SAR TEST REPORT

Test item	:	Mobile Phone
Model No.	:	202K
Order No.	:	DEMC1304-01287
Date of receipt	:	2013-04-15
Test duration	:	2013-05-24 ~ 2013-05-27
Date of issue	:	2013-05-27
Use of report	:	FCC Original Grant

Applicant : KYOCERA Corporation
2-1-1 Kagahara, Tsuzuki-ku, Yokohama-Shi, Kanagawa 224-8502, Japan

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, 449-080, Korea

Test specification	:	§2.1093, FCC/OET Bulletin 65 Supplement C[July 2001]
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

Tested by:	Witnessed by:	Reviewed by:
Engineer NoKyun, Im	Engineer N/A	Technical Director Harvey Sung

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Test Report Version

Test Report No.	Date	Description
DRTFCC1305-0531	May 27, 2013	Final version for approval

1. DESCRIPTION OF DEVICE

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

General Information

Equipment type	Mobile Phone
FCC ID	JOY202K
Equipment model name	202K
Equipment add model name	N/A
Equipment serial no.	Identical prototype
Mode(s) of Operation	PCS1900, W-LAN(802.11a/b/g/n)
TX Frequency Range	1850.2 ~ 1909.8 MHz(PCS Band) 2412 ~ 2462 MHz(802.11b) / 5180 ~ 5240 MHz(802.11a - 5.2 GHz Band) 5260 ~ 5320 MHz(802.11a - 5.3 GHz Band) / 5500 ~ 5700 MHz(802.11a - 5.5 GHz Band)
RX Frequency Range	1930.2 ~ 1989.8 MHz(PCS Band) 2412 ~ 2462 MHz(802.11b) / 5180 ~ 5240 MHz(802.11a - 5.2 GHz Band) 5260 ~ 5320 MHz(802.11a - 5.3 GHz Band) / 5500 ~ 5700 MHz(802.11a - 5.5 GHz Band)

Equipment Class	Band	Measured Conducted Power [dBm]	Reported SAR 1g SAR (W/kg)		
			Head	Body-worn	Hotspot
PCE	PCS1900	30.10	0.47	0.18	0.27
DTS	2.4 GHz W-LAN	16.57	0.47	0.54	0.54
UNII	5.2 GHz W-LAN	13.03	0.34	0.19	-
UNII	5.3 GHz W-LAN	15.41	0.44	0.33	-
UNII	5.5 GHz W-LAN	16.21	0.40	0.27	-
Simultaneous SAR per KDB 690783 D01v01r02			0.94	0.73	0.78

FCC Equipment Class	Licensed Portable Transmitter Held to Ear (PCE)
Date(s) of Tests	2013-05-24 ~ 2013-05-27
Antenna Type	Internal Type Antenna
Functions	● GSM/GPRS(GPRS Class: 12) / EDGE(RX Only) supported * DTM is not supported ● BT(2.4GHz)/WLAN(2.4GHz802.11b/g/n(HT20), 5 GHz 802.11a/n(HT20, HT40) supported * No simultaneous transmission between BT & WLAN * 5.8 GHz W-LAN (DTS Band) is not supported. ● Simultaneous transmission between GSM voice & WLAN / GPRS & WLAN ● VoIP is not supported. ● Mobile Hotspot is supported.

1.1 Guidance Applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G and Hotspot)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01 v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- October 2012 TCB Workshop Notes

1.2Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE Rx Only 1900	Voice/Data	1850.2 ~ 1909.8 MHz
2.4 GHz WLAN	Data	2412 ~ 2462 MHz
5.2 GHz WLAN	Data	5180 ~ 5240 MHz
5.3 GHz WLAN	Data	5260 ~ 5320 MHz
5.6 GHz WLAN	Data	5500 ~ 5700 MHz
Bluetooth	Data	2402 ~ 2480 MHz

1.3 Nominal and Maximum Output Power Specifications

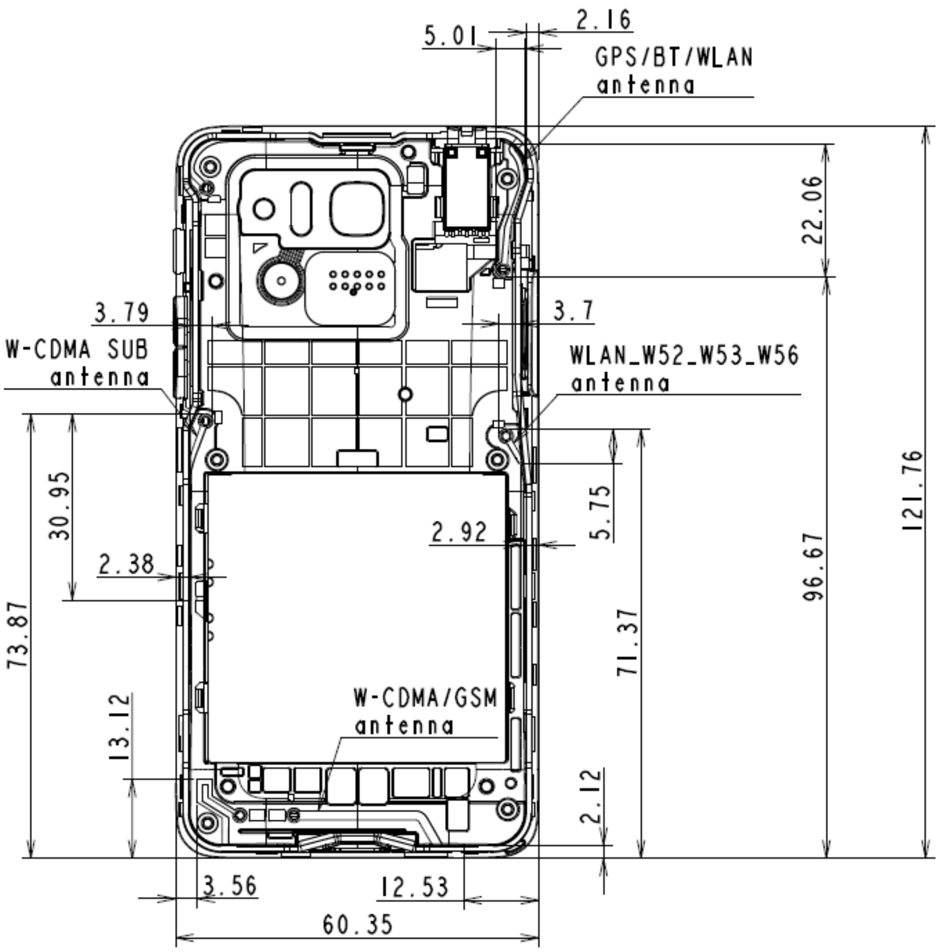
This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05.

Band & Mode		Voice [dBm]	Burst Average GMSK [dBm]			
		1 TX Slot	1 TX Slot	2 TX Slot	3 TX Slot	4 TX Slot
GSM/GPRS 1900	Maximum	30.1	30.1	27.0	25.2	24.0
	Nominal	29.6	29.6	26.5	24.7	23.5

Band & Mode		Modulated Average [dBm]
IEEE 802.11b (2.4 GHz)	Maximum	16.7
	Nominal	14.7
IEEE 802.11g (2.4 GHz)	Maximum	11.9
	Nominal	9.9
IEEE 802.11n (2.4 GHz)	Maximum	11.9
	Nominal	9.9
IEEE 802.11a (5.2, 5.3, 5.6 GHz)	Maximum	16.4
	Nominal	14.4
IEEE 802.11n - HT20 (5.2, 5.3, 5.6 GHz)	Maximum	16.3
	Nominal	14.3
IEEE 802.11n - HT40 (5.2, 5.3, 5.6 GHz)	Maximum	13.7
	Nominal	11.7
Bluetooth	Maximum	6.7
	Nominal	4.7
Bluetooth LE	Maximum	-1.0
	Nominal	-3.0

1.4 DUT Antenna Locations&SAR Test Configurations

DUT Antenna Locations (Rear Side View)



Note: Specific antenna dimensions and separation distances are shown in the antenna distance document.

SAR Test Configurations

Mode	Mobile Hotspot Sides for SAR Testing					
	Top	Bottom	Front	Rear	Right	Left
PCS1900	X	O	O	O	O	O
2.4G W-LAN(802.11b/g/n)	O	X	O	O	X	O

Table 1.1 Mobile Hotspot Sides for SAR Testing

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01guidance, page 2. The antenna document shows the distances between the transmit antennas and the edges of the device. When the wireless router mode is enabled, all 5 GHz bands are disabled. Therefore 5 GHz WIFI is not considered in this section.

1.5 SAR Test Exclusions Applied

(A) WIFI & BT

Since Wireless Router operations are not allowed by the chipset firmware using 5 GHz WIFI, only 2.4 GHz WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v01.

Per FCC KDB 447498 D01v05, **Bluetooth SAR was not required and 2.4 GHz / 5 GHz WIFI SAR was required** based on the maximum conducted power and the Bluetooth/WIFI antenna to user separation distance as followings.

Per FCC KDB 447498 D01v05, the SAR exclusion threshold for distances < 50 mm is defined by the following equation:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 3.0$$

Based on the maximum conducted power of Bluetooth and the antenna to use separation distance, **Bluetooth SAR was not required; (4.677 / 10) * $\sqrt{2.402}$ = 0.7< 3.0.**

Based on the maximum conducted power of WIFI and the antenna to use separation distance, **2.4 GHz WIFI SAR was required; (46.774 / 10) * $\sqrt{2.462}$ = 7.3> 3.0**.

Based on the maximum conducted power of WIFI and the antenna to use separation distance, **5 GHz WIFI SAR was required; (43.652 / 10) * $\sqrt{5.500}$ = 10.2> 3.0**.

This device supports 20 MHz and 40 MHz Bandwidths for IEEE 802.11n for 5 GHz WIFI only. IEEE 802.11n was not evaluated for SAR since the average output power of 20 MHz and 40 MHz bandwidths was not more than 0.25 dB higher than the average output power of IEEE 802.11a.

(B) Licensed Transmitter(s)

GSM/GPRS DTM is not supported for US bands. Therefore, the GSM Voice modes in this report donot transmit simultaneously with GPRS Data.

1.6 Device Serial Numbers

Band & Mode	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
GSM/GPRS/EDGE Rx Only 1900	FCC #1	FCC #1	FCC #1
2.4 GHz WLAN	FCC #1	FCC #1	FCC #1
5 GHz WLAN	FCC #1	FCC #1	FCC #1

2. INTROCUCTION

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95*.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU)absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1.1)

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

Fig. 1.1 SAR Mathematical Equation

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

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

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

3. DESCRIPTION OF TEST EQUIPMENT

3.1 SAR MEASUREMENT SETUP

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 3.1).

A cell controller system contains the power supply, robot controller teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Intel Core i5-2500 3.31GHz desktop computer with Windows NT system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

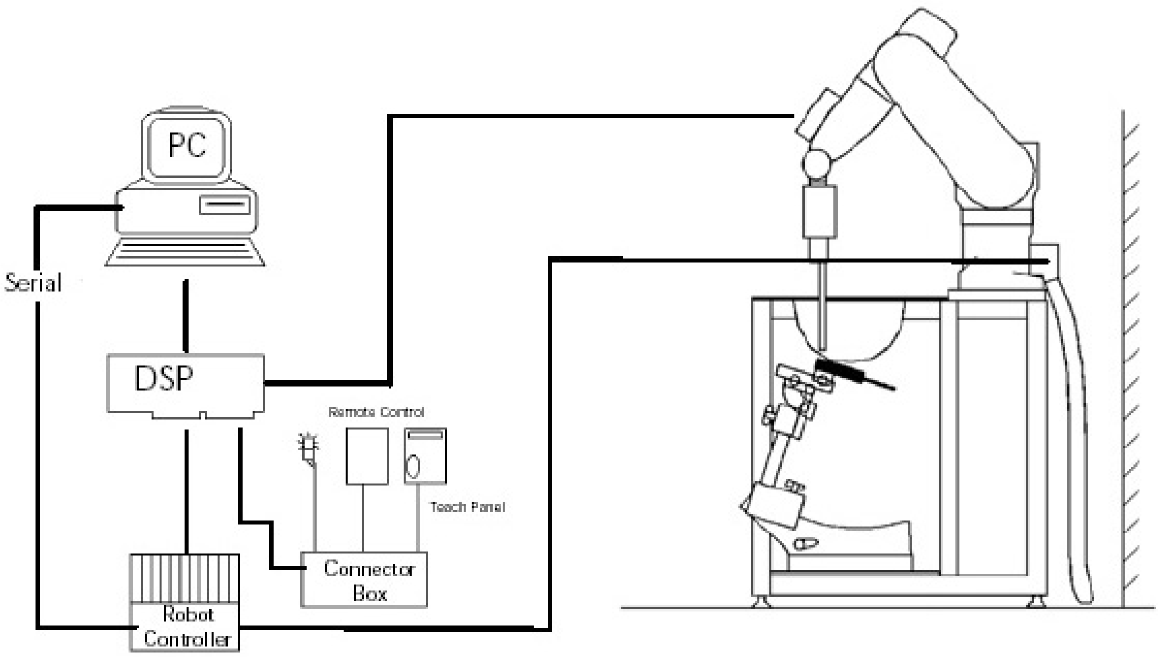


Figure 3.1 SAR Measurement System Setup

The 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail.

3.2 EX3DV4Probe Specification

Calibration In air from 10 MHz to 6 GHz
In brain and muscle simulating tissue atFrequencies of
450 MHz, 750 MHz, 835 MHz, 900 MHz, 1750 MHz, 1900 MHz, 2300 MHz, 2450 MHz
2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5500 MHz, 5600 MHz, 5800 MHz

Frequency 10 MHz to 6 GHz

Linearity ± 0.2 dB(30 MHz to 6 GHz)

Dynamic 5 μW/g to > 100 mW/g

Range Linearity : ±0.2dB

Dimensions Overall length : 330 mm

Tip length 20 mm

Body diameter 12 mm

Tip diameter 2.5 mm

Distance from probe tip to sensor center 1.0 mm

Application SAR Dosimetry Testing
Compliance tests of mobile phones

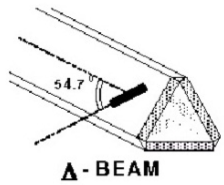


Figure 3.2 Triangular Probe Configurations

Figure 3.3 Probe Thick-Film Technique

DAE System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration (see Fig. 3.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multitier line ending at the front of the probe tip (see Fig. 3.3). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

3.3 Probe Calibration Process

3.3.1 E-Probe Calibration

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium, correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent the rmistorbased temperature probe is used in conjunction with the E-field probe.

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

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

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

SAR is proportional to$\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

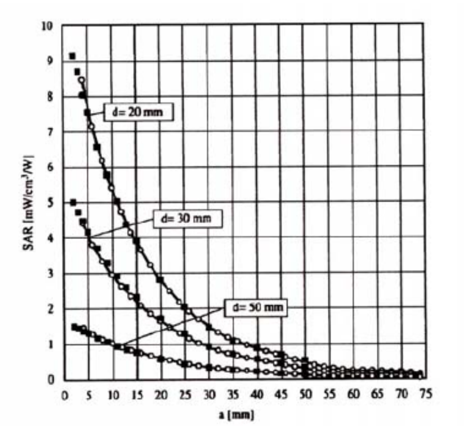


Figure 3.4E-Field and Temperature Measurements at 900MHz

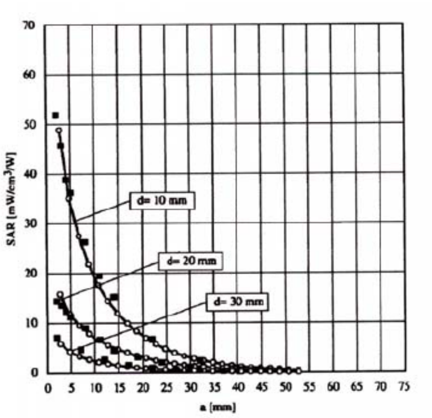


Figure 3.5 E-Field and Temperature Measurements at 1800MHz

3.4 Data Extrapolation

The DASY4 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. 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 like below;

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

with 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:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian 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.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with P_{pwe} = equivalent power density of a plane wave in W/cm^2
E_{tot} = total electric field strength in V/m

3.5 SAM TwinPHANTOM

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. 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 the 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 in the robot. (see Fig. 3.6)

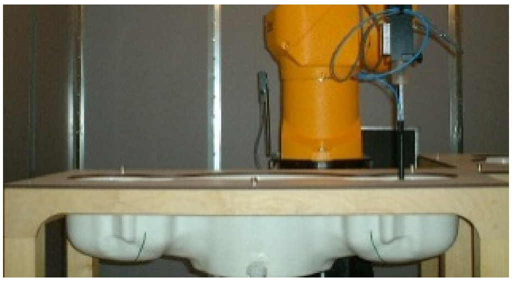


Figure 3.6 SAM Twin Phantom

SAM Twin Phantom Specification

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 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 teaching three points with the robot. Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.
Shell Thickness	2 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet

3.6Device Holder for Transmitters

In combination with the Twin SAM Phantom V4.0/V4.0c or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Figure 3.7 Mounting Device

3.7 Brain & Muscle Simulation Mixture Characterization

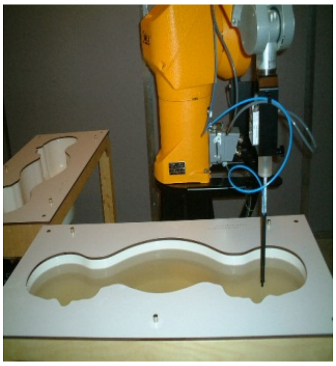


Figure 3.8SimulatedTissue

The brain and muscle mixtures consist of a viscous gel using hydrox-ethylcellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Harts grove.

Table3.1 Composition of the Tissue Equivalent Matter

INGREDIENTS		SIMULATING TISSUE							
		835 MHz Brain	835 MHz Muscle	1900 MHz Brain	1900 MHz Muscle	2450 MHz Brain	2450 MHz Muscle	5200 ~ 5800 MHz Brain	5200 ~ 5800 MHz Muscle
Mixture Percentage									
WATER		40.19	50.75	55.24	70.23	71.88	73.40	65.52	80.00
DGBE		-	-	44.45	29.48	7.990	26.54	-	-
SUGAR		57.90	48.21	-	-	-	-	-	-
SALT		1.480	0.940	0.310	0.290	0.160	0.060	-	-
BACTERICIDE		0.180	0.100	-	-	-	-	-	-
HEC		0.250	-	-	-	-	-	-	-
Triton X-100		-	-	-	-	19.97	-	17.24	-
Diethylenglycolmonohexylether		-	-	-	-	-	-	17.24	-
Polysorbate(Tween) 80		-	-	-	-	-	-	-	20.00
Dielectric Constant	Target	**41.5**	**55.2**	**40.0**	**53.3**	**39.2**	**52.7**	**-**	**-**
Conductivity (S/m)	Target	**0.90**	**0.97**	**1.40**	**1.52**	**1.80**	**1.95**	**-**	**-**

Salt: 99 % Pure Sodium Chloride Sugar: 98 % Pure Sucrose

Water: De-ionized, 16M 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]

3.8 SAR TEST EQUIPMENT

Table 3.2 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date	Next.Cal.Date	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SCHMID	RX90BL	N/A	N/A	F02/5Q85A1/A/01
☒	Robot Controller	SCHMID	CS7MB	N/A	N/A	F02/5Q85A1/C/01
☒	Joystick	SCHMID	N/A	N/A	N/A	D221340031
☒	Intel Core i5-2500 3,31 GHz Windows XP Professional	N/A	N/A	N/A	N/A	N/A
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	SE UKS 030 AA
☒	Mounting Device	SCHMID	SD000H01HA	N/A	N/A	N/A
☒	Twin SAM Phantom	SCHMID	TP1223	N/A	N/A	N/A
☒	Twin SAM Phantom	SCHMID	TP1224	N/A	N/A	N/A
☐	Twin SAM Phantom	SCHMID	QD000P40CD	N/A	N/A	1679
☒	Head/BodyEquivalent Matter(835MHz)	N/A	N/A	2013-01-01	2014-01-01	N/A
☒	Head/BodyEquivalent Matter(1900MHz)	N/A	N/A	2013-01-01	2014-01-01	N/A
☒	Head/BodyEquivalent Matter(2450MHz)	N/A	N/A	2013-01-01	2014-01-01	N/A
☒	Head/BodyEquivalent Matter(5000MHz)	N/A	N/A	2013-01-01	2014-01-01	N/A
☒	DataAcquisition Electronics	SCHMID	DAE3V1	2013-01-23	2014-01-23	519
☒	Dosimetric E-Field Probe	SCHMID	EX3DV4	2013-04-29	2014-04-29	3916
☐	Dummy Probe	N/A	N/A	N/A	N/A	N/A
☐	835MHz System Validation Dipole	SCHMID	D835V2	2012-03-14	2014-03-14	464
☒	1900MHz System Validation Dipole	SCHMID	D1900V2	2012-03-16	2014-03-16	5d029
☒	2450MHz System Validation Dipole	SCHMID	D2450V2	2012-03-15	2014-03-15	726
☒	5000MHz System Validation Dipole	SCHMID	D5GHzV2	2013-03-15	2015-03-15	1103
☒	Network Analyzer	Agilent	E5071C	2012-11-02	2013-11-02	MY46106970
☒	Signal Generator	Rohde Schwarz	SMR20	2013-02-28	2014-02-28	101251
☒	Amplifier	EMPOWER	BBS3Q7ELU	2012-09-18	2013-09-18	1020
☒	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	2012-11-02	2013-11-02	1005
☒	Power Meter	HP	EPM-442A	2013-02-28	2014-02-28	GB37170267
☒	Power Sensor	HP	8481A	2013-02-28	2014-02-28	3318A96566
☒	Power Sensor	HP	8481A	2013-02-14	2014-02-14	3318A96030
☒	Dual Directional Coupler	Agilent	778D-012	2013-01-08	2014-01-08	50228
☒	Directional Coupler	HP	773D	2012-07-01	2013-07-01	2389A00640
☒	Low Pass Filter 1,5GHz	Micro LAB	LA-15N	2013-01-08	2014-01-08	N/A
☒	Low Pass Filter 3,0GHz	Micro LAB	LA-30N	2012-09-17	2013-09-17	N/A
☒	Low Pass Filter 6,0GHz	Micro LAB	LA-60N	2013-03-12	2014-03-12	03942
☒	Attenuators(3 dB)	Agilent	8491B	2012-07-02	2013-07-02	MY39260700
☒	Attenuators(10 dB)	WEINSCHEL	23-10-34	2013-01-08	2014-01-08	BP4387
☐	Step Attenuator	HP	8494A	2012-09-17	2013-09-17	3308A33341
☒	Dielectric Probe kit	SCHMID	DAK-3.5	2012-12-11	2013-12-11	1092
☒	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	2013-02-28	2014-02-28	GB43461134

NOTE: The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Validation measurement is performed by Digital EMC before each test. The brain and muscle simulating material are calibrated by Digital EMC using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

3.8.1 Extended Dipole Calibrations

Referring to FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
The Justification data of dipole D835V2, SN: 464 / D1900V2, SN: 5d029 / D2450V2, SN: 726 can be found in Table 3.2.

Justification Procedure of Dipole Calibration

1. Setup a Network Analyzer (Agilent E5071C) and set the start frequency and stop frequency to Network Analyzer according to the dipole frequency, at least +/- 200 MHz around the calibration point.
2. Using calibration kit to perform Network Analyzer Open, Short and Load calibration.
3. Connect the dipole with the calibrated Network Analyzer.
4. Set the Network Analyzer frequency by the dipole calibration frequency. Monitor the return-loss and impedance results with Log Magnitude format and Smith Chart, respectively.
5. Record the result and compare with the prior calibration.

Referring to FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01, if dipoles are verified in return loss (< -20 dB, within 20 % of prior calibration), and in impedance (with 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Table 3.2 Justification of the extended calibration Result

D835V2 – Serial No. 464												
Date of Measurement	**835 MHz Head**						**835 MHz Body**					
	Return-Loss (dB)	**Delta (%)**	**Real Impedance (ohm)**	**Delta (ohm)**	**Imaginary Impedance (ohm)**	**Delta (ohm)**	**Return-Loss (dB)**	**Delta (%)**	**Real Impedance (ohm)**	**Delta (ohm)**	**Imaginary Impedance (ohm)**	**Delta (ohm)**
2012-03-14 (Calibration)	-32.137		51.215		-2.1855		-25.168		46.469		-3.9863	
2013-03-14 (Measured)	-32.864	**-2.26**	51.758	**-0.543**	-2.2259	**0.040**	-25.295	**-0.50**	46.591	**-0.122**	-3.8298	**-0.1565**
D1900V2 – Serial No. 5d029												
Date of Measurement	**1900 MHz Head**						**1900 MHz Body**					
	Return-Loss (dB)	**Delta (%)**	**Real Impedance (ohm)**	**Delta (ohm)**	**Imaginary Impedance (ohm)**	**Delta (ohm)**	**Return-Loss (dB)**	**Delta (%)**	**Real Impedance (ohm)**	**Delta (ohm)**	**Imaginary Impedance (ohm)**	**Delta (ohm)**
2012-03-16 (Calibration)	-30.838		52.887		-0.61914		-25.415		45.633		-2.6895	
2013-03-16 (Measured)	-30.585	**0.82**	52.599	**0.288**	-0.94326	**0.324**	-25.672	**-1.01**	45.569	**0.064**	-2.6244	**-0.0651**
D2450V2 – Serial No. 726												
Date of Measurement	**2450 MHz Head**						**2450 MHz Body**					
	Return-Loss (dB)	**Delta (%)**	**Real Impedance (ohm)**	**Delta (ohm)**	**Imaginary Impedance (ohm)**	**Delta (ohm)**	**Return-Loss (dB)**	**Delta (%)**	**Real Impedance (ohm)**	**Delta (ohm)**	**Imaginary Impedance (ohm)**	**Delta (ohm)**
2012-03-15 (Calibration)	-26.011		54.014		3.3145		-26.035		50.006		4.9922	
2013-03-15 (Measured)	-26.244	**-0.90**	54.099	**-0.085**	3.4914	**-0.177**	-26.060	**-0.10**	50.305	**-0.299**	4.9089	**0.0833**

4. TEST SYSTEM SPECIFICATIONS

Automated TEST SYSTEM SPECIFICATIONS

Positioner

Robot	Stäubli Unimation Corp. Robot Model: RX90BL
Repeatability	0.02 mm
No. of axis	6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor	Intel Core i5-2500
Clock Speed	3.31 GHz
Operating System	Windows XP Professional
Data Card	DASY4 PC-Board

Data Converter

Features	Signal, multiplexer, A/D converter. & control logic
Software	DASY4
Connecting Lines	Optical downlink for data and status info Optical uplink for commands and clock

PC Interface Card

Function	24 bit (64 MHz) DSP for real time processing Link to DAE 3 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

E-Field Probes

Model	EX3DV4 S/N: 3916
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 6 GHz
Linearity	± 0.2 dB (30 MHz to 6 GHz)

Phantom

Phantom	SAM Twin Phantom (V4.0)
Shell Material	Composite
Thickness	2.0 ± 0.2 mm

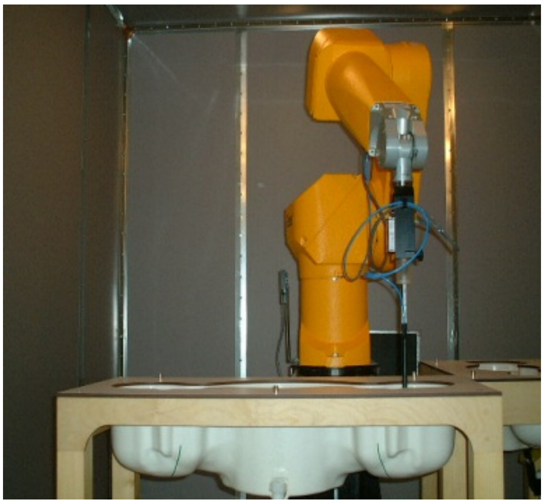
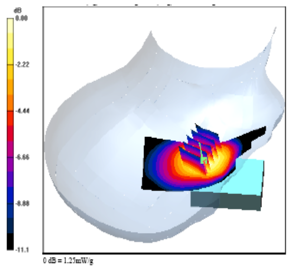


Figure 2.2 DASY4 Test System

5. SAR MEASUREMENT PROCEDURE



Sample SAR Area Scan

The evaluation was performed using the following procedure:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664D01v01.

2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table5.1). On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mmaway from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 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 directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm) $\Delta z_{zoom}(n)$	Minimum Zoom Scan Volume (mm) (x,y,z)
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≥ 22

Table 5.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01

Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Fig. 5.1). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

Figure 5.1 Sam Twin Phantom shell

6. DESCRIPTION OF TEST POSITION

6.1 Ear Reference Point

Figure 6.1 shows the front,back and side views of the SAM Twin Phantom. The point"M" is the reference point for the center of the mouth, "LE" is the left ear reference point(ERP), and "RE" is the right ERP. The ERPs are 15mm posterior to the entrance to the Ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 6.5. The plane Passing, through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck- Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 6.2). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning.

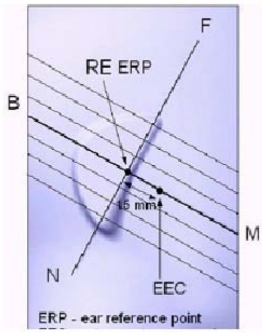


Figure 6.2 Close-up side view of ERP

6.2Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed 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" (See Fig. 6.3). The "test device reference point" was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

Figure 6.1 Front, back and side view SAM Twin Phantom

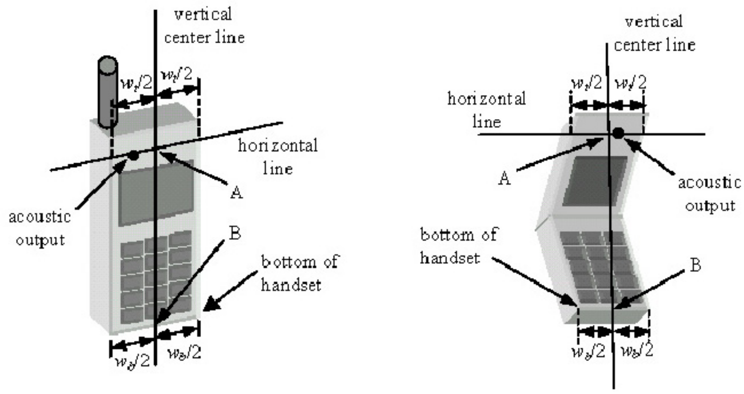


Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points

6.3Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

6.4Positioning for Cheek/Touch

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.4), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

Figure 6.4 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was hen rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). (See Figure 6.5)

6.5 Positioning for Ear / 15 ° Tilt

With the test device aligned in the "Cheek/Touch Position":

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference planeuntil any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 6.6).

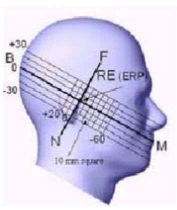


Figure 6.5Side view w/relevant markings

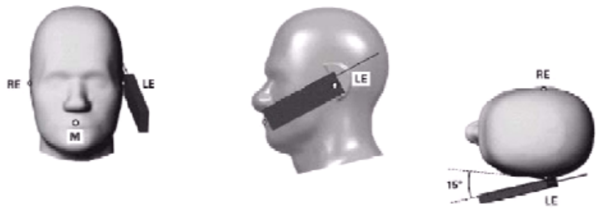


Figure 6.6 Front, Side and Top View of Ear/15^{o}Position

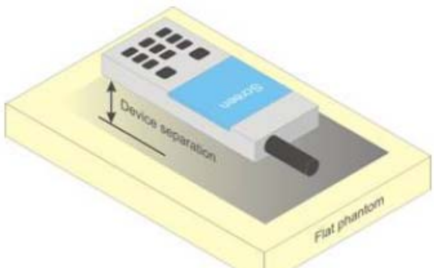


Figure 6.7 Sample Body-Worn Diagram

6.6Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6.7). Per FCC KDB Publication 648474 D04_v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures inFCC KDB Publication 447498 D01_v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

6.7Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v01 where SAR test considerations for handsets(L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with theWIFI transmitter according to FCC KDB Publication 447498 D01v05 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.