



# **SAR Evaluation Report**

**IN ACCORDANCE WITH THE REQUIREMENTS OF  
FCC REPORT AND ORDER:  
ET DOCKET 93-62, AND OET BULLETIN 65 SUPPLEMENT C**

**FOR**

**Single Band Single Mode CDMA Cellular Phone**

**MODEL: VS510**

**FCC ID: GKRVS510**

**REPORT NUMBER: 05I3294-3**

**ISSUE DATE: March 30, 2005**

*Prepared for*

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LAB CODE:200065-0

Revision History

<u>Rev.</u>	<u>Revisions</u>	<u>Revised By</u>
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**CERTIFICATE OF COMPLIANCE (SAR EVALUATION)****DATES OF TEST:** March 30, 2005

APPLICANT:	Compal Electronics Inc.
ADDRESS:	No. 581, Jui-Kuang Rd Neihu, Taipei, 114, Taiwan R.O.C.
FCC ID:	GKRVS510
MODEL:	VS510
DEVICE CATEGORY:	Portable Device
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure

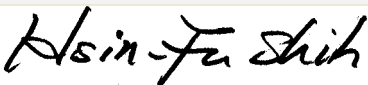
Single Band Single Mode CDMA Cellular Phone				
Test Sample is a:	Prototype unit			
Modulation type:	CDMA			
FCC Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]		Max. Average Power Output [dBm]
22H	824.76 ~ 848.31	Head:	0.921	23.60
		Body:	1.010	
<p>Note: A separation distance of 1.5 cm between the back of the device and a flat phantom.</p> <p>This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for General Population/Uncontrolled Exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC OET 65 Supplement C (Edition 01-01).</p> <p>Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.</p>				
Released For CCS By:				
				
Hsin Fu Shih ( Sunny Shih) COMPLIANCE CERTIFICATION SERVICES				

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## Equipment Under Test (EUT) Description

Single Band Single Mode CDMA Cellular Phone	
Normal operation:	<input checked="" type="checkbox"/> Held to ear <input checked="" type="checkbox"/> Worn on body
Accessory:	<input type="checkbox"/> belt clip <input type="checkbox"/> holster without belt clip <input type="checkbox"/> holster with belt clip <input type="checkbox"/> neck-strap or lanyard <input type="checkbox"/> pistol grip <input checked="" type="checkbox"/> not supplied or available as options
Earphone/Headset Jack:	Earphone (Devices with a headset or earphone output should be tested with a headset or earphone connected to the device)
Duty cycle:	100%
Power supply:	Rechargeable Li-ion Battery Type BPE-5L-L1-R0, 3.8Vdc (Only one type of battery to be used in the EUT)

## FACILITIES AND ACCREDITATION

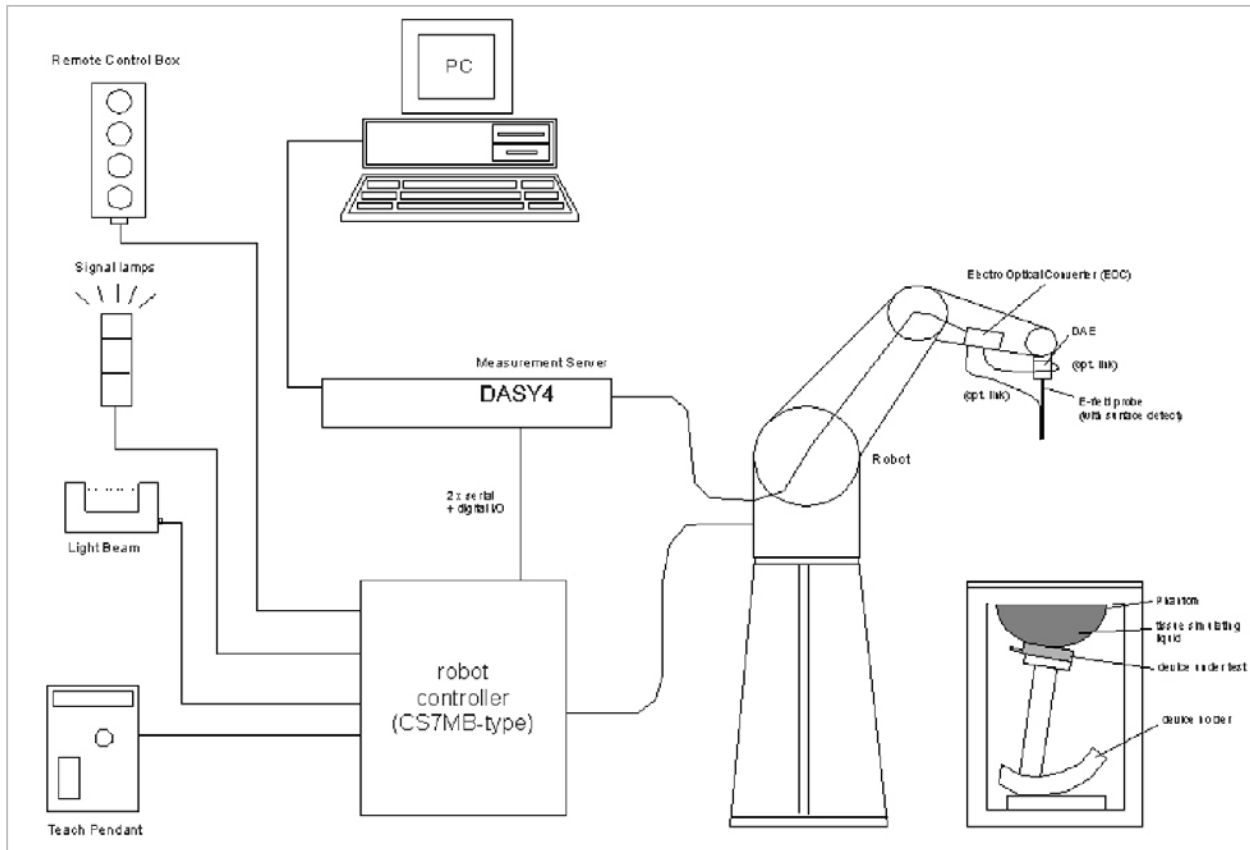
The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."



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## System Description



**The DASY4 system for performing compliance tests consists of the following items:**

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

## System Components

### 1.1 DASY4 MEASUREMENT SERVER



The DASY4 measurement server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chip disk and 64MB RAM. The necessary circuits for communication with either the DAE3 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4 I/O-board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.

### 1.2 DATA ACQUISITION ELECTRONICS (DAE)

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, 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 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 200M $\Omega$ ; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



### 1.3 EX3DV3 ISOTROPIC E-FIELD PROBE FOR DOSIMETRIC MEASUREMENTS

- 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:  $\pm 0.2$  dB (30 MHz to 3 GHz)
- Directivity:**  $\pm 0.3$  dB in HSL (rotation around probe axis);  
 $\pm 0.5$  dB in tissue material (rotation normal to probe axis)
- Dynamic Range:** 10  $\mu$ W/g to > 100 mW/g; Linearity:  $\pm 0.2$  dB (noise: typically < 1  $\mu$ W/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%.



#### 1.4 LIGHT BEAM UNIT

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, so that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



#### 1.5 SAM PHANTOM (V4.0)

**Construction:** The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50361 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:**  $2 \pm 0.2$  mm

**Filling Volume:** Approx. 25 liters

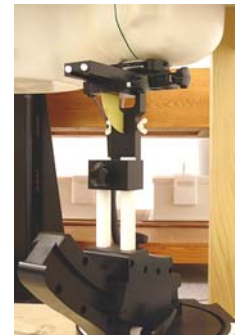
**Dimensions:** Height: 810mm; Length: 1000mm; Width: 500mm





**1.6 DEVICE HOLDER FOR SAM TWIN PHANTOM**

**Construction:** In combination with the Twin SAM Phantom V4.0 or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



**1.7 SYSTEM VALIDATION KITS**

**Construction:** Symmetrical dipole with 1/4 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.

**Frequency:** 450, 900, 1800, 2450, 5800 MHz

**Return loss:** > 20 dB at specified validation position

**Power capability:** > 100 W (f < 1GHz); > 40 W (f > 1GHz)

**Dimensions:** 450V2: dipole length: 270 mm; overall height: 330 mm  
 D900V2: dipole length: 149 mm; overall height: 330 mm  
 D1800V2: dipole length: 72 mm; overall height: 300 mm  
 D835V2: dipole length: 161; overall height: 330  
 D1900V2: dipole length: 68; overall height: 300  
 D2450V2: dipole length: 51.5 mm; overall height: 300 mm D5GHzV2: dipole length: 25.5 mm; overall height: 290 mm

**1.8 COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUID**

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16 MΩ+ resistivity

HEC: Hydroxyethyl Cellulose

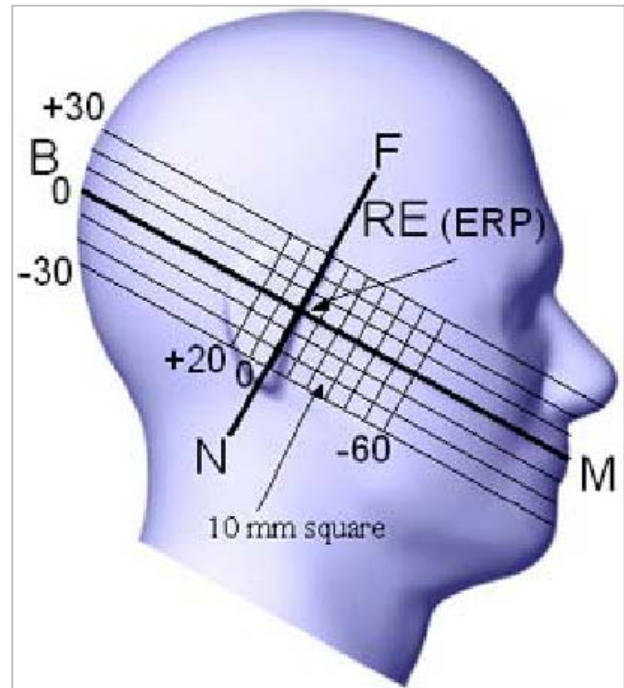
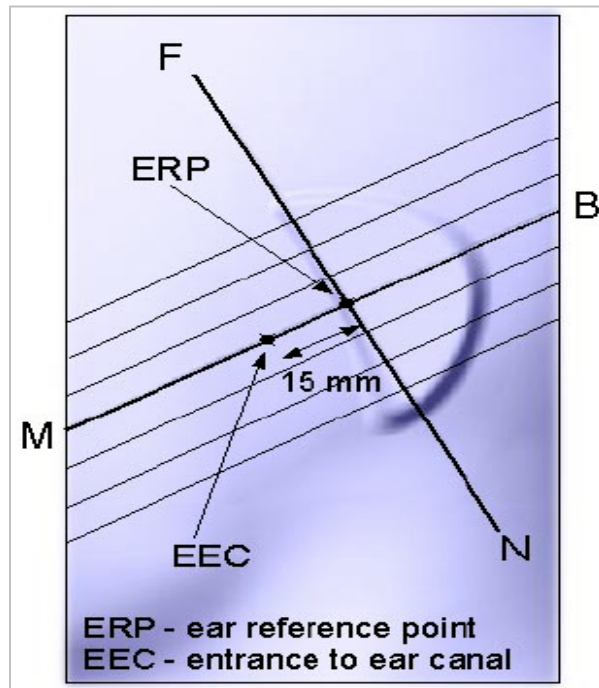
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

Test positions for devices Operating Next To A Person's Ear

This category includes most wireless handsets with fixed, retractable or internal antennas located toward the top half of the device, with or without a foldout, sliding or similar keypad cover. The handset should have its earpiece located within the upper ¼ of the device, either along the centerline or off-centered, as perceived by its users. This type of handset should be positioned in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point". The "test device reference point" should be located at the same level as the center of the earpiece region. The "vertical centerline" should bisect the front surface of the handset at its top and bottom edges. A "ear reference point" is located on the outer surface of the head phantom on each ear spacer. It is located 1.5 cm above the center of the ear canal entrance in the "phantom reference plane" defined by the three lines joining the center of each "ear reference point" (left and right) and the tip of the mouth.

A handset should be initially positioned with the earpiece region pressed against the ear spacer of a head phantom. For the SCC-34/SC-2 head phantom, the device should be positioned parallel to the "N-F" line defined along the base of the ear spacer that contains the "ear reference point". For interim head phantoms, the device should be positioned parallel to the cheek for maximum RF energy coupling. The "test device reference point" is aligned to the "ear reference point" on the head phantom and the "vertical centerline" is aligned to the "phantom reference plane". This is called the "initial ear position". While maintaining these three alignments, the body of the handset is gradually adjusted to each of the following positions for evaluating SAR:



## 1.9 CHEEK/TOUCH POSITION

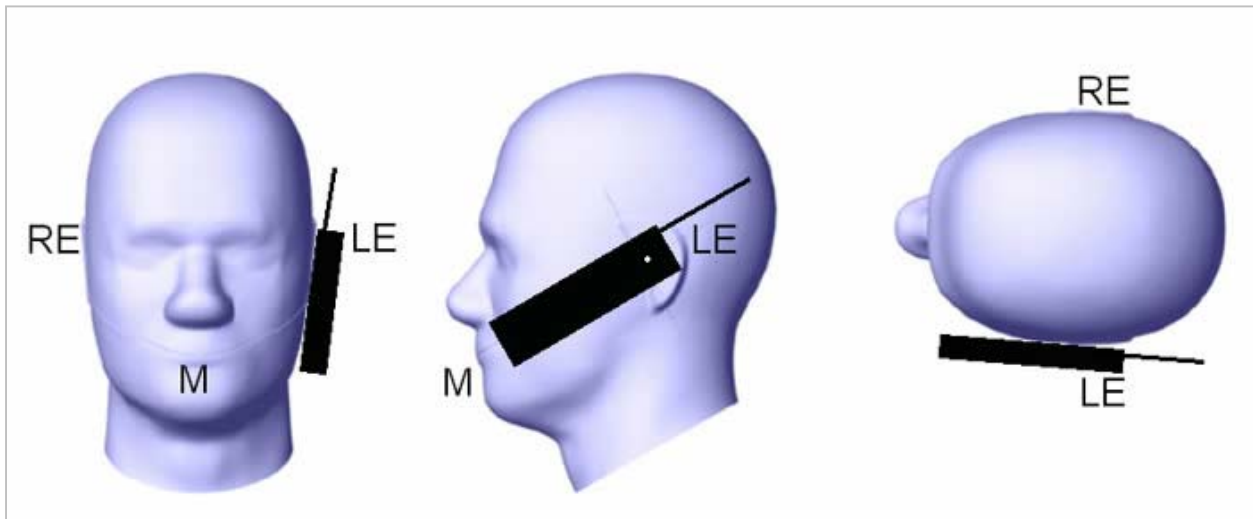
The device is brought toward the mouth of the head phantom by pivoting against the “ear reference point” or along the “N-F” line for the SCC-34/SC-2 head phantom.

This test position is established:

- i. When any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom.
- ii. (or) When any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.

For existing head phantoms – when the handset loses contact with the phantom at the pivoting point, rotation should continue until the device touches the cheek of the phantom or breaks its last contact from the ear spacer.

Cheek / Touch Position



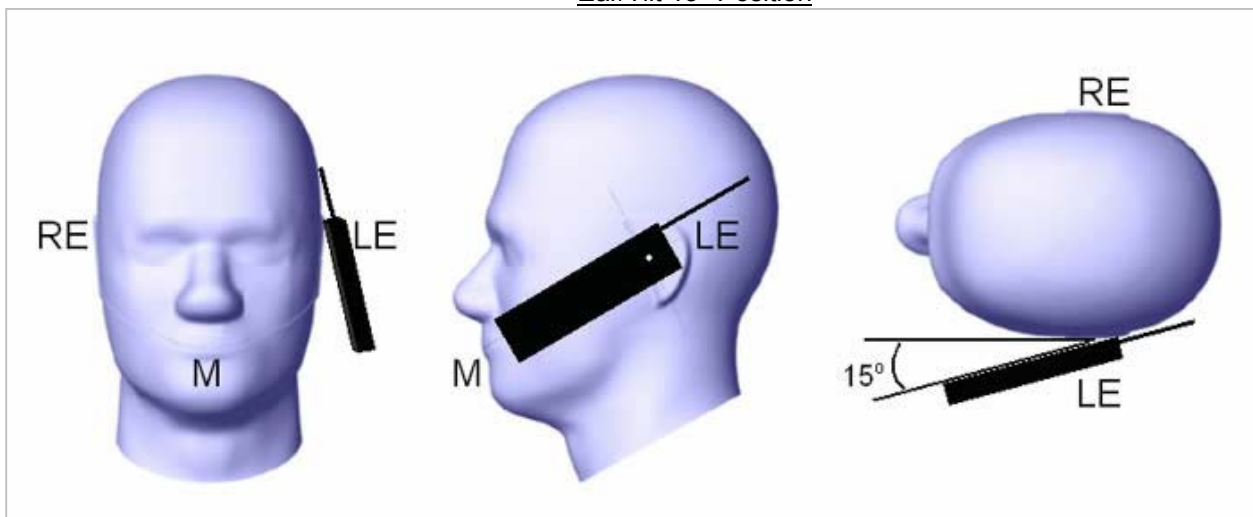
### 1.10 EAR/TILT POSITION

With the handset aligned in the “Cheek/Touch Position”:

- i. If the earpiece of the handset is not in full contact with the phantom’s ear spacer (in the “Cheek/Touch position”) and the peak SAR location for the “Cheek/Touch” position is located at the ear spacer region or corresponds to the earpiece region of the handset, the device should be returned to the “initial ear position” by rotating it away from the mouth until the earpiece is in full contact with the ear spacer.
- ii. (otherwise) The handset should be moved (translated) away from the cheek perpendicular to the line passes through both “ear reference points” (note: one of these ear reference points may not physically exist on a split head model) for approximate 2-3 cm. While it is in this position, the device handset is tilted away from the mouth with respect to the “test device reference point” until the inside angle between the vertical centerline on the front surface of the phone and the horizontal line passing through the ear reference point is by  $15^\circ$ . After the tilt, it is then moved (translated) back toward the head perpendicular to the line passes through both “ear reference points” until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process should be repeated with a tilt angle less than  $15^\circ$  so that the device and its antenna would touch the phantom simultaneously. This test position may require a device holder or positioner to achieve the translation and tilting with acceptable positioning repeatability.

If a device is also designed to transmit with its keypad cover closed for operating in the head position, such positions should also be considered in the SAR evaluation. The device should be tested on the left and right side of the head phantom in the “Cheek/Touch” and “Ear/Tilt” positions. When applicable, each configuration should be tested with the antenna in its fully extended and fully retracted positions. These test configurations should be tested at the high, middle and low frequency channels of each operating mode; for example, AMPS, CDMA, and TDMA. If the SAR measured at the middle channel for each test configuration (left, right, Cheek/Touch, Tile/Ear, extended and retracted) is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s). If the transmission band of the test device is less than 10 MHz, testing at the high and low frequency channels is optional.

Ear/Tilt  $15^\circ$  Position



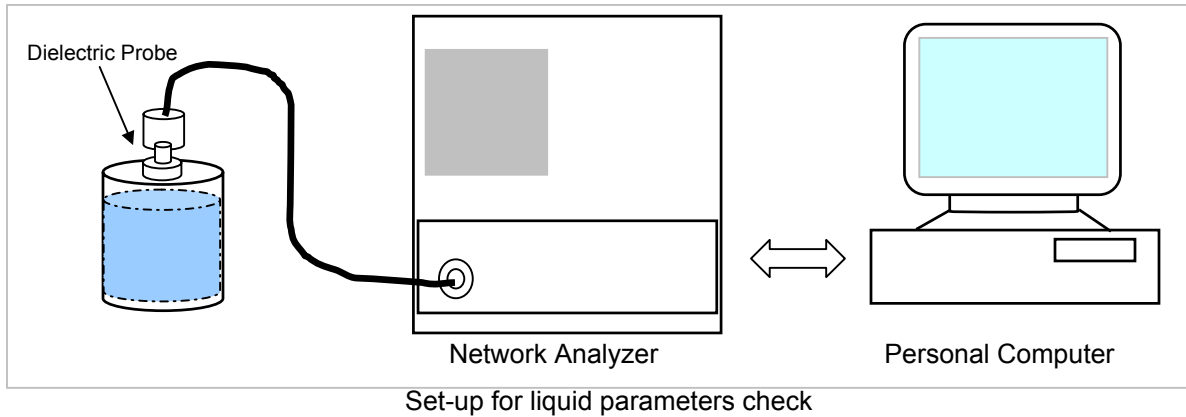
### Test Positions For Body-worn And Other Similar Configurations

#### Without the belt-clips or holsters

Body-worn accessories may not always be supplied or available as options for some devices that are intended to be authorized for body-worn use. A separation distance of 1.5 cm between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances. Other separation distances may be used, but they should not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

Simulating Liquid Parameters Check

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within  $\pm 5\%$  of the values given in the table below.



**Reference Values of Tissue Dielectric Parameters for Head and Body Phantom**

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE Standard 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE Standard 1528.

Target Frequency (MHz)	Head		Body	
	$\epsilon_r$	$\sigma$ (S/m)	$\epsilon_r$	$\sigma$ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

( $\epsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho = 1000 \text{ kg/m}^3$ )

**1.11 SIMULATING LIQUID PARAMETER CHECK RESULT**

Simulating Liquid Parameter Check Result @ Head 835 MHz

Room Ambient Temperature = 23.5°C; Relative humidity = 35%

Measured by: Sunny Shih

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
835	23	15	e'	Relative Permittivity (e'');	41.5	41.7300	0.55	± 5
			20.2229	Conductivity (σ);	0.90	0.9394	4.38	± 5

Simulating Liquid Dielectric Parameters Check @ 835 MHz

Room Ambient Temperature: 23.5 deg. C, Liquid temperature: 23.0 deg. C

March 30, 2005 01:51 PM

Frequency	e'	e''
750000000.	42.8479	20.6183
755000000.	42.7616	20.5793
760000000.	42.7060	20.5215
765000000.	42.6121	20.5314
770000000.	42.5665	20.4609
775000000.	42.4698	20.4498
780000000.	42.4059	20.4304
785000000.	42.3507	20.3979
790000000.	42.2854	20.3243
795000000.	42.2172	20.3186
800000000.	42.1521	20.2794
805000000.	42.0907	20.2506
810000000.	42.0543	20.2697
815000000.	41.9982	20.2725
820000000.	41.9461	20.2474
825000000.	41.8652	20.2307
830000000.	41.7790	20.2478
835000000.	41.7300	20.2229
840000000.	41.6924	20.1794
845000000.	41.5751	20.1483
850000000.	41.5158	20.1329
855000000.	41.4944	20.0654
860000000.	41.4341	20.0407
865000000.	41.3529	20.0122
870000000.	41.2984	19.9662
875000000.	41.2315	19.9448
880000000.	41.1787	19.8994
885000000.	41.1322	19.8729
890000000.	41.1010	19.8623
895000000.	41.0900	19.8159
900000000.	41.0436	19.8002

The conductivity (σ) can be given as:

$$\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$$

where  $f = \text{target } f * 10^6$

$\epsilon_0 = 8.854 * 10^{-12}$

### System Performance Check

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of  $\pm 10\%$ .

### System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Head simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3-SN: 3531 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15 mm from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
- Special 5 x 5 x 7 fine cube was chosen for cube integration(dx=dy=7.5mm; dz=5mm).
- Distance between probe sensors and phantom surface was set 2.5 mm.
- The dipole input power (forward power) was 250 mW $\pm 3\%$ .
- The results are normalized to 1 W input power.

### Reference SAR Values

IEEE Standard 1528 Recommended Reference Value

Frequency (MHz)	1 g SAR	10 g SAR	Local SAR at surface (Above feed point)	Local SAR at surface (y=2cm offset from feed point)
300	3.0	2.0	4.4	2.1
450	4.9	3.3	7.2	3.2
835	9.5	6.2	14.1	4.9
900	10.8	6.9	16.4	5.4
1450	29.0	16.0	50.2	6.5
1800	38.1	19.8	69.5	6.8
1900	39.7	20.5	72.1	6.6
2450	52.4	24.0	104.2	7.7
3000	63.8	25.7	140.2	9.5

### 1.12 SYSTEM PERFORMANCE CHECK RESULT

@ System Validation Dipole: D835V2 SN:4d002

Date: March 30, 2005

Ambient Temperature = 23.5°C; Relative humidity = 35%

Measured by: Sunny Shih

Head Simulating Liquid			Measured		Target <sub>1g</sub>	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
835	23	15	2.53	10.12	9.5	6.53	$\pm 10$



## SAR Measurement Procedures

A summary of the procedure follows:

- a) A measurement of the SAR value at a fixed location is used as a reference value for assessing the power drop of the EUT. The SAR at this point is measured at the start of the test, and then again at the end of the test.
- b) The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 2.5 mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 15 mm x 15 mm. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.
- c) Around this point, a volume of X=Y=Z=30 mm is assessed by measuring 5 x 5 x 7 mm points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:
  - (i) The data at the surface are extrapolated, since the centre of the dipoles is 1.2 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation is based on a least square algorithm. A polynomial of the fourth order is calculated through the points in z-axes. This polynomial is then used to evaluate the points between the surface and the probe tip.
  - (ii) The maximum interpolated value is searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g and 10 g) are computed using the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the "Not a knot"- condition (in x, y and z-direction). The volume is integrated with the trapezoidal – algorithm. One thousand points (10 x 10 x 10) are interpolated to calculate the averages.
  - (iii) All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.
  - (iv) The SAR value at the same location as in Step (a) is again measured to evaluate the actual power drift.

## **DASY4 SAR MEASUREMENT PROCEDURE**

### **Step 1: Power Reference Measurement**

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties (for example, 1.2 mm for an EX3DV3 probe type).

### **Step 2: Area Scan**

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

### **Step 3: Zoom Scan**

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures 5 x 5 x 7 points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

### **Step 4: Power drift measurement**

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

### **Step 5: Z-Scan**

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be larger than the step size in Z-direction.

## Procedures Used to Establish Test Signal

The following procedures had been used to prepare the EUT for the SAR test.

Press the key “\*\*000000##”

Using the u/down key to select the following items

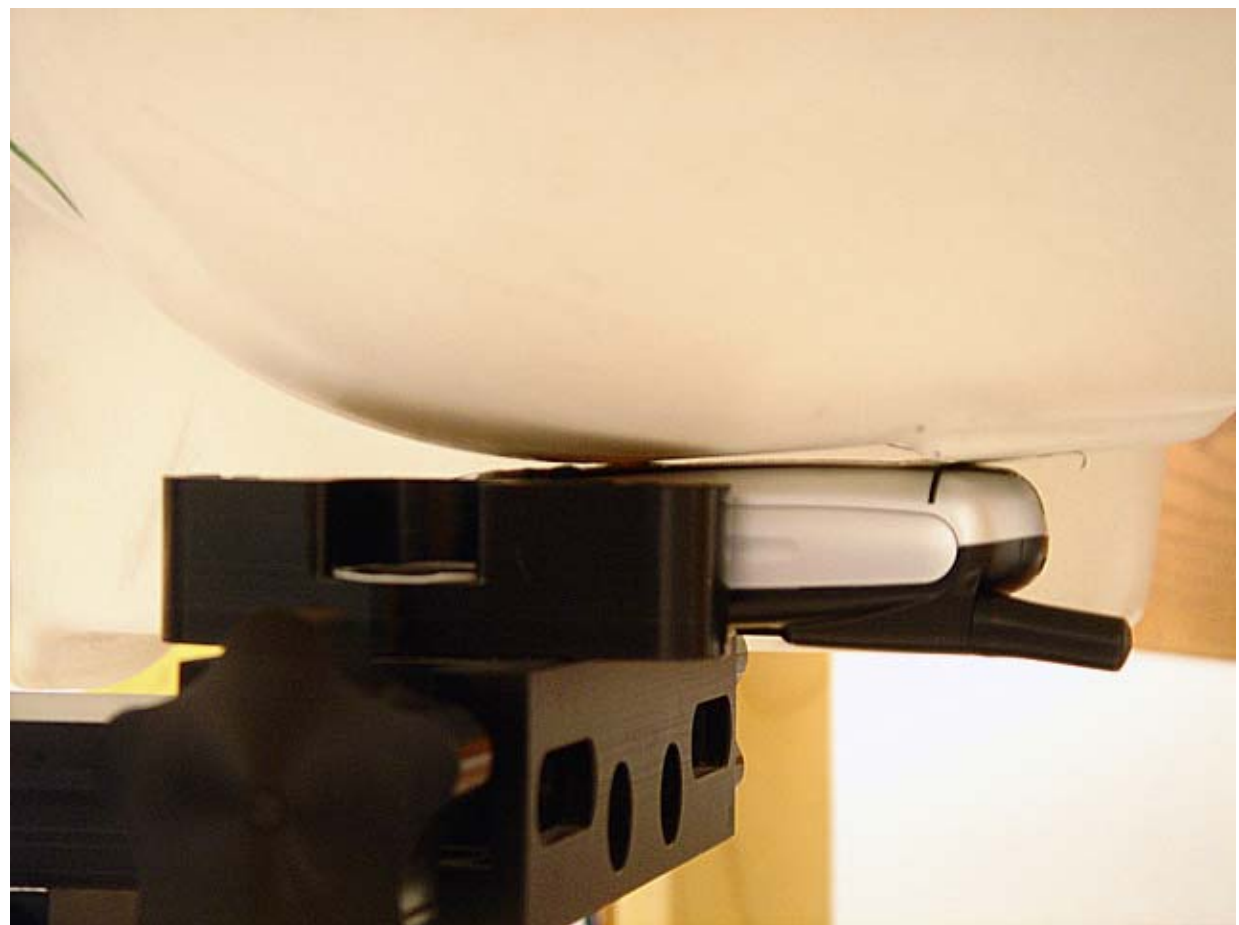
1. SAR Test -
  - a. Channel Set - Select channel
  - b. CDMA Tx On Off - Tx on or off
  - c. CDMA Tx Up/On – Adjust RF output power

The insertion loss of 10.18dB (including 9.68 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	f (MHz)	Average Conducted Power (dBm)
1015	824.76	23.55
363	835.89	23.60
777	848.31	23.50

SAR Measurement Results

**1.13 LEFT HAND SIDE - TOUCH POSITION**



CDMA Cellular band						
Test Position	Channel	f (MHz)	Measured (mW/g)	Drift (dBm)	Extrapolated (mW/g)	Limit (mW/g)
Left hand touch	1015	824.76	0.549	-0.110	0.563	1.6
Left hand touch	363	835.89	0.897	-0.115	0.921	1.6
Left hand touch	777	848.31	0.757	-0.076	0.770	1.6

Notes:

1. The exact method of extrapolation  $SAR = \text{Measured SAR} * 10^{(-\text{Drift}/10)}$ . The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2. The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.
3. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

**1.14 LEFT HAND SIDE – TITLT POSITION**



Test Position	Channel	f (MHz)	Measured (mW/g)	Drift (dBm)	Extrapolated (mW/g)	Limit (mW/g)
Left hand tilt	1015	824.76				
	363	835.89	0.622	-0.051	0.629	1.6
	777	848.31				

Notes:

1. The exact method of extrapolation  $SAR = \text{Measured SAR} * 10^{(-\text{Drift}/10)}$ . The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2. The SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, testing at low & high channel is optional.
3. The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.
4. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

**1.15 RIGHT HAND SIDE - TOUCH POSITION**



CDMA Cellular band						
Test Position	Channel	f (MHz)	Measured (mW/g)	Drift (dBm)	Extrapolated (mW/g)	Limit (mW/g)
	1015	824.76				
Right hand touch	363	835.89	0.777	-0.112	0.797	1.6
	777	848.31				

Notes:

1. The exact method of extrapolation  $SAR = Measured\ SAR * 10^{(-Drift/10)}$ . The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2. The SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, testing at low & high channel is optional.
3. The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.
4. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

**1.16 RIGHT HAND SIDE – TILT POSITION**



CDMA Cellular band						
Test Position	Channel	f (MHz)	Measured (mW/g)	Drift (dBm)	Extrapolated (mW/g)	Limit (mW/g)
	1015	824.76				
Right hand tilt	363	835.89	0.544	-0.037	0.549	1.6
	777	848.31				

Notes:

1. The exact method of extrapolation  $SAR = \text{Measured SAR} * 10^{(-\text{Drift}/10)}$ . The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2. The SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, testing at low & high channel is optional.
3. The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.
4. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

**1.17 BODY POSITION – 1.5 CM SEPERATION**



CDMA Cellular band						
Seperation distance (mm)	Channel	f (MHz)	Measured (mW/g)	Drift (dBm)	Extrapolated (mW/g)	Limit (mW/g)
15	1015	824.76	0.661	-0.173	0.688	1.6
15	363	835.89	1.010	-0.054	1.023	1.6
15	777	848.31	0.810	-0.047	0.819	1.6

Notes:

1. The exact method of extrapolation  $SAR = \text{Measured SAR} * 10^{(-\text{Drift}/10)}$ . The SAR reported at the end of the measurement process by the DASY4 measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process.
2. A separation distance of 1.5 cm between the back of the device and a flat phantom.
3. The earphone wire connected to the EUT to simulate hand-free operation in a body worn configuration.
4. The battery was fully charged in accordance with manufacture's instructions prior to SAR measurements.
5. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.



EUT Photos

EUT PHOTOS (1/3)



**EUT PHOTOS (2/3)**



**EUT PHOTOS (3/3)**



Note: The actual typical voltage is 3.8V. Battery Label will be modified to 3.8V in the future.

Measurement Uncertainty

1.18 MEASUREMENT UNCERTAINTY FOR 300 MHZ – 3GHZ

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
<b>Measurement System</b>							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	1.59	R	1.732	1	1	0.92	0.92
RF Ambient Conditions - Reflections	0.00	R	1.732	1	1	0.00	0.00
Probe Positioner Mechanical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
<b>Test sample Related</b>							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
<b>Phantom and Tissue Parameters</b>							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
<b>Combined Standard Uncertainty</b>			RSS			11.44	10.49
<b>Expanded Uncertainty (95% Confidence Interval)</b>			K=2			22.87	20.98

Notes for table

1. Tol. - tolerance in influence quantity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

## Equipment List &amp; Calibration

<u>Name of Equipment</u>	<u>Manufacturer</u>	<u>Type/Model</u>	<u>Serial Number</u>	<u>Cal. Due date</u>
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A
S-Parameter Network Analyzer	Agilent	8753ES-6	US39173569	8/19/05
Electronic Probe kit	Hewlett Packard	85070C	N/A	N/A
E-Field Probe	SPEAG	EX3DV3	3531	7/18/05
Thermometer	ERTCO	639-1	8402	10/13/2005
Thermometer	ERTCO	639-1	8404	10/21/2005
Thermometer	ERTCO	637-1	8661	10/21/2005
SAM Phantom (SAM1)	SPEAG	TP-1185	QD000P40CA	N/A
SAM Phantom (SAM2)	SPEAG	TP-1015	N/A	N/A
Data Acquisition Electronics	SPEAG	DAE3 V1	500	2/7/05
System Validation Dipole	SPEAG	D835V2	4d002	2/11/06
Signal General	R&H	SMP 04	DE34210	5/5/05
Power Meter	Giga-tronics	8651A	8651404	9/16/05
Power Sensor	Giga-tronics	80701A	1834588	9/16/05
Amplifier	Mini-Circuits	ZVE-8G	0360	N/A
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A
Radio Communication Tester	Rohde & Schwarz	CMU 200	838114/032	12/17/05
Simulating Liquid	CCS	H835	N/A	Within 24 hrs of first test
Simulating Liquid	CCS	M835	N/A	Within 24 hrs of first test

## Attachments

No.	Contents	No. of page (s)
1	System Performance Check Plots	2
2	SAR Test Plots	14
3	Certificate of E-filed Probe EX3DV3 SN 3521	8
4	Certificate of System Validation Dipole D835V2 SN 4d002	6

**END OF REPORT**