TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test of: Sendo Ltd.
S331 Dual Band Mobile Handset with PHF and Case Accessory

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

Measurements were performed on the DASY4 System.

Test Report Serial No:
RFI/SARB2/RP45705JD03A

Supersedes Test Report Serial No:
RFI/SARB1/RP45705JD03A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director:	**Checked By: Joe Lomako**
Tested By: Richelieu Quoi	**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
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 Lomako

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	S331
FCC ID Number	P6PSND331
IMEI Number	004400004474589
Battery Batch Number	8D48 – 1K140 – 20000 (No Individual Identification)
Country Of Manufacture	Netherlands
Date Of Receipt	08 December 2003

Brand Name	Sendo (Personal Hands Free (PHF) Accessory)
Model Name or Number	None Stated by Client
FCC ID Number	None Stated
IMEI Number	Not Applicable
Battery Serial Number	Not Applicable
Country Of Manufacture	None Stated
Date Of Receipt	08 December 2003

Brand Name	Sendo (Case Accessory)
Model Name or Number	None Stated by Client
FCC ID Number	None Stated
IMEI Number	Not Applicable
Battery Serial Number	Not Applicable
Country Of Manufacture	None Stated
Date Of Receipt	08 December 2003

2.2. Modifications Incorporated In EUT

The client has stated that the EUT has not been modified from what is described by the model number or unique type identification number stated above.

2.3. Additional Information Related to the EUT

Equipment Class:	Handheld Mobile Telephone
FCC Rule Part(s):	OET Bulletin 65 Supplement C
Device Category:	Portable
Application Type:	Certification
Maximum Power Output:	850 MHz – 29 dBm / Tx Level 7 1900 MHz – 30dBm / Tx Level 0
Transmit Frequency Allocation Of EUT When Under Test (Channels):	1900MHz Band: 512, 660, 810. 850 MHz Band: 128, 189, 251.
Modulation(s):	GSM
Modulation Scheme (Crest Factor)	GSM (Crest Factor 8.3)
Battery Type(s):	Li - Ion
Antenna Length and Type:	External
Number Of Antenna Positions	1 (Fixed Antenna)
Intended Operating Environment:	Mobile
Weight:	Approx. 90 g
Dimensions (without Antenna) mm:	Approx. 105 (L) x 45 (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):	PHF

2.4. Support Equipment

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

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.
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.

4. Deviations From The Test Specification

None

5. Operation Of The EUT During Testing

The equipment under test is a normal laboratory environment.

5.1. Operating Modes

The EUT was tested in the following operating configurations:
Stand Alone (Full Powered).
Body Configuration with PHF & case attached.

6. Summary Of Test Results

6.1. Summary Of Tests

Test Name	Specification Reference	Compliancy Status
Specific Absorption Rate (SAR)	OET Bulletin 65 Supplement C (2001-01)	Complied

6.2. Test Results For Specific Absorption Rate – 850 MHz

6.2.1. Specific Absorption Rate - 850 MHz Band - Head

Environmental Conditions

Temperature Variation in Lab (°C):	24.0 to 25.0
Temperature Variation in Liquid (°C):	23.8 to 23.6

ERP	Refer to section 6.4

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
Touch	Left	189	10	0.317	1.6	1.283	Complied
Tilt	Left	189	7	0.149	1.6	1.451	Complied
Touch	Right	189	10	0.186	1.6	1.414	Complied
Tilt	Right	189	7	0.100	1.6	1.500	Complied
Touch	Left	128	10	0.462	1.6	1.138	Complied
Touch	Left	251	10	0.222	1.6	1.378	Complied

6.2.2. Specific Absorption Rate - 850 MHz Band - Body

Environmental Conditions

Temperature Variation in Lab (°C):	25.0 to 26.0
Temperature Variation in Liquid (°C):	25.0 to 25.0

ERP	Refer to section 6.4

Position	Section	Frequency Channel No	Distance from antenna to phantom (mm)	SAR Level (W/kg) 1g	SAR Limit (W/kg) 1g	Margin (W/kg) 1g	Result
Rear of Handset Facing Phantom	Flat	189	15	0.311	1.6	1.289	Complied
Display of Handset Facing Phantom	Flat	189	15	0.145	1.6	1.455	Complied
Rear of Handset in Case Facing Phantom	Flat	189	15	0.532	1.6	1.068	Complied
Rear of Handset in Case With PHF Facing Phantom	Flat	189	15	0.610	1.6	0.990	Complied
Rear of Handset With PHF Facing Phantom	Flat	189	15	0.261	1.6	1.339	Complied
Rear of Handset in Case With PHF Facing Phantom	Flat	128	15	0.736	1.6	0.864	Complied
Rear of Handset in Case With PHF Facing Phantom	Flat	251	15	0.545	1.6	1.055	Complied

6.3. Test Results For Specific Absorption Rate - 1900MHz

6.3.1. Specific Absorption Rate - 1900 MHz Band - Head

Environmental Conditions

Temperature Variation in Lab (°C):	24.0 to 25.0
Temperature Variation in Liquid (°C):	23.7 to 23.6

EIRP	Refer to section 6.4

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
Touch	Left	660	10	0.190	1.6	1.410	Complied
Tilt	Left	660	7	0.142	1.6	1.458	Complied
Touch	Right	660	10	0.225	1.6	1.375	Complied
Tilt	Right	660	7	0.131	1.6	1.469	Complied
Touch	Right	512	10	0.205	1.6	1.395	Complied
Touch	Right	810	10	0.161	1.6	1.439	Complied

6.3.2. Specific Absorption Rate - 1900 MHz Band - Body

Environmental Conditions

Temperature Variation in Lab (°C):	24.0 to 25.0
Temperature Variation in Liquid (°C):	24.2 to 24.4

EIRP	Refer to section 6.4

Position	Section	Frequency Channel No	Distance from antenna to phantom (mm)	SAR Level (W/kg) 1g	SAR Limit (W/kg) 1g	Margin (W/kg) 1g	Result
Rear of Handset Facing Phantom	Flat	660	15	0.214	1.6	1.386	Complied
Display of Handset Facing Phantom	Flat	660	15	0.067	1.6	1.533	Complied
Rear of Handset in Case Facing Phantom	Flat	660	15	0.353	1.6	1.247	Complied
Rear of Handset in Case With PHF Facing Phantom	Flat	660	15	0.400	1.6	1.200	Complied
Rear of Handset With PHF Facing Phantom	Flat	660	15	0.242	1.6	1.358	Complied
Rear of Handset in Case With PHF Facing Phantom	Flat	512	15	0.353	1.6	1.247	Complied
Rear of Handset in Case With PHF Facing Phantom	Flat	810	15	0.318	1.6	1.282	Complied

6.4. EIRP Measurement

ERP Measurement – 850 MHz: Performed: 12 December 2003

The ERP of the EUT is as follow: -

Frequency Channel	Tx Power After test / dBm
128	26.2
189	26.6
251	24.0

EIRP Measurement – 1900 MHz: Performed: 12 December 2003

The EIRP of the EUT is as follow: -

Frequency Channel	Tx Power After test / dBm
512	25.9
660	25.1
810	24.9

Note: Due to the build of the EUT a conducted power measurement was not possible and an ERP/EIRP measurement was performed post testing.

6.5. Verification of Device Output and SAR Drifts

Note: Due to the build of the EUT a conducted power measurement was not possible and an ERP/EIRP measurement was performed post testing. A fully charged battery was used between each SAR measurement and the SAR drift evaluated to ensure <5% drift and verify device output. Reference measurements correlating to the drift value were not directly comparable as measurements were performed for different configurations. However with the knowledge the individual batteries were charged between measurements and the SAR drift did not exceed 5%, the ERP/EIRP measurements performed post testing verified a stable device output.

850 MHz Head: Performed 08/12/03

Ref. 1 V/m	Ref. 2 V/m	Drift %	Position	Side of Head/Section	Frequency Channel No.
14.48	14.49	0.07%	Touch	Left	189
12.54	12.43	0.88%	Tilt	Left	189
11.42	11.25	1.51%	Touch	Right	189
9.659	9.652	0.07%	Tilt	Right	189
17.98	17.75	1.30%	Touch	Left	128
12.07	12.01	0.50%	Touch	Left	251

850 MHz Body: Performed 11/12/03

Ref. 1 V/m	Ref. 2 V/m	Drift %	Position	Side of Head/Section	Frequency Channel No.
18.43	18.37	0.60%	Rear of Handset Facing Phantom	Flat	189
13.22	13.15	0.53%	Display of Handset Facing Phantom	Flat	189
22.89	22.94	0.22%	Rear of Handset in Case Facing Phantom	Flat	189
25.83	25.82	0.04%	Rear of Handset in Case With PHF Facing Phantom	Flat	189
13.07	12.74	2.59%	Rear of Handset With PHF Facing Phantom	Flat	189
29.35	29.14	0.72%	Rear of Handset in Case With PHF Facing Phantom	Flat	128
24.88	24.47	1.68%	Rear of Handset in Case With PHF Facing Phantom	Flat	251

1900 MHz Head: Performed: 09 December 2003

Ref. 1 V/m	Ref. 2 V/m	Drift %	Position	Side of Head/Section	Frequency Channel No.
9.904	9.678	2.34%	Touch	Left	660
8.59	8.182	4.99%	Tilt	Left	660
11.07	11.08	0.09%	Touch	Right	660
8.96	8.689	3.12%	Tilt	Right	660
11.21	11.1	0.99%	Touch	Right	512
10.45	10.48	0.29%	Touch	Right	810

1900 MHz Body: Performed: 10 December 2003

Ref. 1 V/m	Ref. 2 V/m	Drift %	Position	Side of Head/Section	Frequency Channel No.
8.283	8.063	2.73%	Rear of Handset Facing Phantom	Flat	660
6.567	6.564	0.05%	Display of Handset Facing Phantom	Flat	660
12.36	12.39	0.24%	Rear of Handset in Case Facing Phantom	Flat	660
8.687	8.691	0.05%	Rear of Handset in Case With PHF Facing Phantom	Flat	660
7.56	7.66	1.32%	Rear of Handset With PHF Facing Phantom	Flat	660
8.765	8.629	1.58%	Rear of Handset in Case With PHF Facing Phantom	Flat	512
8.216	8.301	1.03%	Rear of Handset in Case With PHF Facing Phantom	Flat	810

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 DASY4 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 mulitplexer, 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.

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.

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.

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 or appropriate resolution.

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.

11. System Validation

11.1. Prior to the assessment, the system was verified in the flat region of the phantom. A 900/1800/1900 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:

Dipole Validation Kit	Target SAR 1g (w/kg)	Measured SAR 1g (w/kg)
D900V2/124 (08/12/03) Head	10.6	10.44
D1900V2/540 (09/12/03) Head	41.2	41.6
D1800V2/2d009 (10/12/03) Body	36.7	37.8
D900V2/124 (11/12/03) Body	11.0	10.72

12. Simulated Tissues

12.1. The brain and muscle 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
	1900MHz Brain
Water	55.24%
DGMBE	44.45%
Salt	0.31%

Ingredient	Frequency
	1900MHz Muscle
Water	70.17%
DGMBE	29.44%
Salt	0.39%

Ingredient	Frequency
	850MHz Brain
Water	34.40%
1,2-Propanediol	64.81%
Salt	0.79%

Ingredient	Frequency
	850MHz Muscle
Water	50.75%
Sugar	48.21%
Salt	0.94%
Kathon	0.10%

13. Tissue Parameters

13.1. The dielectric parameters of the fluids were verified prior to the SAR evaluation using an 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)
1900	Brain	39.79	1.43
1900	Muscle	52.15	1.50
850	Brain	41.04	0.96
850	Muscle	53.26	0.93

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 nit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.

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 ±0.1 mm

15. Validation results

15.1. System Validation – 850 MHz Head (08 December 2003)

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	10.6	10.44	Yes

Note: An 900 MHz dipole was used to perform 850 MHz Head 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	41.5	41.04	Yes
Conductivity	0.97	0.96	Yes

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 +15ºC to +30ºC.

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	25.0	24.0
Tissue Simulating Liquid	23.6	23.8

15.4. System Validation – 850 MHz Body (11 December 2003)

15.4.1. 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	11.0	10.72	Yes

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

15.5. Liquid Properties

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

Property	Target Value (835 MHz)	Measured/Calculated Value (835 MHz)	Percentage Difference (≤5%)
Relative Permittivity	55.2	53.26	Yes
Conductivity	0.97	0.93	Yes

15.6. Temperature Variation

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

15.6.2. 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	26.0	25.0
Tissue Simulating Liquid	25.0	25.0

15.7. System Validation – 1900 MHz Head (09 December 2003)

15.7.1. 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	41.2	40.8	Yes

15.8. Liquid Properties

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

Property	Target Value (1900 MHz)	Measured/Calculated Value (1900 MHz)	Percentage Difference (≤5%)
Relative Permittivity	40.0	39.79	Yes
Conductivity	1.40	1.43	Yes

15.9. Temperature Variation

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

15.9.2. 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	25.0	24.0
Tissue Simulating Liquid	23.6	23.7

15.10. System Validation –1900 MHz Body (10 December 2003)

15.10.1. 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 1800 MHz	Measured Value of SAR in 1g volume (W/kg) at 1800 MHz	Percentage Difference (≤5%)
D1800V2 / 2d009	36.7	37.8	Yes

Note: An 1800 MHz dipole was used to perform 1900 Body validation. This was possible as the device centre frequency is within ± 100 MHz of the verification frequencies.

15.11. Liquid Properties

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

Property	Target Value (1900 MHz)	Measured/Calculated Value (1900 MHz)	Percentage Difference (≤5%)
Relative Permittivity	53.3	52.15	Yes
Conductivity	1.52	1.50	Yes

15.12. Temperature Variation

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

15.12.2. 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	25.0	24.0
Tissue Simulating Liquid	24.3	24.2

16. Measurement Uncertainty

16.1. 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.

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

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

16.4. 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%	+17.12%
Specific Absorption Rate	1900 MHz	95%	+17.12%

16.5. 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.

16.6. 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%.

16.7. 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.

16.8. 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.

Measurement Uncertainty (Continued)

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

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	c_i	Standard Uncertainty		υ_i or υ_{eff}	Note
							+ 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 Ambinet 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	Drit 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	

Measurement Uncertainty (Continued)

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		υ_i or υ_{eff}	Note
							+ u (dBµV)	- u (dBµV)		
B	Probe calibration	8.900	8.900	normal (k=2)	2.0000	1.0000	4.450	4.450	∞	
B	Axail 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 Ambinet 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	Drit 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	

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Model Number
A034	Narda 20W Termination	Narda	374BNM
A1097	SMA Directional Coupler	MiDISCO	MDC6223-30
A1174	Dielectric Probe Kit	Agilent Technologies	85070C
A1185	Probe	Schmid & Partners	ET3 DV6
A1225	Low noise Amplifier	Mini Circuits	ZHL-42
A1234	Data Acquisition Electronics	Schmid & Partners	DAE3
A1235	900MHz Validation Dipole	Schmid & Partners	D900V2
A1236	1800MHz Validation Dipole	Schmid & Partners	D1800V2
A1237	1900MHz Validation Dipole	Schmid & Partners	D1900V2
A1238	SAM Phantom	Schmid & Partners	001
A1328	Handset Positioner	Schmid & Partners	Modification
A215	20 dB Attenuator	Narda	766-20
C1052	Cable	Utiflex	FA210A0030M3030
C1053	Cable	Utiflex	FA210A0003M3030
C1054	Cable	Utiflex	FA210A0001M3050A
C1059	Cable	Rosenberger	1
C360	Cable	Rosenberger	UFA210A-1-1181-70x70
G046	Signal Generator	Gigatronics	7100/.01-20
G0528	Robot Power Supply	Schmid & Partners	Dasy4
G088	PSU	Thurlby Thandar	CPX200
M011	NRV-Z1 Power Sensor	Rohde & Schwarz	NRV-Z1
M1015	Network Analyser	Agilent Technologies	8753ES
M1047	Robot Arm	Staubli	RX908 L
M1093	Will'tek	Will'tek	4202S
M1095	10V Insertion Unit 50 Ohm	Rohde & Schwarz	URY-Z2
M136	Temperature/Humidity/Pressure Meter	RS Components	None
M509	Thermometer	Testo	110
M514	RF Millivoltmeter	Rohde & Schwarz	URV-5
S256	Site 56	RFI	N/A

NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

Appendix 2. SAR Distribution Scans

This appendix contains SAR Distribution Scans.

Plot Number	Title
001	LHS_Tilt_660
002	LHS_Tilt_850
003	LHS_Touch_660
004	LHS_Touch_850
005	LHS_Worstcase_High_660
006	LHS_Worstcase_High_850
007	RHS_Right_512
008	RHS_Tilt_660
009	RHS_Tilt_850
010	RHS_Touch_660
011	RHS_Touch_810
012	RHS_Touch_850
013	System Performance Check_D850
014	System Performance Check_D1900
015	Validation 1900
016	Validation 850

Please refer to RFI/SARB2/RP45705JD03A_SAR_Distribution_Scans for actual scans.

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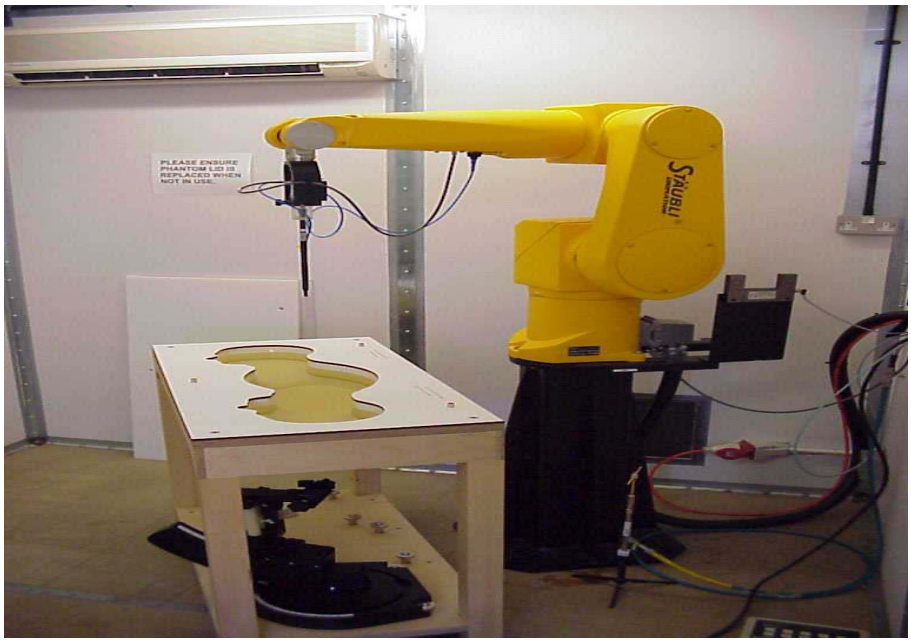
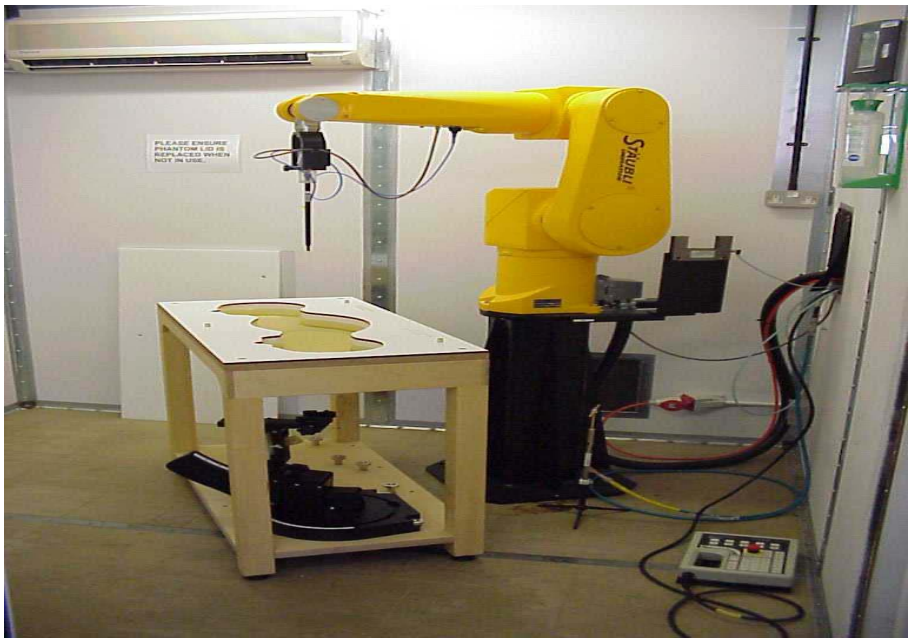
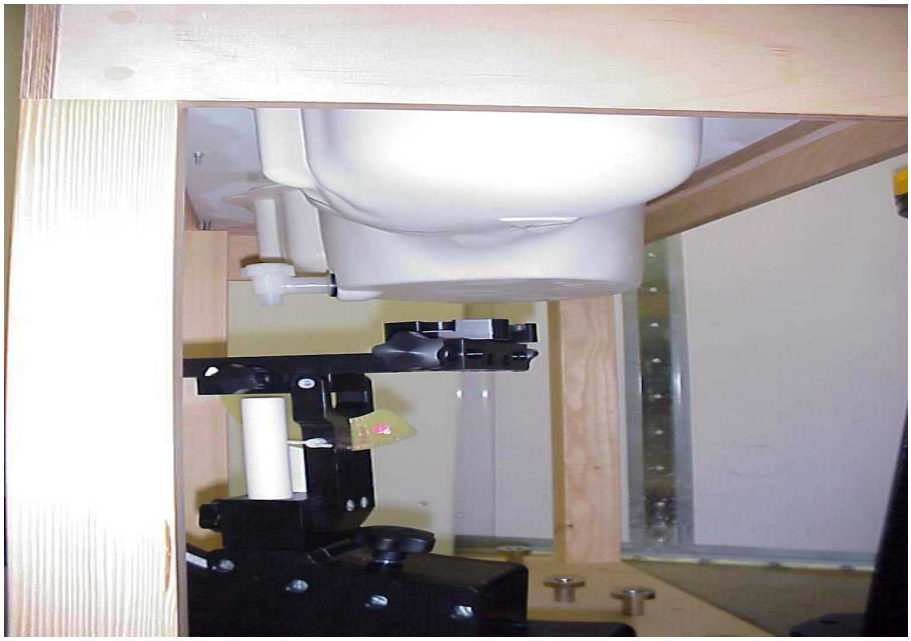
Appendix 3. Test Configuration Photographs

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





Test Configuration Photographs (Continued)



Appendix 4. Calibration Data

This appendix contains the calibration data and certificates.

Please refer to RFI/SARB2/RP45705JD03A_Calibration_Data for actual data.

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Appendix 5. Photographs of EUT

This appendix contains the following photographs

Photo Reference Number	Title
PHT/45705JD03/001	1900 MHz HSL Fluid Level
PHT/45705JD03/002	1900MHz MSL Fluid Level
PHT/45705JD03/003	850MHz HSL Fluid Level
PHT/45705JD03/004	850MHz MSL Fluid Level
PHT/45705JD03/005	Display of Handset Facing phantom
PHT/45705JD03/006	Front View of EUT in case
PHT/45705JD03/007	Front View of EUT
PHT/45705JD03/008	PHF
PHT/45705JD03/009	Rear of Handset facing Phantom
PHT/45705JD03/010	Rear of handset in case facing Phantom
PHT/45705JD03/011	Rear of Handset in Case With PHF Facing Phantom
PHT/45705JD03/012	Rear of Handset in Case With PHF Facing Phantom
PHT/45705JD03/013	Rear of Handset in Case With PHF Facing Phantom
PHT/45705JD03/014	Rear of Handset With PHF Facing Phantom
PHT/45705JD03/015	Rear of Handset with PHF Facing Phantom
PHT/45705JD03/016	Rear View of EUT in Case
PHT/45705JD03/017	Rear View of EUT
PHT/45705JD03/018	Tilt Left
PHT/45705JD03/019	Tilt Right
PHT/45705JD03/020	Touch Left
PHT/45705JD03/021	Touch Right

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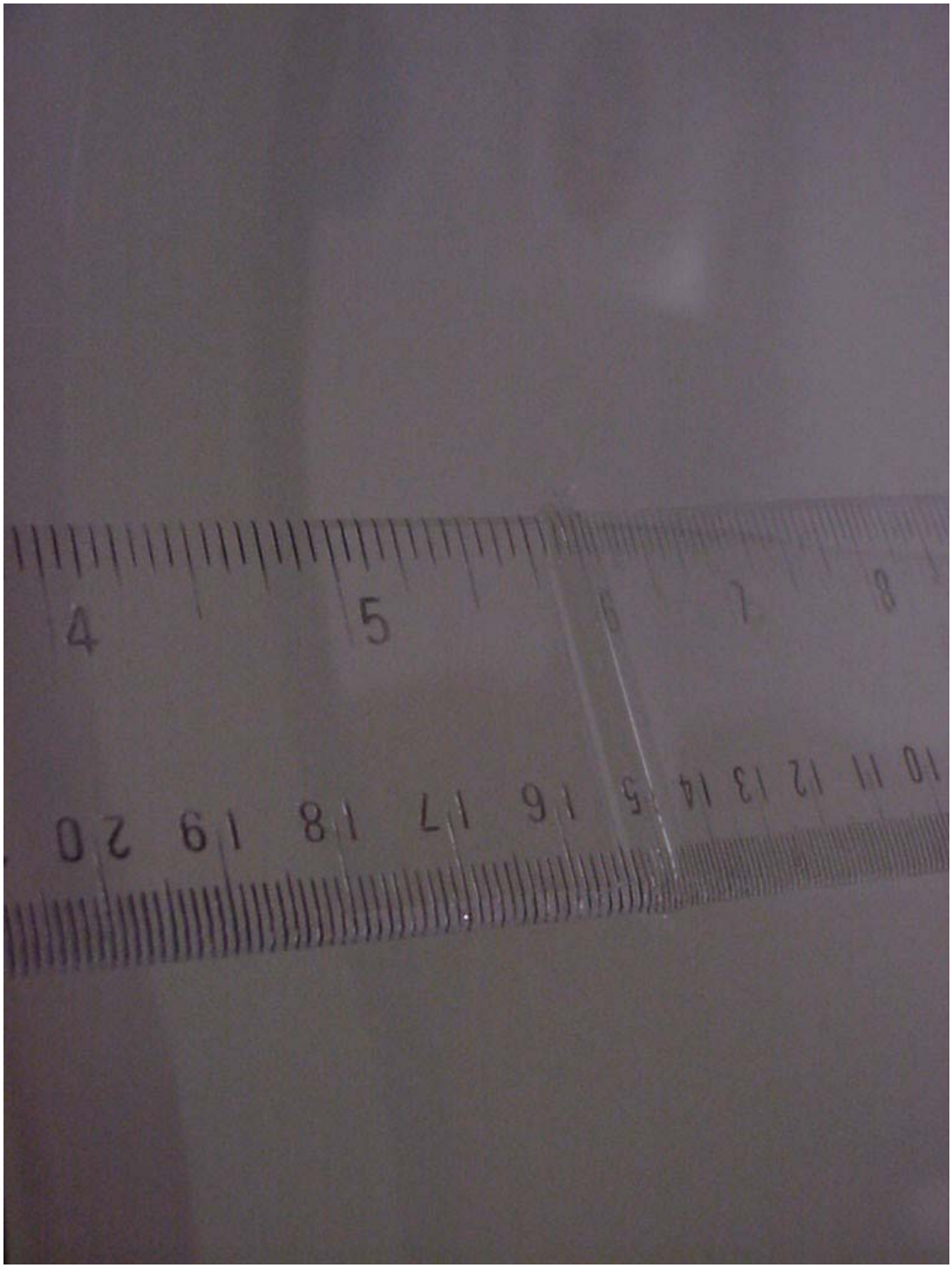
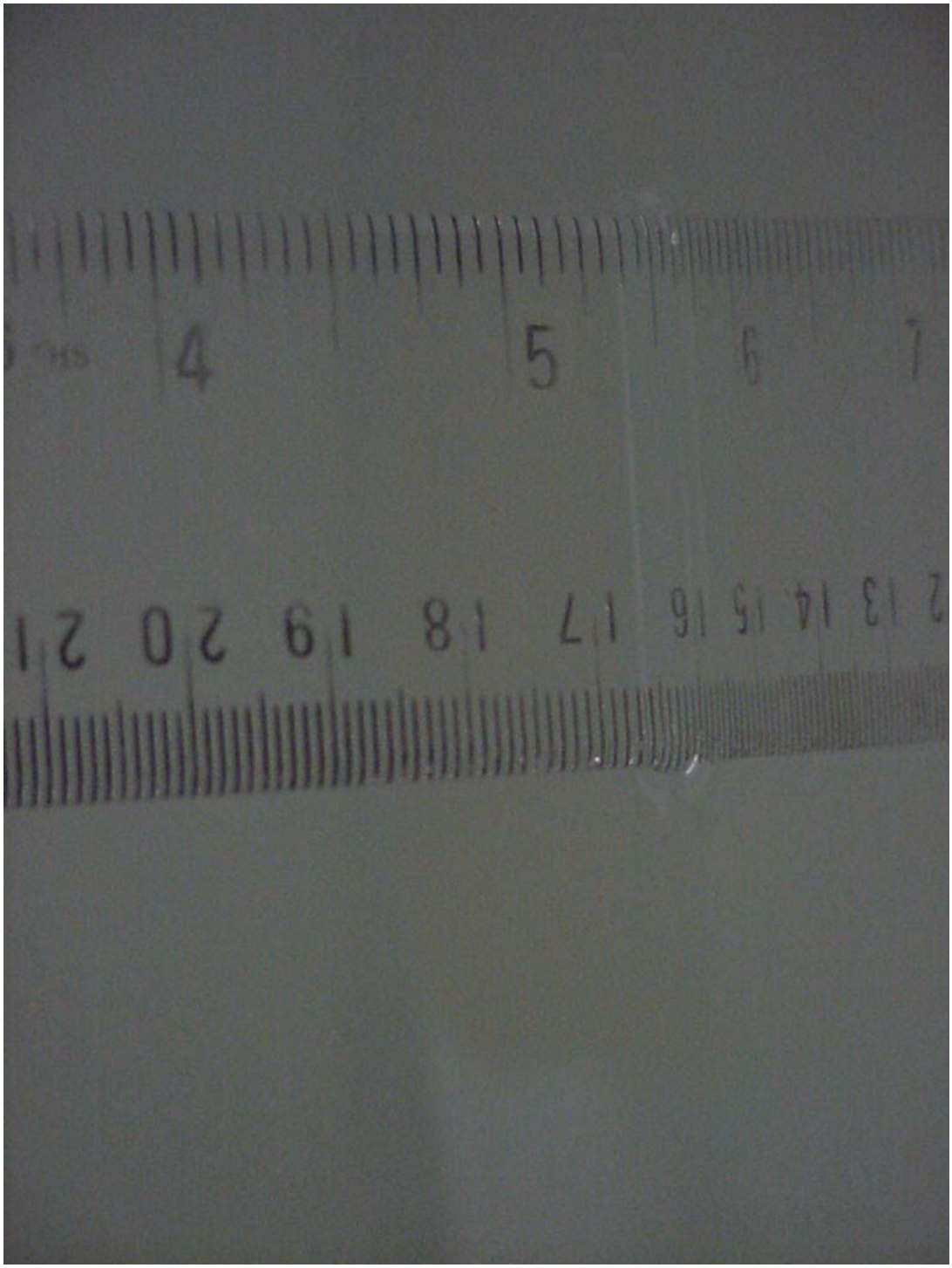
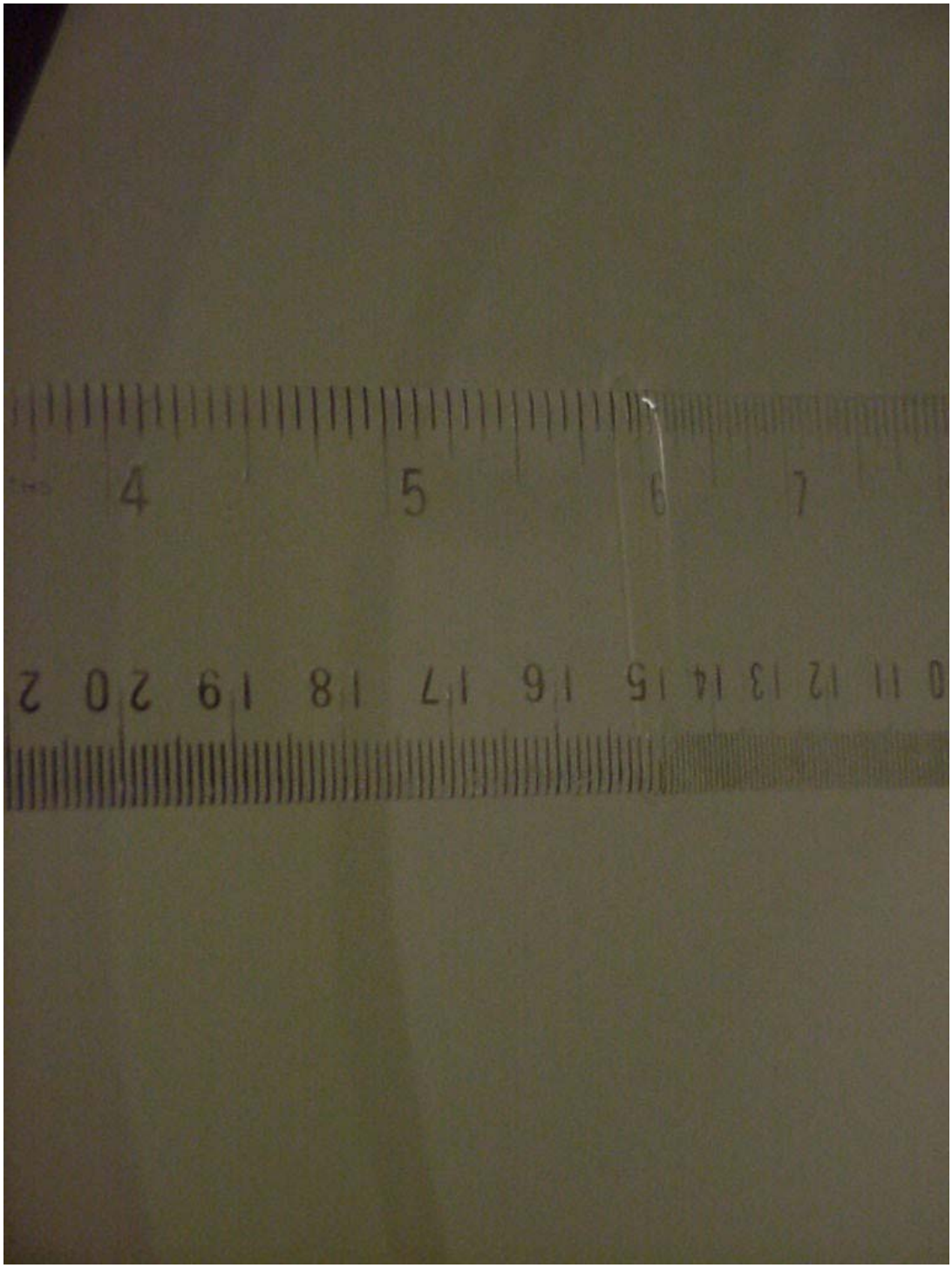
PHT/45705JD03/001 1900 MHz HSL Fluid Level



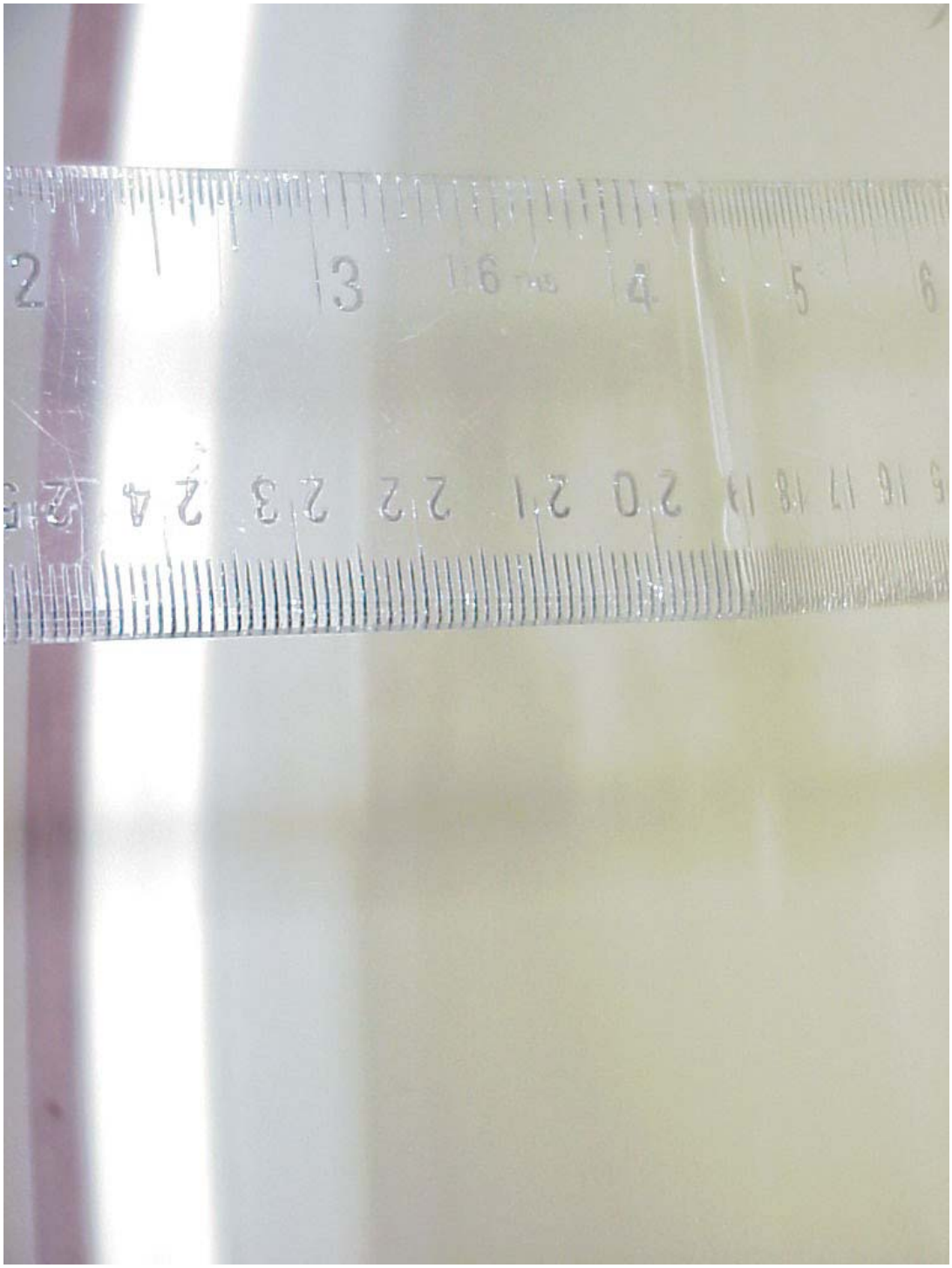
PHT/45705JD03/002 1900MHz MSL Fluid Level



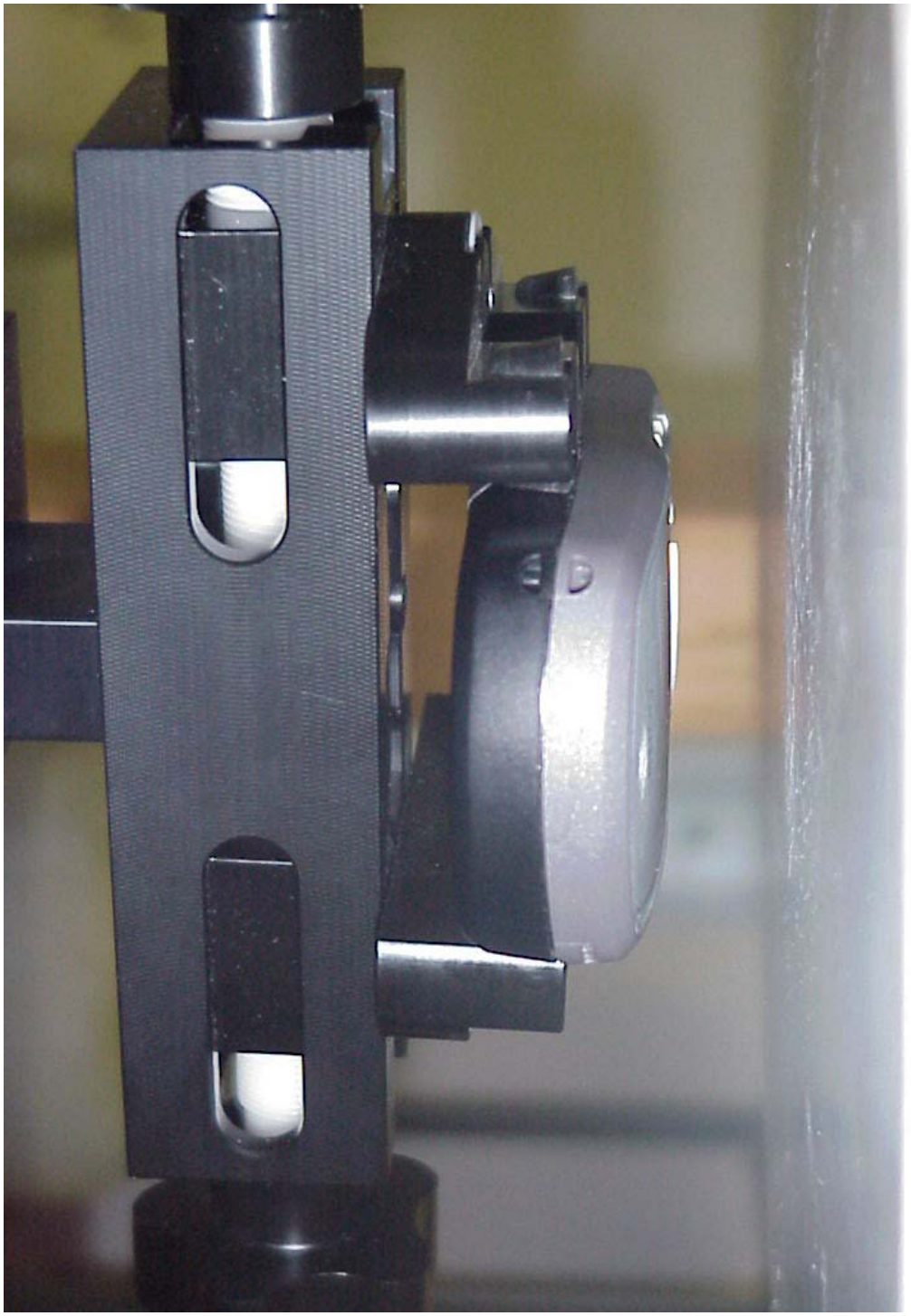
PHT/45705JD03/003 850MHz HSL Fluid Level



PHT/45705JD03/004 850MHz MSL Fluid Level



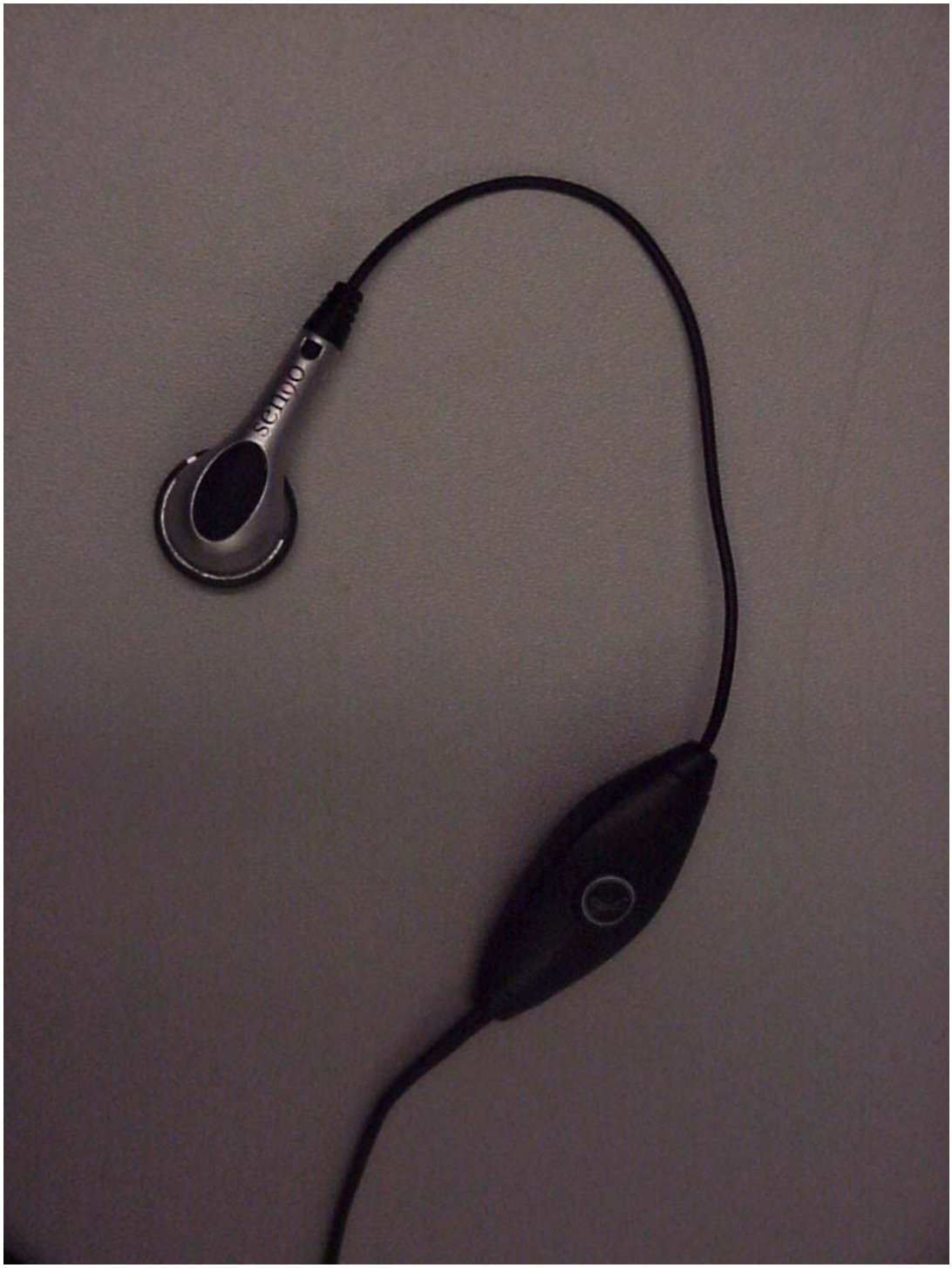
PHT/45705JD03/005 Display of Handset Facing phantom



PHT/45705JD03/006 Front View of EUT in case

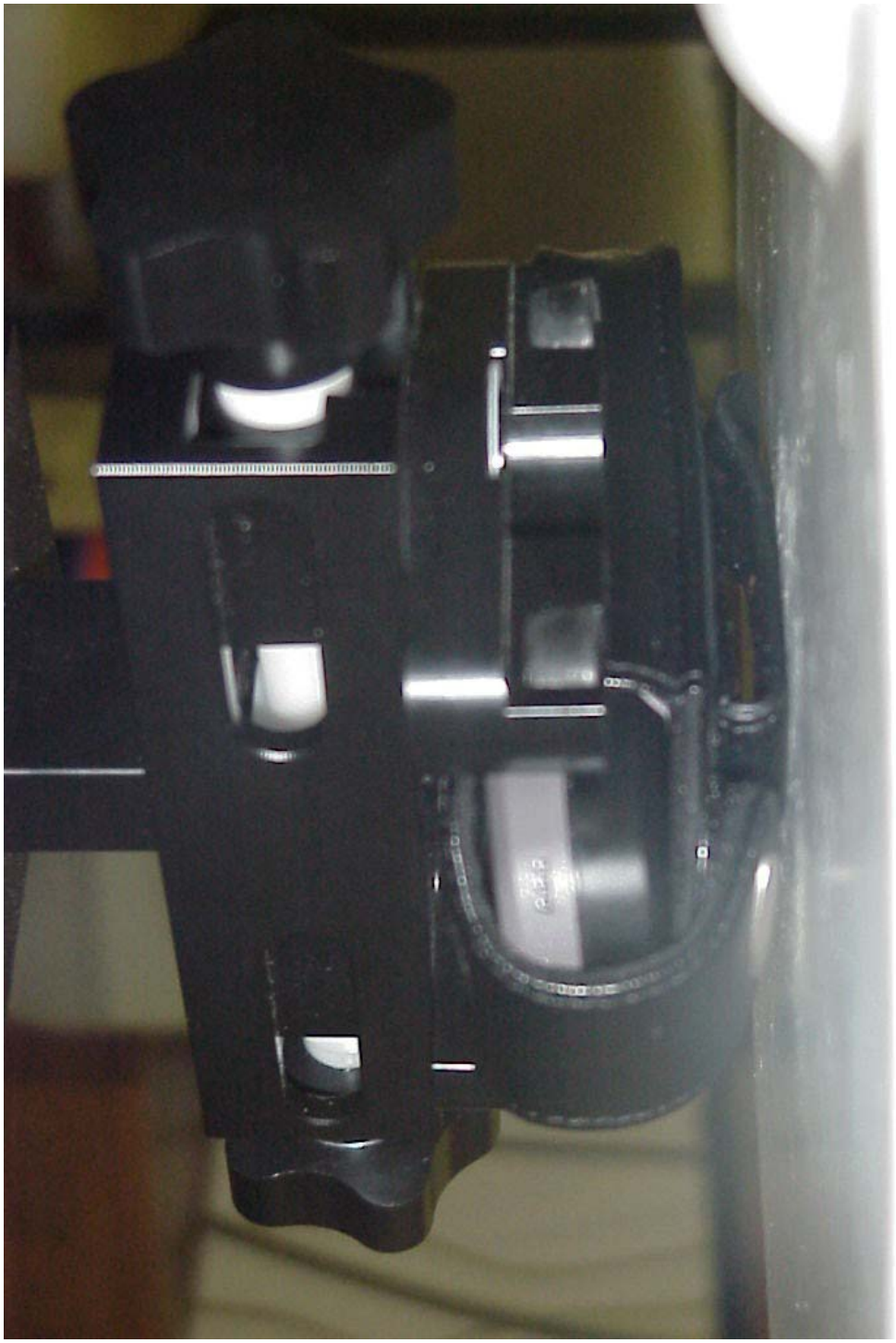
PHT/45705JD03/007 Front View of EUT

PHT/45705JD03/008 PHF

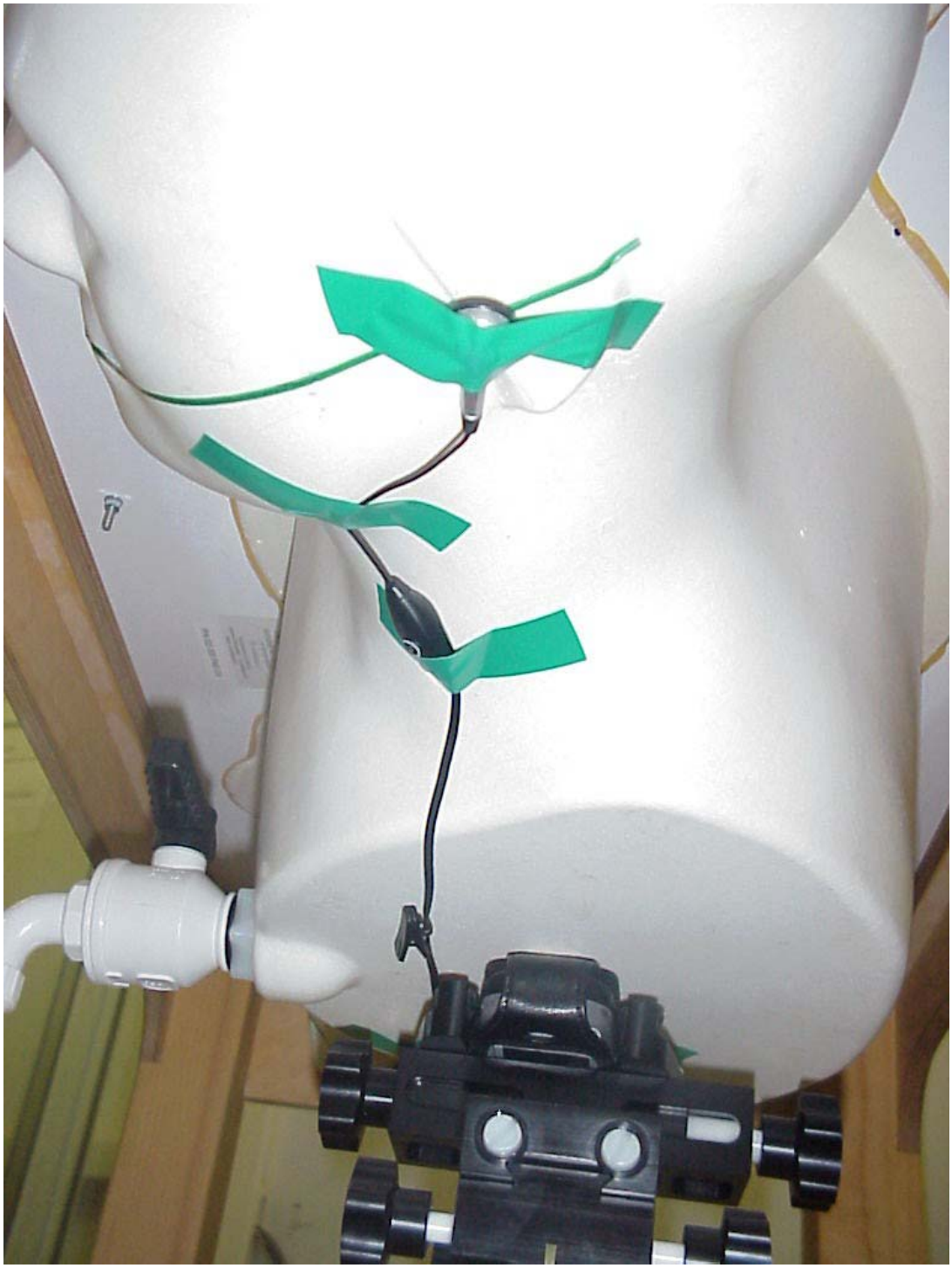


PHT/45705JD03/009 Rear of Handset facing Phantom

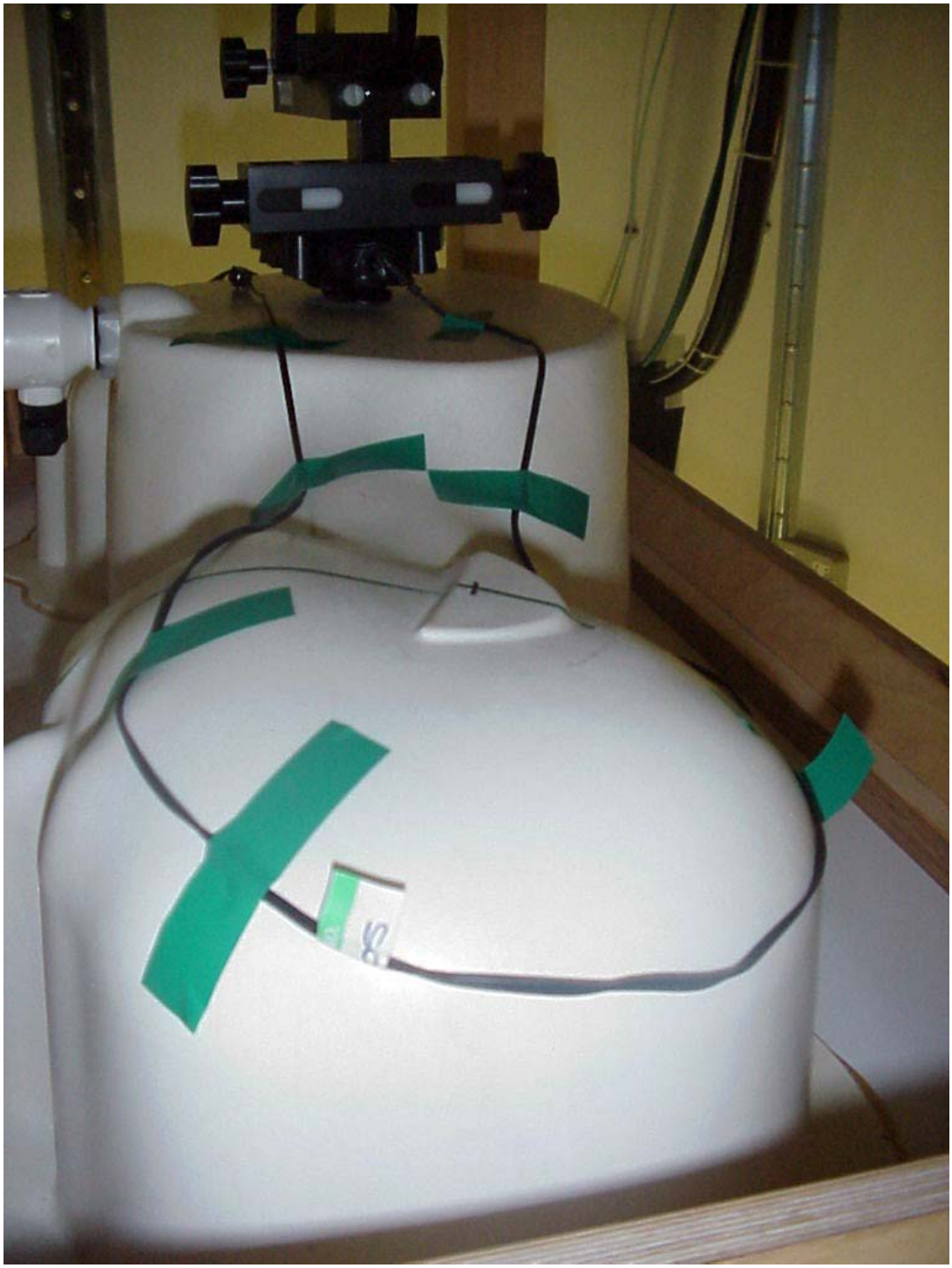
PHT/45705JD03/010 Rear of handset in case facing Phantom



PHT/45705JD03/011 Rear of Handset in Case With PHF Facing Phantom



PHT/45705JD03/012 Rear of Handset in Case With PHF Facing Phantom



PHT/45705JD03/013 Rear of Handset in Case With PHF Facing Phantom

PHT/45705JD03/014 Rear of Handset With PHF Facing Phantom

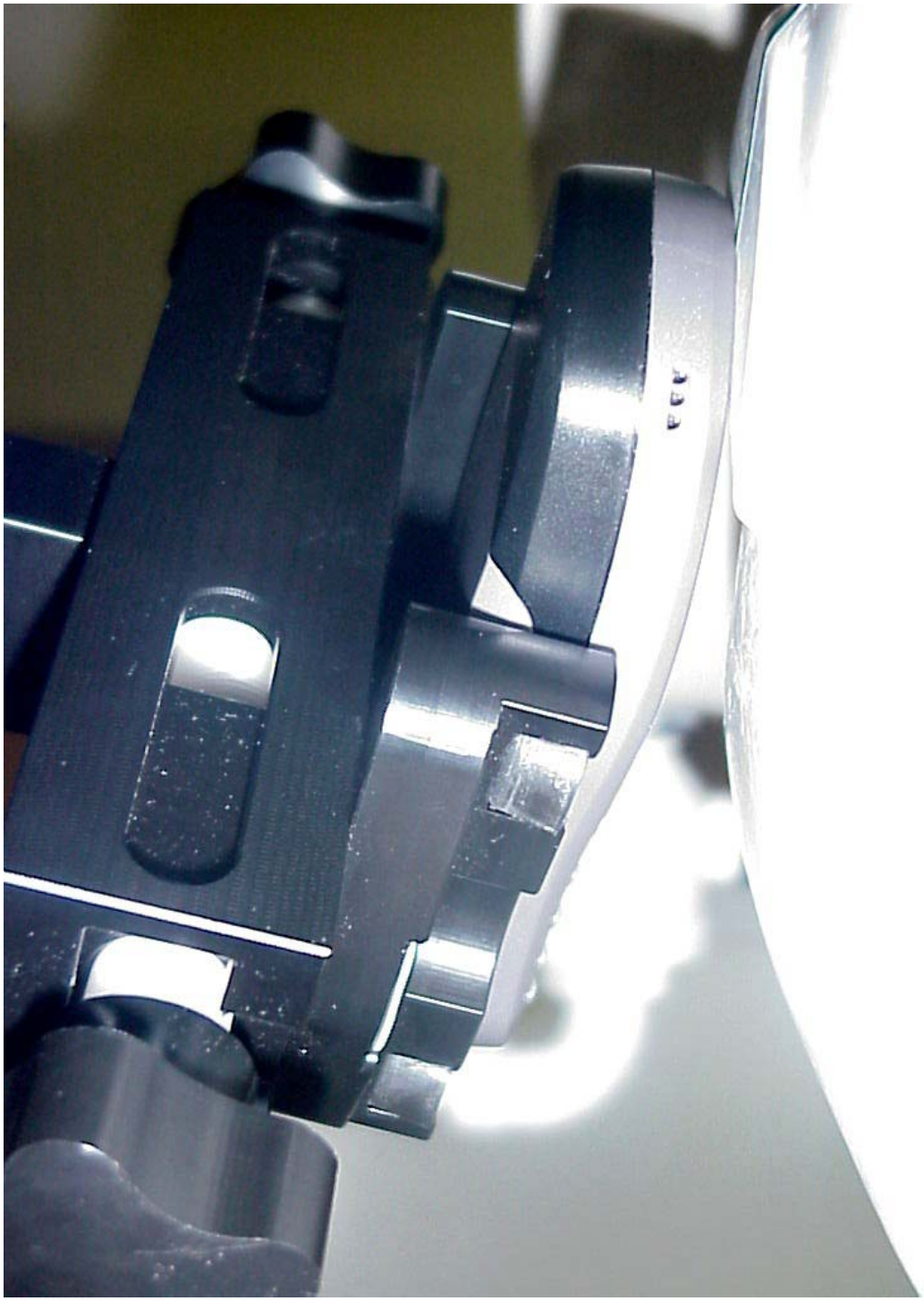
PHT/45705JD03/015 Rear of Handset with PHF Facing Phantom

PHT/45705JD03/016 Rear View of EUT in Case

PHT/45705JD03/017 Rear View of EUT

PHT/45705JD03/018 Tilt Left

PHT/45705JD03/019 Tilt Right



PHT/45705JD03/020 Touch Left

PHT/45705JD03/021 Touch Right

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