GSP-1700 (10-C6421-1)
FCC SAR Test Report

September 26, 2006

80-C6399-1 Rev. D

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80-C6399-1 Rev. D

QUALCOMM
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Overview

Test Report Reference:	80-C6399-1 Rev. D
Responsible Engineer:	Mark Ortlieb, Paul Jayne, Robert Scodellaro
Test Engineer:	Mark Ortlieb
Date of issue:	26 September 2006
Test Laboratory:	QUALCOMM Incorporated 5775 Morehouse Dr. San Diego CA 92121 (General Telephone) 1 858 587 1121
Model Tested:	GSP-1700 (P/N 10-C6421-1)
Test Specification Standard(s):	**ANSI/IEEE C95.1-1992** IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz **ANSI/IEEE C95.3-1992** IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields-RF and Microwave FCC/OET Bulletin 65, including Supplement C, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields **ANSI/IEEE P1528/D1.2 Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques**
Results:	The phone noted above complies with the requirements of the aforementioned standards.

Revision History

Revision	Date	Scope
A	2 August 2006	Initial release
B	18 August 2006	Addition of conducted power data (Table 4-1)
C	19 September 2006	Revision of System Check (Validation) data to reflect calibrated probe values
D	21 September 2006	Corrections per Nemko review comments dated 21 September 2006.

Contents

Figures

Tables

1. Test summary

1.1 Equipment tested

Mobile satellite phone, model GSP-1700 (P/N 10-C6421-1), serial number **N10CTKXJC**. The phone operates only in the Globalstar LEO satellite band using CDMA modulation.

1.2 Maximum (Worst Case Results)

Channel	Section	Physical Position	Antenna Position*	1 g SAR
1	Flat	15 mm distance from phantom	Closed, operation defeat switch disabled	0.564

**see Section 2 for descriptions of antenna positions*

1.3 Measurement Uncertainty (1 g)

Below are combined and expanded uncertainty values for the system, and represent a worst-case analysis. Uncertainty for the specific test program described in this Report was likely less, although it was not assessed. For additional details on measurement uncertainty, see Section 5.

Combined Standard Uncertainty	12.3%
Expanded Standard Uncertainty (k=2)	24.6%

1.4 SAR Limits

Table 1-3 gives 1 gram SAR limits for general public for the frequency range of 10 MHz to 10 GHz as called out in FCC OET Bulletin 65 Supplement C.

Table 1-3 1 Gram SAR Limits

Whole body average SAR (mW/g)	0.08
Localized SAR (head and trunk)	1.6
Localized SAR (limbs)	4.0

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2. EUT Description

2.1 General

Model	GSP-1700, prototype identical to production
Modulation	CDMA
Trade name	QUALCOMM Incorporated
TX Frequency	Globalstar: Low: Ch 1, 1610.73 MHz Middle: Ch 6, 1616.88 MHz High: Ch 9, 1620.57 MHz
Serial Number(s)	N10CTKXJC

2.2 Pictures of EUT

2.2.1 Overall Views

Figure 2-1 Pictures of Model GSP-1700

2.2.2 Pictures of Antenna Positions

Figure 2-2 Antenna positions

Antenna Position 1 **Antenna Position 2** **Antenna Position 3**

2.3 Antenna Description

The GSP-1700 phone employs a telescoping-revolving stacked quadrifilar helix antenna.

2.4 Battery

Battery is a 3.7V, 2.6Ah Lithium-Ion, manufactured by Tyco Electronics Battery System, model GSP-1700BATT (QUALCOMM MCN CV90-R6155-1).

2.5 Body worn accessories

While no body-worn accessories are provided for the phone, the phone was tested for SAR and found to be acceptable for use with a non-metallic belt clip with a body separation distance of 15 mm.

3. SAR Test Facility

3.1 General

Test Location	QUALCOMM Incorporated 5775 Morehouse Dr. San Diego CA 92121
Temperature Range	15-35 °C (29°C actual)
Humidity Range	25-75% (69% actual)
Pressure	860-1060 mbar (1015 mB)

All QUALCOMM dosimetry equipment is operated within a shielded screen room manufactured by Lindgren RF Enclosures to provide isolation from external EM fields. The E-field probes of the DASY4 system are capable of detecting signals as low as 5µW/g in the liquid dielectric, and so external fields are minimized by the screen room, leaving the phone as the dominate radiation source. The floor of the screen room is reflective, so the phantom bench is placed on four ferrite panels measuring 2 ft^2 each, in order to minimize reflected energy that would otherwise re-enter the phantom and combine constructively or destructively with the desired results.

3.2 Dosimetry System

The dosimetry equipment consists of a complete state-of-the-art DASY4 dosimetry system manufactured and calibrated by Schmid & Partner Engineering AG of Zurich, Switzerland. The DASY4 system consists of a six axis robot, a robot controller, a teach pendant, automation software on a 2.4 GHz Intel Pentium4 computer, data acquisition system, isotropic E-field probe, device positioning holder, and validation kit.

Figure 3-1 shows the robot arm, controller box and device positioning holder.

Figure 3-1 DASY4 system: Robot Arm, Controller box, Device Positioning Holder

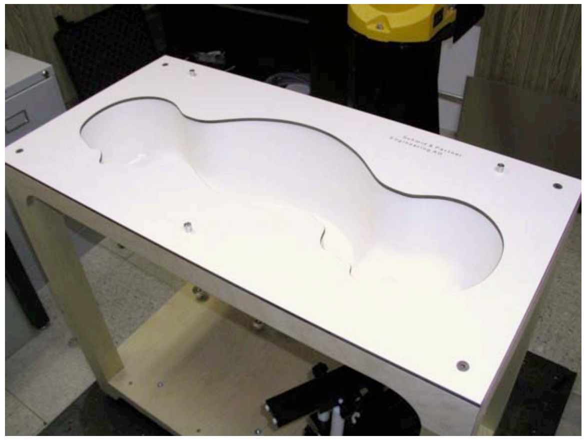
3.3 E-field probe

Manufactured by Schmid & Partner, Model ET3DV6. Calibrated by the manufacturer in head tissue simulating liquid at frequencies ranging from 835 MHz to 1.95 GHz. Dynamic range is said by the manufacturer to be 5 µW/gm to approx.100 mW/g. The probe contains 3 small dipoles positioned symmetrically on a triangular core to provide for isotropic detection of the field. Each dipole contains a diode at the feed point that converts the RF signal to DC, which is conducted down a high impedance line to the data acquisition system.

3.4 Phantom

The phantom is the Standard Anthropomorphic Model ("SAM") phantom supplied by Schmid & Partner AG, and is designed for compliance to the guidelines provided in standard IEEE P1528. It consists of a left and right side head for simulating phone usage on both sides of the head, as well as a flat area for simulating phone usage against the body. The phantom is constructed of fiberglass with 2 mm ±0.1mm shell thickness. The DASY4 system uses a homogeneous tissue phantom based on studies concerning energy absorption of the human head, and the different absorption rates between adults and children. These studies indicated that a homogeneous phantom should overestimate SAR by no more than 15% for 10 g averages and should not underestimate SAR.
Figure 3-2 shows the SAM phantom.

Figure 3-2 SAM Phantom



3.5 Liquid Dielectric

The tissue-simulating liquid filling the phantom is mixed by QUALCOMM staff per manufacturer instructions and regulatory standards. There are separate formulas for the various applicable frequencies. Before the test, the permittivity and conductivity were measured with an automated Hewlett-Packard 85070B dielectric probe in conjunction with a H-P 8752C network analyzer to monitor permittivity change due to evaporation and settling of ingredients. The electromagnetic parameters of the liquid were maintained as shown in Tables 3-1. The target values were obtained from Supplement C of OET Bulletin 65 *Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions.* Figure 3-3 shows liquid depth of the material at the time of testing to be minimum 15 cm.

Table 3-1 Tissue Dielectric Properties at Time of Testing

				Permittivity (ε_r)				Conductivity (σ)			
Date	Freq. (MHz)	Section	Liquid Temp. (°C)	Measured Values	Target Values	Deviation (%)	Limit	Measured Values	Target Values	Deviation (%)	Limit
7/11/06	1610.73	Head	22.0	39.10	40.3	-3.07%	±5%	1.29	1.29	0.00%	±5%
	1616.88	Head	22.0	39.10	40.3	-3.07%	±5%	1.30	1.29	0.77%	±5%
	1620.57	Head	22.0	39.08	40.3	-3.12%	±5%	1.30	1.29	0.77%	±5%
7/12/06	1610.73	Head	21.9	39.10	40.3	-3.07%	±5%	1.29	1.29	0.00%	±5%
	1616.88	Head	21.9	39.10	40.3	-3.07%	±5%	1.30	1.29	0.77%	±5%
	1620.57	Head	21.9	39.10	40.3	-3.07%	±5%	1.30	1.29	0.77%	±5%
7/14/06	1610.73	Body	22.0	53.10	53.8	-1.32%	±5%	1.35	1.40	-3.70%	±5%
	1616.88	Body	22.0	53.10	53.8	-1.32%	±5%	1.37	1.40	-2.19%	±5%
	1620.57	Body	22.0	53.00	53.8	-1.51%	±5%	1.37	1.40	-2.19%	±5%

25 L of each of the tissue simulating liquids were prepared using approximately the following proportions of ingredients:

Head Liquids:

1640 Mhz (Globalstar) Head Tissue Simulating Liquid (approximate)

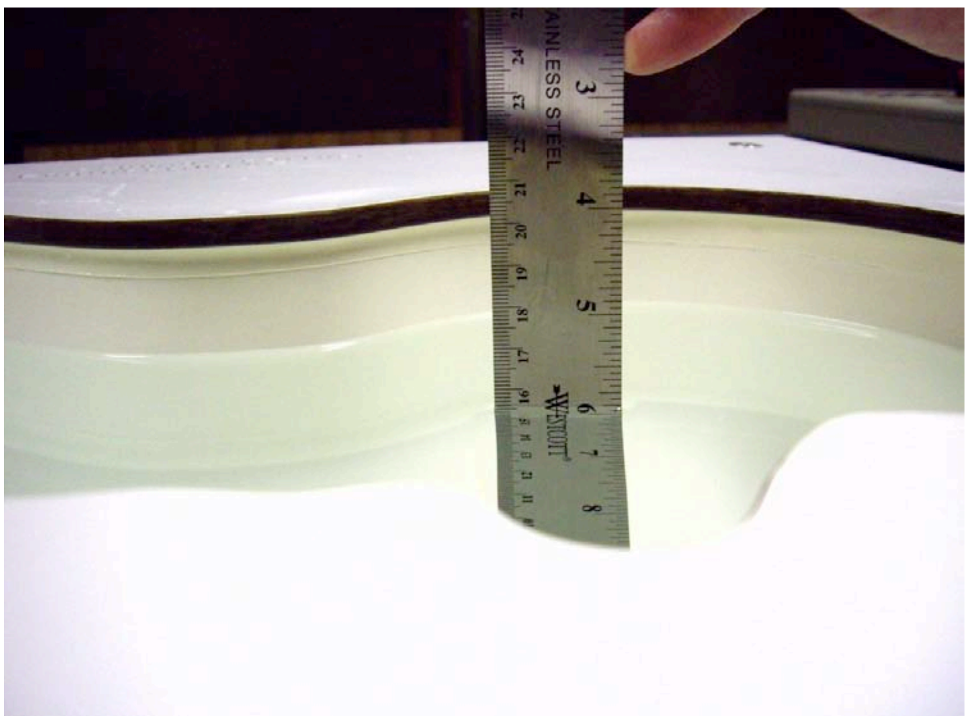
Water – 55.3 %
Glycol Monobutyl Ether – 44.3%
Salt – 0.4%

Body Liquids:

1640 Mhz (Globalstar) Muscle Tissue Simulating Liquid (approximate)

Water – 69 %
Glycol Monobutyl Ether – 30.55%
Salt – 0.45%

Figure 3-3 Liquid depth at time of testing (>15 cm)



4. SAR Measurement Procedure

4.1 Power Verification

For SAR testing, the phone was operated using an Anritsu Globalstar telecommunications tester. The phone was placed into full transmit mode, and a closed loop setting was used to maintain constant conducted output power at the levels shown below.

Table 4-1 Conducted power levels for GSP-1700

Channel	Conducted power (dBm)
1	26.6 dBm
6	26.8 dBm
9	26.7 dBm

4.2 Test positions

The phone was tested in the following SAR test positions:

- Left Head
  - Touch
    - Antenna Position 1
    - Antenna Position 2
    - Antenna Position 3
  - Tilt
    - Antenna Position 1
    - Antenna Position 2
    - Antenna Position 3
- Right Head
  - Touch
    - Antenna Position 1
    - Antenna Position 2
    - Antenna Position 3
  - Tilt
    - Antenna Position 1
    - Antenna Position 2
    - Antenna Position 3
- Flat – Antenna closed
  - Face down, 15 mm spacing from phantom

Section 6 shows photographs of the phone as it was tested per the above positions.

The head and tilt positions are shown in Figures 4-1 and 4-2. See Section 2.2.2 for photos of the three antenna positions for the GSP-1700. See Section 6 for photos of the GSP-1700 as positioned in the test set-up.

Figure 4-1 Cheek/Touch position (Left Head)

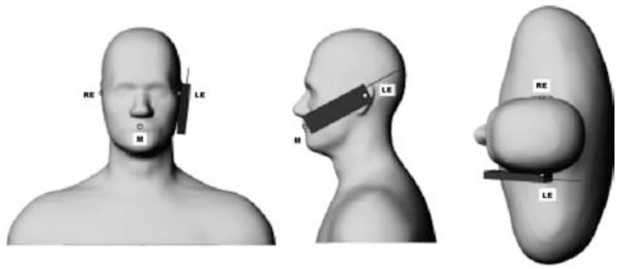
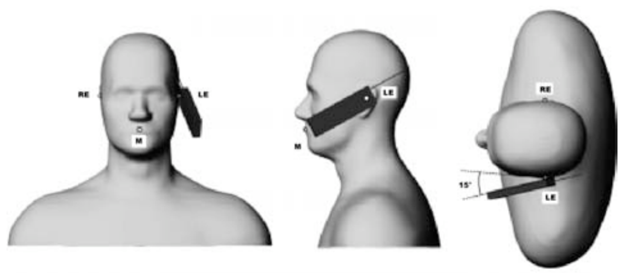


Figure 4-2 Ear/Tilt position (Left Head)



4.3 Scan procedure

The scan routine is set up as follows:

- **Power verification measurement** – an E-field measurement taken at a fixed location to monitor power stability throughout the test.
- **Area scan** – SAR distribution at the near the surface of the phantom was measured at 3.9 mm from the inner surface of the phantom shell. The horizontal grid spacing of the area scan was 12 mm x 12 mm.
- **Zoom or Cube scans** - Cube scans have a resolution of 5 mm (7x7x7). Surface data is extrapolated, as the center of the dipole sensors in the probe is 2.7 mm from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. Extrapolation algorithms are based on Quadratic Shepard's method. Then interpolated data is used to average SAR over the cubes by creating a spatial grid with a 1 mm resolution, again using the Quadratic Shepard's method. 1 g and 10 g values are calculated by then searching for the maximum interpolated values and constructing a 3-D and 2-D quadratic function for each measurement point. After this is completed, the interpolating function is calculated as a weighted average of the quadratics.
- **Power re-verification test (Drift)** – a repeat of the Power verification measurement, compared to the first measurement to verify power stability.

4.4 Test program

4.4.1 Head sections

- The phone was placed into the first Head test position per Section 4.2.
- The phone was placed into full transmit mode on the middle channel (Ch. 6).
- The phone was tested with the three antenna positions (see Section 4.2 above and Section 2.2).
- The worst case antenna position was determined and then the phone was tested on the low and high channels (Ch. 1 and 9 respectively) for that antenna position.
- The above procedure was repeated for all subsequent Head test positions listed in Section 4.2.

4.4.2 Flat (body) section

While the phone is designed to disable normal call transmissions when the antenna is closed, the phone does make short transmissions with the antenna closed in order to establish a link with the satellite. When measuring body SAR, the disable switch was defeated and the phone was placed into a normal call in order to simulate an absolute maximum worst case scenario. The phone was tested face down with 15 mm spacing.

- The phone was placed into the first Flat test position per Section 4.2
- The phone was placed into full transmit mode on the low channel (Ch. 1) and tested.
- The phone was tested again at middle and high channels (Ch. 6 and 9 respectively).

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5. Measurement Uncertainty

5.1 Probe uncertainty

For this test program, because the 1640 MHz band is not commonly used, numerical Conversion Factors were obtained for the Dosimetric probe. Because numerical factors were used, and because boundary compensation factors were required to be set to Alpha=0 and Delta=1, probe uncertainty was greater than if the probe had been actually calibrated by the manufacturer for that frequency band. It is notable that the system check yielded a result that was significantly higher than the target value for the dipole, and therefore SAR measurements were conservative. Furthermore, measured values for the phone were so low due to its physical design (large antenna mounted away from the head, large phone body design) that the expanded uncertainty was deemed not significant.

5.2 Uncertainty budget

The possible errors included in this measurement arise from device positioning uncertainty, device manufacturing uncertainty, liquid dielectric permittivity uncertainty, liquid dielectric conductivity uncertainty, and uncertainty due to disturbance of the fields by the probe.

	Uncertainty value (± %)	Prob. Distr.	Div.	(ci) 1g	(ci) 10g	Std. Unc. (1g) (± %)	Std. Unc. (10g) (± %)	(vi) veff
Measurement System								
Probe Calibration	±7.0%	N	1	1	1	7.0	7.0	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	3.9	3.9	∞
Boundary Effects	±8.0%	R	√3	1	1	4.6	4.6	∞
Linearity	±4.7%	R	√3	1	1	2.7	2.7	∞
System Detection Limits	±1.0%	R	√3	1	1	0.6	0.6	∞
Readout Electronics	±0.3%	N	1	1	1	1.0	1.0	∞
Response Time	±0.8%	R	√3	1	1	0.5	0.5	∞
Integration Time	±2.6%	R	√3	1	1	1.5	1.5	∞
RF Ambient Conditions	±3.0%	R	√3	1	1	1.7	1.7	∞
Probe Positioner	±0.4%	R	√3	1	1	0.2	0.2	∞
Probe Positioning	±2.9%	R	√3	1	1	1.7	1.7	∞
Max. SAR Eval.	±1.0%	R	√3	1	1	0.6	0.6	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	2.9	2.9	145
Device Holder	±3.6%	N	1	1	1	3.6	3.6	5
Power Drift	±5.0%	R	√3	1	1	2.9	2.9	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	√3	1	1	2.3	2.3	∞
Liquid Conductivity (target)	±5.0%	R	√3	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	1.6	1.1	∞
Liquid Permittivity (target)	±5.0%	R	√3	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	1.5	1.2	∞
Combined Std. Uncertainty						12.3%	12.1%	330
Expanded STD Uncertainty						**24.6%**	**24.2%**	

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6. Photos of test setup

6.1 Left Head Positions

Figure 6-1 Left Head, Cheek/Touch position

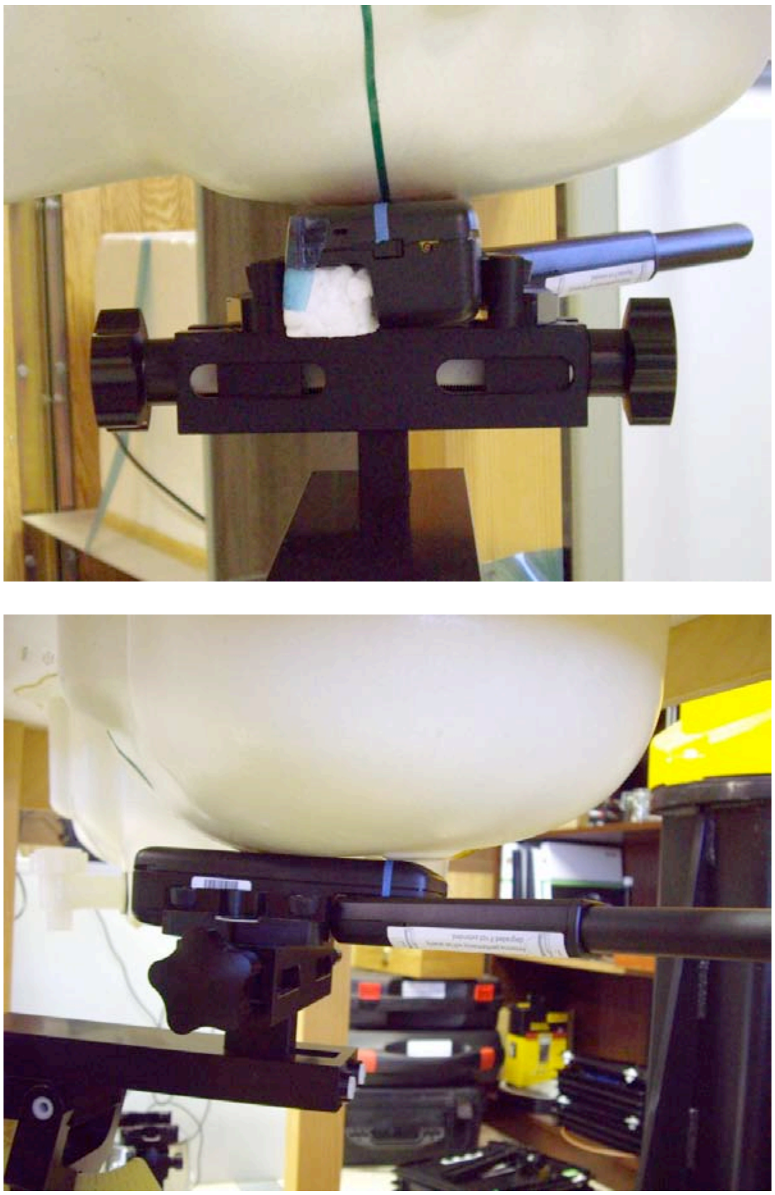


Figure 6-2 Left Head, Ear/Tilt position

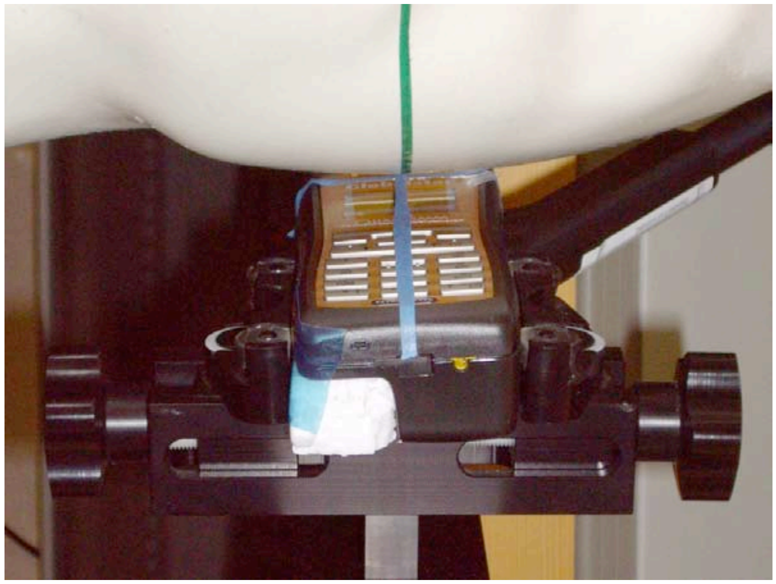


Figure 6-3 Phone positioned on Left phantom head, Antenna position 1

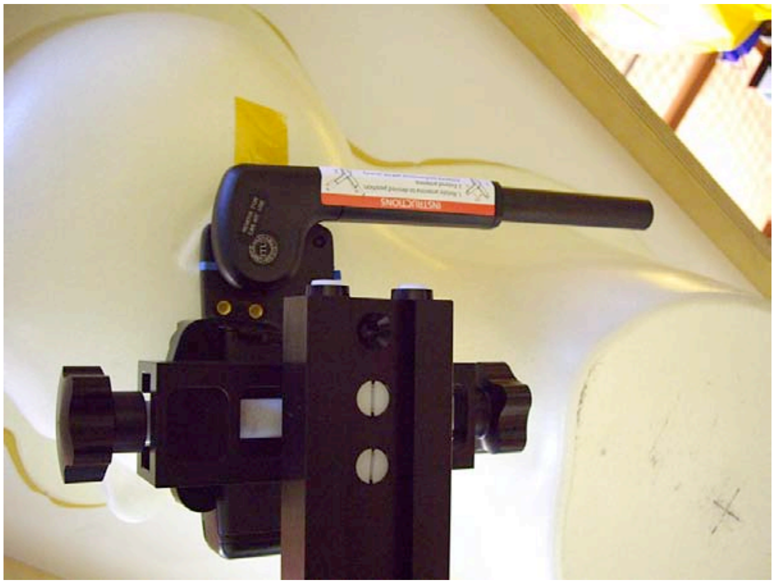


Figure 6-4 Phone positioned on Left phantom head, Antenna position 2

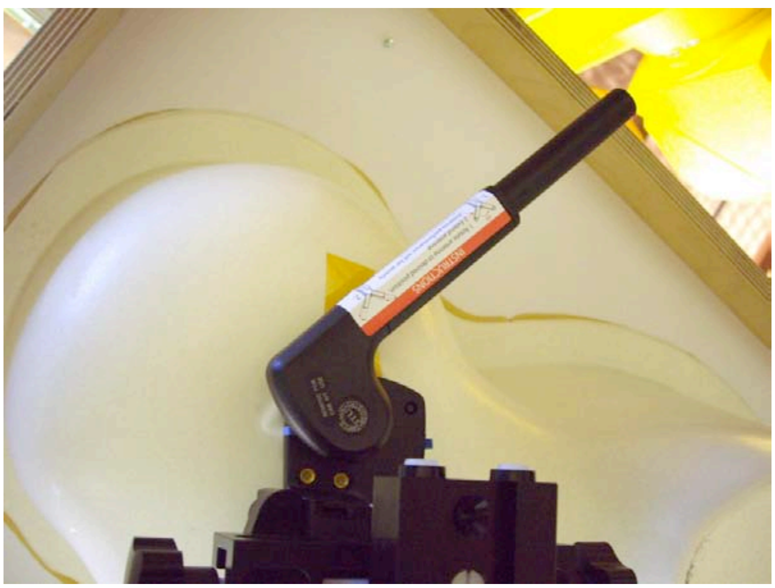
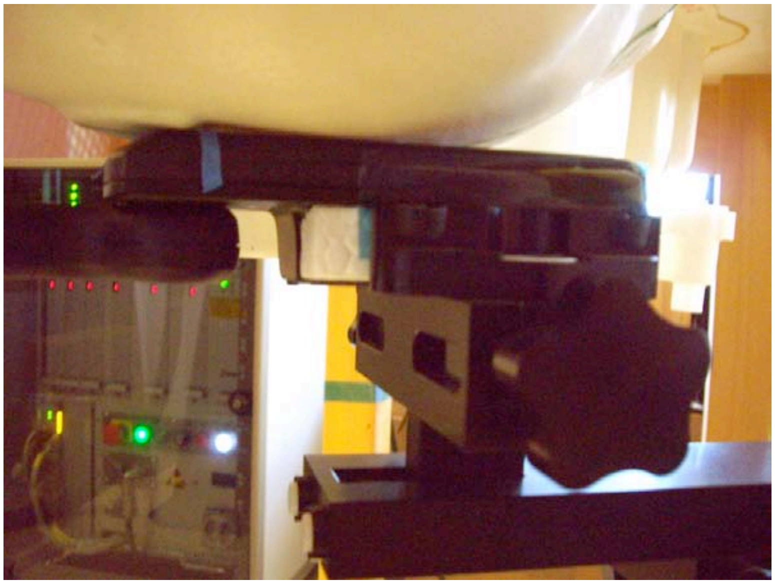


Figure 6-5 Phone positioned on Left phantom head, Antenna position 3

6.2 Right Head Positions

Figure 6-6 Right Head, Cheek/Touch position



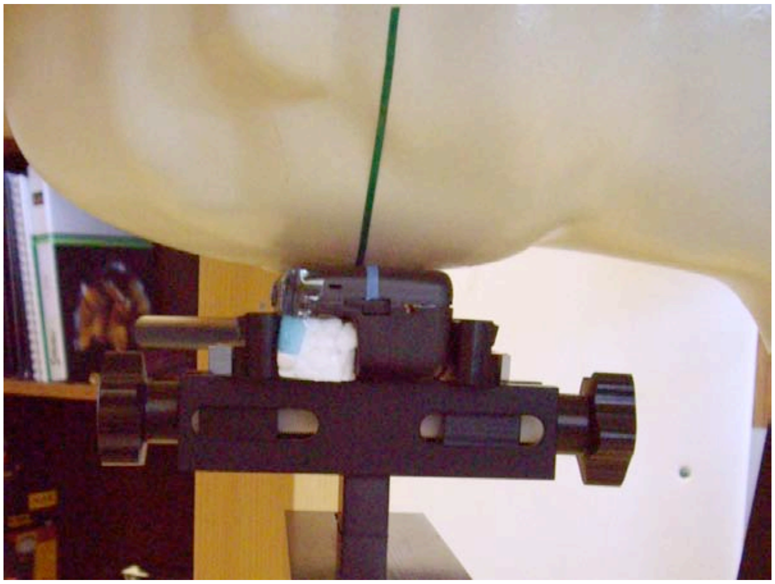
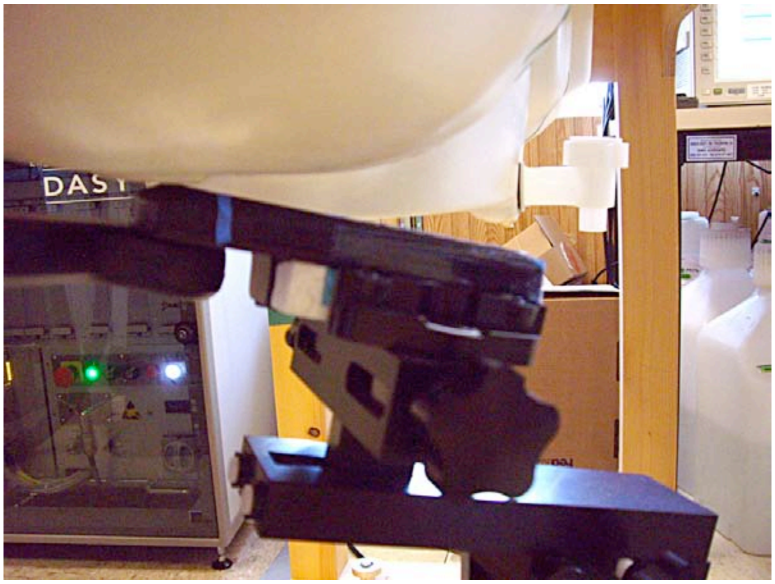


Figure 6-7 Right Head, Ear/Tilt position



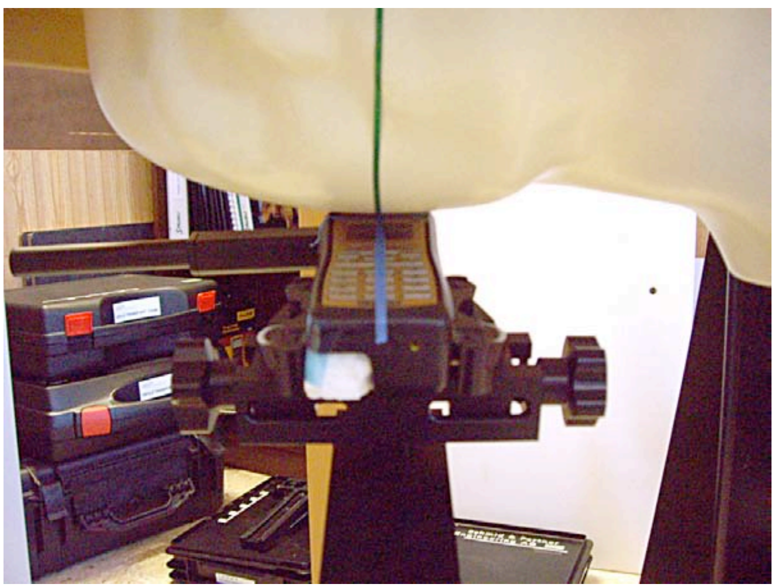


Figure 6-8 Phone positioned on Right phantom head, Antenna position 1

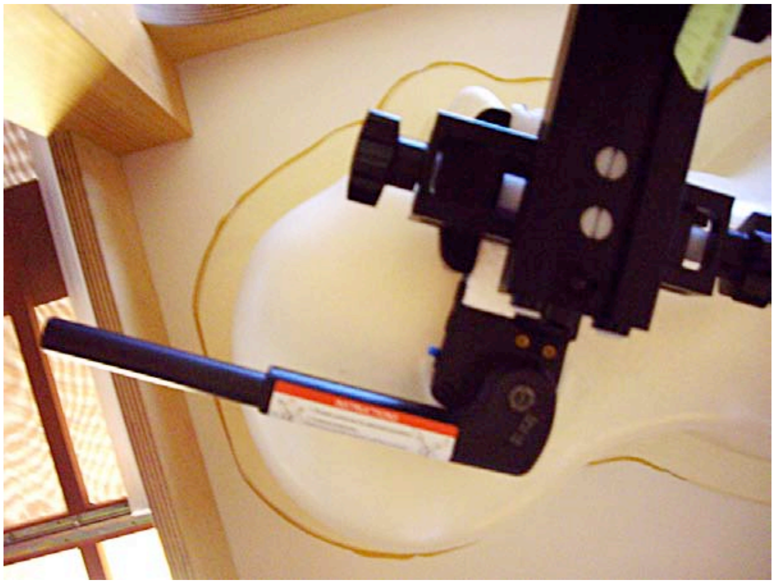


Figure 6-9 Phone positioned on Right phantom head, Antenna position 2

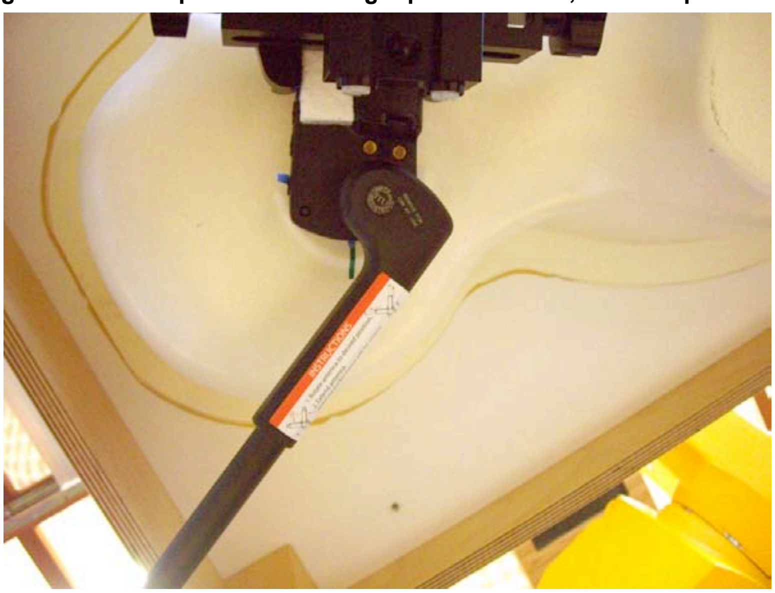


Figure 6-10 Phone positioned on Right phantom head, Antenna position 3

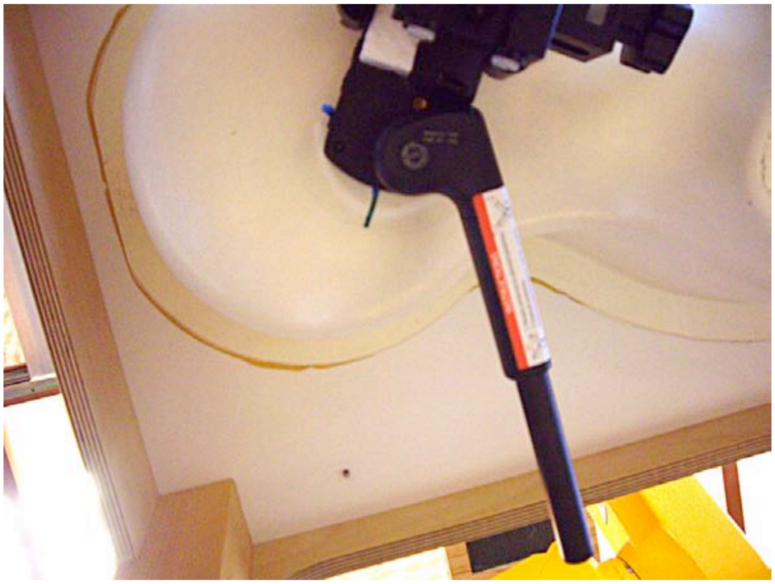
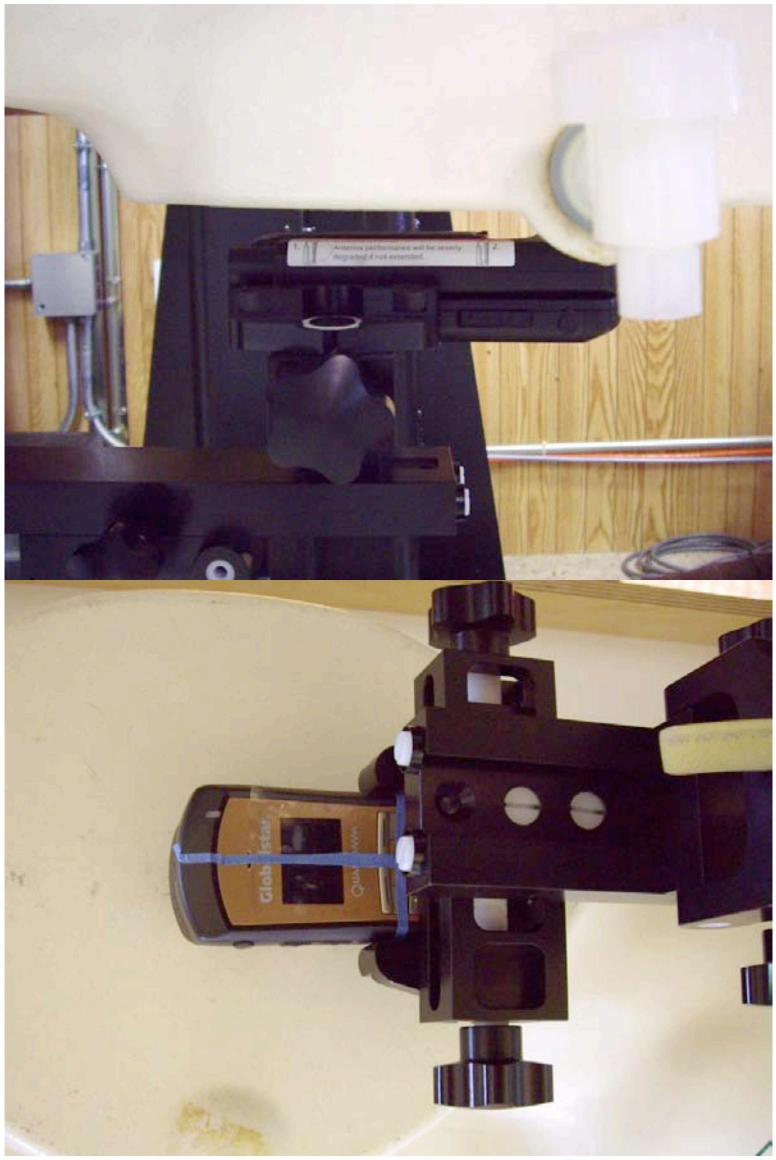


Figure 6-11 Phone positioned on Flat section, face down, 15 mm separation distance



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