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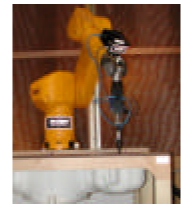

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

APPLICANT NAME & ADDRESS:	DATE & LOCATION OF TESTING:
CASIO COMPUTER CO., LTD. 229, Sakuragaoka, 2-Chome, Higashiyamato-shi, Tokyo, Japan 207-8501 Attn: Yukio Akita, Manager	Dates of Tests: March 7-14, 2003 Test Report S/N: SAR.230304112.BBQ Test Site: PCTEST Lab, Columbia MD

FCC ID:	**BBQDT-X10M30URC**
APPLICANT:	**CASIO COMPUTER CO., LTD.**

EUT Type:	**2.4 GHz Handheld Terminal (WLAN) W/ Bluetooth**
Frequency Range:	**2412 – 2462 MHz (WLAN) / 2402 – 2480 MHz (BT)**
Max. RF Output Power:	**26.9 mW (14.3 dBm) WLAN) / 0.57 mW (-2.45 dBm) Conducted (BT)**
Max. SAR Measurement:	**0.376W/kg Body SAR**
Trade Name/Model(s):	***CASIO DT-X10M30URC, DT-X10M20URC***
FCC Classification:	**Part 15 Spread Spectrum Transmitter (DSS)**
FCC Rule Part(s):	**§2.1093; FCC/OET Bulletin 65 Supplement C [July 2001]**
Application Type:	**Certification**
Test Device Serial No.:	***identical* prototype [S/N: CS94]**

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-200X (Draft 6.5, January 15, 2002).

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Grant Conditions: Output is conducted. This transmitter operates with a specific hand-held terminal and has been tested for SAR compliance for portable and hand-held configurations. This device must not be co-located or operating with any other transmitter or antenna except for the collocated Bluetooth, as described in this filing. End-users must be informed of the body-worn operating requirements for satisfying RF exposure compliance.

PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.

Alfred Cirwithian
Vice President Engineering

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1. INTRODUCTION / SAR DEFINITION

The FCC has adopted the guidelines for evaluating the environmental effects of radiofrequency 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.[1]

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 C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*. (c) 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.[2] The measurement procedure described in *IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave*[3] 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 Radiofrequency Electromagnetic Fields,"* NCRP Report No. 86 (c) NCRP, 1986, Bethesda, MD 20814.[6] 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 (r). 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).

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

Figure 1.1
SAR Mathematical Equation

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

$$SAR = s\,E^2 / r$$

where:

s	=	conductivity of the tissue-simulant material (S/m)
r	=	mass density of the tissue-simulant 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.[6]

2. SAR MEASUREMENT SETUP

Measurements are performed using the DASY3 automated dosimetric assessment system. The DASY3 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium III 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. 2.1).

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 Micron Pentium III 500 MHz computer with Windows NT system and SAR Measurement Software DASY3, 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.

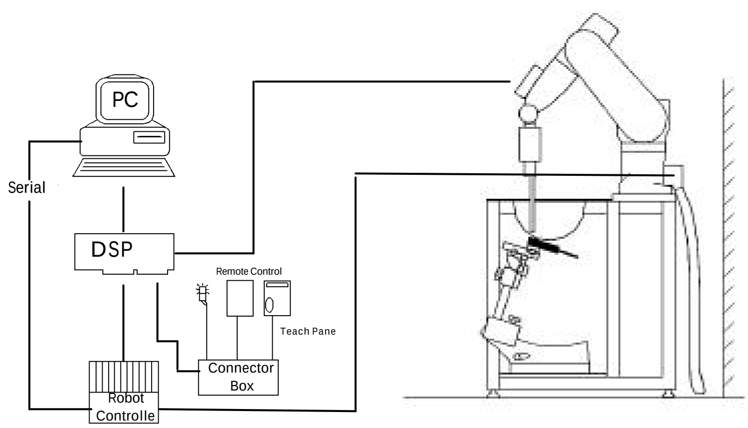

Figure 2.1 SAR Measurement System Setup

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 in [7].

3. DASY3 E-FIELD PROBE SYSTEM

Figure 3.1 DAE System

The SAR measurements were conducted with the dosimetric probe ET3DV6, designed in the classical triangular configuration [7] (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 multifiber 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 DASY3 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig.3.1). The approach is stopped at reaching the maximum.

Calibration:	In air from 10 MHz to 6.0 GHz
	In brain and muscle simulating tissue at
	Frequencies of 450 MHz, 835 MHz, 900 MHz
	1900MHz, 2450MHz and 5800MHz
Frequency:	10 MHz to > 6 GHz; Linearity: ± 0.2 dB
	(30 MHz to 6 GHz)
Directivity:	± 0.2 dB in HSL (rotation around probe axis)
	± 0.4 dB in HSL (rotation normal probe axis)
Dynamic:	5 :W/g to > 100 mW/g;
Range:	Linearity: ± 0.2 dB
Dimensions:	Overall length: 330 mm
	Tip length: 16 mm
	Body diameter: 12 mm
	Tip diameter: 6.8 mm
	Distance from probe tip to dipole centers: 2.7 mm
Application:	General dosimetry up to 6 GHz
	Compliance tests of mobile phones
	Fast automatic scanning in arbitrary phantoms

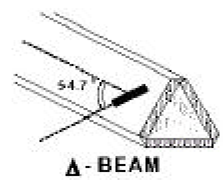

Figure 3.1 Triangular Probe Configuration

Figure 3.2 Probe Thick-Film Technique

4. Probe Calibration Process

Each probe is calibrated according to a dosimetric assessment procedure described in [8] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [9] 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.

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 (see Fig. 4.1), and in a waveguide above 1 GHz 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.

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 thermistor-based temperature probe is used in conjunction with the E-field probe (see Fig. 4.2).

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

where:

Δt = exposure time (30 seconds),

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

ΔT = temperature increase due to RF exposure.

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;

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

where:

σ = simulated tissue conductivity,

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

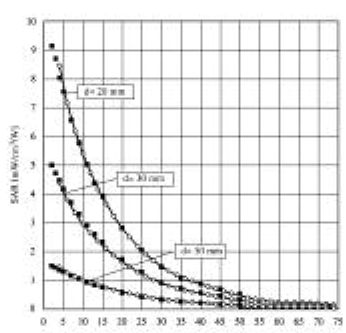

Figure 4.1 E-Field and Temperature measurements at 900MHz [7]

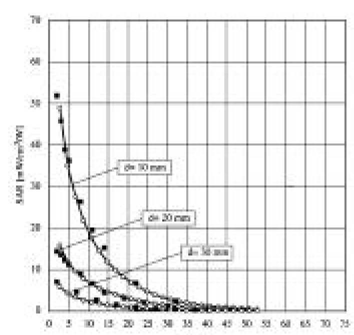

Figure 4.2 E-Field and temperature measurements at 1.9GHz [7]

***NOTE:** *The temperature calibration was not performed by PCTEST. For information use only.*

5. PHANTOM & EQUIVALENT TISSUES

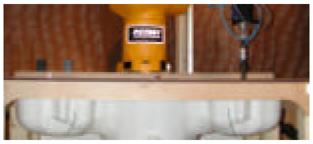

Figure 5.1 SAM Twin Phantom

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 [11][12]. 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. 5.1)

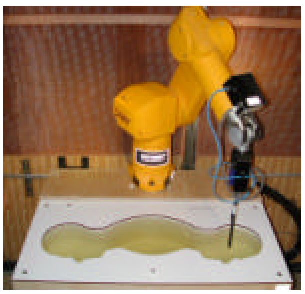

Figure 5.2 Simulated Tissue

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellullose (HEC) gelling agent and saline solution (see Table 6.1). Preservation with a bacteriacide 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 head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table. Other head and body tissue parameters that have not bee specified in P1528 are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrove [13].(see Fig. 5.2)

Table 5.1 Composition of the Brain & Muscle Tissue Equivalent Matter

Ingredients (% by weight)	Frequency (MHz)											
	450		835		915		1900		2450		5800	
Tissue Type	Head	Body	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	55.0	68.0
Salt (NACl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.4	0.0	0.0
Sugar	56.32	46.78	56.0	45.0	56.0	41.76	0.0	58.0	0.0	.0	44.0	31.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0	1.0	1.0
Bacteride	0.19	0.05	0.1	0.1	0.27	0.0	0.1	0.0	0.0	0.0	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	0.0	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7	0.0	0.0

Figure 5.2 Mounting Device

In combination with the SAM Twin Phantom V4.0, the Mounting Device (see Fig. 5.2) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

* 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 [12]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

6. TEST SYSTEM SPECIFICATIONS

Positioner

Robot: Stäubli Unimation Corp. Robot Model: RX60L
Repeatability: 0.02 mm
No. of axis: 6

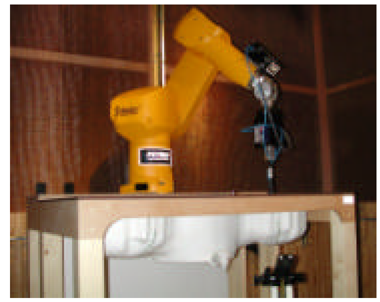

Figure 6.1 DASY3 Test System

Data Acquisition Electronic (DAE) System

Cell Controller

Processor: Pentium III
Clock Speed: 450 MHz
Operating System: Windows NT
Data Card: DASY3 PC-Board

Data Converter

Features: Signal Amplifier, multiplexer, A/D converter, & control logic
Software: DASY3 software
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 DAE3
16 bit A/D converter for surface detection system
serial link to robot
direct emergency stop output for robot

E-Field Probes

Model: ET3DV6 S/N: 1677
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: VIVAC Composite
Thickness: 2.0 ± 0.2 mm

7. DOSIMETRIC ASSESSMENT & PHANTOM SPECS

The evaluation was performed using the following procedure:

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20mm x 20mm.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32mm x 32mm x 34mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see Fig. 7.1):

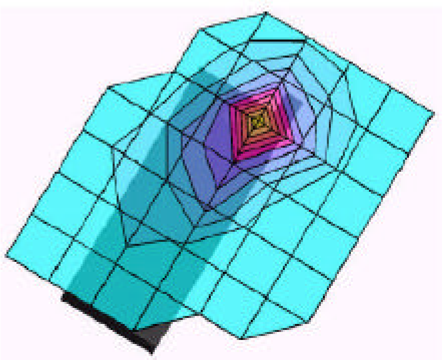

Figure 7.1 Sample SAR Area Scan

   a. The data at the surface was extrapolated, since the center of the dipoles is 2.7mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm [15]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
   b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were 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 directions) [15][16]. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
   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 procedure #1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.

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. 7.2). 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 7.2 SAM Twin Phantom shell

8. TEST CONFIGURATION POSITIONS

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 9.5). A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

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 supplied with the device, the device is tested with each accessory that contains a unique metallic component. 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.

Figure 8.1 Body Belt Clip & Holster Configurations

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 where a separation distance between the back of the device and the flat phantom is used. All test position spacings are 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. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory(ies), including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

9. ANSI/IEEE C95.1 - 1992 RF EXPOSURE LIMITS

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 9.1. Safety Limits for Partial Body Exposure [2]

	HUMAN EXPOSURE LIMITS	
	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)
SPATIAL PEAK SAR [1] Brain	1.60	8.00
SPATIAL AVERAGE SAR [2] Whole Body	0.08	0.40
SPATIAL PEAK SAR [3] Hands, Feet, Ankles, Wrists	4.00	20.00

1 The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2 The Spatial Average value of the SAR averaged over the whole body.
3 The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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10. MEASUREMENT UNCERTAINTIES

a	b	c	d	e= f(d,k)	f	g	h = cxf/e	i = cxg/e	k
Uncertainty Component	**Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1 - g)**	**c_i (10 - g)**	**1 - g u_i (± %)**	**10 - g u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E1.1	6.0	N	1	1	1	6.0	6.0	∞
Axial Isotropy	E1.2	4.88	R	√3	0.5	0.5	1.4	1.4	∞
Hemishperical Isotropy	E1.2	9.6	R	√3	0.5	0.5	2.8	2.8	∞
Boundary Effect	E1.3	11.0	R	√3	1	1	6.4	6.4	∞
Linearity	E1.4	4.7	R	√3	1	1	2.7	2.7	∞
System Detection Limits	E1.5	1.0	R	√3	1	1	0.6	0.6	∞
Readout Electronics	E1.6	1.0	R	1	1	1	1.0	1.0	∞
Response Time	E1.7	0.8	R	√3	1	1	0.5	0.5	∞
Integration Time	E1.8	1.7	R	√3	1	1	1.0	1.0	∞
RF Ambient Conditions	E5.1	1.2	R	√3	1	1	0.7	0.7	∞
Probe Positioner Mechanical Tolerance	E5.2	0.4	R	√3	1	1	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E5.3	2.9	R	√3	1	1	1.7	1.7	∞
Extrapolation, Interpolation & Integration Algorithms for Max. SAR Evaluation	E4.2	3.9	R	√3	1	1	2.3	2.3	∞
Test Sample Related									
Test Sample Positioning	E3.2.1	10.6	R	√3	1	1	6.1	6.1	11
Device Holder Uncertainty	E3.1.1	8.7	R	√3	1	1	5.0	5.0	8
Output Power Variation - SAR drift measurement	5.6.2	5.0	R	√3	1	1	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E2.1	4.0	R	√3	1	1	2.3	2.1	∞
Liquid Conductivity - deviation from target values	E2.2	5.0	R	√3	0.7	0.5	2.0	1.4	∞
Liquid Conductivity - measurement uncertainty	E2.2	10.0	R	√3	0.7	0.5	4.0	2.9	∞
Liquid Permittivity - deviation from target values	E2.2	5.0	R	√3	0.6	0.5	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E2.2	5.0	R	√3	0.6	0.5	1.7	1.4	∞
Combined Standard Uncertainty (k=1)			RSS				14.4	13.9	
Expanded Uncertainty (k=2) (95% CONFIDENCE LEVEL)							28.8	27.8	

The above measurement uncertainties are according to IEEE Std. 1528-200x (July, 2001)

11. SYSTEM VERIFICATION

Table 11.1 Simulated Tissue Verification [5]

MEASURED TISSUE PARAMETERS									
Date(s)	03/03/03	1900MHz Brain		1900MHz Muscle		2450MHz Brain		2450MHz Muscle	
Liquid Temperature (°C)	17.8	Target	Measured	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ε		40.00	N/A	53.30	N/A	39.20	40.30	52.70	53.60
Conductivity: σ		1.400	N/A	1.520	N/A	1.800	1.820	1.950	1.960

Prior to assessment, the system is verified to the ±10% of the specifications at 2450MHz by using the system validation kit(s). (Graphic Plots Attached)

Table 11.2 System Validation [5]

SYSTEM DIPOLE VALIDATION TARGET & MEASURED				
System Validation Kit: D-2450V2, S/N: 719	2450MHz Brain	Targeted SAR_{1g} (mW/g) 13.000	Measured SAR_{1g}(mW/g) **12.93**	Deviation (%) **- 0.8**

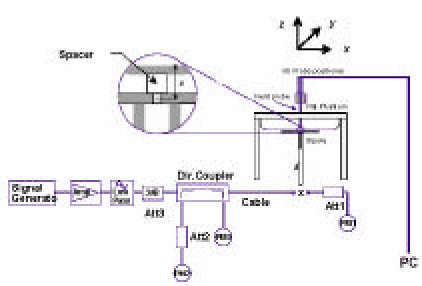

Figure 11.1 Dipole Validation Test Setup

12. SAR TEST DATA SUMMARY

The EUT was placed into simulated call mode (DSS modes) using manufacturers test codes. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR [4]. When test modes are not available or inappropriate for testing a handset, the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

The EUT is battery operated. Each SAR measurement was taken with a fully charged battery. In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a conducted power deviation of more than 5% occurred, the test was repeated.

SAR DATA SUMMARY

Mixture Type: 2450MHz Muscle

12.1 MEASUREMENT RESULTS (Body SAR - Bystander)

FREQUENCY		Modulation	Begin / End POWER‡			Data Rate (Mbps)	Separation Distance (cm)	SAR (W/kg)	BT
MHz	Ch.		(dBm)		Battery				
2412	01	DSSS	13.97	13.91	Extended	1	0.0	0.122	OFF
2412	01	DSSS	13.98	14.08	Extended	2	0.0	0.120	OFF
2412	01	DSSS	14.09	14.20	Extended	5.5	0.0	0.124	OFF
2412	01	DSSS	14.02	13.99	Extended	11	0.0	0.123	OFF
2437	06	DSSS	14.05	13.91	Extended	1	0.0	0.163	OFF
2437	06	DSSS	14.04	13.88	Extended	2	0.0	0.176	OFF
2437	06	DSSS	14.24	14.30	Extended	5.5	0.0	0.182	OFF
2437	06	DSSS	14.14	13.99	Extended	11	0.0	0.181	OFF
2462	11	DSSS	13.19	13.10	Extended	1	0.0	0.344	OFF
2462	11	DSSS	13.18	13.28	Extended	2	0.0	0.333	OFF
2462	11	DSSS	13.33	13.32	Extended	5.5	0.0	0.376	OFF
2462	11	DSSS	13.25	13.33	Extended	11	0.0	0.372	OFF
2462	11	DSSS	13.98	13.20	Standard	5.5	0.0	0.001	ON*
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Brain 1.6 W/kg (mW/g) averaged over 1 gram			

NOTES:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings. Standard and Extended Batteries are the only options.

   ‡Power Measured ☒ Conducted ☐ ERP ☐ EIRP
4. SAR Measurement System ☒ DASY3 ☐ IDX

   Phantom Configuration ☐ Left Head ☒ Flat Phantom ☐ Right Head
5. SAR Configuration ☐ Head ☒ Body ☐ Hand
6. Test Signal Call Mode ☒ Manu. Test Codes ☐ Base Station Simulator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.1 cm. ± 0.1
9. * WLAN and BT cannot transmit simultaneously per CASIO.

Alfred Cirwithian
Vice President Engineering

Figure 12.1 Body SAR Test Setup -- Bystander Position --

SAR DATA SUMMARY (Continued)

Mixture Type: 2450MHz Muscle

12.2 MEASUREMENT RESULTS (Body SAR - Backside)

FREQUENCY		Modulation	Begin / End POWER‡			Data Rate (Mbps)	Separation Distance (cm)	SAR (W/kg)
MHz	Ch.		(dBm)		Battery			
2412	01	DSSS	14.35	14.46	Extended	5.5	0.0	**0.0190**
2437	06	DSSS	14.37	14.43	Extended	5.5	0.0	**0.0228**
2462	11	DSSS	13.44	13.43	Extended	5.5	0.0	**0.0331**
2462	11	DSSS	13.57	13.30	Standard	5.5	0.0	**0.0327**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Body/ Muscle 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTES:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings. Standard Batteries are the only options.

	‡Power Measured	☒ Conducted	☐ ERP	☐ EIRP
4.	SAR Measurement System	☒ DASY3	☐ IDX	
	Phantom Configuration	☐ Left Head	☒ Flat Phantom	☐ Right Head
5.	SAR Configuration	☐ Head	☒ Body	☐ Hand
6.	Test Signal Call Mode	☒ Manu. Test Codes	☐ Base Station Simulator	

7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.1 cm. ± 0.1

Alfred Cirwithian
Vice President Engineering

Figure 12.2 Body SAR SAR Test Setup -- Backside Position --

13. SAR TEST EQUIPMENT

Table 13.1 Test Equipment Calibration

EQUIPMENT SPECIFICATIONS		
Type	**Calibration Date**	**Serial Number**
Stäubli Robot RX60L	February 2003	599131-01
Stäubli Robot Controller	February 2003	PCT592
Stäubli Teach Pendant (Joystick)	February 2003	3323-00161
Micron Computer, 450 MHz Pentium III, Windows NT	February 2003	PCT577
SPEAG EDC3	February 2003	321
SPEAG DAE3	February 2003	330
SPEAG E-Field Probe ET3DV6	April 2002	1677
SPEAG Dummy Probe	February 2003	PCT583
SPEAG SAM Twin Phantom V4.0	February 2003	PCT666
SPEAG Light Alignment Sensor	February 2003	205
PCTEST Validation Dipole D300V2	September 2002	PCT301
SPEAG Validation Dipole D835V2	February 2003	PCT512
SPEAG Validation Dipole D1900V2	February 2003	PCT613
SPEAG Validation Dipole D2450V2	February 2003	PCT713
Brain Equivalent Matter (300MHz)	March 2003	PCTBEM601
Brain Equivalent Matter (835MHz)	March 2003	PCTBEM101
Brain Equivalent Matter (1900MHz)	March 2003	PCTBEM301
Brain Equivalent Matter (2450MHz)	March 2003	PCTBEM501
Muscle Equivalent Matter (300MHz)	March 2003	PCTMEM701
Muscle Equivalent Matter (835MHz)	March 2003	PCTMEM201
Muscle Equivalent Matter (1900MHz)	March 2003	PCTMEM401
Muscle Equivalent Matter (2450MHz)	March 2003	PCTMEM601
Microwave Amp. Model: 5S1G4, (800MHz - 4.2GHz)	January 2003	22332
Gigatronics 8651A Power Meter	January 2003	1835299
HP-8648D (9kHz ~ 4GHz) Signal Generator	January 2003	PCT530
Amplifier Research 5S1G4 Power Amp	January 2003	PCT540
HP-8753E (30kHz ~ 3GHz) Network Analyzer	January 2003	PCT552
HP85070B Dielectric Probe Kit	January 2003	PCT501
Ambient Noise/Reflection, etc. <12mW/kg/<3%of SAR	January 2003	Anechoic Room PCT01

NOTE:

The E-field probe was calibrated by SPEAG, by waveguide technique procedure. Dipole Validation measurement is performed by PCTEST Lab. before each test. The brain simulating material is calibrated by PCTEST using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

14. CONCLUSION

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.[3]

15. REFERENCES

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APPENDIX A: SAR TEST DATA

CASIO COMPUTER FCC ID:BBQDT-X10M30URC -- 2450MHz Body SAR

SAM Phantom; Flat Section; Probe:ET3DV6 - SN1677; ConvF(4.00,4.00,4.00)

Med. Parameters 2450 MHz Muscle: σ = 1.96 mho/m ε_r = 53.6 ρ = 1.00 g/cm^3; Antenna Position -- In; Crest Factor 1.0

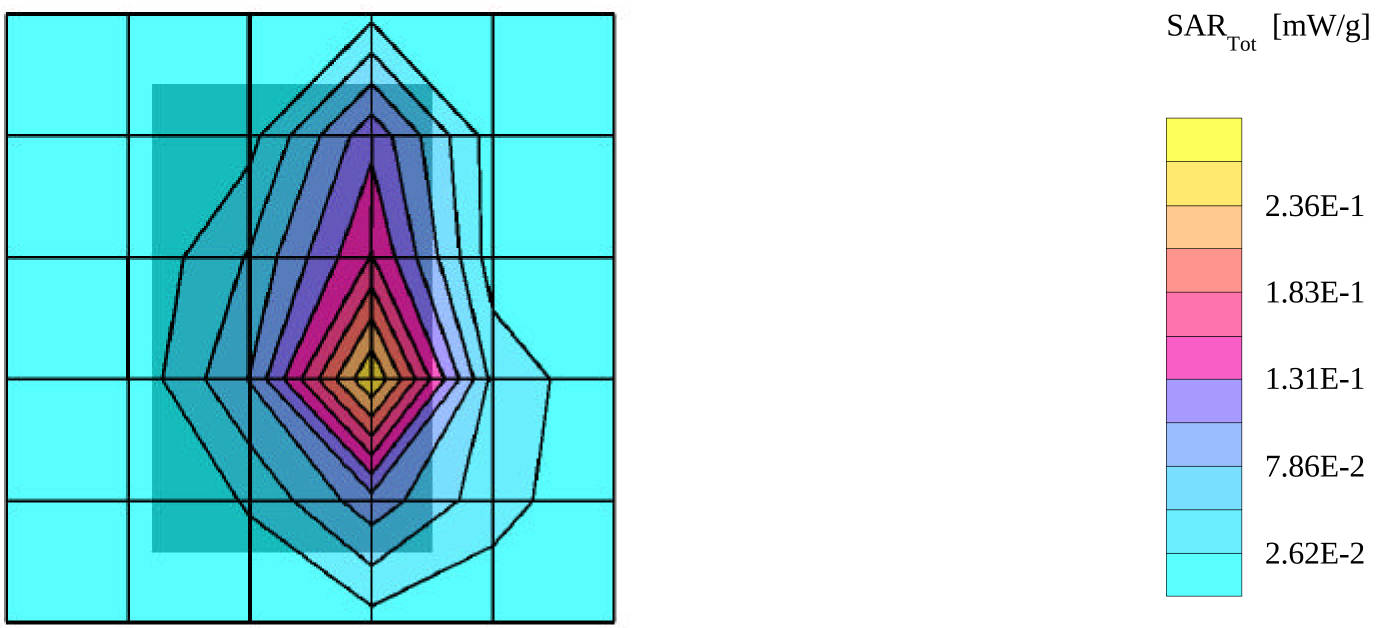
SAR (1g): 0.376 mW/g, SAR (10g): 0.155 mW/g

CASIO COMPUTER Handheld Terminal; Model:DT-X10M30URC; FCC ID:BBQDT-X10M30URC

Extended Battery; Ambient Temp. = 19.1°C / Meas. Tissue Temp. = 17.8°C

Ch.11 [2462MHz]; 5.5Mbps; Conducted Power = 15.0dBm; Bystander position; 0.0cm from top side of EUT to flat phantom

Test Date -- 03/07/2003 [FCC/OET Bulletin 65 - Supplement C, July 2001]



CASIO COMPUTER FCC ID:BBQDT-X10M30URC -- 2450MHz Body SAR

SAM Phantom; Flat Section; Probe:ET3DV6 - SN1677; ConvF(4.00,4.00,4.00)

Med. Parameters 2450 MHz Muscle: σ = 1.96 mho/m ε_r = 53.6 ρ = 1.00 g/cm^3; Antenna Position -- In; Crest Factor 1.0

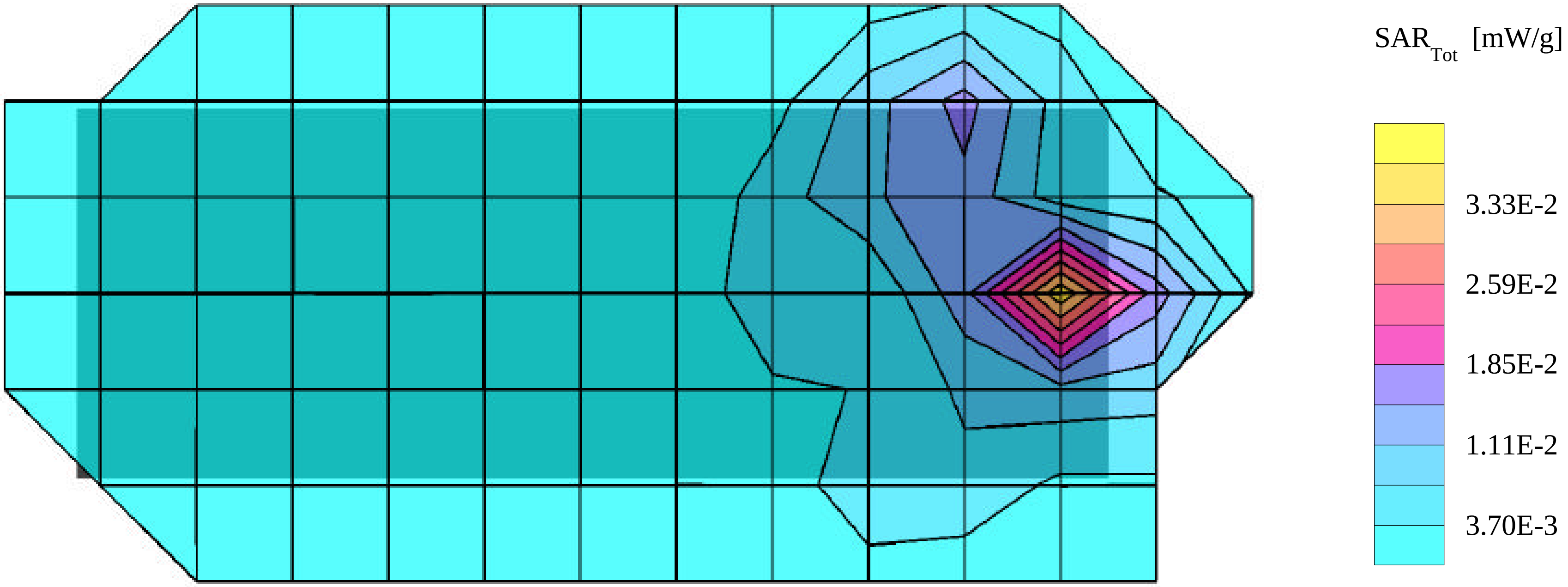
SAR (1g): 0.0331 mW/g, SAR (10g): 0.0155 mW/g

CASIO COMPUTER Handheld Terminal; Model:DT-X10M30URC; FCC ID:BBQDT-X10M30URC

Extended Battery; Ambient Temp. = 19.1°C / Meas. Tissue Temp. = 17.8°C

Ch.11 [2462MHz]; 5.5Mbps; Conducted Power = 15.0dBm; 0.0cm from back of EUT to flat phantom

Test Date -- 03/07/2003 [FCC/OET Bulletin 65 - Supplement C, July 2001]



APPENDIX B: DIPOLE VALIDATION

2450MHz.. Brain Dipole Validation

SAM Phantom; Flat Section; Probe:ET3DV6 - SN1677; ConvF(4.40,4.40,4.40)

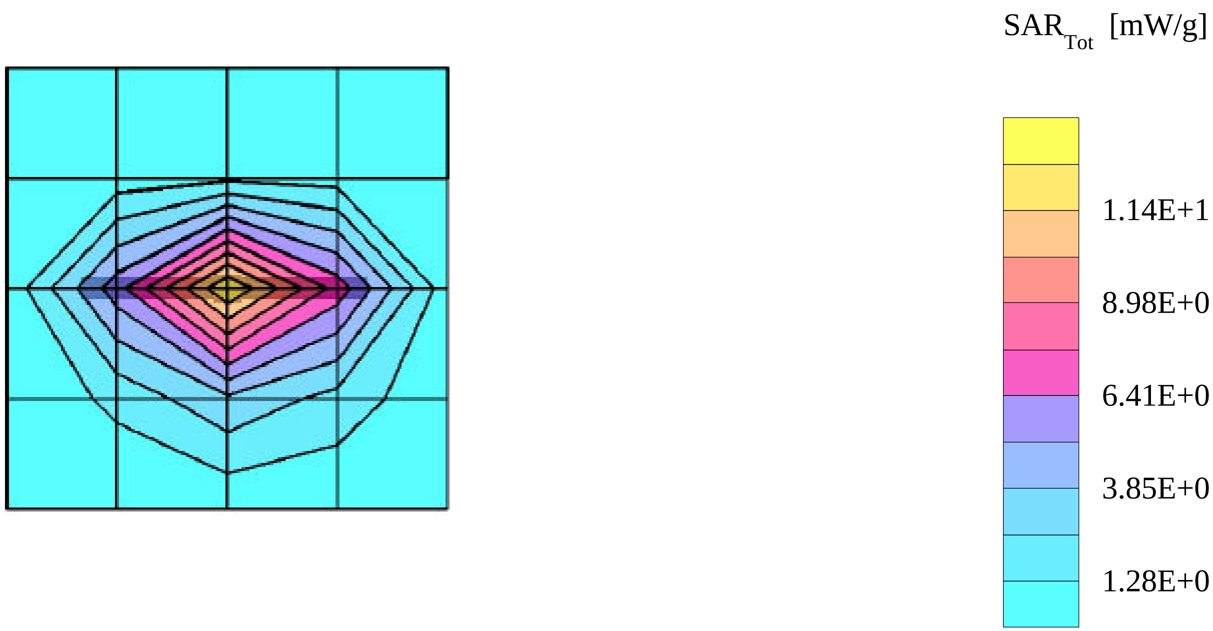
Med. Parameters 2450 MHz Brain: σ = 1.82 mho/m ε_r = 40.3 ρ = 1.00 g/cm^3; Antenna Position -- Out; Crest Factor 1.0

SAR (1g): 12.93 mW/g, SAR (10g): 9.21 mW/g

2450MHz Brain Dipole Validation (D2450V2 S/N: 719)

Frequency: 2450MHz; Antenna Input Power: 250 [mW]; Ambient Temp. = 19.4°C / Measured Tissue Temp. = 18.3°C

PCTEST Brain Tissue Simulating Liquid [03/07/2003]



APPENDIX C: PROBE CALIBRATION

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1677**
Place of Calibration:	**Zurich**
Date of Calibration:	**April 10, 2002**
Calibration Interval:	**12 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:

Approved by:

Probe ET3DV6

SN:1677

Manufactured: March 7, 2002
Last calibration: April 10, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1677

Sensitivity in Free Space

NormX	**1.70**	$\mu V/(V/m)^2$
NormY	**1.76**	$\mu V/(V/m)^2$
NormZ	**1.67**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**93**	mV
DCP Y	**93**	mV
DCP Z	**93**	mV

Sensitivity in Tissue Simulating Liquid

Head 835 MHz ε_r **= 41.5 ± 5%** σ **= 0.90 ± 5% mho/m**
Head 900 MHz ε_r **= 41.5 ± 5%** σ **= 0.97 ± 5% mho/m**

ConvF X	**6.7**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.7**	± 9.5% (k=2)	Alpha	**0.33**
ConvF Z	**6.7**	± 9.5% (k=2)	Depth	**2.62**

Head 1900 MHz ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**
Head 1800 MHz ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

ConvF X	**5.3**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.3**	± 9.5% (k=2)	Alpha	**0.54**
ConvF Z	**5.3**	± 9.5% (k=2)	Depth	**2.35**

Boundary Effect

Head 835/900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	9.1	5.2
SAR_{be} [%]	With Correction Algorithm	0.3	0.5

Head 1800/1900 MHz Typical SAR gradient: 10 % per mm

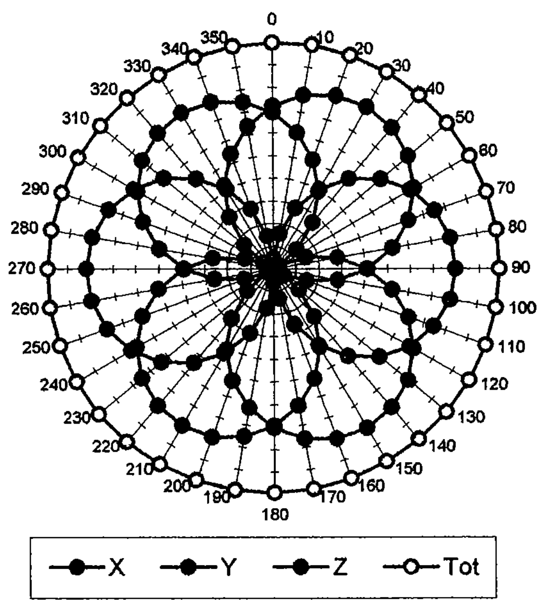
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	10.4	6.5
SAR_{be} [%]	With Correction Algorithm	0.3	0.3

Sensor Offset

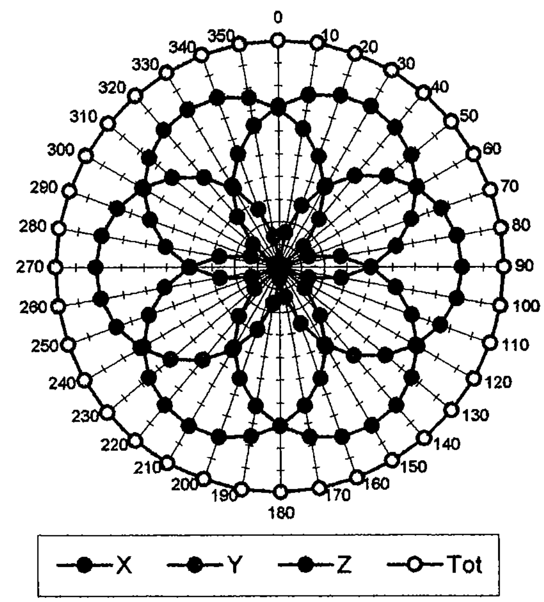
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.6 ± 0.2**	mm

Receiving Pattern (ϕ), θ = 0°

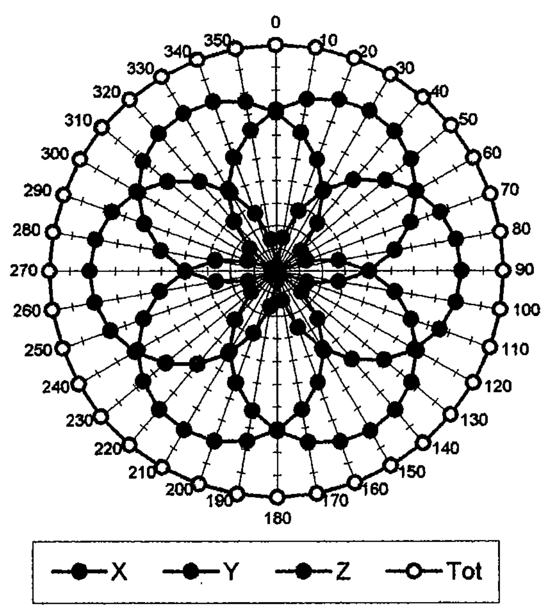
f = 30 MHz, TEM cell ifi110



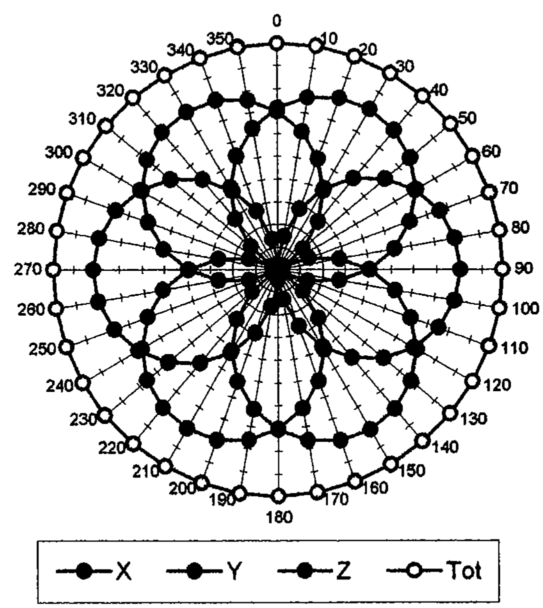
f = 100 MHz, TEM cell ifi110



f = 300 MHz, TEM cell ifi110

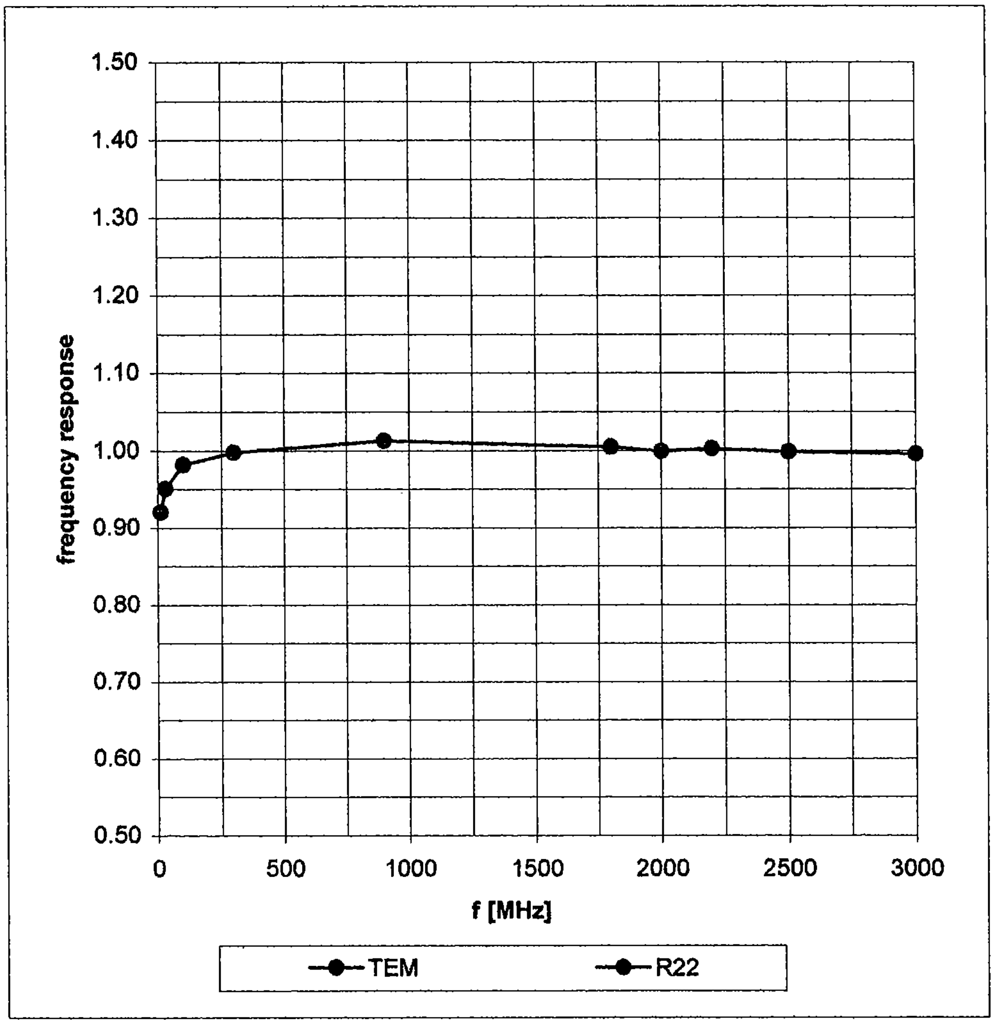


f = 900 MHz, TEM cell ifi110

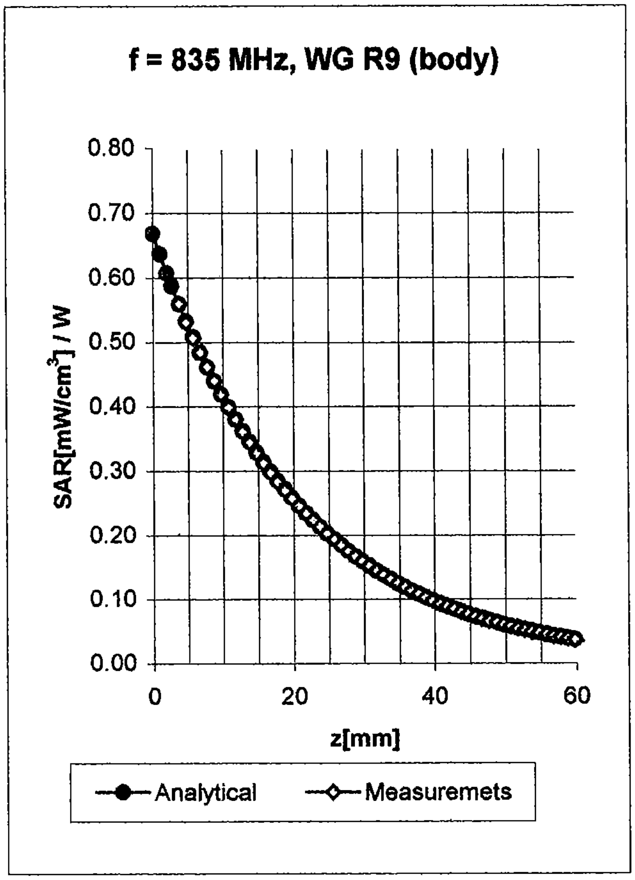


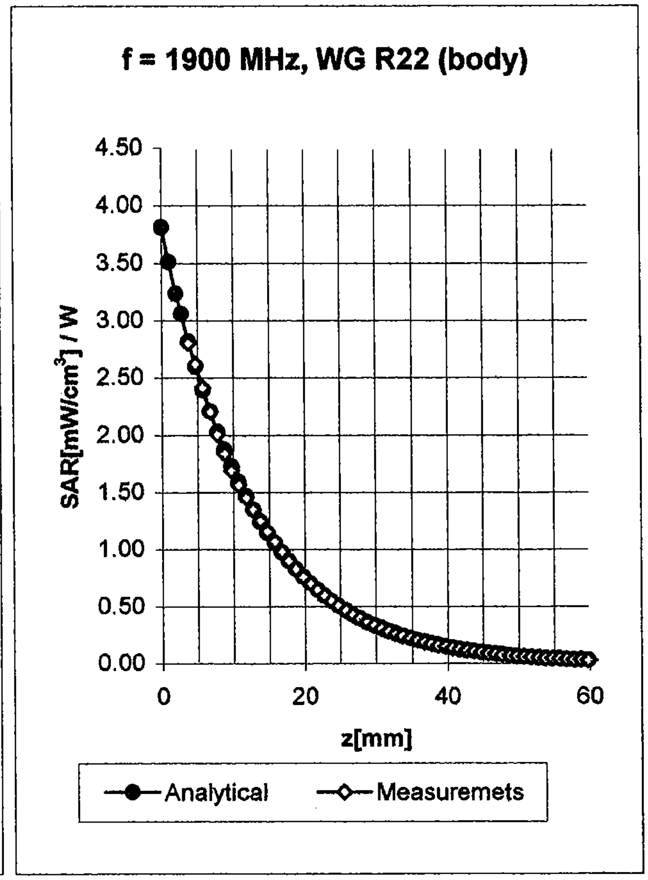
Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



Conversion Factor Assessment





Body	**835 MHz**		ε_r = **55.2 ± 5%**	σ = **0.97 ± 5% mho/m**	
Body	**900 MHz**		ε_r = **55.0 ± 5%**	σ = **1.05 ± 5% mho/m**	
	ConvF X	**6.4**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.4**	± 9.5% (k=2)	Alpha	**0.43**
	ConvF Z	**6.4**	± 9.5% (k=2)	Depth	**2.27**

Body	**1900 MHz**		ε_r = **53.3 ± 5%**	σ = **1.52 ± 5% mho/m**	
Body	**1800 MHz**		ε_r = **53.3 ± 5%**	σ = **1.52 ± 5% mho/m**	
	ConvF X	**4.9**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**4.9**	± 9.5% (k=2)	Alpha	**0.78**
	ConvF Z	**4.9**	± 9.5% (k=2)	Depth	**2.01**

Schmid & Partner
Engineering AG

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1677**
Place of Assessment:	**Zurich**
Date of Assessment:	**April 11, 2002**
Probe Calibration Date:	**April 10, 2002**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:

Dosimetric E-Field Probe ET3DV6 SN:1677

Conversion factor (± standard deviation)

450 MHz	ConvF	**7.5 ± 8%**	**ε_r = 56.7 +/- 5%** **σ = 0.94 +/- 5% mho/m** (body tissue)
2450 MHz	ConvF	**4.4 ± 8%**	**ε_r = 39.2 +/- 5%** **σ = 1.80 +/- 5% mho/m** (head tissue)
2450 MHz	ConvF	**4.0 ± 8%**	**ε_r = 52.7 +/- 5%** **σ = 1.95 +/- 5% mho/m** (body tissue)