



TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

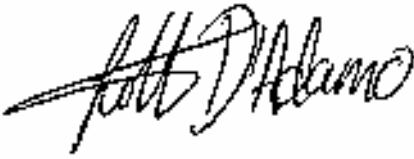
Test Of: Sendo Ltd.
Sendo S601 with Personal Handsfree Accessory

Measurements were performed on the DASY4 System

To: OET Bulletin 65 Supplement C: (2001-01)

Test Report Serial No:
RFI/SARB2/RP46027JD02A

Supersedes Test Report Serial No:
RFI/SARB1/RP46027JD02A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	Checked By: Joe Lomako 
Tested By: Richelieu Quoi  PP	Release Version No: PDF01
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It should be noted that the standard, OET Bulletin 65 Supplement C: (2001-01) is not listed on RFI's current UKAS schedule and is therefore "not UKAS accredited".

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1. Client Information

1.1. Client Details

Company Name:	Sendo Ltd.
Address:	Hatchford Brook Hatchford Way Sheldon Birmingham B26 3RZ United Kingdom
Contact Name:	Mr M Bailey

1.2. Test Laboratory

Company Name:	Radio Frequency Investigation Ltd.
Address:	Ewhurst Park Ramsdell Basingstoke Hampshire RG26 5RQ.
Contact Name:	Mr J Lomako

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2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification Of Equipment Under Test (EUT)

Brand Name:	Sendo
Model Name or Number:	S601
Unique Type Identification:	0400C16YZ600004
IMEI Number:	001031000051023
Country Of Manufacture:	None Stated
Battery Serial Number:	None Stated
F.C.C. ID Number:	P6PSND601
Date Of Receipt:	28 April 2004

Brand Name:	None Stated
Model Name or Number:	Personal Handsfree
Unique Type Identification:	None Stated
IMEI Number:	None Stated
Country Of Manufacture:	None Stated
Battery Serial Number:	None Stated
F.C.C. ID Number:	None Stated
Date Of Receipt:	28 April 2004

2.2. Description Of EUT

The equipment under test is a Dual-band mobile handset operating at 850MHz and 1900MHz, with personal handsfree accessory (PHF).

2.3. Modifications Incorporated In EUT

During the course of testing the EUT was not modified.

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2.4. Additional Information Related to the EUT

Equipment Class:	Handheld Mobile Station		
FCC Rule Part(s):	OET Bulletin 65 Supplement C		
Device Category:	Portable		
Application Type:	Certification		
Transmitter Frequency Range (MHz):	850 MHz – 824 – 849 MHz 1900 MHz – 1850 – 1910 MHz		
Receiver Frequency Range (MHz):	850 MHz – 824 – 849 MHz 1900 MHz – 1850 – 1910 MHz		
Transmit Frequency Allocation Of EUT When Under Test (Channels):	Channel Number	Channel Description	Frequency (MHz)
	810	High	1909.8
	660	Middle	1879.8
	512	Low	1850.2
	251	High	848.80
	189	Middle	836.40
	128	Low	824.20
Modulation(s):	217 Hz		
Modulation Scheme (Crest Factor)	GSM (Crest Factor 8.3)		
Maximum RF Output Power: (as stated by client)	850 MHz – 29.0 dBm 1900 MHz – 30.0 dBm		
Battery Type(s):	Li-Ion		
Antenna Length and Type:	Internal (Length Unknown)		
Number Of Antenna Positions:	1 (Fixed Antenna)		
Intended Operating Environment:	Commercial		
Weight:	Approx. 85.22g (Including Battery)		
Dimensions (without Antenna) mm:	Approx. 111 (L) x 46 (W) x 20 (H) mm		
Power Supply Requirement:			
DC Supply (Volts/Amps)	Not Applicable		
AC Supply (Volts/Amps)	Not Applicable		
Internal Battery (Volts/Amps)	3.7 V Li-Ion		
Port(s):	Enclosure		
	Multifunction port for AC mains charge input / PHF.		

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2.5. Support Equipment

Description:	Communication Test Set
Brand Name:	Will'tek
Model Name or Number:	4202S
Serial Number:	0513018
FCC ID Number:	None Stated
Cable Length And Type:	Antenna
Connected to Port:	RF In / Output (Air link)

Description:	GSM MS Test Set
Brand Name:	HP
Model Name or Number:	8922H
Serial Number:	3503U00372
FCC ID Number:	None Stated
Cable Length And Type:	140 mm, BNC
Connected to Port:	RF In / Out (Air Link)

Description:	DCS / PCS MS Test Set
Brand Name:	HP
Model Name or Number:	83220E
Serial Number:	3741U02702
FCC ID Number:	None Stated
Cable Length And Type:	Antenna
Connected to Port:	RF In / Out (Air link)

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3. Test Specification, Methods And Procedures

3.1. Test Specification

Reference:	OET Bulletin 65 Supplement C: (2001-01)
Title:	Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields.
Comments:	None
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification.

3.2. Methods And Procedures

The methods and procedures used were as detailed in:

EN 50361: 2001

Title: Basic standard for the measurement of specific absorption rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz).

ANSI/IEEE C95.1: 1999

IEEE standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz.

Federal Communications Commission, "Evaluating compliance with FCC Guidelines for human exposure to radio frequency electromagnetic fields", OET Bulletin 65 Supplement C, FCC, Washington, D.C, 20554, 2001.

Thomas Schmid, Oliver Egger and Neils Kuster, "Automated E-field scanning system for dosimetric assessments", IEEE Transaction on microwave theory and techniques, Vol. 44, pp. 105-113, January 1996.

Neils Kuster, Ralph Kastle and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with know precision", IEICE Transactions of communications, Vol. E80-B, No.5, pp. 645-652, May 1997.

3.3. Definition Of Measurement Equipment

The measurement equipment used complied with the requirements as detailed in OET Bulletin 65 Supplement C, Appendix D.

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4. Deviations From The Test Specification

At the clients request the EUT was tested at 1900 MHz band and 850MHz band.

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5. Operation Of The EUT During Testing

The equipment under test is a standard production model.

5.1. Operating Modes

The EUT was tested in the following operating configurations:

- 1) Call Allocated.

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6. Summary Of Test Results

6.1. Summary Of Tests

Test Name	Specification Reference	Compliance Status
Specific Absorption Rate (SAR)	OET Bulletin 65 Supplement C	Complied

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6.2. Test Results For Specific Absorption Rate - 850 MHz Brain

6.2.1. Specific Absorption Rate - 850 MHz Band

Environmental Conditions:

Temperature Variation in Lab (°C):	23.0 to 24.0
Temperature Variation in Liquid (°C):	22.3 to 23.0

ERP after Test:	Refer to section 6.6
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Results:

Position	Side of Head	Frequency Channel No	Distance from antenna to phantom (mm)	SAR Level (W/kg) 1g	SAR Limit (W/kg) 1g	Margin (W/kg) 1g	Result
Touch	Left	189	10	0.411	1.6	1.189	Complied
Tilt	Left	189	8	0.218	1.6	1.382	Complied
Touch	Right	189	10	0.213	1.6	1.387	Complied
Tilt	Right	189	8	0.131	1.6	1.469	Complied
Touch	Left	128	10	0.359	1.6	1.241	Complied
Touch	Left	251	10	0.489	1.6	1.111	Complied

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6.3. Test Results For Specific Absorption Rate - 850 MHz Body

6.3.1. Specific Absorption Rate - 850 MHz Band

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	23.4 to 23.5

ERP after Test:	Refer to section 6.6
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Results:

Position	Configuration	Frequency Channel No	Distance from EUT to phantom (mm)	SAR Level (W/kg) 1g	SAR Limit (W/kg) 1g	Margin (W/kg) 1g	Result
Flat	Rear facing phantom	189	15	0.126	1.6	1.474	Complied
Flat	Front facing phantom	189	15	0.065	1.6	1.535	Complied
Flat	Rear facing phantom with PHF	189	15	0.163	1.6	1.437	Complied
Flat	Rear facing phantom with PHF	128	15	0.183	1.6	1.417	Complied
Flat	Rear facing phantom with PHF	251	15	0.124	1.6	1.476	Complied

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6.4. Test Results For Specific Absorption Rate - 1900 MHz Brain

6.4.1. Specific Absorption Rate - 1900 MHz Band

Environmental Conditions:

Temperature Variation in Lab (°C):	23.0 to 24.0
Temperature Variation in Liquid (°C):	23.6 to 22.7

EIRP after Test:	Refer to section 6.7
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Results:

Position	Side of Head	Frequency Channel No	Distance from antenna to phantom (mm)	SAR Level (W/kg) 1g	SAR Limit (W/kg) 1g	Margin (W/kg) 1g	Result
Touch	Left	660	10	0.225	1.6	1.375	Complied
Tilt	Left	660	8	0.193	1.6	1.407	Complied
Touch	Right	660	10	0.219	1.6	1.381	Complied
Tilt	Right	660	8	0.157	1.6	1.446	Complied
Touch	Left	512	10	0.118	1.6	1.482	Complied
Touch	Left	810	10	0.389	1.6	1.211	Complied

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6.5. Test Results For Specific Absorption Rate - 1900 MHz Body

6.5.1. Specific Absorption Rate - 1900 MHz Band

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	23.5 to 23.7

EIRP after Test:	Refer to section 6.7
------------------	----------------------

Results:

Position	Configuration	Frequency Channel No	Distance from EUT to phantom (mm)	SAR Level (W/kg) 1g	SAR Limit (W/kg) 1g	Margin (W/kg) 1g	Result
Flat	Rear facing phantom	660	15	0.170	1.6	1.430	Complied
Flat	Display facing phantom	660	15	0.018	1.6	1.582	Complied
Flat	Rear facing phantom with PHF	660	15	0.165	1.6	1.435	Complied
Flat	Rear facing phantom	512	15	0.174	1.6	1.426	Complied
Flat	Rear facing phantom	810	15	0.412	1.6	1.188	Complied

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6.6. ERP Measurement – 850 MHz

ERP Measurement

The ERP of the EUT is as follow: -

Frequency Channel	Tx Power After test / dBm
Low	24.3
Middle	25.9
High	24.7

Note: The ERP measurements were performed post testing.

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6.7. EIRP Measurement – 1900 MHz

EIRP Measurement

The EIRP of the EUT is as follow: -

Frequency Channel	Tx Power After test / dBm
Low	21.5
Middle	24.8
High	26.8

Note: The EIRP measurements were performed post testing.

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7. SAR Measurement System

7.1. Radio Frequency Investigation SAR measurement facility utilises the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, and the SAM phantom containing brain or muscle 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). A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit 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. The DAE3 utilises 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.

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8. SAR Safety Limits

Exposure Limits (General populations/Uncontrolled Exposure Environment)	SAR (W/Kg)
Spatial Peak (averaged over any 1 g of tissue)	1.60

Notes:

1. The FCC SAR safety limits specified in the table above apply to devices operated in the General Population / Uncontrolled Exposure Environment.
2. Uncontrolled environments are defined as locations where there is exposure of individuals who have no knowledge or control of their exposure.

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9. Details of SAR Evaluation

9.1. The equipment under test was found to be compliant for localised specific absorption rate (SAR) based on the following provisions and conditions:

- a) The handset was placed in a normal operating position with the centre of the ear-piece aligned with the ear canal on the phantom.
- b) With the ear-piece touching the phantom the centre line of the handset was aligned with an imaginary plane (X and Y axis) consisting of three lines connecting both ears and the mouth.
- c) For the cheek position the handset was gradually moved towards the cheek until any point of the mouth-piece or keypad touched the cheek.
- d) For the tilted position the EUT was positioned as for the cheek position, then the horizontal angle was increased by fifteen degrees (the phone keypad was moved away from the cheek by fifteen degrees).
- e) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimise the drift.
- f) The device was keyed to operate continuously in the transmit mode for the duration of the test.
- g) The location of the maximum spatial SAR distribution (Hot Spot) was determined relative to the handset and its antenna.
- h) The EUT was tested with a fully charged battery.

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10. Evaluation Procedures

10.1. The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

- a) (i) The evaluation was performed in an applicable area of the phantom depending on the type of device being tested. For devices worn about the ear during normal operation, both the left and right ear positions were evaluated at the centre frequency of the band at maximum power. The side, which produced the greatest SAR, determined which side of the phantom would be used for the entire evaluation. The positioning of the head worn device relative to the phantom was dictated by FCC OET bulletin 65 Supplement C.

(ii) For body worn devices or devices which can be operated within 20 cm of the body, the flat section of the phantom was used. The type of device being evaluated dictated the distance of the EUT to the outer surface of the phantom flat section.
- b) The SAR was determined by a pre-defined procedure within the DASY4 software. The exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm.
- c) A 7x7x7 matrix was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.
- d) If the EUT had any appreciable drift over the course of the evaluation, then the EUT was re-evaluated. Any unusual anomalies over the course of the test also warranted a re-evaluation.

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11. System Validation

11.1. Prior to the assessment, the system was verified in the flat region of the phantom. A 1900 MHz dipole was used. A forward power of 250 mW was applied to the dipole and system was verified to a tolerance of ± 5 for the 1900 MHz dipole. The applicable verification (normalised to 1 Watt) is as follows. This procedure was also performed with a 900 MHz dipole.

Dipole Validation Kit	Target SAR 1g (w/kg)	Measured SAR 1g (w/kg)
D900V2 / 124 (29/04/04)	11.0	10.56
D900V2 / 124 (30/04/04)	10.6	10.92
D1900V2 / 540 (28/04/04)	41.2	39.28
D1900V2 / 540 (29/04/04)	41.2	39.88

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12. Simulated Tissues

12.1. The head and body mixtures consist of water and glycol. Visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

Ingredient	Frequency	
	900 MHz Head	900 MHz Body
Water	34.40%	50.75%
Salt	0.79%	0.94%
Propanediol	64.81%	0.0%
Sugar	0.0%	48.21%
Kathon	0.0%	0.10%

Ingredient	Frequency	
	1900 MHz Head	1900 MHz Body
Water	55.24%	70.17%
D.G.B.E. (Glycol)	44.45%	29.44%
Salt	0.31%	0.39%

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13. Tissue Parameters

13.1. The dielectric parameters of the fluids were verified prior to the SAR evaluation using a 58070C Dielectric Probe Kit and an 8753E Network Analyser. The dielectric parameters of the fluid are as follows:

Frequency (MHz)	Equivalent Tissue	Dielectric Constant ϵ_r	Conductivity σ (mho/m)
900 (30/04/04)	Head	42.21	0.99
900 (29/04/04)	Head	54.10	1.03
1900 (28/04/04)	Head	38.34	1.44
1900 (28/04/04)	Body	51.39	1.50
1900 (29/04/04)	Head	40.20	1.43
1900 (29/04/04)	Body	50.72	1.56

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14. DASY4 Systems Specifications

Robot System

Positioner:	Stäubli Unimation Corp. Robot Model: RX90L
Repeatability:	0.025 mm
No. of axis:	6
Serial Number:	F00/SD89A1/A/01
Reach:	1185 mm
Payload:	3.5 kg
Control Unit:	CS7
Programming Language:	V+

Data Acquisition Electronic (DAE) System

Cell Controller

PC:	Dell Precision 340
Operating System:	Windows NT
Data Card:	DASY4 Measurement Server
Serial Number:	1080

Data Converter

Features:	Signal Amplifier, multiplexer, A/D converter and control logic.
Software:	DASY4 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.
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E-Field Probe

Model:	ET3DV6
Serial No:	1528
Construction:	Triangular core fibre optic detection system
Frequency:	10 MHz to 3 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)
Probe Length (mm):	337
Probe Diameter (mm):	12
Tip Length (mm):	10
Tip Diameter (mm):	6.8
Sensor X Offset (mm):	2.7
Sensor Y Offset (mm):	2.7
Sensor Z Offset (mm):	2.7

Phantom

Phantom:	SAM Phantom
Shell Material:	Fibreglass
Thickness:	2.0 $\pm$ 0.1 mm

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15. Validation results – 900 MHz Head (Performed: 30/04/04)

15.1. System Validation

15.1.1. Validation of the system test configuration was carried out prior to testing.

Validation Dipole Type and Serial No.	Calibrated Value of SAR in 1g volume (W/kg) at 900 MHz	Measured Value of SAR in 1g volume (W/kg) at 900 MHz	Percentage Difference (<5%)
D900V2 / 124	10.60	10.92	Yes (3.02%)

Note: A 900 dipole was used to perform 850 MHz Head system validation. This was possible as the device centre frequency is within ± 100 MHz of the verification frequencies.

15.2. Liquid Properties

15.2.1. Properties of the tissue simulating liquid were measured prior to testing.

Property	Target Value (900 MHz)	Measured/Calculated Value (900 MHz)	Percentage Difference (<5%)
Relative Permittivity	41.50	42.21	Yes (1.71%)
Conductivity	0.97	0.99	Yes (2.06%)

15.3. Temperature Variation

15.3.1. The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15°C to +30°C.

15.3.2. The actual temperature measured at the beginning and end of each test was recorded and the maximum range is shown below:

Measurement	Maximum Temperature	Minimum Temperature
Laboratory	24.0	23.0
Tissue Simulating Liquid	23.0	22.3

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16. Validation results – 900 MHz Body (Performed: 29/04/04)

16.1. System Validation

16.1.1. Validation of the system test configuration was carried out prior to testing.

Validation Dipole Type and Serial No.	Calibrated Value of SAR in 1g volume (W/kg) at 900 MHz	Measured Value of SAR in 1g volume (W/kg) at 900 MHz	Percentage Difference (<5%)
D900V2 / 124	11.00	10.56	Yes (4.00%)

Note: A 900 dipole was used to perform 850 MHz Body system validation. This was possible as the device centre frequency is within ± 100 MHz of the verification frequencies.

16.2.Liquid Properties

16.2.1. Properties of the tissue simulating liquid were measured prior to testing.

Property	Target Value (900 MHz)	Measured/Calculated Value (900 MHz)	Percentage Difference (<5%)
Relative Permittivity	55.00	54.10	Yes (1.64%)
Conductivity	1.05	1.03	Yes (1.90%)

16.3. Temperature Variation

16.3.1. The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15°C to +30°C.

16.3.2. The actual temperature measured at the beginning and end of each test was recorded and the maximum range is shown below:

Measurement	Maximum Temperature	Minimum Temperature
Laboratory	24.0	24.0
Tissue Simulating Liquid	23.5	23.4

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17. Validation results – 1900 MHz Head (Performed: 28/04/04)

17.1. System Validation

17.1.1. Validation of the system test configuration was carried out prior to testing.

Validation Dipole Type and Serial No.	Calibrated Value of SAR in 1g volume (W/kg) at 1900 MHz	Measured Value of SAR in 1g volume (W/kg) at 1900 MHz	Percentage Difference (<5%)
D1900V2 / 540	41.20	39.28	Yes (4.66)

Note: 1900 MHz Head system validation was performed in place of 1900 MHz Body validation.

17.2. Liquid Properties

17.2.1. Properties of the tissue simulating liquid were measured prior to testing.

Property (Head)	Target Value (1900 MHz)	Measured/Calculated Value (1900 MHz)	Percentage Difference (<5%)
Relative Permittivity	40.00	38.34	Yes (4.15%)
Conductivity	1.40	1.44	Yes (2.86%)

Property (Body)	Target Value (1900 MHz)	Measured/Calculated Value (1900 MHz)	Percentage Difference (<5%)
Relative Permittivity	53.30	51.39	Yes (3.58%)
Conductivity	1.52	1.50	Yes (1.32%)

17.3. Temperature Variation

17.3.1. The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15°C to +30°C.

17.3.2. The actual temperature measured at the beginning and end of each test was recorded and the maximum range is shown below:

Measurement	Maximum Temperature	Minimum Temperature
Laboratory	24.0	23.0
Tissue Simulating Liquid	23.6	22.7

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18. Validation results – 1900 MHz Head (Performed: 29/04/04)

18.1. System Validation

18.1.1. Validation of the system test configuration was carried out prior to testing.

Validation Dipole Type and Serial No.	Calibrated Value of SAR in 1g volume (W/kg) at 1900 MHz	Measured Value of SAR in 1g volume (W/kg) at 1900 MHz	Percentage Difference (<5%)
D1900V2 / 540	41.20	39.88	Yes (3.20%)

Note: 1900 MHz Head system validation was performed in place of 1900 MHz Body validation.

18.2. Liquid Properties

18.2.1. Properties of the tissue simulating liquid were measured prior to testing.

Property (Head)	Target Value (1900 MHz)	Measured/Calculated Value (1900 MHz)	Percentage Difference (<5%)
Relative Permittivity	40.00	40.20	Yes (0.50%)
Conductivity	1.40	1.43	Yes (2.14%)

Property (Body)	Target Value (1900 MHz)	Measured/Calculated Value (1900 MHz)	Percentage Difference (<5%)
Relative Permittivity	53.30	50.72	Yes (4.84%)
Conductivity	1.52	1.56	Yes (2.63%)

18.3. Temperature Variation

18.3.1. The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15°C to +30°C.

18.3.2. The actual temperature measured at the beginning and end of each test was recorded and the maximum range is shown below:

Measurement	Maximum Temperature	Minimum Temperature
Laboratory	24.0	24.0
Tissue Simulating Liquid	23.7	23.5

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19. Measurement Uncertainty

19.1. No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

19.2. The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

19.3. The uncertainty of the result may need to be taken into account when interpreting the measurement results.

19.4. The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
Specific Absorption Rate	900MHz	95%	$\pm 17.12\%$
Specific Absorption Rate	1900MHz	95%	$\pm 17.12\%$

19.5. The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

19.6. Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environment. However, the estimated measurement uncertainties in SAR are less than 30%.

19.7. According to ANSI/IEEE C95.3, the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of ± 1 to 3 dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least ± 2 dB can be expected.

19.8. According to CENELEC, typical worst-case uncertainty of field measurements is ± 5 dB. For well-defined modulation characteristics the uncertainty can be reduced to ± 3 dB.

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**19.1. Specific Absorption Rate Uncertainty at 900 MHz, GSM Modulation Scheme
calculated in accordance with IEEE 1528-200X**

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	c_i	Standard Uncertainty		u_i or u_{eff}
							+ u (dB μ V)	- u (dB μ V)	
B	Probe calibration	8.900	8.900	normal (k=2)	2.0000	1.0000	4.450	4.450	∞
B	Axial Isotropy	0.100	0.100	normal (k=2)	2.0000	1.0000	0.050	0.050	∞
B	Hemispherical Isotropy	0.100	0.100	normal (k=2)	2.0000	1.0000	0.050	0.050	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	2.330	2.330	Rectangular	1.7321	1.0000	1.345	1.345	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.650	0.650	normal (k=2)	2.0000	1.0000	0.325	0.325	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	0.005	0.005	Rectangular	1.7321	1.0000	0.003	0.003	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration/ Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	0.584	0.584	normal (k=1)	1.0000	1.0000	0.584	0.584	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (measured value)	2.440	2.440	Rectangular	1.7321	1.0000	1.409	1.409	∞
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Permittivity (measured value)	2.440	2.440	Rectangular	1.7321	1.0000	1.409	1.409	∞
	Combined standard uncertainty			t-distribution			8.74	8.74	>500
	Expanded uncertainty			k = 1.96			17.12	17.12	>500

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19.2. Specific Absorption Rate Uncertainty at 1900 MHz, GSM Modulation
Scheme calculated in accordance with IEEE 1528-200X

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i	Standard Uncertainty		U _i or U _{eff}
							+ u (dBμV)	- u (dBμV)	
B	Probe calibration	8.900	8.900	normal (k=2)	2.0000	1.0000	4.450	4.450	∞
B	Axial Isotropy	0.100	0.100	normal (k=2)	2.0000	1.0000	0.050	0.050	∞
B	Hemispherical Isotropy	0.100	0.100	normal (k=2)	2.0000	1.0000	0.050	0.050	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	2.330	2.330	Rectangular	1.7321	1.0000	1.345	1.345	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.650	0.650	normal (k=2)	2.0000	1.0000	0.325	0.325	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	0.005	0.005	Rectangular	1.7321	1.0000	0.003	0.003	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration/ Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	0.584	0.584	normal (k=1)	1.0000	1.0000	0.584	0.584	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (measured value)	2.440	2.440	Rectangular	1.7321	1.0000	1.409	1.409	∞
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Permittivity (measured value)	2.440	2.440	Rectangular	1.7321	1.0000	1.409	1.409	∞
	Combined standard uncertainty			t-distribution			8.74	8.74	>500
	Expanded uncertainty			k = 1.96			17.12	17.12	>500

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Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Model Number
A1071	Double Ridged Guide Antenna	EMCO	3115
A1094	Sony MVC FD-81	Sony	MVC - FD81
A1097	SMA Directional Coupler	MiDISCO	MDC6223-30
A1137	3dB Attenuator	Narda	779
A1174	Dielectric Probe Kit	Agilent Technologies	85070C
A1185	Probe	Schmid & Partner	ET3 DV6
A1225	Low noise Amplifier	Mini Circuits	ZHL-42
A1234	Data Acquisition Electronics	Schmid & Partner	DAE3
A1235	900MHz Validation Dipole	Schmid & Partner	D900V2
A1237	1900MHz Validation Dipole	Schmid & Partner	D1900V2
A1238	SAM Phantom	Schmid & Partner	001
A1328	Handset Positioner	Schmid & Partner	Modification
A1410	Omni Spectra	Omni Spectra	FSC 16179
C1025	Cable	Rosenberger	FA210A-1-020m
C1052	Cable	Utiflex	FA210A0030M3030
C1053	Cable	Utiflex	FA210A0003M3030
C1054	Cable	Utiflex	FA210A0001M3050A
C1090	Cable	Rosenberger	FA210A1050005050
G046	Signal Generator	Gigatronics	7100/.01-20
G0528	Robot Power Supply	Schmid & Partner	DASY
G088	PSU	Thurlby Thandar	CPX200
M1013	GSM Test set	Hewlett Packard	8922H
M1014	DCS Test set	Hewlett Packard	83220E
M1015	Network Analyser	Agilent Technologies	8753ES
M103	URY Power Meter	Rohde & Schwarz	URY
M1047	Robot Arm	Staubli	RX908 L
M1069	Diode Power Sensor	Rohde & Schwarz	NRV-Z2

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Test Equipment Used (Continued)

RFI No.	Instrument	Manufacturer	Model Number
M1093	Will'tek	Will'tek	4202S
M1130	Power Sensor	Rohde & Schwarz	URY-Z2
M136	Temperature/Humidity/Pressure Meter	RS Components	None
M509	Thermometer	Testo	110
S256	Site 56	RFI	N/A