QSEC-2700 FCC SAR Test Report

October 31, 2003

80-R0923-1 Rev. A

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QSEC-2700 FCC SAR Test Report
80-R0923-1 Rev. A

Revision history

Revision	Date	Description
A	August 2003	Initial release

5775 Morehouse Dr.
San Diego CA 92121

Overview

Test Report Reference:	80-R0923-1 Rev. A
Responsible Engineer:	Robert Scodellaro
Signature:	
Test Engineer:	Mark Ortlieb
Signature:	
Date of issue:	31 October 2003
Test Laboratory:	QUALCOMM Incorporated 5775 Morehouse Dr. San Diego CA 92121 (General Telephone) 1 858 587 1121
Model Tested:	QSEC-2700
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 QSEC-2700 cellular phone complies with the requirements of the aforementioned standards. The QSEC-2700 cellular phone is in compliance with the FCC Part 2.1093 RF exposure limit.

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Tables

1. Test summary

1.1 Equipment tested

Mobile phone, model QSEC-2700, serial number P2b-361, employing two frequency bands of operation: Band Class 0 (US CDMA Cellular) and Band Class 1 (US PCS). The phone tested was a preproduction model.

1.2 Maximum (Worst Case Results)

Tables 1-1 and 1-2 give maximum SAR results for head and body-worn positions respectively.

Table 1-1 Maximum Head SAR

Band	Channel	Section	Position	1 g SAR
CDMA 835	383	Left Head	Touch	1.16
PCS	1175	Left & Right Heads	Touch	1.43
CDMA 835	383	Flat	Push-to-talk (PTT)	0.426

Table 1-2 Maximum Body-worn SAR

Band	Channel	Section	Position	1 g SAR
PCS	600	Flat	Belt clip	0.49

1.3 Measurement Uncertainty

Combined Standard Uncertainty	10.0%
Extended Standard Uncertainty (k=2)	20.1%

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

2. EUT Description

2.1 General

Model	QSEC-2700
Modulation	CDMA
Trade name	QUALCOMM Incorporated
TX Frequency	US CDMA Cellular: Ch 1013 (Low): 824.7 MHz Ch 383 (Middle): 836.49 MHz Ch 777 (High): 848.31 MHz US PCS: Ch 25 (Low): 1851.25 MHz Ch 600 (Middle): 1880 MHz Ch 1175 (High): 1908.75 MHz
Serial Number(s)	P2b-361

2.2 Pictures of DUT

Figures 2-1 through 2-13 show Model QSEC-2700 with all accessories.

Figure 2-1 Front view of QSEC-2700

Figure 2-2 Rear view of QSEC-2700

Figure 2-3 QSEC-2700 with Slim Battery installed

Figure 2-4 QSEC-2700 with Standard Battery installed

Figure 2-5 Standard Battery (left) and Slim Battery

Figure 2-6 Side view of QSEC-2700 with Belt Clip installed

Figure 2-7 Belt clip, model DXBLC0011(2 views)

Figure 2-8 Rear housing removed,

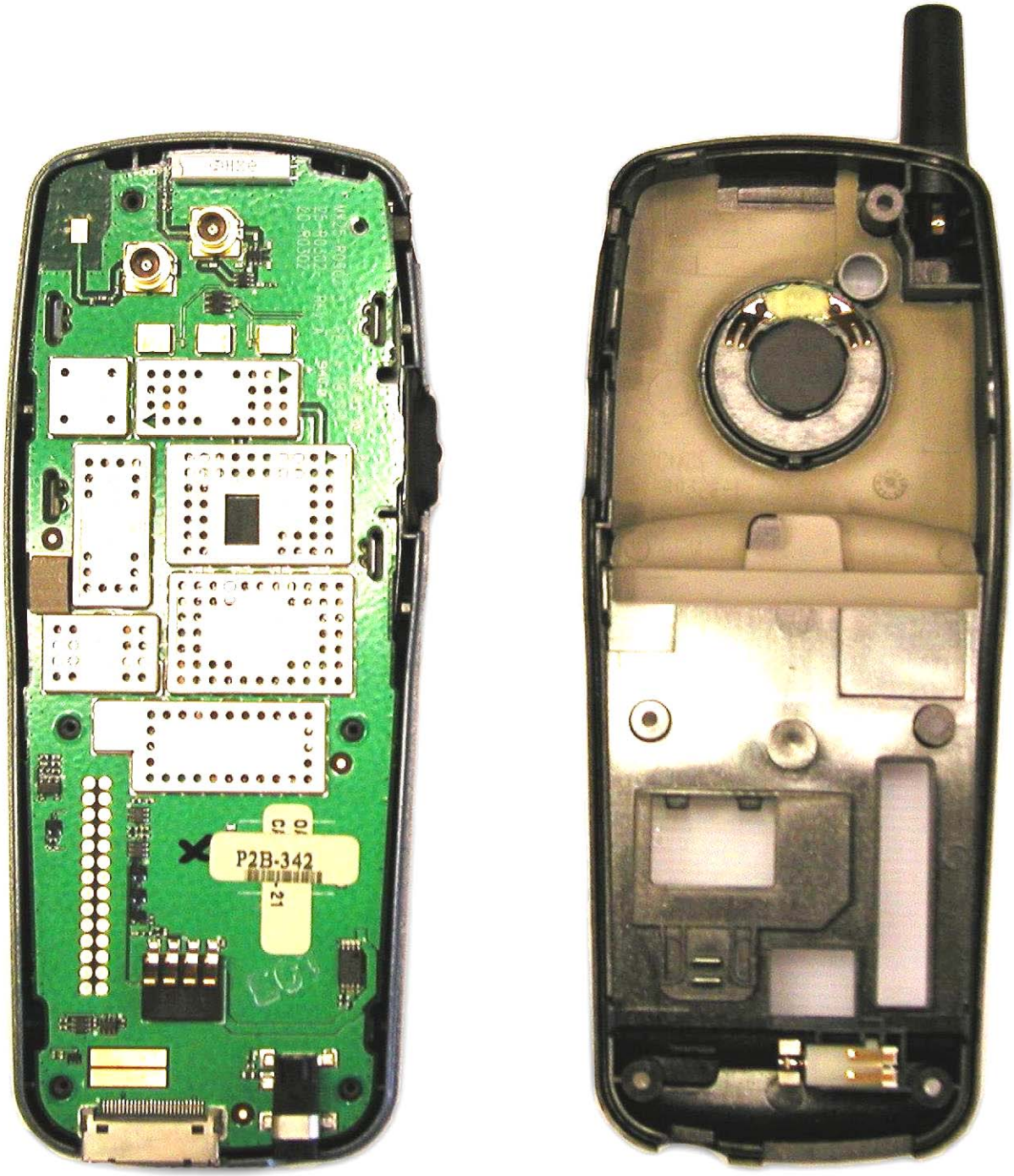


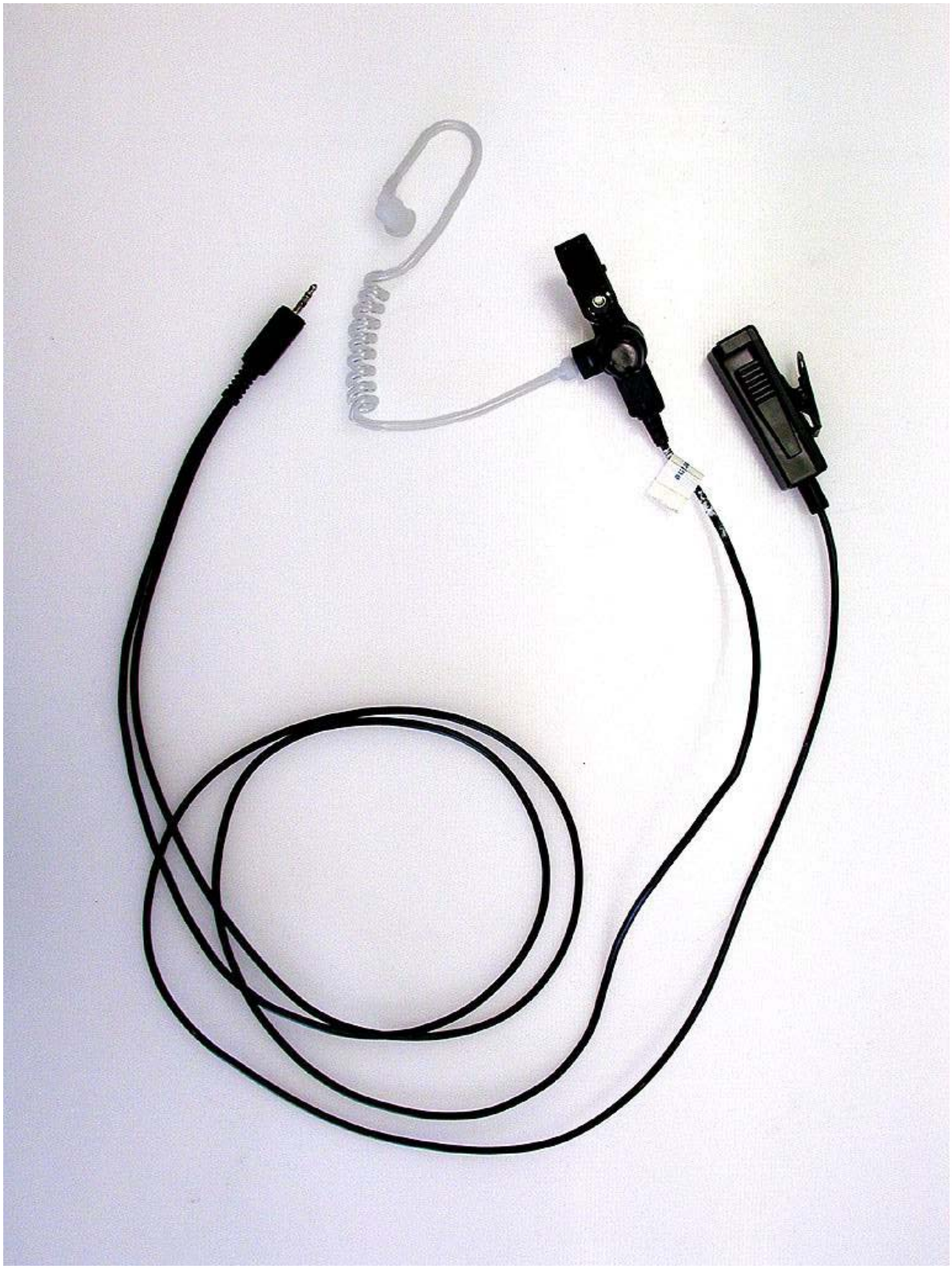
Figure 2-9 Front housing assembly with main printed wiring board removed

Figure 2-10 Front housing with keypad printed wiring board removed

Figure 2-11 Front housing with keypad removed

Figure 2-12 Rear housing

Figure 2-13 Ear bud/microphone accessory



2.3 Antenna Description

The QSEC-2700 phone employs a fixed stubby antenna.

2.4 Battery

The standard battery is a 4.2 V Li-ion battery, manufactured by Centurion, Model DXBAT0011. The slim battery is a 4.2 Li-ion battery, manufactured by Centurion, Model DXBAT0021. The two different size batteries had no impact on SAR levels.

2.5 Body worn accessories

A belt clip is provided measuring 29 mm deep. An ear bud with microphone is also supplied. See Section 2.2 for photographs.

3. SAR Test Facility

3.1 General

Test Location	QUALCOMM Incorporated 5775 Morehouse Dr. San Diego CA 92121
Temperature Range	15-35 °C (23°C actual)
Humidity Range	25-75% (38% 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

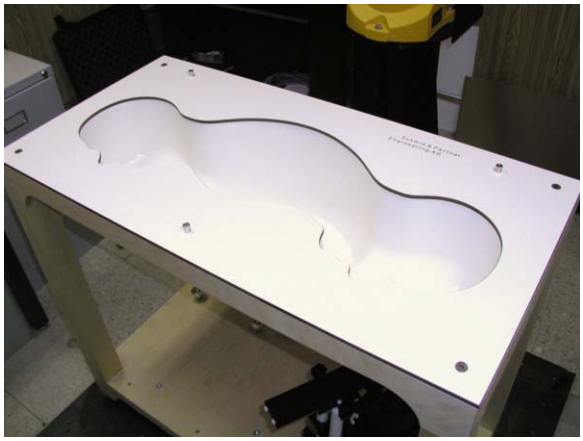
3.3 E-field probe

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 the FCC web page for Tissue Dielectric Properties at http://www.fcc.gov/fcc-bin/dielec.sh.

Table 3-1 Tissue Dielectric Properties at Time of Testing

			Permittivity (ε_r)				Conductivity (σ)			
	Frequency (MHz)	Section	Measured Values	Target Values	Deviation (%)	Limit	Measured Values	Target Values	Deviation (%)	Limit
8/20/2003	1.85	Head	40.8	40.0	2%	5%	1.44	1.45	-1%	5%
	1.88		40.6	40.0	2%	5%	1.48	1.45	2%	5%
	1.91		40.6	40.0	1%	5%	1.50	1.45	4%	5%
8/21/2003	1.85	Head	39.5	40.0	-1%	5%	1.42	1.45	-2%	5%
	1.88		39.4	40.0	-1%	5%	1.46	1.45	1%	5%
	1.91		39.3	40.0	-2%	5%	1.49	1.45	3%	5%
9/9/2003	0.82	Head	39.9	41.0	-3%	5%	0.87	0.89	-2%	5%
	0.84		39.8	41.0	-3%	5%	0.89	0.89	0%	5%
	0.85		39.7	41.0	-3%	5%	0.90	0.89	1%	5%
9/10/2003	0.82	Body	55.9	55.2	1%	5%	0.96	0.97	-1%	5%
	0.84		55.7	55.2	1%	5%	0.97	0.97	0%	5%
	0.85		55.6	55.2	1%	5%	0.99	0.97	2%	5%
9/10/2003	1.85	Body	55.7	53.3	5%	5%	1.53	1.52	0%	5%
	1.88		55.6	53.3	4%	5%	1.55	1.52	2%	5%
	1.91		55.4	53.3	4%	5%	1.58	1.52	4%	5%
10/29/03	1.85	Body	54.6	55.2	-1%	5%	1.5	1.52	-1%	5%
	1.88		54.5	55.2	-1%	5%	1.55	1.52	2%	5%
	1.91		54.4	55.2	-1%	5%	1.58	1.52	4%	5%
10/30/03	0.82	Body	56.1	53.3	5%	5%	0.97	0.97	0%	5%
	0.84		56.0	53.3	5%	5%	0.98	0.97	1%	5%
	0.85		55.9	53.3	5%	5%	0.99	0.97	2%	5%

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

Head Liquids:

900 Mhz (CDMA 900) Head Tissue Simulating Liquid

Water – 51.07%
Cellulose – 0.23%
Sugar – 47.31%
Preventol – 0.24%
Salt – 1.15%

1800 Mhz (PCS) Head Tissue Simulating Liquid

Water – 55.3 %
Glycol Monobutyl Ether – 44.5%
Salt – 0.31%

Body Liquids:

900 Mhz (CDMA 900) Body Tissue Simulating Liquid

Water – 50.8%
Salt – 9.94%
Preventol – 0.01%
Sugar – 48%

1800 Mhz (PCS) Body Tissue Simulating Liquid

Water – 70.2%
Glycol Monobutyl Ether – 29.4%
Salt – 0.4%

4. SAR Measurement Procedure

4.1 Power Verification

For SAR testing, the phone was operated using FTM phone test software. The phone was placed into the applicable transmit mode and set to fixed output power levels. Conducted power was measured and recorded, before each scan.

4.2 Test Configurations

Because model QSEC-2700 has a fixed antenna, there is only one test configuration for the phone.

4.3 Test positions

For regulatory submittal, the phone must be tested in both PCS and CDMA 835 bands in all SAR test positions:

- Left Head
  - Touch
  - Tilt
- Right Head
  - Touch
  - Tilt
- Belt clip (belt clip installed, with the back of the phone facing the phantom, belt clip flush against phantom).
- Push-to-Talk (PTT), 25 mm below flat part of phantom, phone facing phantom. Head medium used since PTT position in practice is with respect to the head.

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.

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

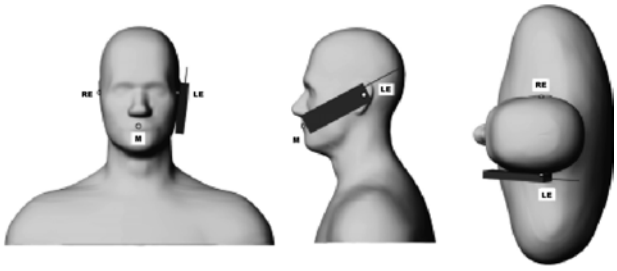
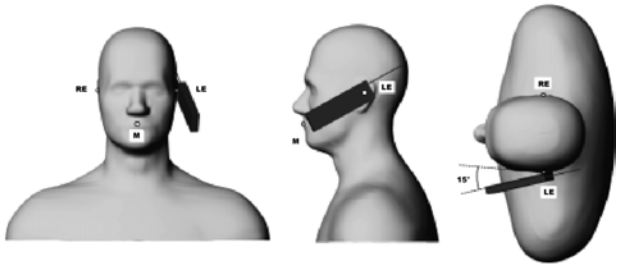


Figure 4-2 Tilt/Ear position (Left Head)



4.4 Scan procedure

The scan routine is set up as follows:
- Power verification measurement
- Area scan
- 7x7x7 cube (zoom) scan
- Power verification re-test (Drift)

Both 1 g and 10 g measurements are handled with the same scan process.

5. Measurement Uncertainty

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. DIST	Div.	(ci) 1g	(ci) 10g	Std. Unc. (1g) (± %)	Std. Unc. (10g)	(vi) veff
Measurement System								
Probe Calibration	4.8	N	1	1	1	4.8	4.8	∞
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 E ects	1	R	√3	1	1	0.6	0.6	∞
Linearity	4.7	R	√3	1	1	2.7	2.7	∞
System Detection Limits	1	R	√3	1	1	0.6	0.6	∞
Readout Electronics	1	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	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	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	R	√3	1	1	2.9	2.9	∞
Phantom and Setup								
Phantom Uncertainty	4	R	√3	1	1	2.3	2.3	∞
Liquid Conductivity (target)	5	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	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						10.3 %	10.0 %	330
Expanded STD Uncertainty						**20.6 %**	**20.1 %**	

6. Photos of test setup

6.1 Phone in positioning device

Figure 6-1 Phone in positioning device (view 1)

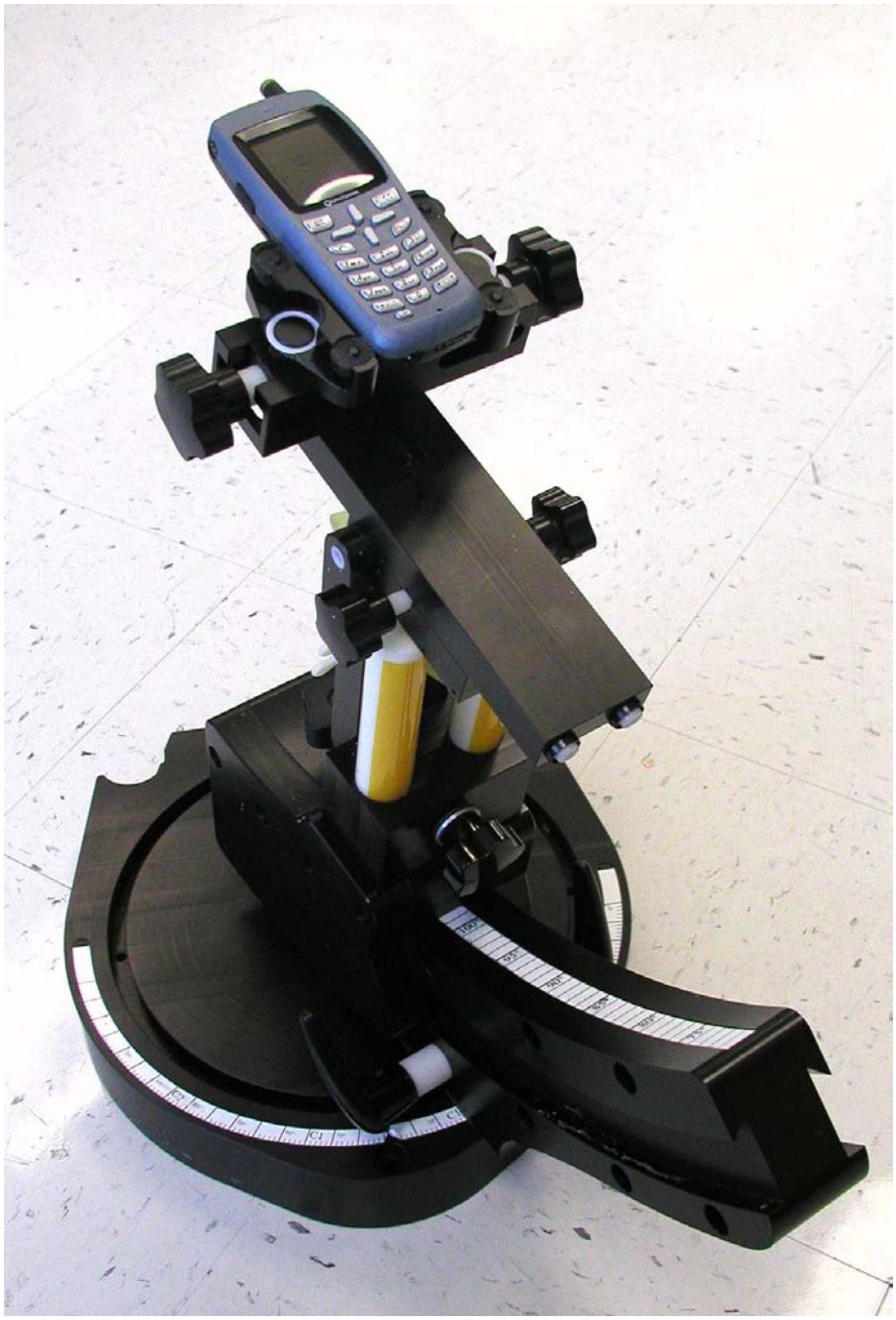


Figure 6-2 Phone in positioning device (view 2)

6.2 Left Head Positions

Figure 6-3 Left Touch position

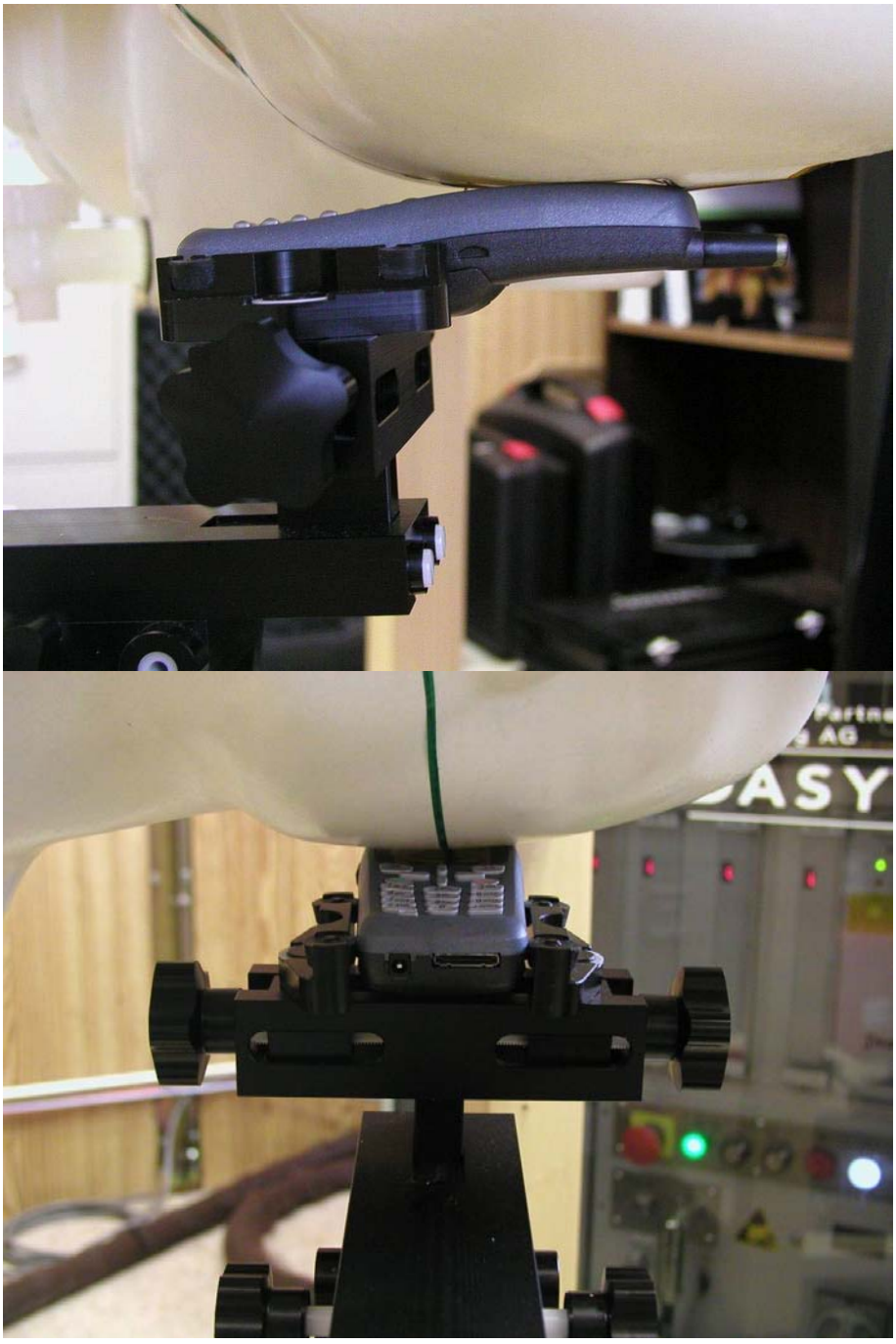
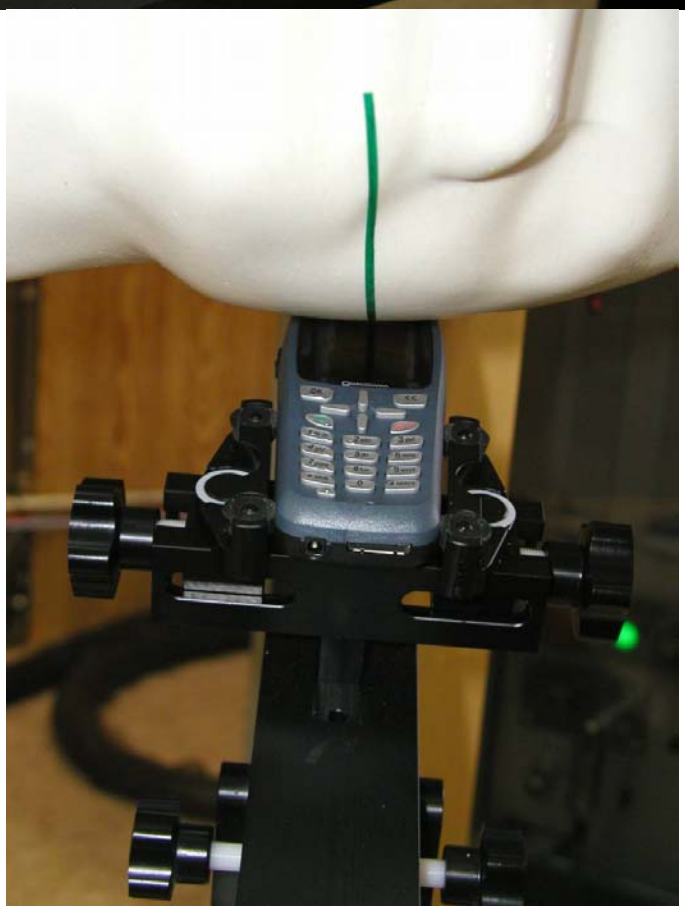


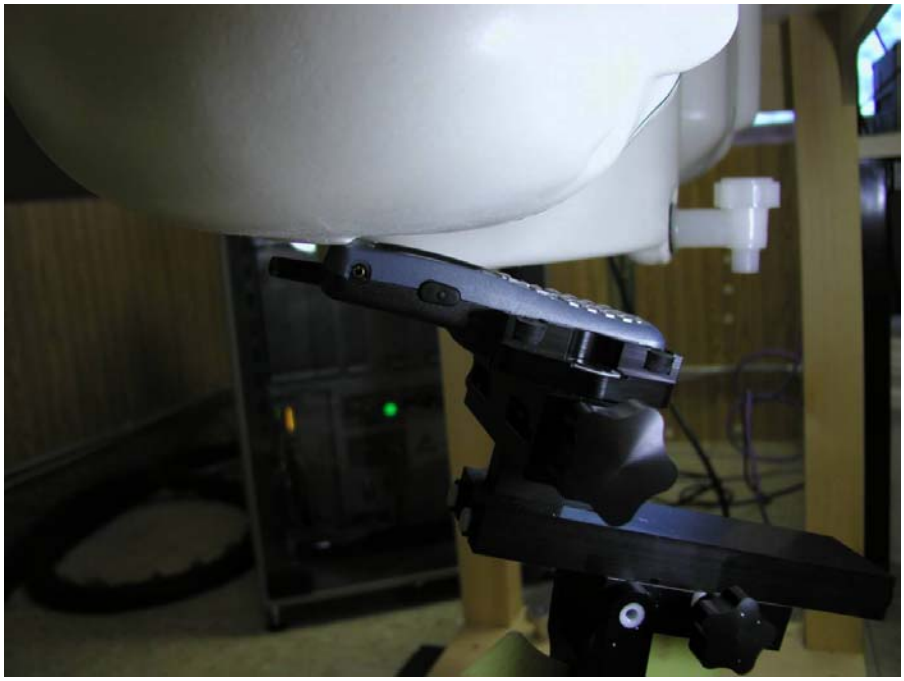
Figure 6-4 Left Tilt position



6.3 Right Head Positions

Figure 6-5 Right Touch position

Figure 6-6 Right Tilt position



6.4 Flat Positions

Figure 6-7 Belt clip position

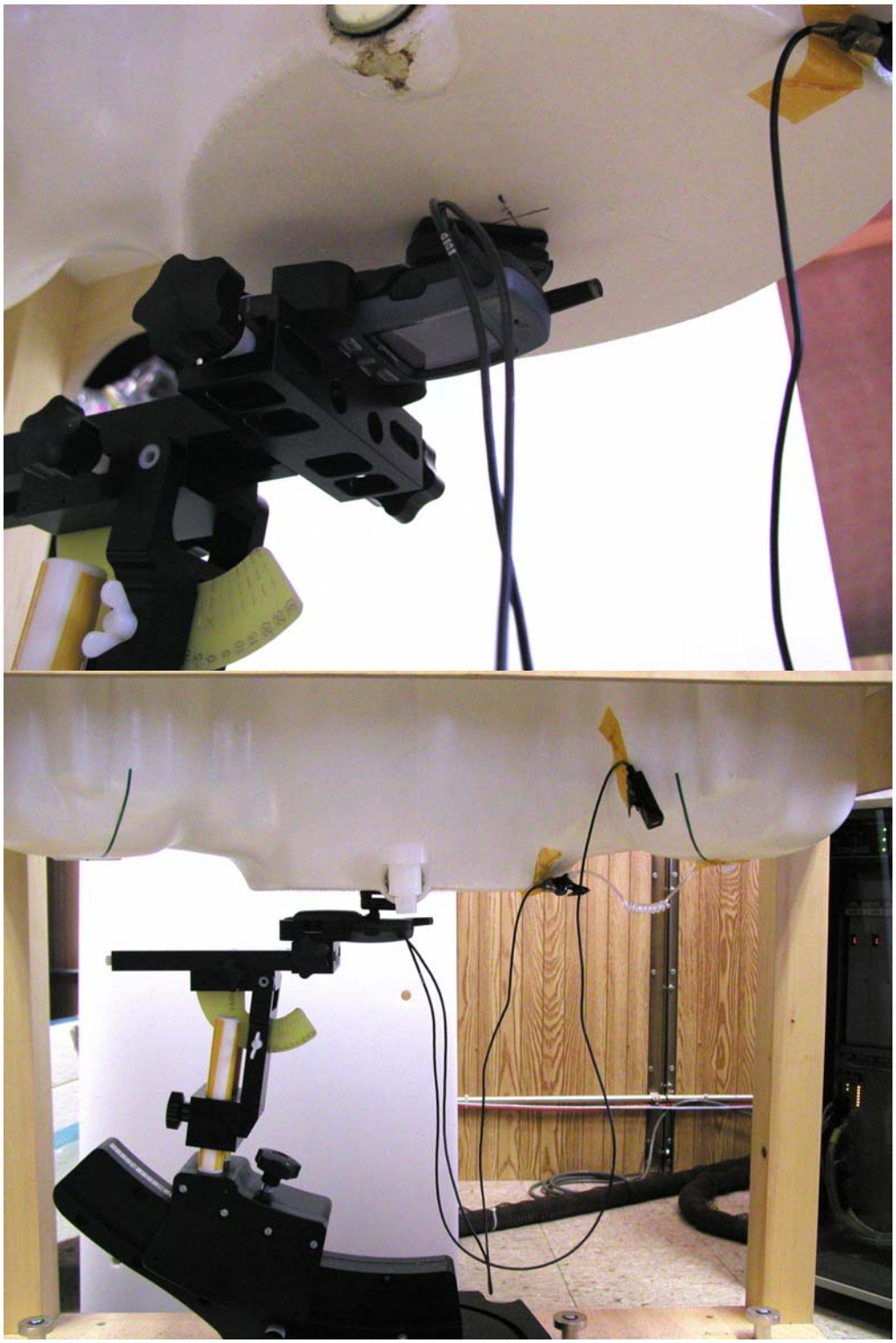


Figure 6-8 Push-to-talk (PTT) position

Figure 6-9(a) Set-up for Clip-less position with belt clip in place

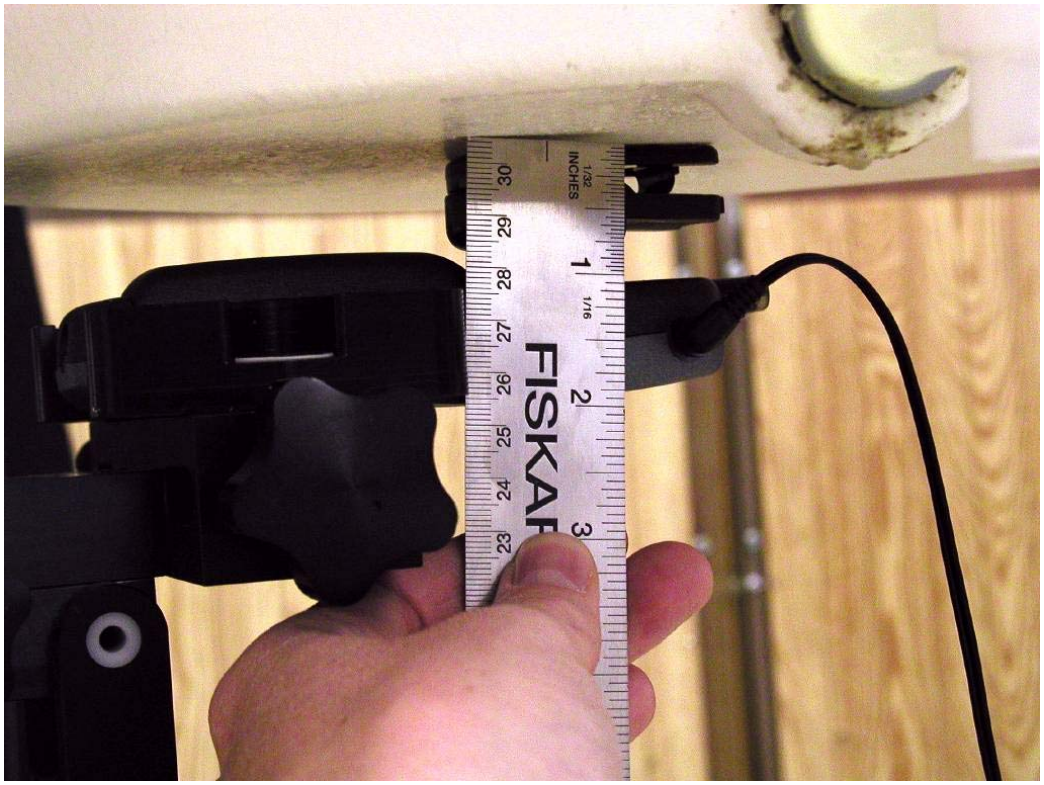


Figure 6-9(b) Clip-less Position (belt clip removed)

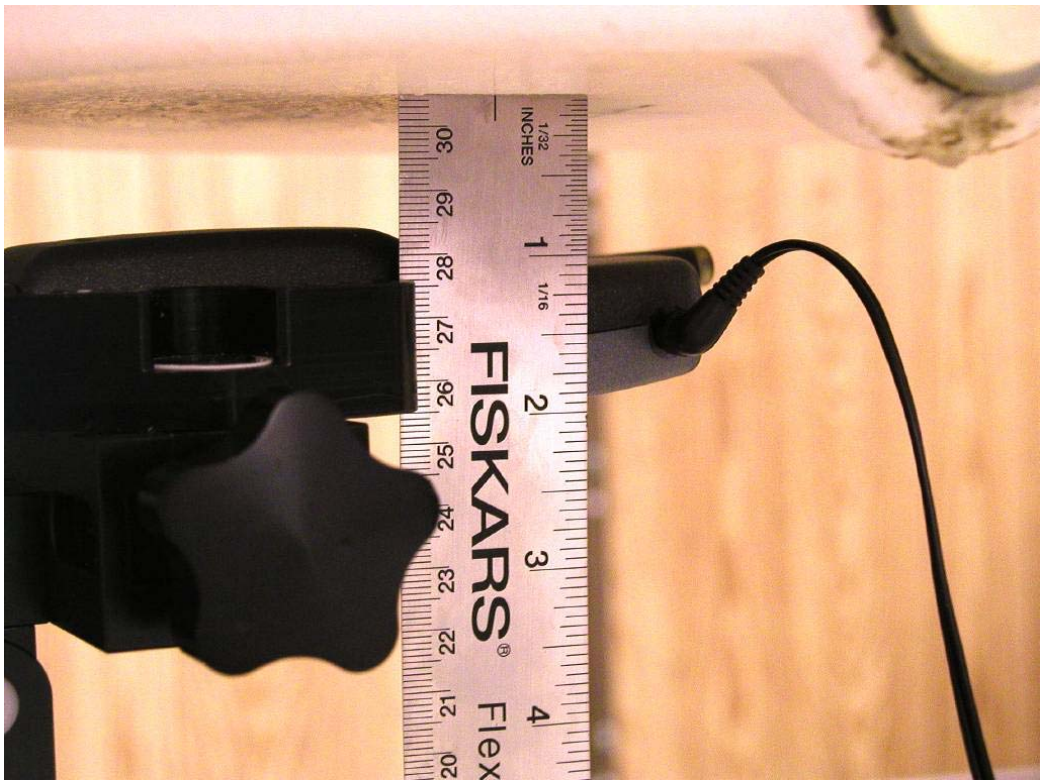


Figure 6-10 Clip-less position (wide view)

7. Test Data

7.1 Numerical Data

Tables 7-1 and 7-2 show 1 g SAR test data for the 2 frequency bands tested.

Table 7-1 CDMA 835 Mhz SAR

Ch.	Section	Position	Cond. Power (dBm)	1 g (mW/g)	Air temp (°C)	Liq. Temp (°C)	Humidity (%)
1013	Left	Touch	23.9	1.09	22	22	59
1013	Left	Tilt	23.9	0.768	22	22	59
383	Left	Touch	24.0	1.16	22	22	59
383	Left	Tilt	24.0	0.761	22	22	59
777	Left	Touch	24.2	1.15	22	22	59
777	Left	Tilt	24.2	0.939	23	22	51
1013	Right	Touch	24.1	1.12	23	23	51
1013	Right	Tilt	24.1	0.661	23	23	51
383	Right	Touch	24.2	1.09	23	23	51
383	Right	Tilt	24.2	0.745	23	23	51
777	Right	Touch	24.1	1.15	23	23	51
777	Right	Tilt	24.1	0.748	23	23	51
1013	Flat	PTT	23.9	0.359	23	23	51
383	Flat	PTT	23.9	0.426	23	23	51
777	Flat	PTT	24.0	0.385	23	23	51
1013	Flat	Belt clip	24.0	0.37	23	22	54
383	Flat	Belt clip	24.0	0.357	23	22	54
777	Flat	Belt clip	24.0	0.501	23	22	54
1013	Flat	Clip-less	24.0	0.295	22	21	53
383	Flat	Clip-less	24.1	0.352	22	22	50
777	Flat	Clip-less	24.1	0.394	23	23	49

Table 7-2 CDMA PCS SAR

Ch.	Section	Position	Cond. power (dBm)	1 g (mW/g)	Air temp (°C)	Liq. Temp (°C)	Humidity (%)
25	Left	Touch	23.3	1.37	23	22	55
600	Left	Touch	23.2	1.36	23	22	56
1175	Left	Touch	23.2	1.43	23	23	61
25	Left	Tilt	23.2	1.35	23	23	56
600	Left	Tilt	23.2	1.31	23	23	57
1175	Left	Tilt	23.2	1.41	23	23	60
25	Right	Touch	23.3	1.33	23	23	59
600	Right	Touch	23.2	1.44	23	23	56
1175	Right	Touch	23.3	1.43	23	23	57
25	Right	Tilt	23.3	1.24	23	23	58
600	Right	Tilt	23.2	1.29	23	23	56
1175	Right	Tilt	23.3	1.22	23	23	58
25	Flat	PTT	23.2	0.229	23	23	58
600	Flat	PTT	23.2	0.227	23	23	58
1175	Flat	PTT	23.2	0.196	23	23	58
25	Flat	Belt clip	23.2	0.0498	23	22	59
600	Flat	Belt clip	23.2	0.49	23	22	59
1175	Flat	Belt clip	23.2	0.336	23	22	59
25	Flat	Clip-less	23.2	0.0157	22	22.6	53
600	Flat	Clip-less	23.2	0.189	22	22.4	53
1175	Flat	Clip-less	23.3	0.202	22	22.3	53