 + 0.615) / 5.6 = 0.209

The calculation of SAR to peak location separation ratio for (Body-Back Face, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.013, 0.0453, -0.207), T3(-0.0455, 0.0282, -0.207)
Peak Location Spacing = 3.7 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.553 + 0.503) / 3.7 = 0.285

The calculation of SAR to peak location separation ratio for (Body-Back Face, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(-0.0185, -0.0106, -0.207), T3(-0.0455, 0.0282, -0.207)
Peak Location Spacing = 4.7 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.615 + 0.503) / 4.7 = 0.238

Table 7.4 Co-located Simultaneous Transmission Analysis for CDMA1900 Voice + DO850 Data + WLAN

Position	Transmitter 1 CDMA 1900 Voice	Transmitter 2 DO 850 Data	Transmitter 3 WLAN	All 3 SAR Summation	SPLSR T1&T2	SPLSR T1&T3	SPLSR T2&T3	Note
Head-Right Cheek	1.07	1.25	0.104	**2.424**	0.286	0.175	0.212	All SPLSR<0.3, Simul-TX SAR not required
Head-Right Tilted	0.419	0.669	0.049	1.137	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Cheek	0.841	0.868	0.314	**2.023**	**0.322**	**0.608**	0.179	**T1+T2 & T1+T3 SPLSR>0.3, Simul-TX SAR required**
Head-Left Tilted	0.242	0.424	0.035	0.701	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Front Face	1.04	0.388	0.129	1.557	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Back Face	0.461	1.01	0.503	**1.974**	0.144	0.197	0.213	All SPLSR<0.3, Simul-TX SAR not required
Body-Bottom Side	0.593	0	0.075	0.668	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Top Side	0	0.031	0	0.031	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Left Side	0.242	1.12	0.596	**1.958**	0.184	**0.493**	0.291	**T1+T3 SPLSR>0.3, Simul-TX SAR required**
Body-Right Side	0.959	0	0	0.959	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required

Note: The calculation of SPLSR is as follows.

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0645, -0.253, -0.174), T2(0.0462, -0.332, -0.174)
Peak Location Spacing = 8.1 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.07 + 1.25) / 8.1 = 0.286

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0645, -0.253, -0.174), T3(0.103, -0.306, -0.16)
Peak Location Spacing = 6.7 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.07 + 0.104) / 6.7 = 0.175

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(0.0462, -0.332, -0.174), T3(0.103, -0.306, -0.16)
Peak Location Spacing = 6.4 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.25 + 0.104) / 6.4 = 0.212

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0631, 0.252, -0.175), T2(0.0169, 0.277, -0.171)
Peak Location Spacing = 5.3 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.841 + 0.868) / 5.3 = 0.322

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0631, 0.252, -0.175), T3(0.0658, 0.233, -0.172)
Peak Location Spacing = 1.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.841 + 0.314) / 1.9 = 0.608

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(0.0169, 0.277, -0.171), T3(0.0658, 0.233, -0.172)
Peak Location Spacing = 6.6 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.868 + 0.314) / 6.6 = 0.179

The calculation of SAR to peak location separation ratio for (Body-Back Face, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0013, 0.0437, -0.206), T2(-0.0538, -0.0419, -0.206)
Peak Location Spacing = 10.2 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.461 + 1.01) / 10.2 = 0.144

The calculation of SAR to peak location separation ratio for (Body-Back Face, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0013, 0.0437, -0.206), T3(-0.0455, 0.0282, -0.207)
Peak Location Spacing = 4.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.461 + 0.503) / 4.9 = 0.197

The calculation of SAR to peak location separation ratio for (Body-Back Face, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(-0.0538, -0.0419, -0.206), T3(-0.0455, 0.0282, -0.207)
Peak Location Spacing = 7.1 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.01 + 0.503) / 7.1 = 0.213

The calculation of SAR to peak location separation ratio for (Body-Left Edge, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.0195, 0.0465, -0.206), T2(-0.0181, -0.0271, -0.207)
Peak Location Spacing = 7.4 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.242 + 1.12) / 7.4 = 0.184

The calculation of SAR to peak location separation ratio for (Body-Left Edge, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.0195, 0.0465, -0.206), T3(-0.012, 0.0313, -0.207)
Peak Location Spacing = 1.7 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.242 + 0.596) / 1.7 = 0.493

The calculation of SAR to peak location separation ratio for (Body-Left Edge, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(-0.0181, -0.0271, -0.207), T3(-0.012, 0.0313, -0.207)
Peak Location Spacing = 5.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.12 + 0.596) / 5.9 = 0.291

Table 7.5 Co-located Simultaneous Transmission Analysis for CDMA1900 Voice + DO1900 Data + WLAN

Position	Transmitter 1 CDMA 1900 Voice	Transmitter 2 DO 1900 Data	Transmitter 3 WLAN	All 3 SAR Summation	SPLSR T1&T2	SPLSR T1&T3	SPLSR T2&T3	Note
Head-Right Cheek	1.07	0.605	0.104	**1.779**	0.209	0.175	0.098	All SPLSR<0.3, Simul-TX SAR not required
Head-Right Tilted	0.419	0.322	0.049	0.79	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Cheek	0.841	0.358	0.314	1.513	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Tilted	0.242	0.296	0.035	0.573	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Front Face	1.04	0.179	0.129	1.348	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Back Face	0.461	0.27	0.503	1.234	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Bottom Side	0.593	0	0.075	0.668	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Top Side	0	0.079	0	0.079	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Left Side	0.242	0.547	0.596	1.385	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Right Side	0.959	0	0	0.959	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required

Note: The calculation of SPLSR is as follows.

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0645, -0.253, -0.174), T2(0.0358, -0.328, -0.175)
Peak Location Spacing = 8.0 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.07 + 0.605) / 8.0 = 0.209

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0645, -0.253, -0.174), T3(0.103, -0.306, -0.16)
Peak Location Spacing = 6.7 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.07 + 0.104) / 6.7 = 0.175

The calculation of SAR to peak location separation ratio for (Head-Right Cheek, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(0.0358, -0.328, -0.175), T3(0.103, -0.306, -0.16)
Peak Location Spacing = 7.2 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.605 + 0.104) / 7.2 = 0.098

Table 7.6 Co-located Simultaneous Transmission Analysis for CDMA1900 Voice + LTE700 Data + WLAN

Position	Transmitter 1 CDMA 1900 Voice	Transmitter 2 LTE 700 Data	Transmitter 3 WLAN	All 3 SAR Summation	SPLSR T1&T2	SPLSR T1&T3	SPLSR T2&T3	Note
Head-Right Cheek	1.07	0.352	0.104	1.526	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Right Tilted	0.419	0.345	0.049	0.813	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Head-Left Cheek	0.841	0.756	0.314	**1.911**	0.186	**0.608**	0.102	**T1+T3 SPLSR>0.3, Simul-TX SAR required**
Head-Left Tilted	0.242	0.642	0.035	0.919	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Front Face	1.04	0.444	0.129	**1.613**	0.201	0.216	0.077	All SPLSR<0.3, Simul-TX SAR not required
Body-Back Face	0.461	0.615	0.503	1.579	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Bottom Side	0.593	0	0.075	0.668	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Top Side	0	0.455	0	0.455	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Left Side	0.242	0	0.596	0.838	N/A	N/A	N/A	SUM SAR<1.6, Simul-TX SAR not required
Body-Right Side	0.959	0.644	0	**1.603**	0.272	0	0	All SPLSR<0.3, Simul-TX SAR not required

Note: The calculation of SPLSR is as follows.

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0631, 0.252, -0.175), T2(0.0268, 0.33, -0.175)
Peak Location Spacing = 8.6 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.841 + 0.756) / 8.6 = 0.186

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(0.0631, 0.252, -0.175), T3(0.0658, 0.233, -0.172)
Peak Location Spacing = 1.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.841 + 0.314) / 1.9 = 0.608

The calculation of SAR to peak location separation ratio for (Head-Left Cheek, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(0.0268, 0.33, -0.175), T3(0.0658, 0.233, -0.172)
Peak Location Spacing = 10.5 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.756 + 0.314) / 10.5 = 0.102

The calculation of SAR to peak location separation ratio for (Body-Front Face, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.0355, 0.05, -0.206), T2(-0.039, -0.0235, -0.207)
Peak Location Spacing = 7.4 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.444 + 1.04) / 7.4 = 0.201

The calculation of SAR to peak location separation ratio for (Body-Front Face, T1+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.0355, 0.05, -0.206), T3(0.014, 0.0276, -0.207)
Peak Location Spacing = 5.4 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (1.04 + 0.129) / 5.4 = 0.216

The calculation of SAR to peak location separation ratio for (Body-Front Face, T2+T3) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T2(-0.039, -0.0235, -0.207), T3(0.014, 0.0276, -0.207)
Peak Location Spacing = 7.4 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.444 + 0.129) / 7.4 = 0.077

The calculation of SAR to peak location separation ratio for (Body-Right Edge, T1+T2) is as below:
Coordinate of Peak SAR Location (X, Y, Z) : T1(-0.0195, 0.0405, -0.206), T2(-0.0216, -0.0184, -0.207)
Peak Location Spacing = 5.9 cm
SPLSR (SAR to Peak Location Spacing Ratio) = (0.959 + 0.644) / 5.9 = 0.272

Table 7.7 Volume Scan SAR Measurement Results

Plot No.	Band	Mode	Test Position	Ch.	Ant Status	Battery	Standalone SAR_{1g} (W/kg)	Volume SAR_{1g} (W/kg)	Multi Band SAR_{1g}(W/kg)
171	LTE Band 13	QPSK (RB 1, OS 0)	Left Cheek	23230	3(Data)	1	0.756	0.708	1.02
173	CDMA2000 BC1	RC3+SO55	Left Cheek	600	1(Voice)	1	0.841	0.901	
174	802.11b	-	Left Cheek	6	4	1	0.314	0.281	
172	CDMA2000 BC0	RTAP 153.6	Left Cheek	777	2(Data)	1	0.868	0.74	1.13
173	CDMA2000 BC1	RC3+SO55	Left Cheek	600	1(Voice)	1	0.841	0.901	
174	802.11b	-	Left Cheek	6	4	1	0.314	0.281	
179	**CDMA2000 BC0**	**RTAP 153.6**	**Left Edge**	**777**	**2(Data)**	**1**	**1.12**	**1.29**	**1.4**
180	**CDMA2000 BC1**	**RC3+SO32**	**Left Edge**	**600**	**1(Voice)**	**1**	**0.242**	**0.265**	
181	**802.11b**	**-**	**Left Edge**	**6**	**4**	**1**	**0.596**	**0.526**	

Notes:
1. The worst configuration on each position is used for the volume scan.

7.6 SAR LIMITS

HUMAN EXPOSURE	SAR (W/kg)	
	(GENERAL POPULATION / UNCONTROLLED EXPOSURE ENVIRONMENT)	(OCCUPATIONAL / CONTROLLED EXPOSURE ENVIRONMENT)
Spatial Average (whole body)	0.08	0.4
Spatial Peak (averaged over 1 g)	**1.6**	8.0
Spatial Peak (hands / wrists / feet / ankles averaged over 10 g)	4.0	20.0

NOTE: This limits accord to 47 CFR 2.1093 – Safety Limit.

8. 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 certificates of our laboratories obtained from approval agencies can be downloaded from our web site: www.adt.com.tw/index.5.phtml. If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab:
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF Lab:
Tel: 886-3-5935343
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Hwa Ya EMC/RF/Safety/Telecom Lab:
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Email: service.adt@tw.bureauveritas.com
Web Site: www.adt.com.tw

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

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