TEST REPORT

Your Ref: | Date: 6 Jun 2003

Our Ref: 56S030405/01_CORR01 | Page: 1 of 18

DID: 68851464 | Fax: 67741459

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COMPLIANCE REPORT ON TESTING IN ACCORDANCE WITH
SAR (SPECIFIC ABSORPTION RATE) REQUIREMENTS

Supplement C (Edition 01-01)
FCC OET Bulletin 65 (Edition 97-01)

OF A

Bluetooth Class 1 Compact Flash Adapter
[Model: CFPA-001]

TEST FACILITY Telecoms & EMC, Testing Group, PSB Corporation Pte Ltd
1 Science Park Drive, Singapore 118221

APPLICANT Mr. Chua Teck Chuan
GigaWaveTech Pte Ltd
No 1 Jalan Kilang Timor,
#07-02, Pacific Tech Centre
Singapore 159303

Tel: (65) 63774801 Fax: (65) 63750966

JOB NUMBER 56S030405

TEST PERIOD 4 Jun 2003 - 5 Jun 2003

PREPARED BY	APPROVED BY
Gary Ng Ah Chye	Benjamin Foo
Associate Engineer	Assistant Vice President

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TEST SUMMARY

PRODUCT DESCRIPTION

TEST RESULTS

ANNEX A	-	TEST INSTRUMENTATION & GENERAL PROCEDURES
ANNEX B	-	EUT PHOTOGRAPHS / DIAGRAMS Test Setup EUT Photographs
ANNEX C	-	TISSUE SIMULANT DATA SHEETS
ANNEX D	-	SAR VALIDATION RESULTS
ANNEX E	-	CALIBRATION CERTIFICATES Validation Dipole Calibration Certificates SAR Probe Calibration Certificates
ANNEX F	-	REFERENCES

The product was tested in accordance with the following standards.

Test Results Summary

Test Standards	Description	Pass / Fail
• Supplement C (Edition 01-01) to FCC OET Bulletin 65 (Edition 97-01) • ANSI/IEEE Standard C95.1-1993	SAR Measurement (Device at body phantom)	Pass *

Note:

1. The worst-case SAR value was found to be **0.928W/kg** which is lower than the maximum limit of 1.60 W/kg, over 1g of tissue.

* Based on spatial peak uncontrolled exposure / general population level:
  Head: 1.60 W/kg, over 1g of tissue.
  Body: 1.60 W/kg, over 1g of tissue.

Modification

No modification was made.

Compact Flash Adapter (EUT) DESCRIPTION

Compact Flash Adapter (EUT) Description	The Equipment Under Test (EUT) is a Bluetooth Class 1 Compact Flash Adapter
Compact Flash Adapter (EUT) Test Device Type	Identical Prototype
Compact Flash Adapter (EUT) Model	CFPA-001
Compact Flash Adapter (EUT) Brand Name	GigaWaveTech
Compact Flash Adapter (EUT) Serial Numbers	Labelled as " CFA055000017 "
Compact Flash Adapter (EUT) FCC ID	QXZCFPA-001

PDA (Host) DESCRIPTION

PDA (Host) Device Category	Portable Device (Pocket PC - iPAQ 3850)
PDA (Host) Exposure Environment	General Population/Uncontrolled exposure
PDA (Host) FCC ID	DoC

DEVICE OPERATING CONFIGURATION

PDA (Host) Operating Frequencies	Ch 0 (2402MHz) Ch 39 (2441MHz) Ch 78 (2480MHz)
Compact Flash Adapter (EUT) (Operating Temperature Tolerance)	0 ~ +35 Degree Celsius
Compact Flash Adapter (EUT) (Operating Voltage Tolerance)	3.15 V ~ 3.45 V Volt DC
PDA (Host) Continuous Transmission Tolerance	The PDA shall cause no problem after transmitting for 100 minutes under maximum power transmitting rate.
PDA (Host) Rated Output Power	17.35 dBm ± 1 dBm, Maximum (2402MHz) 17.35 dBm ± 1 dBm, Maximum (2441MHz) 17.35 dBm ± 1 dBm, Maximum (2480MHz)
PDA (Host) Antenna Type	Internal dielectric antenna. (Monopole)
PDA (Host) Crest Factor	1.0
PDA (Host) Input Power	5 Volts DC, 2A
PDA (Host) Accessories	1) Charger 2) Compaq - CF Adapter Expansion Pack for IPAQ 3850

MANUFACTURER

Manufacturer Address	OFFICE: Wisetronics Ltd 6/F Elite Industrial Building, 135 -137 Hoi Bun Road, Kwun Tong, Kowloon, Hong Kong FACTORY: Elite Industrial City, Meilin Distric, Dailing Mount Twon, Dongguan, Guangdong China
DID	852 23412265
Fax	852 23436291

DEVICE OPERATING CONDITION

The EUT was put into operation by a radio communication tester. Communication between the EUT and the radio communication tester was established by air link. The EUT is operating in the following conditions:

- Loopback Bluetooth test mode
- Non-hopping, single Tx/Rx frequency as shown:

	Tx Frequency	Rx Frequency
Low Frequency	2402MHz	2480MHz
Mid Frequency	2441MHz	2402MHz
High Frequency	2480MHz	2402MHz

- ACL link is established with a R&S CMU 200 with Bluetooth option, DH1 data packets, data pattern PRBS9
- Transmitter transmits at maximum output power

For every SAR measurement, the EUT was set to maximum output power level using fully charged battery.

TEMPERATURE AND HUMIDITY

Ambient Temperature: 23 ± 1^0 C
Tissue Temperature: 23 ± 1^0 C
Humidity: 58% to 63%

Measurement Uncertainty

All test measurement carried out are traceable to national standards. The uncertainty of measurement at a confidence level of 95%, with a coverage of 2, is ±20.5%.

Error Description	Uncertainty Value ± %	Probability Distribution	Divisor	ci 1g	Standard Unc.(1g)	Vi or Veff
Measurement System						
Probe Calibration	± 4.8	normal	1	1	± 4.8	∞
Axial isotropy	± 4.7	rectangular	√3	(1-cp)^1/2	± 1.9	∞
Hemispherical Isotropy	± 9.6	rectangular	√3	(cp)^1/2	± 3.9	∞
Spatial resolution	± 0.0	rectangular	√3	1	± 0.0	∞
Boundary effects	± 1.0	rectangular	√3	1	± 0.6	∞
Linearity	± 4.7	rectangular	√3	1	± 2.7	∞
System Detection limit	± 1.0	rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	normal	1	1	± 1.0	∞
Response time	± 0.8	rectangular	√3	1	± 0.5	∞
Integration time	± 2.6	rectangular	√3	1	± 1.5	∞
RF ambient conditions	± 3.0	rectangular	√3	1	± 1.7	∞
Probe Positioning Mechanical Tolerance	± 0.4	rectangular	√3	1	± 0.2	∞
Probe Positioning with respect to Phantom Shell	± 2.9	rectangular	√3	1	± 1.7	∞
Extrapolation, Interpolation and Integration Algorithms for Max. SAR Evaluation	± 1.0	rectangular	√3	1	± 0.6	∞
Test Sample Related						
Device positioning	± 2.9	normal	1	1	± 2.9	145
Device holder uncertainty	± 3.6	normal	1	1	± 3.6	5
Power drift	± 5.0	rectangular	√3	1	± 2.9	∞
Phantom and Tissue Parameters						
Phantom uncertainty	± 4.0	rectangular	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	rectangular	√3	0.64	± 1.8	∞
Liquid conductivity (meas)	± 2.4	normal	1	0.64	± 1.5	∞
Liquid permittivity (target)	± 5.0	rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (meas)	± 2.1	normal	1	0.6	± 1.2	∞
Combined Standard Uncertainty					± 10.3	330
Coverage Factor for 95%		**k=2**				
Extended Standard Uncertainty					± 20.5	

The measurement results were obtained with the EUT tested in the conditions described in this report (Annex A).

Table 1 – Body Worn Position SAR Test Results, device without belt clip (15mm spacing).

Phantom Configuration	Device Test Positions	Antenna Position	SAR (W/kg), over 1g Tissue Device Test Channel & Frequency		
			Channel: 0 2402MHz	Channel: 39 2441MHz	Channel: 78 2480MHz
Flat Phantom	EUT **Rear** To Phantom	fixed	0.040	0.052	0.060
Output Power (dBm) Before Test			18.15	17.85	17.55
Output Power (dBm) After Test			18.15	17.85	17.55

Table 2 – Body Worn Position SAR Test Results, device without belt clip(Touching).

Phantom Configuration	Device Test Positions	Antenna Position	SAR (W/kg), over 1g Tissue Device Test Channel & Frequency		
			Channel: 0 2402MHz	Channel: 39 2441MHz	Channel: 78 2480MHz
Flat Phantom	EUT **Front** Touched Phantom	fixed	0.070	0.054	0.044
Flat Phantom	EUT **Rear** Touched Phantom	fixed	0.928	0.756	0.559
Output Power (dBm) Before Test			18.15	17.85	17.55
Output Power (dBm) After Test			18.15	17.85	17.55

Remarks:

1. All modes of operations were investigated and the worst-case SAR levels are reported.
2. A fully charged Battery was used for each mode of operation.
3. The worst-case SAR value was found to be **0.928W/Kg** (over a 1g tissue) at **Channel 0**, EUT Rear Touched Phantom, which is lower than the maximum limit of 1.60 W/Kg, please refer to the above table.
4. The SAR limit of 1.60W/Kg (Spatial Peak level for Uncontrolled Exposure / General Population) is based on the Test Standards:
   a) Supplement C (Edition 01-01) to FCC OET Bulletin 65 (Edition 97-01)
   b) ANSI/IEEE Standard C95.1-1993

Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **58% to 63%**

Figure 1: SAR Test Distribution Plot – device without belt clip (15mm spacing).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Rear** To Phantom	Fixed	Channel: 0 2402MHz	0.040

Date: 06/05/03

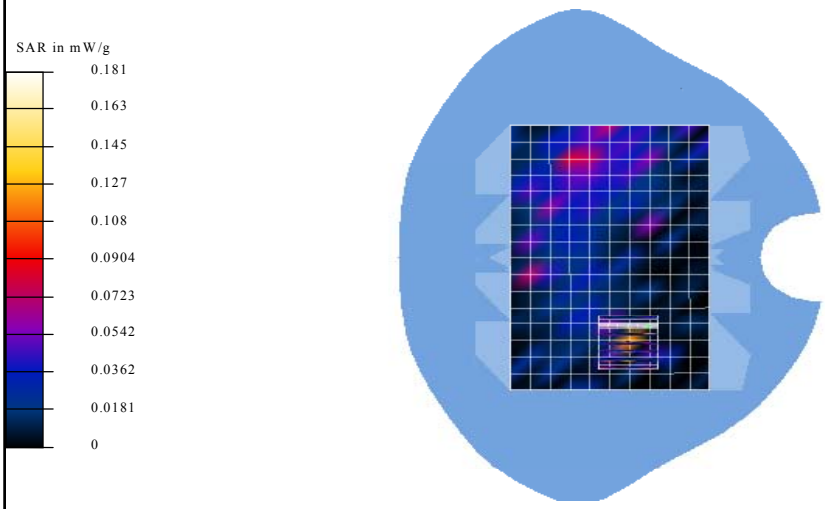
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT belt clip_ch 0_data 7.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT belt clip_ch 0_data 7

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2402 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 2.57 V/m
Peak SAR = 0.218 mW/g
SAR(1 g) = 0.0404 mW/g; SAR(10 g) = 0.0259 mW/g
Power Drift = 6 dB



Ambient Temperature: 23 ± 1^0 C
Tissue Temperature: 23 ± 1^0 C
Humidity: 58% to 63%

Figure 2: SAR Test Distribution Plot – device without belt clip (15mm spacing).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Rear** To Phantom	Fixed	Channel: 39 2441MHz	0.052

Date: 06/05/03

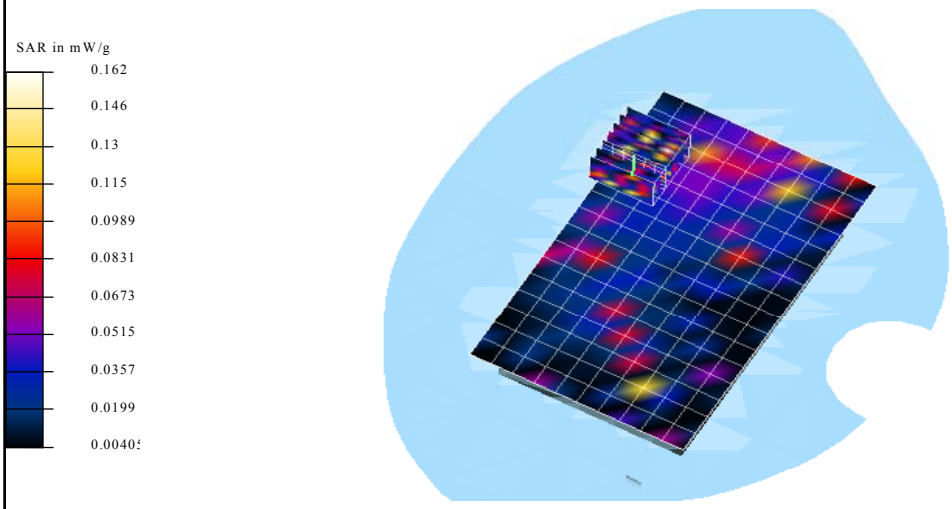
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT 15mm Spacing_ch 39_data 8.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT 15mm Spacing_ch 39_data 8

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Zoom Scan 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 2.69 V/m
Peak SAR = 0.19 mW/g
SAR(1 g) = 0.0521 mW/g; SAR(10 g) = 0.0365 mW/g
Power Drift = 0.5 dB
Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm



Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **58% to 63%**

Figure 3: SAR Test Distribution Plot – device without belt clip (15mm spacing).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Rear** To Phantom	Fixed	Channel: 78 2480MHz	0.060

Date: 06/05/03

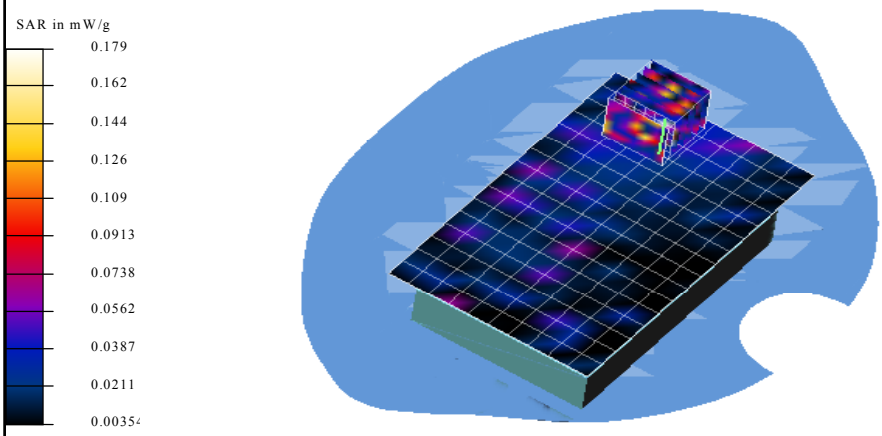
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT 15mm Spacing_ch 78_data 9.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT 15mm Spacing_ch 78_data 9

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2480 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 2.78 V/m
Peak SAR = 0.204 mW/g
SAR(1 g) = 0.0602 mW/g; SAR(10 g) = 0.0488 mW/g
Power Drift = -1 dB
Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm



Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **58% to 63%**

Figure 4: SAR Test Distribution Plot – device without belt clip (Touching).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Front** Touched Phantom	Fixed	Channel: 0 2402MHz	0.070

Date: 06/05/03

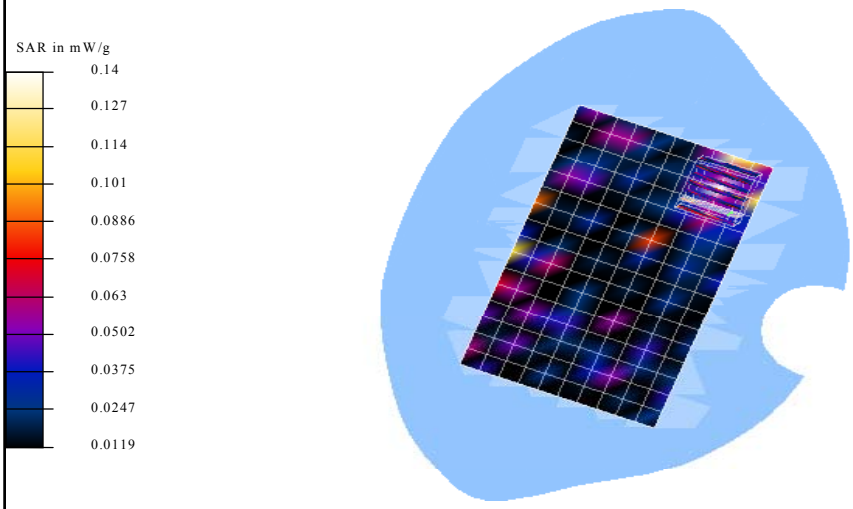
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT front touch_ch 1_data 1.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT front touch_ch 1_data 1

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2402 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 2.29 V/m
Peak SAR = 0.936 mW/g
SAR(1 g) = 0.0705 mW/g; SAR(10 g) = 0.0512 mW/g
Power Drift = -0.4 dB



Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **58% to 63%**

Figure 5: SAR Test Distribution Plot – device without belt clip (Touching).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Front** Touched Phantom	Fixed	Channel: 39 2441MHz	0.054

Date: 06/05/03

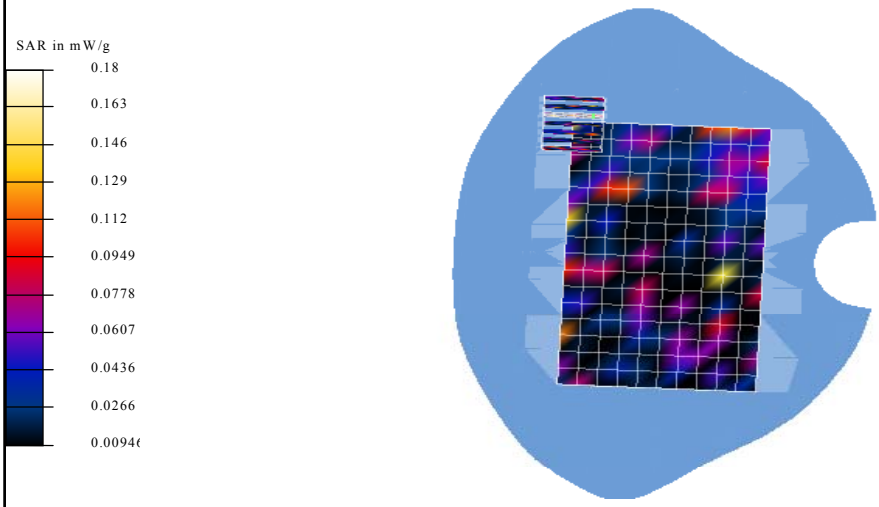
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT front touch_ch 39_data 2.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT front touch_ch 39_data 2

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 2.58 V/m
Peak SAR = 0.176 mW/g
SAR(1 g) = 0.0546 mW/g; SAR(10 g) = 0.0349 mW/g
Power Drift = -0.8 dB



Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **58% to 63%**

Figure 6: SAR Test Distribution Plot – device without belt clip (Touching).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Front** Touched Phantom	Fixed	Channel: 78 2480MHz	0.044

Date: 06/05/03

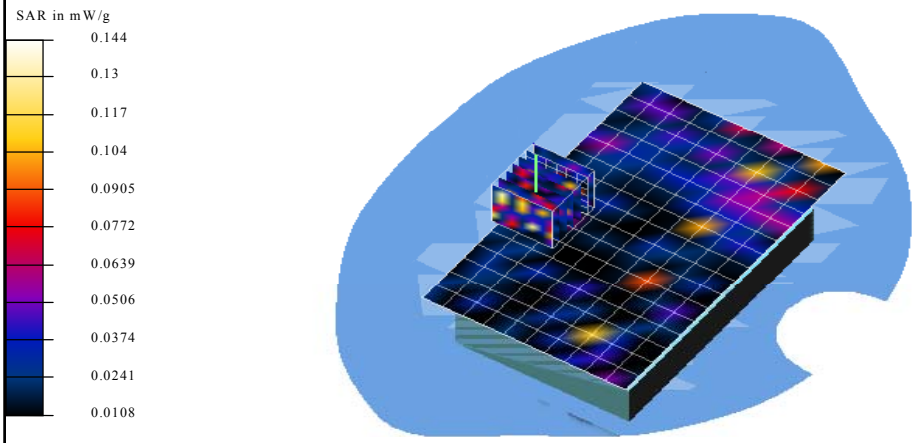
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT front touch_ch 78_data 3.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT front touch_ch 78_data 3

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2480 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Zoom Scan 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 2.51 V/m
Peak SAR = 0.149 mW/g
SAR(1 g) = 0.0443 mW/g; SAR(10 g) = 0.0335 mW/g
Power Drift = <Undefined>
Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm



Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **58% to 63%**

Figure 7: SAR Test Distribution Plot – device without belt clip (Touching).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Rear** Touched Phantom	Fixed	Channel: 0 2402MHz	0.928

Date: 06/05/03

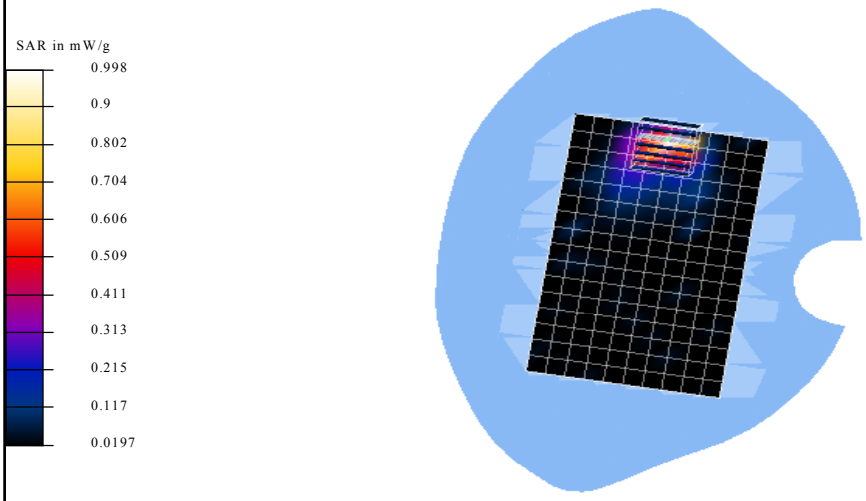
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT back touch_ch 0_data 4.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT back touch_ch 0_data 4

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2402 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 4.03 V/m
Peak SAR = 3.17 mW/g
SAR(1 g) = 0.928 mW/g; SAR(10 g) = 0.372 mW/g
Power Drift = -3 dB



Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **58% to 63%**

Figure 8: SAR Test Distribution Plot – device without belt clip (Touching).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Rear** Touched Phantom	Fixed	Channel: 39 2441MHz	0.756

Date: 06/05/03

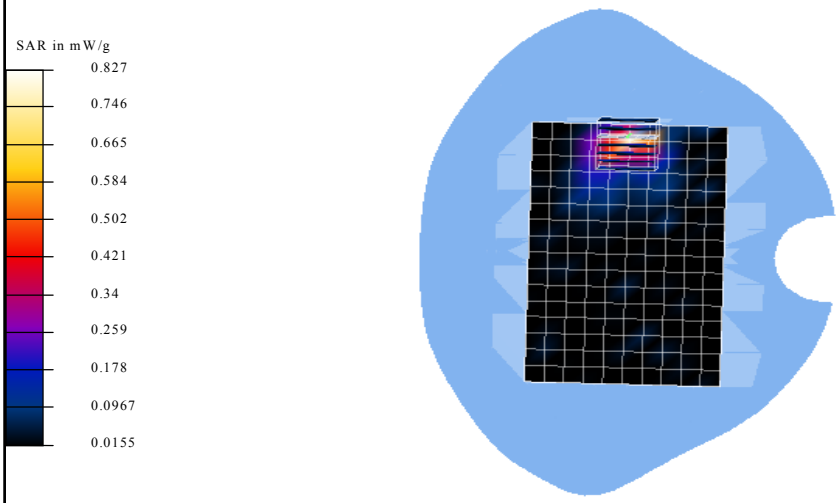
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT back touch_ch 39_data 5.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT back touch_ch 39_data 5

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 2.73 V/m
Peak SAR = 2.85 mW/g
SAR(1 g) = 0.756 mW/g; SAR(10 g) = 0.293 mW/g
Power Drift = 0.5 dB



Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **58% to 63%**

Figure 9: SAR Test Distribution Plot – device without belt clip (Touching).

Phantom Configuration	Device Test Positions	Antenna Position	Channel	SAR (W/kg), over 1g Tissue
Flat Phantom	EUT **Rear** Touched Phantom	Fixed	Channel: 78 2480MHz	0.559

Date: 06/05/03

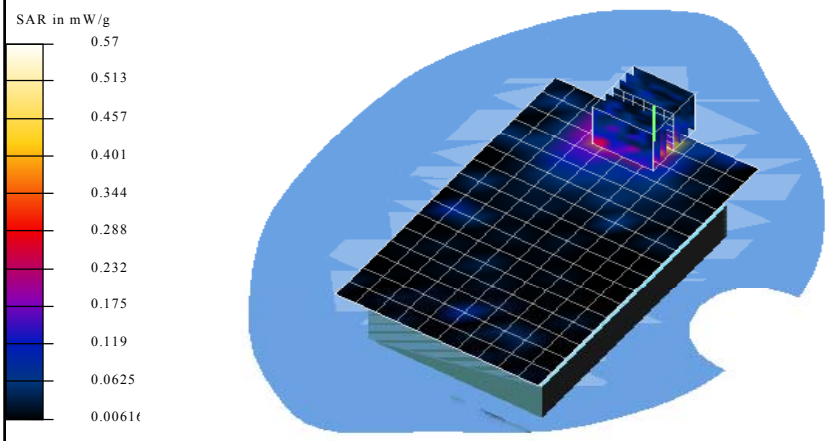
Test Laboratory: Telecom & EMC Testing Group
File Name: Flat Phantom_EUT back touch_ch 78_data 6.da4

DUT: Gigawavetech PDA_For Body Test Type & Serial Number: Nil
Program: Job No: 56S030405; Flat Phantom_EUT back touch_ch 78_data 6

Communication System: 2450 Mhz_Gigawavetech; Frequency: 2480 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 2.8 V/m
Peak SAR = 1.77 mW/g
SAR(1 g) = 0.559 mW/g; SAR(10 g) = 0.231 mW/g
Power Drift = -1 dB
Area Scan (11x17x1): Measurement grid: dx=10mm, dy=10mm



ANNEX A

TEST INSTRUMENTATION
&
GENERAL PROCEDURE

A.1 General Test Procedure

In the SAR measurement, the positioning of the probes must be performed with sufficient accuracy to obtain repeatable measurements in the presence of rapid spatial attenuation phenomena. The accurate positioning of the E-field probe is accomplished by using a high precision robot. The robot can be taught to position the probe sensor following a specific pattern of points. In a first sweep, the sensor is positioned as close as possible to the interface, with the sensor enclosure touching the inside of the fiberglass shell. The SAR is measured on a grid of points, which covers the curved surface of the phantom in an area larger than the size of the DUT. After the initial scan, a high- resolution grid is used to locate the absolute maximum measured energy point. At this location, attenuation versus depth scan will be accomplished by the measurement system to calculate the SAR value.

A.2 SAR Test Instrumentation

SAR Measurement System

- **Positioning Equipment**
  Type: High Precision Industrial Robot, RX90.
  Precision: High precision (repeatability 0.02mm)
  Reliability: High reliability (industrial design)

- **Compaq Computer**
  Type: 2.4GHz Pentium
  Memory: 512MB SDRAM
  Operating System: Windows 2000
  Dell Monitor: 17” LCD

- **Dosimetric E-Field Probe**
  Type: ET3DV6
  Isotropy Error (∅): ±0.25dB
  Dynamic Range: 0.01 – 100 W/kg

- **Phantom & Tissue**
  Phantom: “SAM v4.0 Phantom”, manufactured by SPEAG
  Tissue: Simulated Tissue with electrical characteristics similar to those of the human at normal body temperature (23 ± 1°C)
  Shell: Fiberglass shell phantom with 2mm thickness
  Dimension: A100cm x 50cm x 85cm (L x W x H)

A.3 Test Setup

Phantom

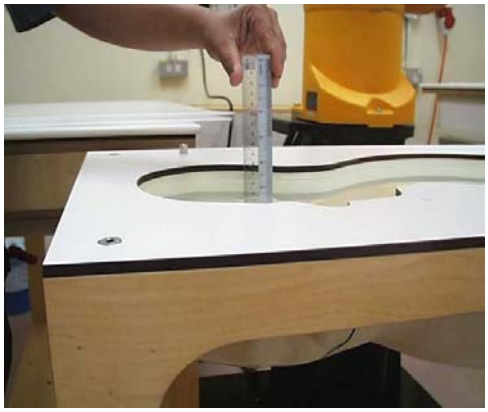
The "SAM v4.0 Phantom", manufactured by SPEAG is a fiberglass shell phantom with 2 mm shell thickness. It has three measurement areas:

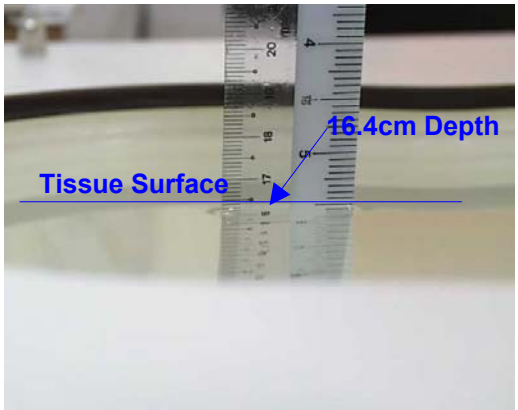
- Left hand
- Right hand
- Flat phantom

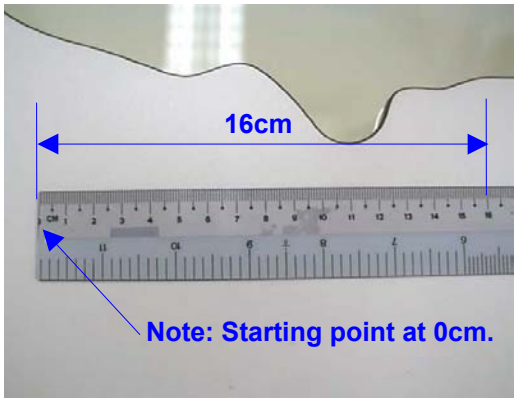
The phantom table comes in the sizes: A 100x50x85 cm (LxWxH) table for use with free standing robots.
The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used (e.g., for different solutions).

Liquid Depth

The liquid depth at the head of the SAM v4.0 Phantom is approximately 16.4cm.







Simulated tissue

Simulated Tissue: Suggested in a paper by George Hartsgrove and colleagues in University of Ottawa Ref.: Bioelectromagnetics 8:29-36 (1987)

This simulated tissue is mainly composed of water, sugar and salt. At higher frequencies, in order to achieve the proper conductivity, the solution does not contain salt. Also, at these frequencies, D.I. water and alcohol is preferred.
Tissue Density : Approximately 1.25 g/cm^3

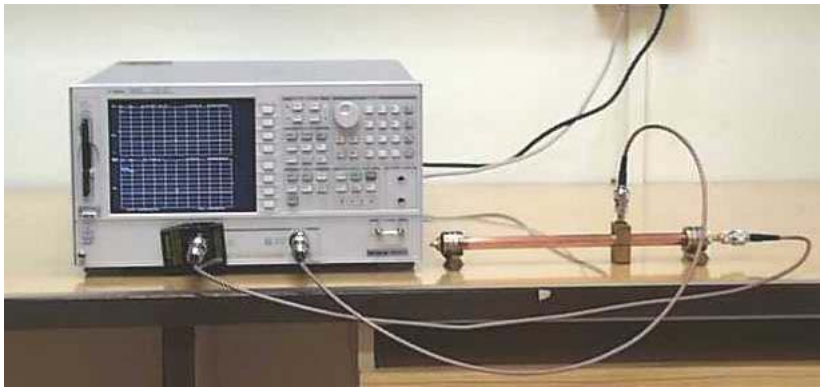
- **Preparation**
  The ingredients (i.e. water, sugar, salt, etc) required to prepare the simulated tissue are carefully weighed and poured into a clean container for mixing. A stirring paddle, that is attached to a hand drill is used to stir the solution for a duration of about 30 minutes or more. When the ingredients are completely dissolved, the solution is left in the container for the air bubbles to disappear.

- **Measurement of Electrical Characteristics of Simulated Tissue**
  1) S-PARAMETER Network Analyzer, Agilent 8753ES (30kHz – 6GHz)
  2) Slotted Coaxial Waveguide

- **Description of the slotted coaxial waveguide**
  The cylindrical waveguide is constructed with copper tube of about 30 to 40 cm of length, generally 12.5 mm diameter, with connectors at both ends. Inside of this tube, a conductive rod about 6.3 mm is coaxial supported by the two ends connectors (radiator). A slot 3 mm wide start at the beginning of the tube to almost the two third of the tube length. The outer edge of the slotted tube is marked in centimeters. For frequency below 1GHz, 1 centimeter per step. For higher frequency above 1 GHz, 0.5 centimeter per step. A saddle piece containing the sampling probe is inserted in the slot so the tip of the probe is close but not in contact with the inner conductor (radiator).

  To measure the electrical characteristics of the liquid simulated tissue, which fill the coaxial waveguide, select CW frequency and measure amplitude and phase with the Network Analyzer for every point in the slot (typically 11). An effort is made to keep the results dielectric constant and conductivity within 5 % of published data.

ELECTRICAL CHARACTERISTIC MEASUREMENT SETUP



Determining Relative Dielectric Constant and Effective Conductivity

$$c = 3 \cdot 10^8 (m/s) \qquad A = \frac{\Delta A}{20} \cdot \ln(10) \qquad \theta = \frac{\Delta\theta \cdot 2 \cdot \pi}{360}$$

$$\lambda = \frac{c}{f} \cdot \frac{100}{2.54} (inches) \qquad \varepsilon_{re} = \left(A^2 + \theta^2\right) \cdot \frac{\lambda^2}{(4 \cdot \pi)^2}$$

$$\theta = \left(|A| \cdot \frac{\lambda}{4 \cdot \pi \cdot \sqrt{\varepsilon_{re}}} \right) \qquad S = \tan\left(2 \cdot \theta^2\right)$$

Where:

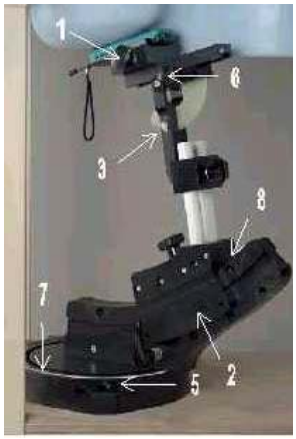
ΔA is the amplitude attenuation in dB
Δt is the phase change in degrees for 5 cm of wave propagation in the slotted line
f is the frequency of interest in Hz
ε_{re} is the real part of the complex dielectric constant

$$\varepsilon_r = \frac{\varepsilon_{re}}{\sqrt{1 + S^2}}$$

$$\sigma = S \cdot 2 \cdot \pi \cdot f \cdot 8.854 \cdot 10^{-12} \cdot \varepsilon_r (S/m)$$

The results: ε_r is the relative dielectric constant and σ is the conductivity in S/m.

Positioning of EUT



The DASY4 holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65º. The intended use position in the CENELEC document is has a rotation angle of 65º and an inclination angle of 80º. The rotation centers for both scales is the ear opening. Thus the device needs no repositioning when changing the angles. The device rotation around the device axis is not changed in the holder. In the CENELEC standard it is always 0º. If the standard changes, a support will be provided with the new angle.

1. **"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 pivotingpoint, rotation should continue until the device touches the cheek of the phantom or breaks its last contact from the ear spacer.

2. **"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 handset is tilted away from the mouth with respect to the "test device reference point" by 15°. 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° 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.

3. **Body Worn Configuration**

All body worn accessories are tested for the FCC RF exposure compliance. The phone is positioned into carrying case (if available) and placed below of the flat phantom. Headset or ear piece (if available) is connected during measurements.

Spatial Peak SAR Evaluation

Spatial Peak SAR for 1 g and 10 g
The DASY4 software includes all numerical procedures necessary to evaluate the spatial peak SAR values.

Based on the Draft: SCC-34, SC-2, WG-2 - Computational Dosimetry, IEEE P1529/D0.0 (Draft Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) Associated with the Use of Wireless Handsets - Computational Techniques), a new algorithm has been implemented. The spatial-peak SAR can be computed over any required mass.

The base for the evaluation is a ”cube” measurement in a volume of (30mm)3 (7x7x7 points). The measured volume must include the 1 g and 10 g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan. If the 10g cube or both cubes are not entirely inside the measured volumes, the system issues a warning regarding the evaluated spatial peak values within the Postprocessing engine (SEMCAD). This means that if the measured volume is shifted, higher values might be possible. To get the correct values you can use a finer measurement grid for the area scan. In complicated field distributions, a large grid spacing for the area scan might miss some details and give an incorrectly interpolated peak location.

The entire evaluation of the spatial peak values is performed within the Postprocessing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

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

The significant parts are outlined in more detail within the following sections.

Interpolation, Extrapolation and Detection of Maxima

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

In DASY4, the choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and extrapolation routines. The interpolation, extrapolation and maximum search routines are all based on the modified Quadratic Shepard’s method [1].

Thereby, the interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. The DASY4 routines construct a once-continuously differentiable function that interpolates the measurement values as follows:

- For each measurement point a trivariate (3-D) / bivariate (2-D) quadratic is computed. It interpolates the measurement values at the data point and forms a least-square fit to neighboring measurement values.

- the spatial location of the quadratic with respect to the measurement values is attenuated by an inverse distance weighting. This is performed since the calculated quadratic will fit measurement values at nearby points more accurate than at points located further away.

- After the quatratics are calculated for at all measurement points, the interpolating function is calculated as a weighted average of the quadratics.

There are two control paramaters that govern the behavior of the interpolation method . One specifies the number of measurement points to be used in computing the least-square fits for the local quadratics. These measurement points are the ones nearest the input point for which the quadratic is being computed. The second parameter specifies the number of measurement points that will be used in calculating the weights for the quadratics to produce the final function. The input data points used there are the ones nearest the point at which the interpolation is desired. Appropriate defaults are chosen for each of the control parameters

The trivariate quadratics that have been previously computed for the 3-D interpolation and whose input data are at the closest distance from the phantom surface, are used in order to extrapolate the fields to the surface of the phantom.

In order to determine all the field maxima in 2-D (Area Scan) and 3-D (Zoom Scan), the measurement grid is refined by a default factor of 10 and the interpolation function is used to evaluate all field values between corresponding measurement points. Subsequently, a linear search is applied to find all the candidate maxima. In a last step, non physical maxima are removed and only those maxima which are within 2 dB of the global maximum value are retained.

Important: To be processable by the interpolation/extrapolation scheme, the Area Scan requires at least 6 measurement points. The Cube Scan requires at least 10 measurement points to allow a application of these algorithms.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extrema of the SAR distribution. The uncertainty on the locations of the extrema is less than 1/20 of the grid size. Only local maxima within -2 dB of the global maximum are searched and passed for the Cube Scan measurement.

In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5mm.

Averaging and Determination of Spatial Peak SAR

The interpolated data is used to average the SAR over the 1g and 10g cubes by spatially discretizing the entire measured volume. The resolution of this spatial grid used to calculate the averaged SAR is 1mm or about 42875 interpolated points. The resulting volumes are defined as cubical volumes containing the appropriate tissue parameters that are centered at the location. The location is defined as the center of the incremental volume (voxel).

The spatial-peak SAR must be evaluated in cubical volumes containing a mass that is within 5% of the required mass. The cubical volume centered at each location, as defined above, should be expanded in all directions until the desired value for the mass is reached, with no surface boundaries of the averaging volume extending beyond the outermost surface of the considered region. In addition, the cubical volume should not consist of more than 10% of air. If these conditions are not satisfied then the center of the averaging volume is moved to the next location. Otherwise, the exact size of the final sampling cube is found using an inverse polynomial approximation algorithm, leading to results with improved accuracy. If one boundary of the averaging volume reaches the boundary of the measured volume during its expansion, it will not be evaluated at all. Reference is kept of all locations used and those not used for averaging the SAR. All average SAR values are finally assigned to the centered location in each valid averaging volume.

All locations included in an averaging volume are marked to indicate that they have been used at least once. If a location has been marked as used, but has never been assigned to the center of a cube, the highest averaged SAR value of all other cubical volumes which have used this location for averaging, is assigned to this location. Only those locations that are not part of any valid averaging volume should be marked as unused. For the case of an unused location, a new averaging volume must be constructed which will have the unused location centered at one surface of the cube. The remaining five surfaces are expanded evenly in all directions until the required mass is enclosed, regardless of the amount of included air. Of the six possible cubes with one surface centered on the unused location, the smallest cube is used, which still contains the required mass.

If the final cube containing the highest averaged SAR touches the surface of the measured volume, an appropriate warning is issued within the Postprocessing engine.

TEST INSTRUMENTATION & GENERAL PROCEDURE ANNEX A

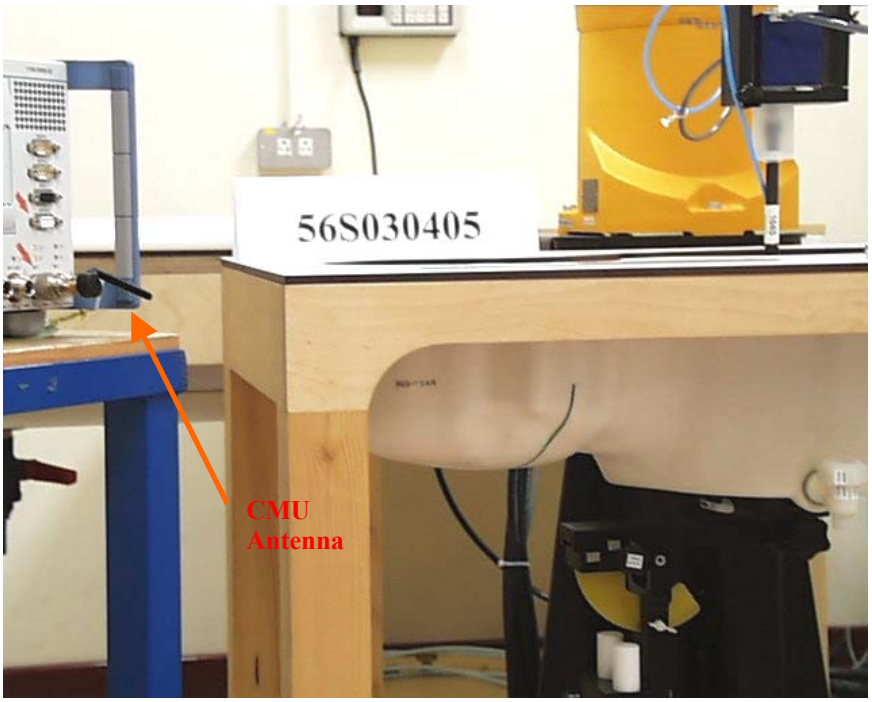
Instrument	Model	S/No	Cal Due Date	
Boonton RF Power Meter (Dual Channel)	4532	72901	31 Aug 2003	×
Boonton Peak Power Sensor	56218-S/1	1417	31 Aug 2003	
Boonton Power Sensor	51075	32079	31 Aug 2003	×
Boonton Power Sensor	51075	51075	31 Aug 2003	×
Agilent Spectrum Analyzer (30Hz – 40GHz)	8564E	3846A09953	4 Aug 2003	×
S-Parameter Network Analyzer (30kHz – 3GHz)	HP8753ES	US37390533	17 Sep 2003	×
Agilient Signal Generator (10MHz – 20GHz)	83620B	3844A01337	11 Oct 2003	×
Amplifier Research Power Amplifier (1MHz – 1000MHz)	25W1000B	27225	-	
Amplifier Research Power Amplifier (800MHz – 4.2GHz)	25S1G4A	29346	-	×
Agilent Dual Directional Coupler	HP778D	18289	-	×
Radio Test Set	2967	296501/331	-	
R&S Universal Radio Communication Tester	CMU-200	837587/068	18 Sep 2003	
450MHz System Validation Dipole	D450V2	1004	4 Apr 2003	
835MHz System Validation Dipole	D835V2	447	12 Nov 2003	
900MHz System Validation Dipole	D900V2	134	11 Nov 2003	
1800MHz System Validation Dipole	D1800V2	2d019	11 Nov 2003	
1900MHz System Validation Dipole	D1900V2	546	25 Nov 2003	
2450MHz System Validation Dipole	D2450V2	715	25 Sep 2004	×
Data Acquisition Electronics (DAE)	DAE3V1	475	11 Nov 2003	×
Dosimetric E-field Probe	ET3DV6	1645	20 Nov 2003	×
Dosimetric E-field Probe	ET3DV6	1646	25 Nov 2002	
Dosimetric E-field Probe	ET3DV6	1647	20 Nov 2003	
Isotropic H-field Probe	H3DV6	6115	6 Mar 2003	

ANNEX B

TEST SETUP PHOTOGRAPHS

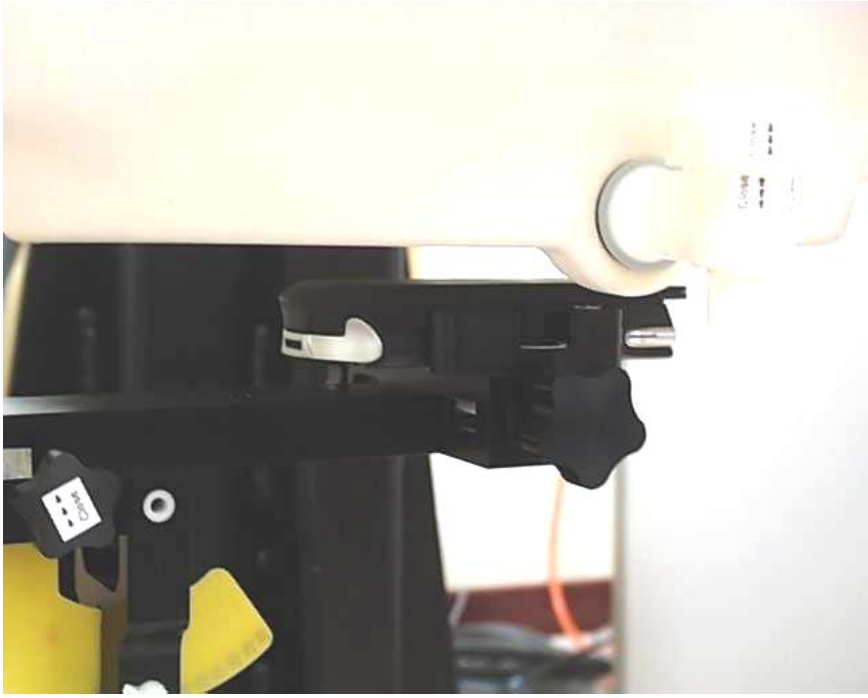
SAR Test Setup Photographs

SAR Test Setup At Flat Phantom – Far View



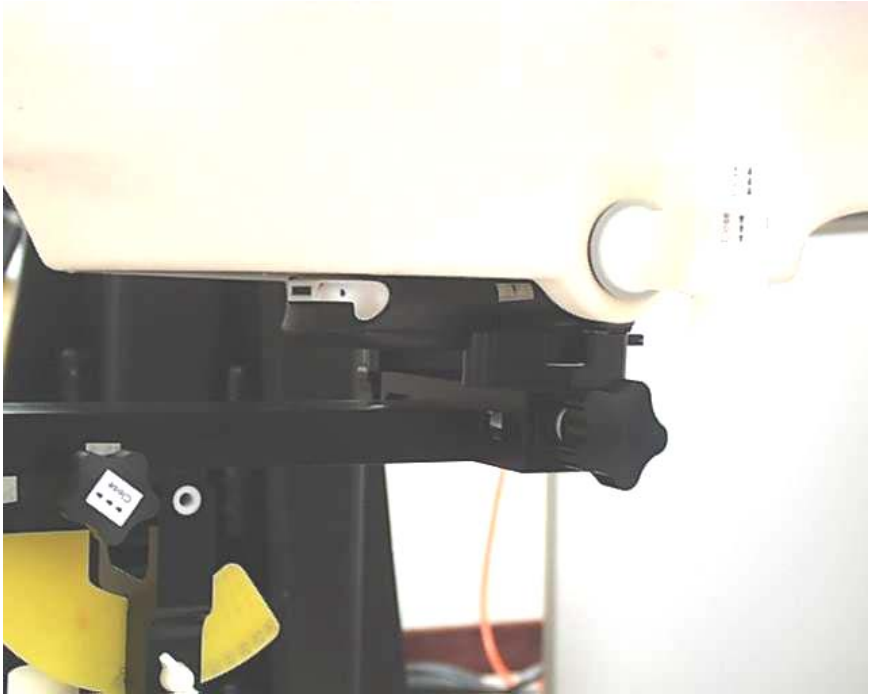
SAR Test Setup At Flat Phantom – Closer View showing CMU antenna distance with respect to SAM

SAR Test Setup Photographs

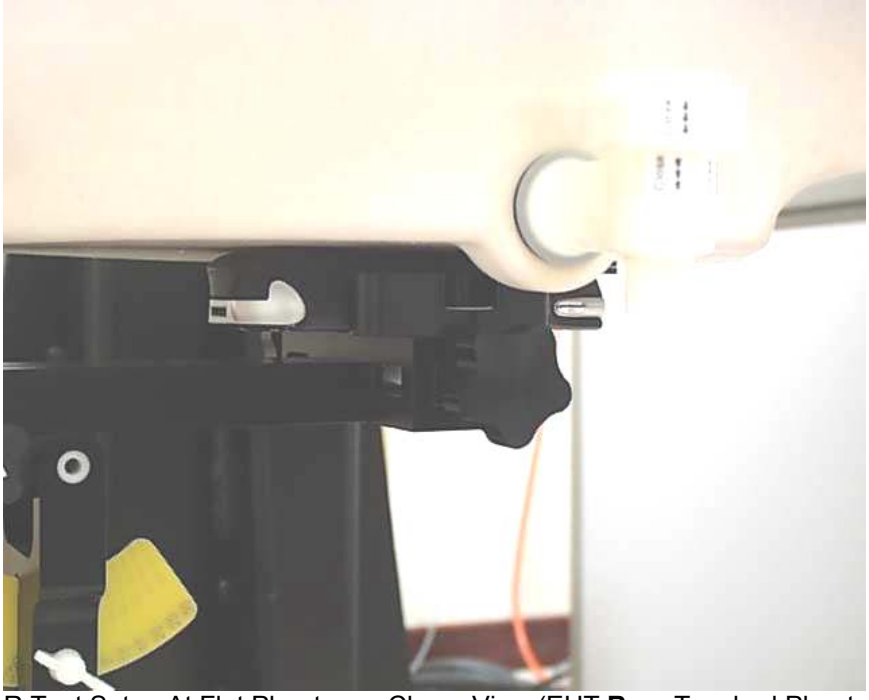


SAR Test Setup At Flat Phantom – Closer View (EUT **Rear** To Phantom, 15mm spacing)

SAR Test Setup Photographs

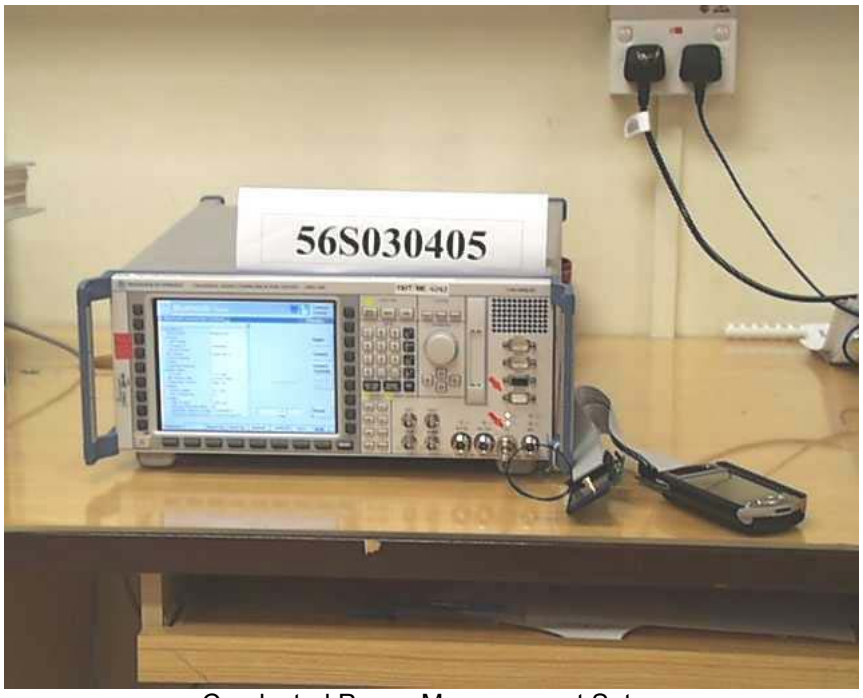


SAR Test Setup At Flat Phantom – Closer View (EUT **Front** Touched Phantom)



SAR Test Setup At Flat Phantom – Closer View (EUT **Rear** Touched Phantom)

Conducted Power Measurement Setup Photographs



Conducted Power Measurement Setup

EUT PHOTOGRAPHS

Front of EUT

Rear of EUT

PDA (HOST) PHOTOGRAPHS

Front of PDA (Host)

Rear of PDA (Host)

PDA (HOST) HOLDER PHOTOGRAPHS

Front of PDA Holder (Host)

Rear of PDA Holder (Host)

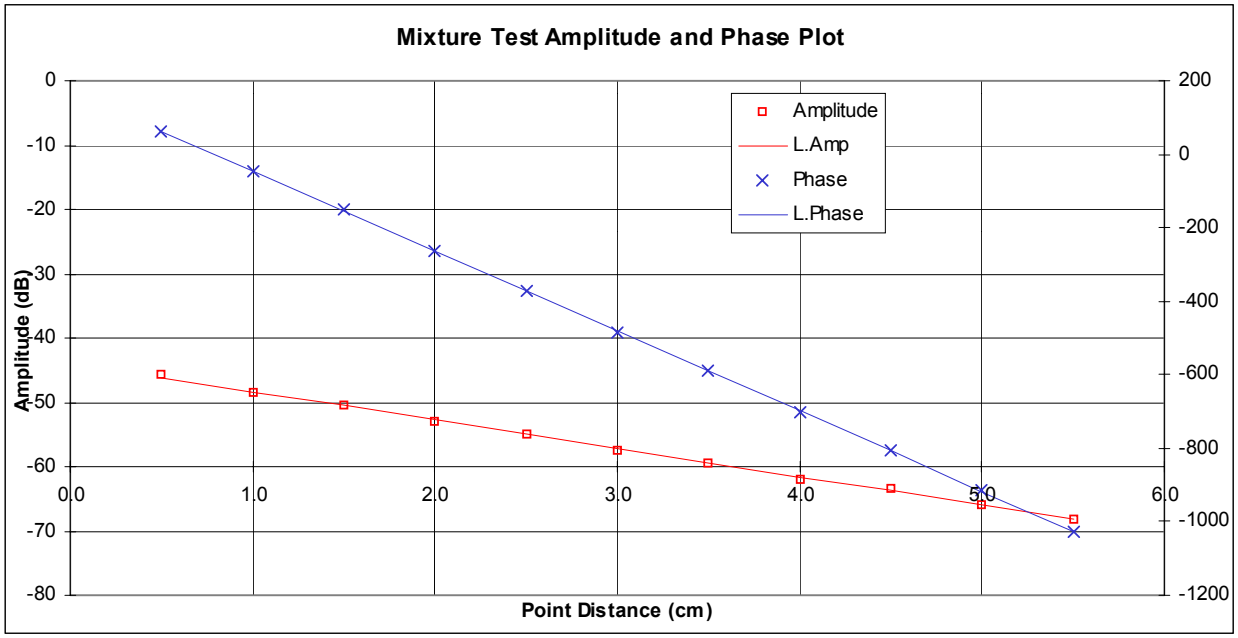
ANNEX C

TISSUE SIMULANT DATA SHEETS

Type of Tissue	Body
Target Frequency (MHz)	2450
Target Dielectric Constant	52.7
Target Conductivity (S/m)	1.95
Composition (by weight)	Ultra Pure Water (72.51%) Ethanol (27.33%) Sugar (0%) Salt (0.11%) HEC (0%) Bactericide (0.06%)
Measured Dielectric Constant	53.810
Measured Conductivity (S/m)	1.997
Probe Name	Dosimetric E-field Probe ET3DV6
Probe Serial Number	1645
Dimension	Overall Length: 330mm (Tip: 16mm) Tip Diameter: 6.8mm (Body: 12mm)
Sensor Offset	2.7mm
Conversion Factor	4.7 ± 8.9%
Probe Calibration Due Date (DD/MM/YY)	20 Nov 2003

Body Tissue at 2450MHz

Tested By:	Gary Ng Ah Chye					**Date:**	4th June 03	
			Ultra-Pure Water R = 18.2M Ohms					
Frequency:	2450	MHz	Composition					
			Ultra-Pure Water	Ethanol	Sugar	Salt	HEC	Bactericide
			25500.00 g	9610.00 g	0.00 g	38.40 g	0.00 g	20.00 g
Mixture:	Body Tissue		72.51 %	27.33 %	0.00 %	0.11 %	0.00 %	0.06 %
# of Points:	11		**Point Dist:**	0.5	cm	**Temperature:**	23	°C
Point	**Amplitude**	**Phase**			**-49.9**			
1	-45.70	60.00			**-51.6**	-4.414545455		
2	-48.50	-46.00			**-53.5**	-43.92		
3	-50.50	-151.00			**-55.3**	-217.7636364		
4	-53.00	96.00			**-56.9**	172.0181818		
5	-54.90	-10.00						
6	-57.60	-124.00			**Omega:**	15393804003	rad/sec	
7	-59.30	132.00			**Epsilon 0:**	8.85E-14	F/m	
8	-61.90	19.00			**mu:**	1.26E-08	H/m	
9	-63.30	-86.00			**alpha avg:**	-0.508243328	Np/cm	
10	-65.80	164.00			**beta avg:**	-3.800692446	rad/cm	
11	-68.30	52.00						
Results:		**Target**	**Low Limit**	**High Limit**	**% Off Target**			
D. Const:	**53.810**	52.70	50.07	55.34	2.08			
Cond:	**1.997**	1.95	1.85	2.05	2.39			



ANNEX D

SAR VALIDATION RESULTS

SAR Validation –Body Tissue at 2450MHz
Antenna Input Power: 250mW

Ambient Temperature: **23 ± 1^0 C**
Tissue Temperature: **23 ± 1^0 C**
Humidity: **57% to 60%**

Date: 06/05/03

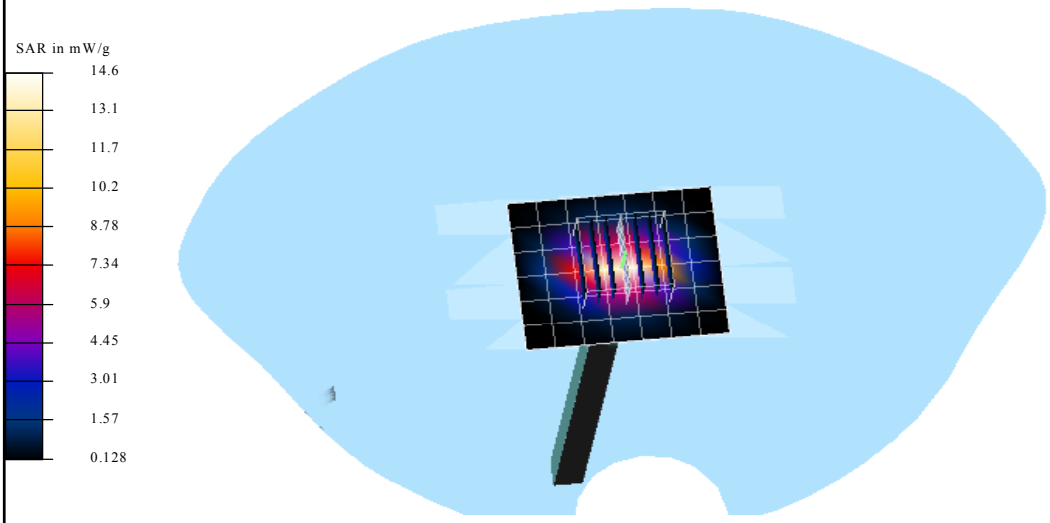
Test Laboratory: Telecom & EMC Testing Group
File Name: 56S030405_2450Mhz Dipole Validation.da4

DUT: Dipole 2450MHz Type & Serial Number: 715
Program: Job No: 56S030405; 2450Mhz dipole validation

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: Body 2450 MHz (σ = 1.997 mho/m, ε = 53.81, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1645; ConvF(4.7, 4.7, 4.7); Calibrated: 11/20/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn475; Calibrated: 11/14/2002
- Phantom: - TP:
- Software: DASY4, V4.0 Build 51

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 91.9 V/m
Peak SAR = 26.5 mW/g
SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.81 mW/g
Power Drift = 0.03 dB
Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm



ANNEX E

VALIDATION DIPOLE CALIBRATION CERTIFICATES

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SAR PROBE CALIBRATION CERTIFICATES

Schmid & Partner
Engineering AG

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

Calibration Certificate

2450 MHz System Validation Dipole

Type:	**D2450V2**
Serial Number:	**715**
Place of Calibration:	**Zurich**
Date of Calibration:	**September 25, 2002**
Calibration Interval:	**24 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:	N. Kellen
Approved by:	Pokovic Katja

Schmid & Partner
Engineering AG

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

DASY

Dipole Validation Kit

Type: D2450V2

Serial: 715

Manufactured: July 5, 2002
Calibrated: September 25, 2002

1. Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with head simulating solution of the following electrical parameters at 2450 MHz:

Relative permitivity	**37.7**	± 5%
Conductivity	**1.88 mho/m**	± 10%

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 5.0 at 2450 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

2.1. SAR Measurement with DASY3 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the worst-case extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	**56.8 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**26.2 mW/g**

2.2 SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	**53.6 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**25.0 mW/g**

3. Dipole impedance and return loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.155 ns**	(one direction)
Transmission factor:	**0.980**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:	Re{Z} = **52.3 Ω**
	Im {Z} = **1.5 Ω**
Return Loss at 2450 MHz	**- 31.3 dB**

4. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

5. Design

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

Small end caps have been added to the dipole arms in order to improve matching when loaded according to the position as explained in Section 1. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

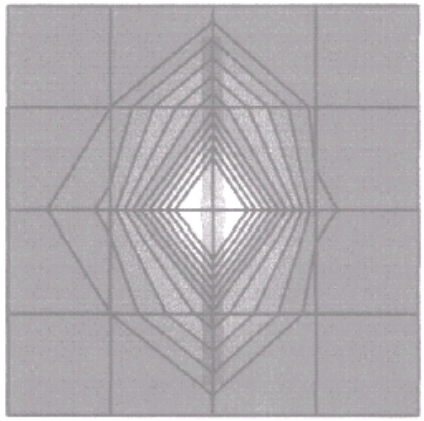
6. Power Test

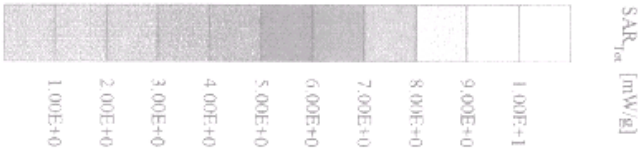
After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

09/25/02

Validation Dipole D2450V2 SN715, d = 10 mm

Frequency: 2450 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(5.00,5.00,5.00) at 2450 MHz; IEEE1528 2450 MHz σ = 1.88 mho/m ε_r = 37.7 ρ = 1.00 g/cm³
Cubes (2): Peak: 26.7 mW/g ± 0.00 dB, SAR (1g): 13.4 mW/g ± 0.01 dB, SAR (10g): 6.26 mW/g ± 0.02 dB, (Advanced extrapolation)
Penetration depth: 6.8 (6.7, 7.0) [mm]
Powerdrift: -0.04 dB





Schmid & Partner Engineering AG, Zurich, Switzerland

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:	**1645**
Place of Calibration:	**Zurich**
Date of Calibration:	**November 20, 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:	

Schmid & Partner
Engineering AG

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

Probe ET3DV6

SN:1645

Manufactured:	November 7, 2001
Last calibration:	November 26, 2001
Recalibrated:	November 20, 2002

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1645 November 20, 2002

DASY - Parameters of Probe: ET3DV6 SN:1645

Sensitivity in Free Space

NormX	**1.67**	$\mu V/(V/m)^2$	DCP X	**94**	mV
NormY	**1.77**	$\mu V/(V/m)^2$	DCP Y	**94**	mV
NormZ	**1.71**	$\mu V/(V/m)^2$	DCP Z	**94**	mV

Sensitivity in Tissue Simulating Liquid

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

ConvF X	**6.7**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.7**	± 9.5% (k=2)	Alpha	**0.36**
ConvF Z	**6.7**	± 9.5% (k=2)	Depth	**2.71**

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

ConvF X	**5.6**	± 8.9% (k=2)	Boundary effect:	
ConvF Y	**5.6**	± 8.9% (k=2)	Alpha	**0.51**
ConvF Z	**5.6**	± 8.9% (k=2)	Depth	**2.41**

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	10.4	6.0
SAR_{be} [%]	With Correction Algorithm	0.4	0.7

Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	12.2	8.1
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

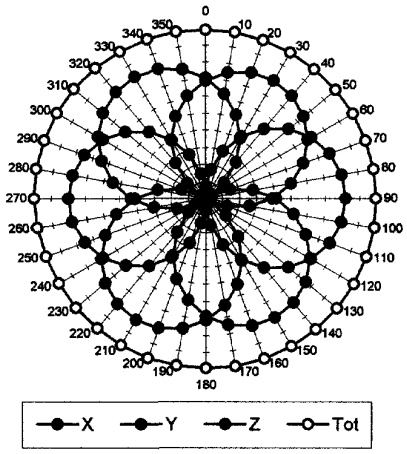
Sensor Offset

Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.5 ± 0.2**	mm

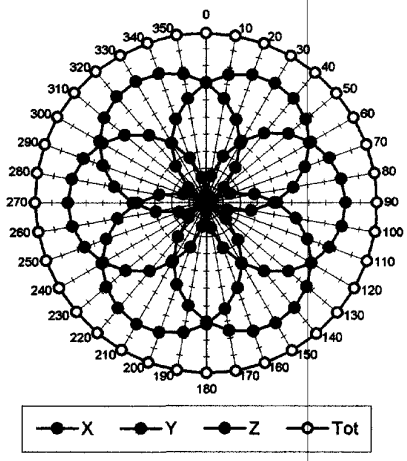
ET3DV6 SN:1645 **November 20, 2002**

Receiving Pattern (ϕ), θ = 0°

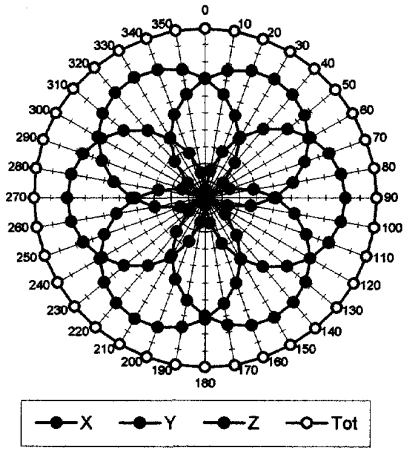
f = 30 MHz, TEM cell ifi110



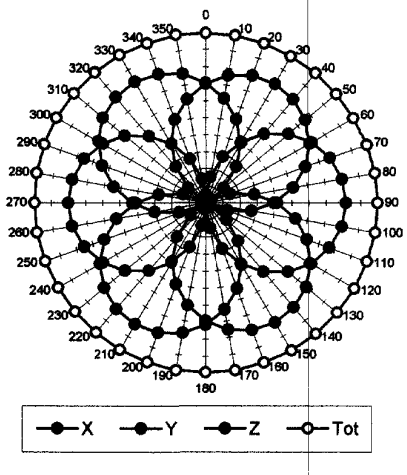
f = 100 MHz, TEM cell ifi110



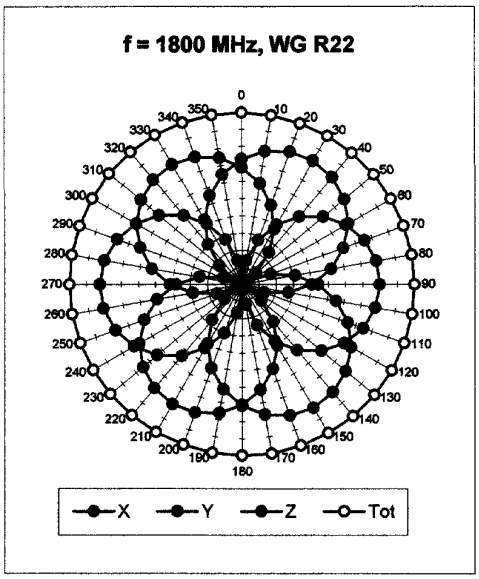
f = 300 MHz, TEM cell ifi110

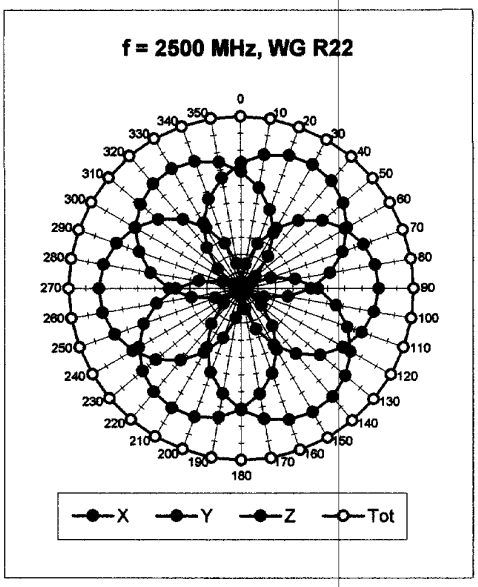


f = 900 MHz, TEM cell ifi110

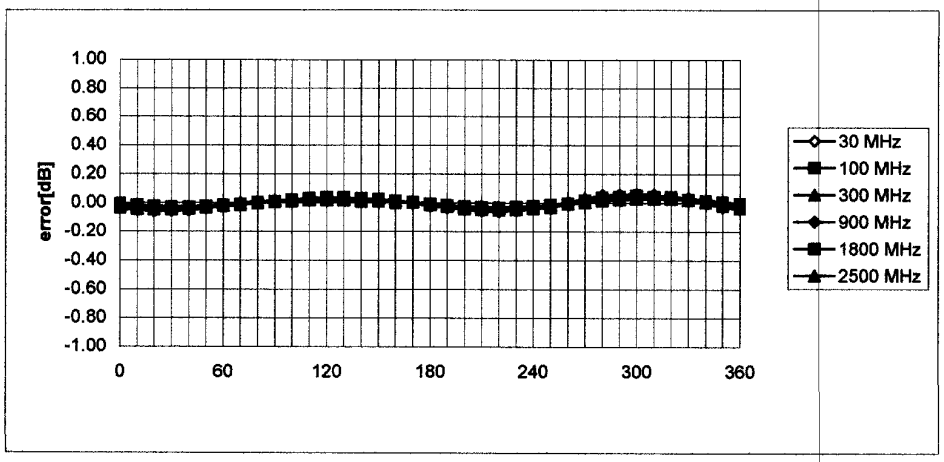


ET3DV6 SN:1645 **November 20, 2002**





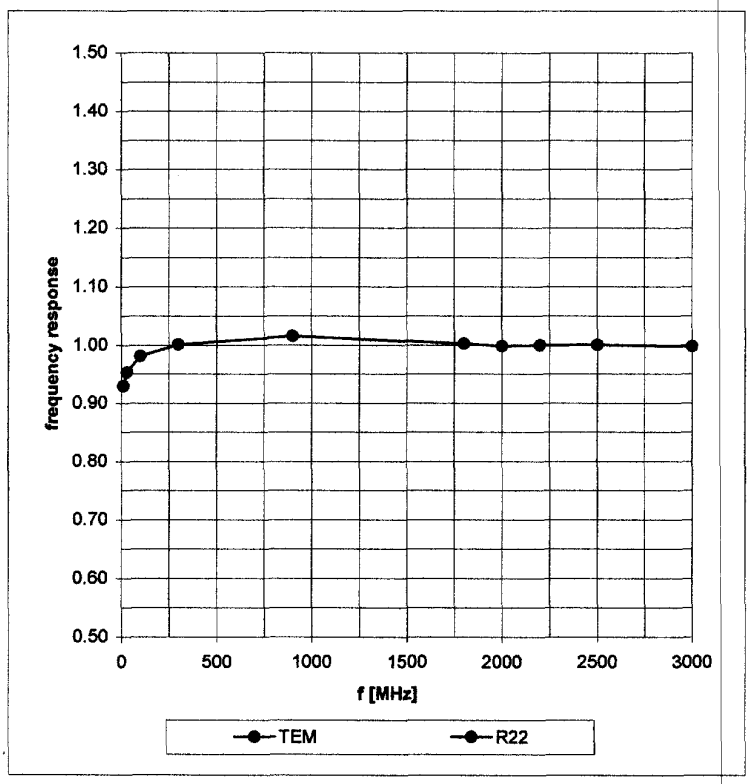
Isotropy Error (ϕ), θ = 0°



ET3DV6 SN:1645 November 20, 2002

Frequency Response of E-Field

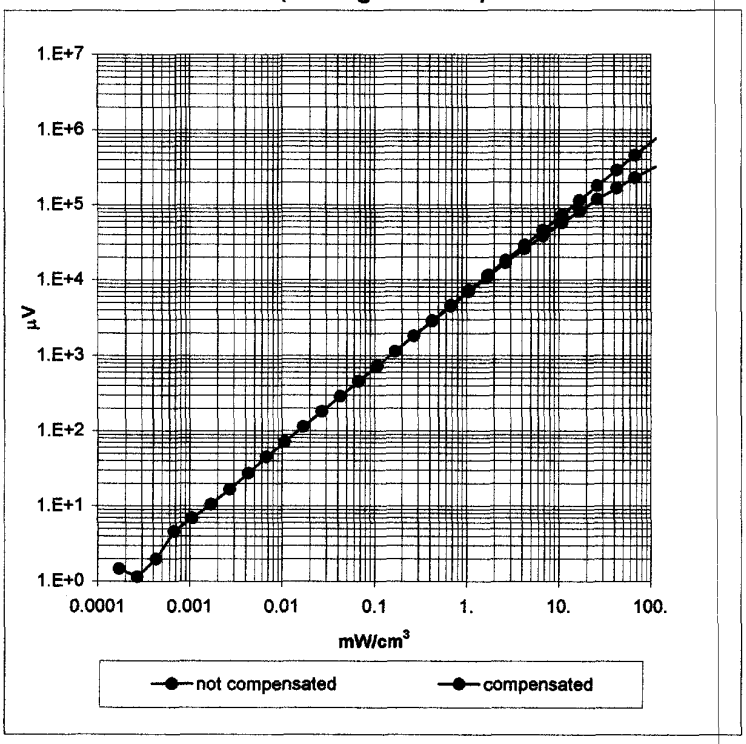
(TEM-Cell:ifi110, Waveguide R22)

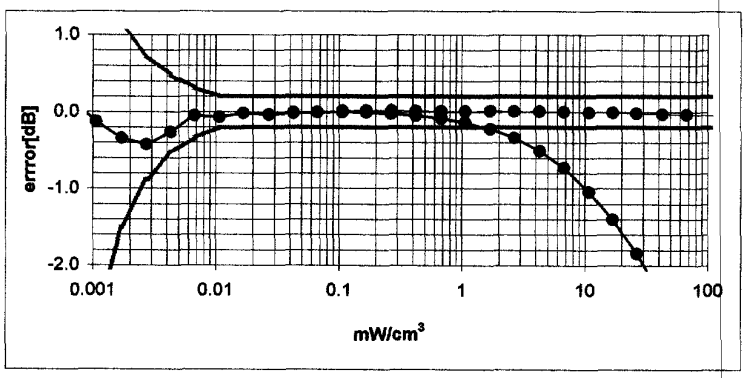


ET3DV6 SN:1645 November 20, 2002

Dynamic Range f(SAR_{brain})

(Waveguide R22)





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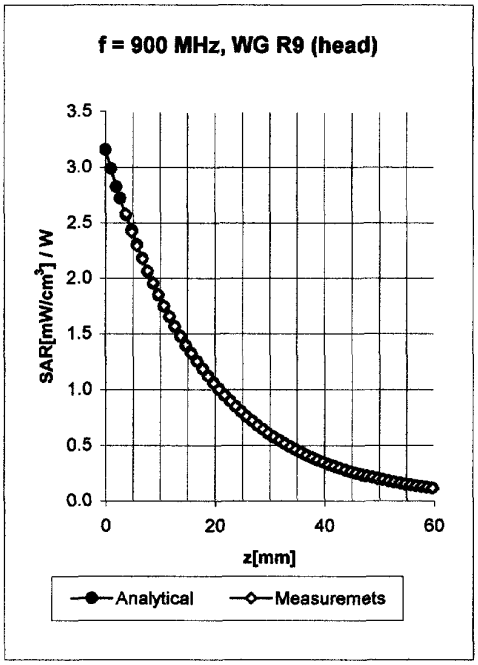
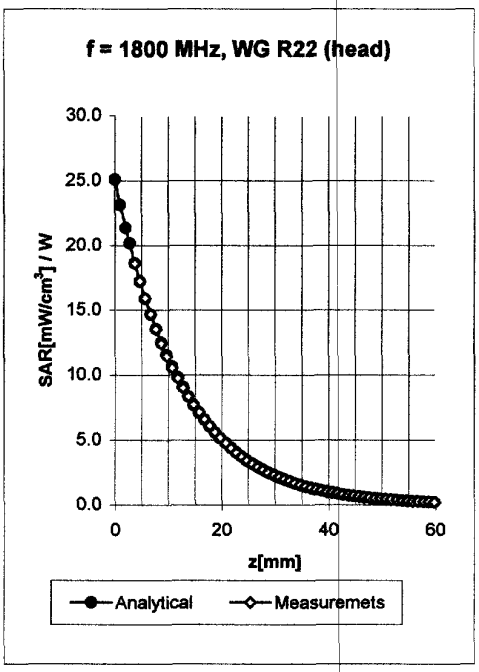
ET3DV6 SN:1645 **November 20, 2002**

Conversion Factor Assessment



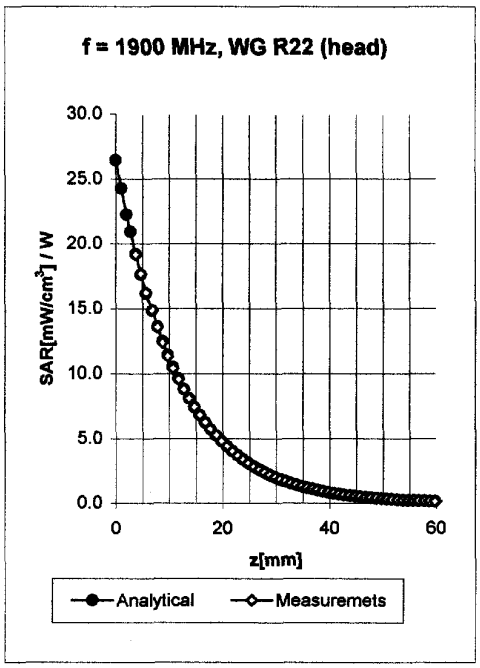


Head	**900 MHz**	ε_r **= 41.5 ± 5%**	σ **= 0.97 ± 5% mho/m**	
Head	**835 MHz**	ε_r **= 41.5 ± 5%**	σ **= 0.90 ± 5% mho/m**	
	ConvF X	**6.7** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.7** ± 9.5% (k=2)	Alpha	**0.36**
	ConvF Z	**6.7** ± 9.5% (k=2)	Depth	**2.71**

Head	**1800 MHz**	ε_r **= 40.0 ± 5%**	σ **= 1.40 ± 5% mho/m**	
	ConvF X	**5.6** ± 8.9% (k=2)	Boundary effect:	
	ConvF Y	**5.6** ± 8.9% (k=2)	Alpha	**0.51**
	ConvF Z	**5.6** ± 8.9% (k=2)	Depth	**2.41**

ET3DV6 SN:1645 **November 20, 2002**

Conversion Factor Assessment

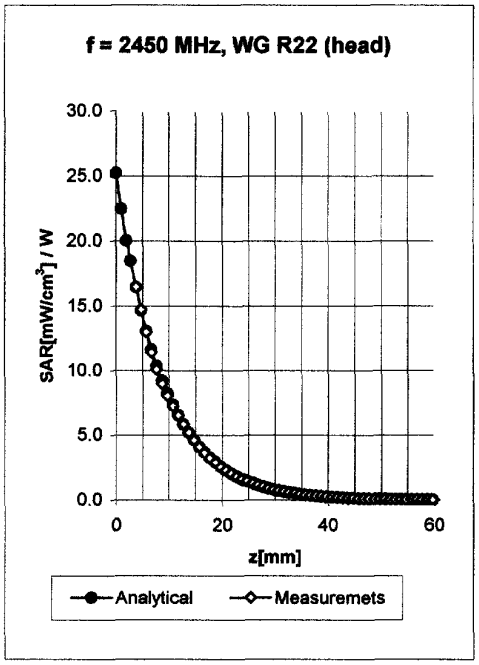


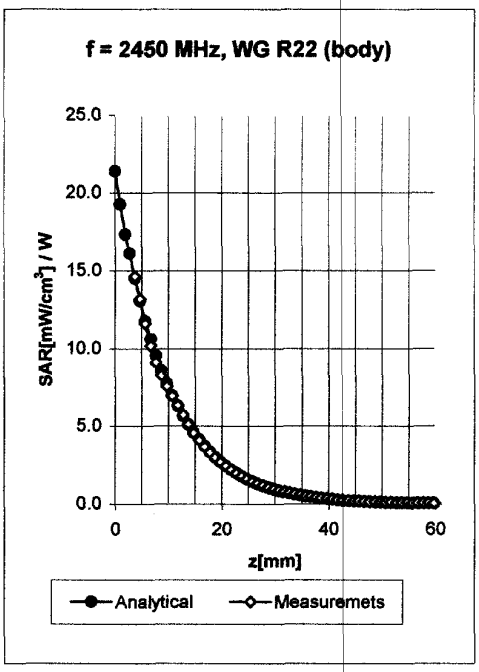
Head **1900 MHz** **ε_r = 40.0 ± 5%** **σ = 1.40 ± 5% mho/m**

ConvF X	**5.5**	± 8.9% (k=2)	Boundary effect:	
ConvF Y	**5.5**	± 8.9% (k=2)	Alpha	**0.57**
ConvF Z	**5.5**	± 8.9% (k=2)	Depth	**2.32**

ET3DV6 SN:1645 **November 20, 2002**

Conversion Factor Assessment





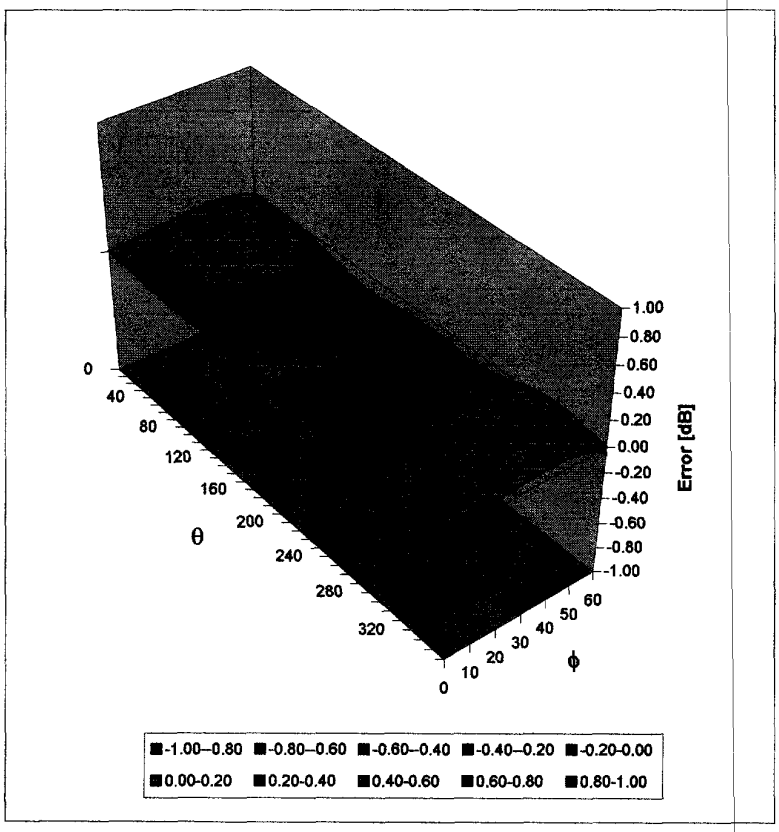
2450	**Head**	**MHz**	ε_r **= 39.2 ± 5%**		σ **= 1.80 ± 5% mho/m**	
	ConvF X	**5.2**	± 8.9% (k=2)		Boundary effect:	
	ConvF Y	**5.2**	± 8.9% (k=2)		Alpha	**1.00**
	ConvF Z	**5.2**	± 8.9% (k=2)		Depth	**1.69**

2450	**Body**	**MHz**	ε_r **= 52.7 ± 5%**		σ **= 1.95 ± 5% mho/m**	
	ConvF X	**4.7**	± 8.9% (k=2)		Boundary effect:	
	ConvF Y	**4.7**	± 8.9% (k=2)		Alpha	**1.00**
	ConvF Z	**4.7**	± 8.9% (k=2)		Depth	**1.68**

ET3DV6 SN:1645 November 20, 2002

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



ANNEX F

REFERENCES

The methods and procedures used for the measurements contained in this report are details in the following reference standards:

Publications	Year	Title
Supplement C (Edition 01-01) to FCC OET Bulletin 65 (Edition 97-01)	2001	"Evaluating Compliance with FCC Guidelines for Human Exposure to radio Frequency Fields"
IEEE Standard 1528-200X	2000	"Product Performance Standards Relative to the safe Use of Electromagnetic Energy"
ANSI/IEEE C95.3	1992	"Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave"
ANSI/IEEE C95.1	1992	"Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz"
ACA, Radio Communications (EMR Human Exposure)	2000 (No.2)	“Radiocommunication (Electromagnetic Radiation – Human Exposure)”
EN50360	2001	Product Standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz – 3GHz)
EN50361	2001	Basic Standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phone (300MHz – 3GHz)