



TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Sendo Ltd.
SND251 Mobile Telephone Handset

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

Test Report Serial No:
RFI/SARB1/RP43652JD05A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	Checked By: 
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Issue Date: 03 October 2002	Test Dates: 04 September 2002

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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The results in this report apply only to the sample(s) tested.

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RADIO FREQUENCY INVESTIGATION LTD.

TEST REPORT

EMC Department

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1. Client Information

1.1. Client Details

Company Name:	Sendo Ltd.
Address:	Sendo Base Station, Hatchford Brook, Hatchford Way, Sheldon, Birmingham, B26 3QA.
Contact Name:	Mr. M. Roper.

1.2. Test Laboratory

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

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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	SND 251
Unique Type Identification	SND 251
IMEI Number	0010310167526
Battery Serial Number	8D47-02140-200000091T
Country Of Manufacture	Czech Republic
Date Of Receipt	03 September 2002

Brand Name	Sendo
Model Name or Number	Personal Hands Free Headset 8P02-02000-21000
Unique Type Identification	8P02-02000-21000 (Sales Pack Part Number: 8M14-02000-20000)
Serial Number	As above, including 6 digit date code DD/WW/YY on plastic bag
Country Of Manufacture	China
Date Of Receipt	03 September 2002

Brand Name	Sendo
Model Name or Number	Case (2 types)
Unique Type Identification	None Stated by client
Serial Number	None Stated by client
Country Of Manufacture	None Stated by client
Date Of Receipt	03 September 2002

2.2. Modifications Incorporated In EUT

The EUT has not been modified from what is described by the Model Name and Unique Type Identification stated above.

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2.3. Additional Information Related to the EUT

Equipment Class:	Handheld Mobile Telephone
FCC Rule Part(s):	OET Bulletin 65 Supplement C
Application Type:	Certification
Transmitter Frequency Range 850 MHz Band (MHz):	824.2 – 849.0
Receiver Frequency Range 850 MHz Band (MHz):	869.0 – 894.0
Transmitter Frequency Range 1900 MHz Band (MHz):	1850 – 1910
Receiver Frequency Range 1900 MHz Band (MHz):	1930 – 1990
Transmit Frequency Allocation Of EUT When Under Test (Channels):	850 MHz – 128, 189, 251 1900 MHz – 512, 660, 810
Modulation(s):	GSM 850 and GSM 1900
Modulation Scheme (Crest Factor)	GSM (Crest Factor 8)
Measured Output Power (Max Conducted): 850 MHz	Bottom Channel (128): 32.7 dBm Middle Channel (189): 32.9 dBm Top Channel (251): 33.1 dBm
Measured Output Power (Max Conducted): 1900 MHz	Bottom Channel (512): 30.0dBm Middle Channel (660): 29.9 dBm Top Channel (810): 29.6 dBm
Battery Type(s):	Rechargeable NiMH
Antenna Length and Type:	Fixed Integral
Number Of Antenna Positions	1 (Fixed Antenna)
Intended Operating Environment:	Residential, Commercial, Light Industry
Weight:	Approx. 100 g
Dimensions (without Antenna) mm:	Approx. 50 x 25 x 100 mm
Power Supply Requirement:	
DC Supply (Volts/Amps)	Not applicable
AC Supply (Volts/Amps)	Not applicable
Internal Battery (Volts/Amps)	+ 3.6 V
Port(s):	Enclosure Personal Hands Free Connector

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2.4. Support Equipment

Description:	GSM Test set
Brand Name:	Will'tek
Model Name or Number:	4202S
Serial Number:	0513018
Cable Length And Type:	Not applicable (Air Link)
Connected to Port:	Antenna

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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 Radiofrequency Electromagnetic Fields.
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

Due to the EUT not having an external direct connection it was not possible to measure the EUT conducted power before and after each individual test case. The conducted power was however measured before and after the total test. This was done by disassembling the EUT and connecting a coaxial cable in place of the antenna. Details of this can be found in Appendix 2 of this report.

The SAR at a reference point within the phantom was also measured before and after each test case. The SAR at the reference point did not change by more than 6.0% for any test case.

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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) Operating Mode (including maximum device rating):

The EUT was tested in GSM Allocated Mode in the 850MHz and 1900 MHz frequency bands. The EUT was tested at full transmit power, at the maximum duty factor (1/8).

2) Operating Frequency Range (including maximum device rating):

The EUT was tested at the Centre, Top and Bottom channels (refer to Section 2.3, Transmitter/Receiver Frequency Range).

3) Operating Tolerances:

Not applicable.

4) Antenna Type and Operating Position(s):

The EUT has a fixed integral antenna.

5) Applicable Body-Worn Configuration:

The EUT was tested in two different cases for body worn configuration and with a personal hands free kit.

6) Battery Options that could affect the results:

The EUT was tested with a standard battery as supplied with the handset. It is not intended for any other type of battery to be used with the EUT.

7) The EUT was exercised during the test with a Will'tek 4202S GSM test set. The maximum power from the EUT was measured as 32.9 dBm (850 MHz) and 29.9 dBm (1900 MHz) at the centre channel prior to the test. The GSM test set was then set to operate the EUT at power control level 5 for GSM 850 and power level 0 for GSM 1900 (maximum power) at all times.

The EUT has no external antenna connection, therefore the SAR at a reference point was recorded before and after each test case to check for any drift. Additionally the manufacturer supplied a calibrated test jig and the output power from the EUT was checked in the jig before and after each test case. Further details of this can be found in appendix 2 of this report.

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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 (Not UKAS accredited)

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6.2. Test Results For Specific Absorption Rate - 850 MHz

6.2.1. Specific Absorption Rate - 850 MHz Band

Environmental Conditions

Temperature Variation in Lab (°C):	20.5 to 21.5
Temperature Variation in Liquid (°C):	20.2 to 20.4

Conducted Power before Test:	Refer to section 4
Conducted Power after Test:	Refer to section 4

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
Cheek	Left	128	10	0.962	1.6	0.638	Complied
Cheek	Left	189	10	0.979	1.6	0.621	Complied
Cheek	Left	251	10	1.070	1.6	0.530	Complied
Tilted	Left	189	7	0.667	1.6	0.933	Complied
Cheek	Right	189	10	0.839	1.6	0.761	Complied
Tilted	Right	189	7	0.528	1.6	1.072	Complied

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6.3. Test Results For Specific Absorption Rate - 850 MHz**6.3.1. Specific Absorption Rate - 850 MHz Band – Body Worn Position****Environmental Conditions**

Temperature Variation in Lab (°C):	21.5 to 21.5
Temperature Variation in Liquid (°C):	20.1 to 20.1

Conducted Power before Test:	Refer to section 4
Conducted Power after Test:	Refer to section 4

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
Body With Case1	Flat	189	14	0.435	1.6	1.165	Complied
Body with Case 2	Flat	189	18	0.368	1.6	1.232	Complied
Body With Case 1 and PHF	Flat	189	14	0.299	1.6	1.301	Complied
Body With Case 2 and PHF	Flat	189	18	0.247	1.6	1.353	Complied

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6.4. Test Results For Specific Absorption Rate - 1900 MHz**6.4.1. Specific Absorption Rate - 1900 MHz Band****Environmental Conditions**

Temperature Variation in Lab (°C):	20.5 to 21.5
Temperature Variation in Liquid (°C):	19.7 to 19.4

Conducted Power before Test:	Refer to section 4
Conducted Power after Test:	Refer to section 4

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
Cheek	Left	512	10	1.380	1.6	0.220	Complied
Cheek	Left	660	10	1.320	1.6	0.280	Complied
Cheek	Left	810	10	1.390	1.6	0.210	Complied
Tilted	Left	660	7	0.998	1.6	0.602	Complied
Cheek	Right	660	10	0.890	1.6	0.710	Complied
Tilted	Right	660	7	0.877	1.6	0.723	Complied

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6.5. Test Results For Specific Absorption Rate - 1900 MHz**6.5.1. Specific Absorption Rate - 1900 MHz Band – Body Worn Position****Environmental Conditions**

Temperature Variation in Lab (°C):	20.5 to 21.5
Temperature Variation in Liquid (°C):	19.7 to 19.4

Conducted Power before Test:	Refer to section 4
Conducted Power after Test:	Refer to section 4

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
Body With Case1	Flat	660	14	0.388	1.6	1.212	Complied
Body with Case 2	Flat	660	18	0.253	1.6	1.347	Complied
Body With Case 1 and PHF	Flat	660	14	0.371	1.6	1.229	Complied
Body With Case 2 and PHF	Flat	660	18	0.206	1.6	1.394	Complied

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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 test device reference point aligned with the ear reference point 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) The EUT was tested in a body-worn configuration with the handset placed in the belt holster which was placed on the device holder with the back of the phone facing parallel to, and the belt-clip touching, the outer surface of the phantom flat section. The belt holster provided a spacing between the back of the phone and the outer surface of the phantom flat section.
- f) 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.
- g) The device was keyed to operate continuously in the transmit mode for the duration of the test.
- h) The location of the maximum spatial SAR distribution (Hot Spot) was determined relative to the handset and its antenna.
- i) 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 DASY3 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 and a 900 MHz dipole was used. A forward power of 250 mW was applied to the dipole and the system was verified to a tolerance of $\pm 5\%$. The applicable verification (normalised to 1 Watt) is as follows:

Dipole Validation Kit	Target SAR 1g (w/kg)	Measured SAR 1g (w/kg)
D900V2	11.28	11.4
D1900V2	42.4	43.6

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12. Simulated Tissues

12.1. The brain and muscle mixtures consist of water and organic solvent. 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	
	1900 MHz Brain	1900 MHz Muscle
Water	10.96 Litres	14.01 Litres
D.G.B.E. (Organic Solvent)	8.97 Litres	6.0 Litres
Salt	0.064 grams	42 grams

Ingredient	Frequency	
	850 MHz Brain	
Water	8.6 Litres	
1,2 Propanediol. (Organic Solvent)	16.2 Litres	
Salt	197.5 grams	

Ingredient	Frequency	
	850 MHz Muscle	
Water	15.8 Litres	
Sugar	15.0 kilograms	
Salt	293 grams	
Kathon (Antibacterial Agent)	30 grams	

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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)
1850-1910	Brain	$38.87 \pm 10\%$	$1.5 \pm 10\%$
1850-1910	Muscle	$53.68 \pm 10\%$	$1.55 \pm 10\%$
824-849	Brain	$41.50 \pm 10\%$	$0.90 \pm 10\%$
824-849	Muscle	$55.20 \pm 10\%$	$0.90 \pm 10\%$

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14. DASY3 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 Optiplex GX110
Operating System:	Windows NT
Data Card:	DASY3 PC-Board
Serial Number:	220

Data Converter

Features:	Signal Amplifier, multiplexer, A/D converter and control logic.
Software:	DASY3 Software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock.

PC Interface Card

Function:	24 bit (64 MHz) DSP for real time processing Link to DAE3 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.
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E-Field Probe

Model:	ET3DV6
Serial No:	1529
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 ± 0.1 mm

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15. Validation results – 900 MHz (for 850 MHz)**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 850 MHz	Measured Value of SAR in 1g volume (W/kg) at 850 MHz	Percentage Difference (<6%)
D900V2 / 124	11.28	11.40	Yes

15.2. Liquid Properties - Brain

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

Property	Target Value (850 MHz)	Measured/Calculated Value (850 MHz)	Percentage Difference (<10%)
Relative Permittivity	41.5	41.32	Yes
Conductivity	0.90	0.95	Yes

15.3. Liquid Properties - Body

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

Property	Target Value (850 MHz)	Measured/Calculated Value (850 MHz)	Percentage Difference (<10%)
Relative Permittivity	55.2	54.1	Yes
Conductivity	0.97	0.91	Yes

15.4. Temperature Variation

15.4.1. The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15°C to +25°C.

15.4.2. 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	21.5	20.5
Tissue Simulating Liquid	20.4	20.1

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16. Validation results – 1900 MHz**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 1900 MHz	Measured Value of SAR in 1g volume (W/kg) at 1900 MHz	Percentage Difference (<6%)
D1900V2 / 540	42.4	43.6	Yes

16.2. Liquid Properties - Brain

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

Property	Target Value (1900 MHz)	Measured/Calculated Value (1900 MHz)	Percentage Difference (<10%)
Relative Permittivity	40.0	39.7	Yes
Conductivity	1.40	1.52	Yes

16.3. Liquid Properties - Body

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

Property	Target Value (1900 MHz)	Measured/Calculated Value (1900 MHz)	Percentage Difference (<10%)
Relative Permittivity	53.3	54.15	Yes
Conductivity	1.52	1.60	Yes

16.4. Temperature Variation

16.4.1. The temperature of the laboratory and within the tissue simulating liquid for this test shall not exceed the range +15°C to +25°C.

16.4.2. 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	21.5	20.5
Tissue Simulating Liquid	19.7	19.4

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17. Measurement Uncertainty

17.1. 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.

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

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

17.4. 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	850 MHz	95%	$\pm 17.51\%$
Specific Absorption Rate	1900 MHz	95%	$\pm 18.02\%$

17.5. 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.

17.6. 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%.

17.7. 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.

17.8. 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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SND251 Mobile Telephone Handset

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

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

Type of Uncertainty	Source of uncertainty			Value $\pm\%$	Probability distribution	Divisor	C_i	$U_i()$ $\pm$	V_i or V_{eff}
B	Probe Calibration			9.5000	Normal	2.0000	1.0000	4.7500	∞
B	Axial Isotropy			2.3000	Rectangular	1.7321	0.7000	0.9295	∞
B	Hemispherical Isotropy			4.7000	Rectangular	1.7321	0.7000	1.8995	∞
B	Spatial Resolution			0.5000	Rectangular	1.7321	1.0000	0.2887	∞
B	Boundary Effect			0.7390	Rectangular	1.7321	1.0000	0.4267	∞
B	Linearity			2.3300	Rectangular	1.7321	1.0000	1.3452	∞
B	Detecton Limits			0.2000	Rectangular	1.7321	1.0000	0.1155	∞
B	Readout Electronics			0.6500	Normal	2.0000	1.0000	0.3250	∞
B	Response time			0.0000	Rectangular	1.7321	1.0000	0.0000	∞
B	Integration Time			0.0040	Rectangular	1.7321	1.0000	0.0023	∞
B	RF Ambient Conditions			3.0000	Rectangular	1.7321	1.0000	1.7321	∞
B	Probe Positioner Mech. Restrictions			6.6700	Rectangular	1.7321	1.0000	3.8509	∞
B	Probe Positioning with regard to Phantom Shell			2.8500	Rectangular	1.7321	1.0000	1.6454	∞
B	Extrapolation and Integration/Max SAR Evaluation			5.0800	Rectangular	1.7321	1.0000	2.9329	∞
A	Test Sample Positioning			0.5840	Normal	1.0000	1.0000	0.5840	10
A	Device Holder Uncertainty			0.1540	Rectangular	1.7321	1.0000	0.0889	10
B	Drift of output power			5.0000	Rectangular	1.7321	1.0000	2.8868	∞
B	Phantom Uncertainty			4.0000	Rectangular	1.7321	1.0000	2.3094	∞
B	Liquid conductivity (target value)			5.0000	Rectangular	1.7321	0.7000	2.0207	∞
B	Liquid conductivity (measured value)			2.4400	Rectangular	1.7321	0.7000	0.9861	∞
B	Liquid Permittivity (target value)			5.0000	Rectangular	1.7321	0.6000	1.7321	∞
B	Liquid Permittivity (measured value)			2.4400	Rectangular	1.7321	0.6000	0.8452	∞
	Combined standard uncertainty				normal			9.01	>500
	Expanded uncertainty				normal k=2			18.02	>500

Statement of Confidence:-

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Test Of: Sendo Ltd.

SND251 Mobile Telephone Handset

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

Specific Absorption Rate Uncertainty at 850 MHz, GSM Modulation Scheme calculated in accordance with IEEE 1528-200X

Type of Uncertainty	Source of uncertainty			value	Probability distribution	Divisor	c _i	u _i ()	v _i or v _{eff}
B	Probe Calibration			9.5000	Normal	2.0000	1.0000	4.7500	∞
B	Axial Isotropy			2.3000	Rectangular	1.7321	0.7000	0.9295	∞
B	Hemispherical Isotropy			4.7000	Rectangular	1.7321	0.7000	1.8995	∞
B	Spatial Resolution			0.5000	Rectangular	1.7321	1.0000	0.2887	∞
B	Boundary Effect			0.7390	Rectangular	1.7321	1.0000	0.4267	∞
B	Linearity			2.3300	Rectangular	1.7321	1.0000	1.3452	∞
B	Detection Limits			0.2000	Rectangular	1.7321	1.0000	0.1155	∞
B	Readout Electronics			0.6500	Normal	2.0000	1.0000	0.3250	∞
B	Response time			0.0000	Rectangular	1.7321	1.0000	0.0000	∞
B	Integration Time			0.0040	Rectangular	1.7321	1.0000	0.0023	∞
B	RF Ambient Conditions			3.0000	Rectangular	1.7321	1.0000	1.7321	∞
B	Probe Positioner Mech. Restrictions			6.6700	Rectangular	1.7321	1.0000	3.8509	∞
B	Probe Positioning with regard to Phantom Shell			2.8500	Rectangular	1.7321	1.0000	1.6454	∞
B	Extrapolation and Integration/Max SAR Evaluation			5.0800	Rectangular	1.7321	1.0000	2.9329	∞
A	Test Sample Positioning			0.5840	Normal	1.0000	1.0000	0.5840	10
A	Device Holder Uncertainty			0.3070	Rectangular	1.7321	1.0000	0.1772	10
B	Drift of output power			5.0000	Rectangular	1.7321	1.0000	2.8868	∞
B	Phantom Uncertainty			4.0000	Rectangular	1.7321	1.0000	2.3094	∞
B	Liquid Conductivity (deviation from target)			3.1210	Rectangular	1.7321	0.7000	1.2613	∞
B	Liquid Conductivity (measurement error)			2.4400	Rectangular	1.7321	0.7000	0.9861	∞
B	Liquid Permittivity (deviation from target)			2.7930	Rectangular	1.7321	0.6000	0.9675	∞
B	Liquid Permittivity (measurement error)			2.4400	Rectangular	1.7321	0.6000	0.8452	∞
	Combined standard uncertainty				normal			8.75	>500
	Expanded uncertainty				normal k=2			17.51	>500

Statement of Confidence:-

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

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Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A1174	Dielectric Probe Kit	Agilent Technologies	85070C	Us99360072
A1182	Handset Positioner	Schmid & Partners	V3.0	None
A1184	Data Acquisition Electronics	Schmid & Partners	DAE	394
A1186	Probe	Schmid & Partners	ET3 DV6	1529
A1225	Low noise Amplifier	Mini Circuits	ZHL-42	E022601
A1235	900MHz Validation dipole	Schmid & Partners	D900V2	124
A1237	1900MHz Validation Dipole	Schmid & Partners	D1900V2	540
A1238	SAM Phantom	Schmid & Partners	001	001
G046	Signal Generator	Gigatronics	7100/.01-20	749474
G0528	Robot Power Supply	Schmid & Partner	Dasy3	None
M037	RF Power Meter	Rohde & Schwarz	URY	891.259/053
M292	Baro/Hygro/Thermo meter	Oregon Scientific	BA888	M292-05081999
M1047	Robot Arm	Staubli	RX908 L	F00/SD89A1/A/01
M1049	Power meter head	Rohde & Schwarz	URY Z2	891 647/80
M1015	Network Analyser	Agilent Technologies	8753ES	US39172406
M1069	Diode Power Sensor	Rohde & Schwarz	NRV-Z2	838824/010
S256	SAR Lab	RFI	N/A	N/A

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Appendix 2. Measurement Methods

Conducted Power Output.

Before the test, the antenna was removed from the EUT and a direct coaxial cable was connected. The conducted output power was then measured. Once the measurements were complete, the coaxial cable was removed and the antenna replaced. The EUT was then re-assembled.

A test jig was supplied by the client, which allowed the EUT to be placed within it at a repeatable position which allowed the test engineer to measure the radiated power output of the EUT. A calibration factor was calculated to allow for the difference between the measurement in the test jig and the conducted power output measurement.

The EUT power output before and after each test case was then measured in the test jig and the relevant factors applied to show a true power output value.

At the conclusion of the total test the antenna was once again swapped for the coaxial cable and the power output was verified.

The conducted power output of the EUT and the test jig calibration factors are as follows:-

Channel ARFCN 850 MHz	Conducted Power out (dBm)	Calibration Factor (dB)
Bottom (128)	32.7	5.5
Middle (189)	32.9	6
Top (251)	33.1	6.2

Channel ARFCN 1900 MHz	Conducted Power out (dBm)	Calibration Factor (dB)
Bottom (512)	30.0	14.3
Middle (660)	29.9	15.9
Top (810)	29.6	16.5

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The conducted power output at the conclusion of the test was as follows: -

850 MHz: -

Channel ARFCN 850 MHz	Conducted Power out (dBm)
Bottom (128)	32.2
Middle (189)	32.2
Top (251)	32.4

1900 MHz: -

Channel ARFCN 1900 MHz	Conducted Power out (dBm)
Bottom (512)	29.3
Middle (660)	29.9
Top (810)	29.7

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Carrier Output Power – Results:-

Power measurements were taken before and after each test case in the supplied test jig.
The results are as follows.

850 MHz Head:

Position	Side of Head	ARFCN	Tx Power Before test	Tx Power After test
Cheek	Left	189	32.3	32.0
Tilted	Left	189	32.2	32.2
Cheek	Right	189	32.2	32.2
Tilted	Right	189	32.2	32.0
Cheek	Left	128	32.0	32.0
Cheek	Left	251	32.3	32.4

850 MHz Body:

Position	Side of Head	ARFCN	Tx Power Before test	Tx Power After test
Body With Case 1	Flat	189	32.3	32.1
Body With Case 2	Flat	189	32.1	32.1
Body With Case 1 and PHF	Flat	189	32.1	32.2
Body With Case 2 and PHF	Flat	189	32.2	32.1

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1900 MHz Head:

Position	Side of Head	ARFCN	Tx Power Before test	Tx Power After test
Cheek	Left	660	30.8	30.8
Cheek	Left	512	30.0	29.97
Cheek	Left	810	30.0	30.2
Tilted	Left	660	29.9	30.3
Cheek	Right	660	29.9	29.8
Tilted	Right	660	29.8	29.7

1900 MHz Body:

Position	Side of Head	ARFCN	Tx Power Before test	Tx Power After test
Body With Case 1	Flat	660	29.2	29.2
Body With Case 2	Flat	660	29.2	29.2
Body With Case 1 and PHF	Flat	660	29.3	29.1
Body With Case 2 and PHF	Flat	660	29.1	28.9

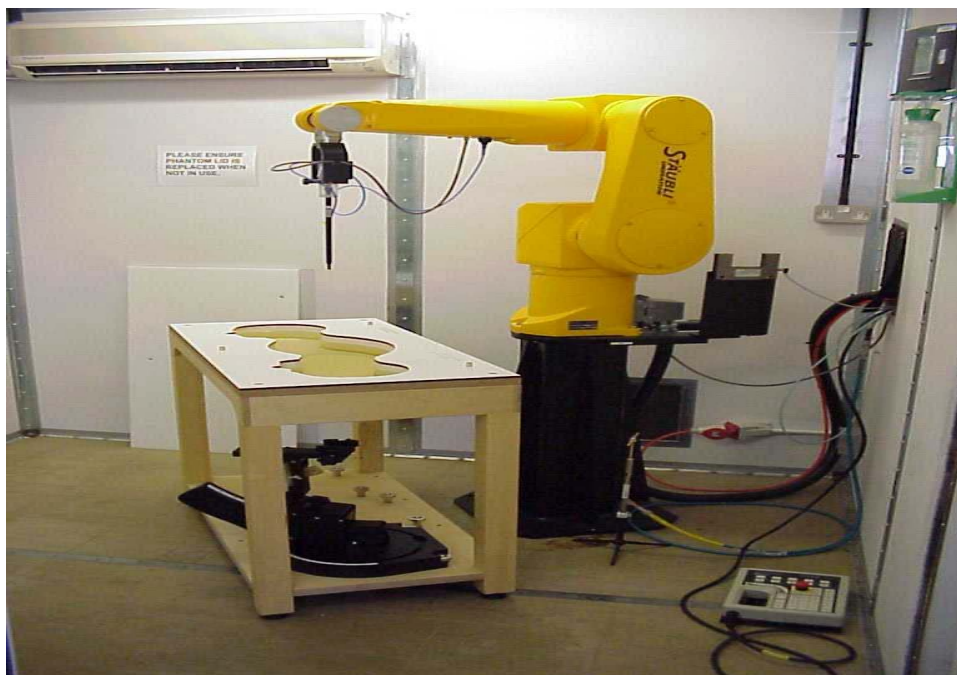
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Appendix 3. Test Configuration Photograph

This appendix contains photographs showing the test configuration for the measurement of Specific Absorption Rate (SAR)



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