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## Report

# **Dosimetric Assessment of the Portable Device Siemens A56 (FCC ID: PWX-A56) According to the FCC Requirements**

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## Executive Summary

The A56 is a new mobile phone (Portable Device) from Siemens operating in the 800 MHz and 1900 MHz frequency range. The device has an integrated antenna. The system concepts used are the GSM 850 and PCS 1900 standards including GPRS capability with 1 TX slot.

The objective of the measurements done by IMST was the dosimetric assessment of one device in the GSM 850 and PCS 1900 standards. The examinations have been carried out with the dosimetric assessment system „DASY3“.

The measurements were made according to the Supplement C to OET Bulletin 65 of the Federal Communications Commission (FCC) Guidelines [FCC 2001] for evaluating compliance of mobile and portable devices with FCC limits for human exposure (general population) to radiofrequency emissions.

**The Siemens A56 mobile phone (FCC ID: PWX-A56) is in compliance with the Federal Communications Commission (FCC) Guidelines [FCC 2001] for uncontrolled exposure. The phone was tested in the Body Worn configuration with the following accessories and combinations: “Belt Clip” with “Headset” and “Tour Case” with “Headset” for normal Talk mode (1 TX slot). “Belt Clip” without “Headset” and “Tour Case” without “Headset” for GPRS mode (1 TX slot).**

**A larger Belt Clip (plastic, with no metal components) is also available, but since it dictates a larger distance than the tested Belt Clip, additional measurements are not required. The additionally available Leather Case was not tested since it is only a carry case, to establish or to answer a call is not possible because there are no apertures for a headset.**

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## 1 Subject of Investigation

The A56 is a new mobile phone (Portable Device) from Siemens operating in the 800 MHz and 1900 MHz frequency range. The device has an integrated antenna. The system concepts used are the GSM 850 and PCS 1900 standards including GPRS capability with 1 TX slot.



Fig. 1: Picture of the device under test.

The objective of the measurements done by IMST was the dosimetric assessment of one device in the GSM 850 and PCS 1900 standards. The examinations have been carried out with the dosimetric assessment system „DASY3“ described below.

## 2 The IEEE Standard C95.1 and the FCC Exposure Criteria

In the USA the recent FCC exposure criteria [FCC 2001] are based upon the IEEE Standard C95.1 [IEEE 1999]. The IEEE standard C95.1 sets limits for human exposure to radio frequency electromagnetic fields in the frequency range 3 kHz to 300 GHz.

### 2.1 Distinction Between Exposed Population, Duration of Exposure and Frequencies

The American Standard [IEEE 1999] distinguishes between controlled and uncontrolled environment. Controlled environments are locations where there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment or by other cognizant persons. Uncontrolled environments are locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces. For exposure in controlled environments higher field strengths are admissible. In addition the duration of exposure is considered.

Due to the influence of frequency on important parameters, as the penetration depth of the electromagnetic fields into the human body and the absorption capability of different tissues, the limits in general vary with frequency.

## 2.2 Distinction between Maximum Permissible Exposure and SAR Limits

The biological relevant parameter describing the effects of electromagnetic fields in the frequency range of interest is the specific absorption rate SAR (dimension: power/mass). It is a measure of the power absorbed per unit mass. The SAR may be spatially averaged over the total mass of an exposed body or its parts. The SAR is calculated from the r.m.s. electric field strength  $E$  inside the human body, the conductivity  $\sigma$  and the mass density  $\rho$  of the biological tissue:

$$SAR = \sigma \frac{E^2}{\rho} = c \frac{\partial T}{\partial t} \Big|_{t \rightarrow 0+} . \quad (1)$$

The specific absorption rate describes the initial rate of temperature rise  $\partial T / \partial t$  as a function of the specific heat capacity  $c$  of the tissue. A limitation of the specific absorption rate prevents an excessive heating of the human body by electromagnetic energy.

As it is sometimes difficult to determine the SAR directly by measurement (e.g. whole body averaged SAR), the standard specifies more readily measurable maximum permissible exposures in terms of external electric  $E$  and magnetic field strength  $H$  and power density  $S$ , derived from the SAR limits. The limits for  $E$ ,  $H$  and  $S$  have been fixed so that even under worst case conditions, the limits for the specific absorption rate SAR are not exceeded.

For the relevant frequency range the maximum permissible exposure may be exceeded if the exposure can be shown by appropriate techniques to produce SAR values below the corresponding limits.

## 2.3 SAR Limit

In this report the comparison between the American exposure limits and the measured data is made using the spatial peak SAR; the power level of the device under test guarantees that the whole body averaged SAR is not exceeded.

Having in mind a worst case consideration, the SAR limit is valid for uncontrolled environment and mobile respectively portable transmitters. According to Table 1 the SAR values have to be averaged over a mass of 1 g ( $SAR_{1g}$ ) with the shape of a cube.

| Standard   | Status   | SAR limit [W/kg] |
|------------|----------|------------------|
| IEEE C95.1 | In force | 1.6              |

Table 1: Relevant spatial peak SAR limit averaged over a mass of 1 g.

### 3 The FCC Measurement Procedure

The Federal Communications Commission (FCC) has published a report and order on the 1<sup>st</sup> of August 1996 [FCC 1996], which requires routine dosimetric assessment of mobile telecommunications devices, either by laboratory measurement techniques or by computational modeling, prior to equipment authorization or use. In 2001 the Commission's Office of Engineering and Technology has released Edition 01-01 of Supplement C to OET Bulletin 65. This revised edition, which replaces Edition 97-01, provides additional guidance and information for evaluating compliance of mobile and portable devices with FCC limits for human exposure to radiofrequency emissions [FCC 2001].

#### 3.1 General Requirements

The test shall be performed in a laboratory with an environment which avoids influence on SAR measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature shall be in the range of 20°C to 26°C and 30-70% humidity.

#### 3.2 Device Operating Next to a Person's Ear

##### 3.2.1 Phantom Requirements

The phantom is a simplified representation of the human anatomy and comprised of material with electrical properties similar to the corresponding tissues. The physical characteristics of the phantom model shall resemble the head and the neck of a user since the shape is a dominant parameter for exposure.

##### 3.2.2 Test Positions

As it cannot be expected that the user will hold the mobile phone exactly in one well defined position, different operational conditions shall be tested. The Supplement C to OET Bulletin 65 requires two test positions. For an exact description helpful geometrical definitions are introduced and shown in Fig. 2 - 3.

There are two imaginary lines on the mobile, the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width  $w_t$  of the handset at the level of the acoustic output (point A on Fig. 2), and the midpoint of the width  $w_b$  of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Fig. 2). The two lines intersect at point A.

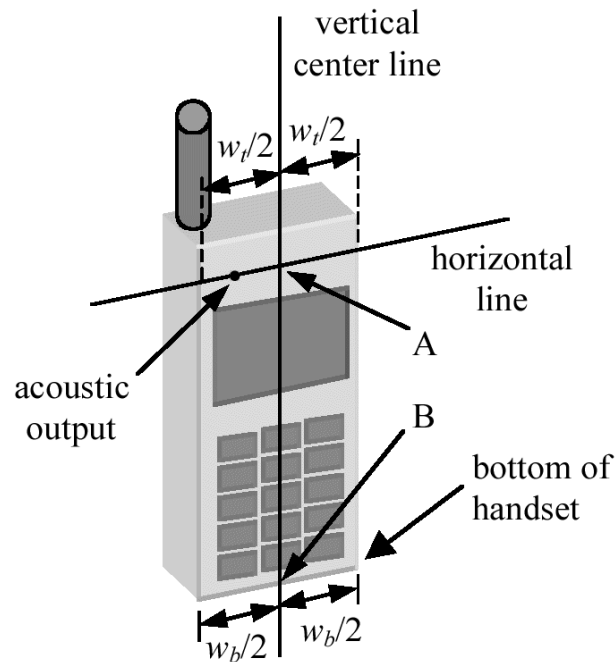


Fig. 2: Handset vertical and horizontal reference lines.

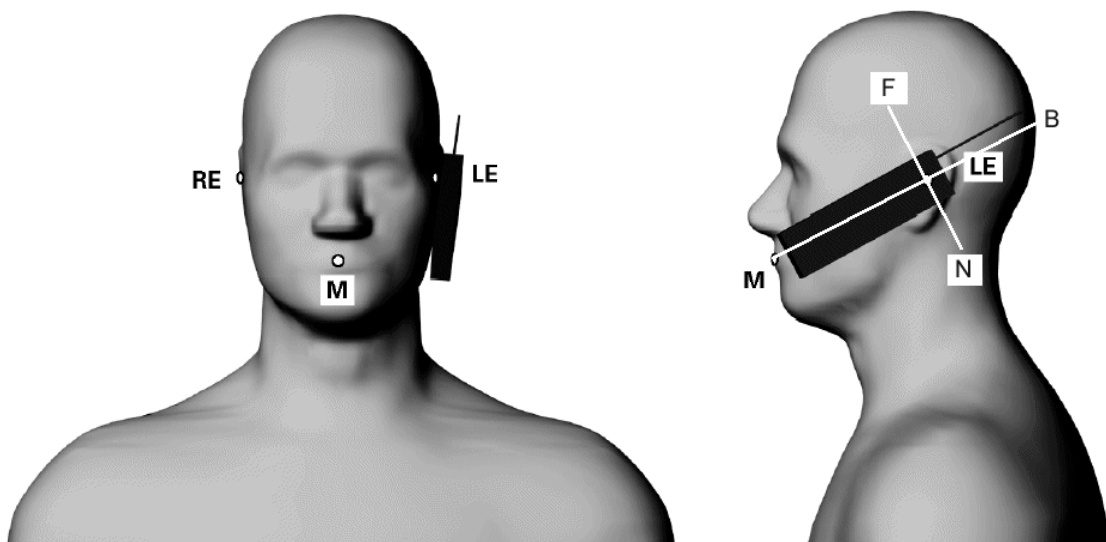


Fig. 3: Phantom reference points.

According to Fig. 3 the human head position is given by means of the following three reference points: auditory canal opening of both ears (RE and LE) and the center of the closed mouth (M). The ear reference points are 15-17 mm above the entrance to the ear canal along the BM line (back-mouth), as shown in Fig. 3. The plane passing through the two ear canals and M is defined as the reference plane. The line NF (Neck-Front) perpendicular to the reference plane and passing through the RE (or LE) is called the reference pivoting line. Line BM is perpendicular to the NF line. With this definitions the test positions are given by

- **Cheek position (see Fig. 4):**

Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Fig. 3), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom. Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane). Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the ear.

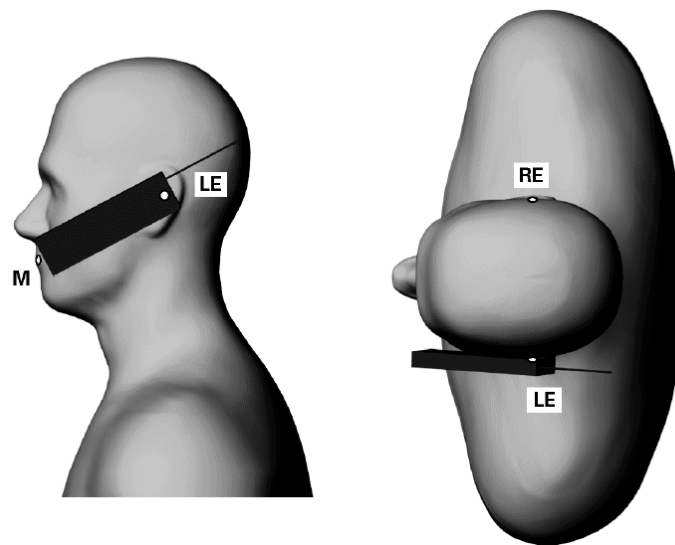


Fig. 4: The cheek position.

- **Tilted position (see Fig. 5):**

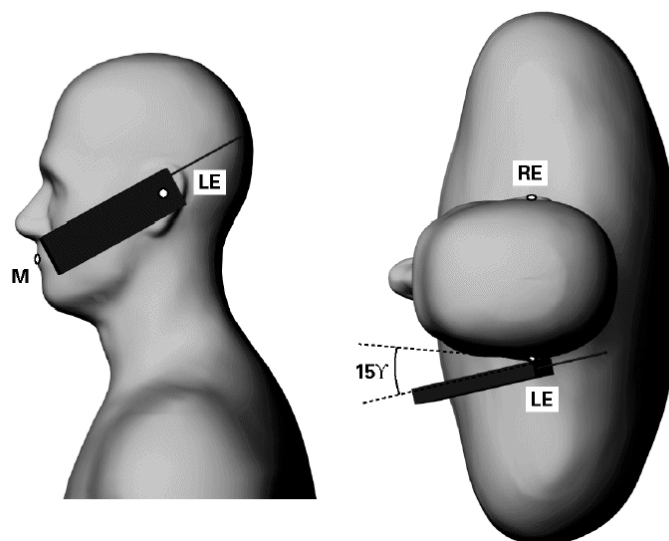


Fig. 5: The tilted position.

While maintaining the orientation of the phone retract the phone parallel to the reference plane far enough to enable a rotation of the phone by 15°. Rotate the phone around the horizontal line by 15°. While maintaining the orientation of the phone, move the phone parallel to the reference plane until any part of the phone touches the head. In this position, point A will be located on the line RE-LE.

### **3.2.3 Test to be Performed**

The SAR test shall be performed with both phone positions described above, on the left and right side of the phantom. The device shall be measured for all modes operating when the device is next to the ear, even if the different modes operate in the same frequency band.

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional.

## **3.3 Body-worn and Other Configurations**

### **3.3.1 Phantom Requirements**

For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

### **3.3.2 Test Position**

The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration. Devices with a headset output shall be tested with a connected headset.

### **3.3.3 Test to be Performed**

For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body.

For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested.

If the manufacturer provides none body-worn accessories a separation distance of 1.5 cm between the back of the device and the flat phantom is recommended. Other separation distances

may be used, but they shall not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional.

## 4 The Measurement System

DASY is an abbreviation of „Dosimetric Assessment System“ and describes a system that is able to determine the SAR distribution inside a phantom of a human being according to different standards. It consists of a robot, several field probes calibrated for use in liquids, a shell phantom, tissue simulating liquid and software. The software controls the robot and processes the measured data to compare them with safety levels with respect to human exposure to radio frequency electromagnetic fields. Fig. 6 shows the equipment, similar to the installations in other laboratories [DASY 1995].



Fig. 6: The measurement set-up with two SAM phantoms containing tissue simulating liquid.

The mobile phone operating at the maximum power level is placed by a non metallic device holder (delivered from Schmid & Partner) in the above described positions at a shell phantom of a human being. The distribution of the electric field strength  $E$  is measured in the tissue simulating liquid within the shell phantom. For this miniaturised field probes with high sensitivity and low field disturbance are used. Afterwards the corresponding SAR values are calculated with the known electrical conductivity  $\sigma$  and the mass density  $\rho$  of the tissue. The system software is able to determine the averaged SAR values (averaging region 1 g or 10 g) for compliance testing.

This is done by two scans: first a coarse scan determines the region of the maximum SAR, afterwards the 1 g and 10 g averaged SAR is measured in a second fine scan. The measurement time takes about 20 minutes.

#### 4.1 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM Twin Phantom V4.0) defined by the IEEE SCC-34/SC2 group and delivered by Schmid & Partner Engineering AG is used. The phantom is a fibreglass shell integrated in a wooden table. The thickness of the phantom amounts to  $2 \text{ mm} \pm 0.2 \text{ mm}$ . It enables the dosimetric evaluation of left and right hand phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a coverage (polyethylene), which prevents the evaporation of the liquid. The details and the Certificate of conformity can be found in Fig. 19.

#### 4.2 Probe

For the measurements the Dosimetric E-Field Probe ET3DV6 manufactured and calibrated annually by Schmid & Partner Engineering AG with following specifications is used.

- Dynamic range:  $5 \mu\text{W/g}$  to  $> 100 \text{ mW/g}$
- Tip diameter: 6.8 mm
- Probe linearity:  $\pm 0.2 \text{ dB}$  (30 MHz to 3 GHz)
- Axial isotropy:  $\pm 0.2 \text{ dB}$
- Spherical isotropy:  $\pm 0.4 \text{ dB}$
- Calibration range: 835MHz/1900 MHz for head & body simulating liquid

#### 4.3 Measurement Procedure

The following steps are used for each test position:

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile phone and the base station simulator is established via air interface.
- Measurement of the local E-field value at a fixed location (P1). This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with a grid spacing of 15 mm x 15 mm and a constant distance to the inner surface of the phantom. With interpolation of these values, the area of the maximum SAR is calculated.
- Around this point, a cube of 30 mm x 30 mm x 30 mm is assessed by measuring 7 x 7 x 7 points. With these data, the peak spatial-average SAR value is calculated (all additionally peaks within 2.0 dB of the highest peak identified during the grid scan are assessed by additional cubes).
- Repetition of the E-field measurement at the fixed location (P1) and repetition of the whole procedure if the two results differ by more than  $\pm 0.21 \text{ dB}$ .

#### 4.4 Uncertainty Assessment

Table 2 includes the uncertainty budget suggested by the [IEEE 200X] and determined by Schmid & Partner Engineering AG. The extended uncertainty (K=2) is assessed to be  $\pm 27.1\%$ .

| Error Sources                | Uncertainty Value | Probability Distribution | Divisor    | $c_i$          | Standard Uncertainty | $v_i^2$ or $v_{eff}$ |
|------------------------------|-------------------|--------------------------|------------|----------------|----------------------|----------------------|
| <b>Measurement System</b>    |                   |                          |            |                |                      |                      |
| Probe calibration            | $\pm 4.4 \%$      | Normal                   | 1          | 1              | $\pm 4.4 \%$         | $\infty$             |
| Axial isotropy               | $\pm 4.7 \%$      | Rectangular              | $\sqrt{3}$ | $(1-cp)^{1/2}$ | $\pm 1.9 \%$         | $\infty$             |
| Spherical isotropy           | $\pm 9.6 \%$      | Rectangular              | $\sqrt{3}$ | $(cp)^{1/2}$   | $\pm 3.9 \%$         | $\infty$             |
| Spatial resolution           | $\pm 0.0 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 0.0 \%$         | $\infty$             |
| Boundary effects             | $\pm 5.5 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 3.2 \%$         | $\infty$             |
| Probe linearity              | $\pm 4.7 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 2.7 \%$         | $\infty$             |
| Detection limit              | $\pm 1.0 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 0.6 \%$         | $\infty$             |
| Readout electronics          | $\pm 1.0 \%$      | Normal                   | 1          | 1              | $\pm 1.0 \%$         | $\infty$             |
| Response time                | $\pm 0.8 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 0.5 \%$         | $\infty$             |
| Integration time             | $\pm 1.4 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 0.8 \%$         | $\infty$             |
| RF ambient conditions        | $\pm 3.0 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 1.7 \%$         | $\infty$             |
| Mech. robot constraints      | $\pm 0.4 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 0.2 \%$         | $\infty$             |
| Probe positioning            | $\pm 2.9 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 1.7 \%$         | $\infty$             |
| Extrapolation & integration  | $\pm 3.9 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 2.3 \%$         | $\infty$             |
| <b>Test Sample Related</b>   |                   |                          |            |                |                      |                      |
| Device positioning           | $\pm 6.0 \%$      | Normal                   | 0.89       | 1              | $\pm 6.7 \%$         | 12                   |
| Device holder uncertainty    | $\pm 5.0 \%$      | Normal                   | 0.84       | 1              | $\pm 5.9 \%$         | 8                    |
| Power drift                  | $\pm 5.0 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 2.9 \%$         | $\infty$             |
| <b>Phantom and Set-up</b>    |                   |                          |            |                |                      |                      |
| Phantom uncertainty          | $\pm 4.0 \%$      | Rectangular              | $\sqrt{3}$ | 1              | $\pm 2.3 \%$         | $\infty$             |
| Liquid conductivity (target) | $\pm 5.0 \%$      | Rectangular              | $\sqrt{3}$ | 0.6            | $\pm 1.7 \%$         | $\infty$             |
| Liquid conductivity (meas.)  | $\pm 10.0 \%$     | Rectangular              | $\sqrt{3}$ | 0.6            | $\pm 3.5 \%$         | $\infty$             |
| Liquid permittivity (target) | $\pm 5.0 \%$      | Rectangular              | $\sqrt{3}$ | 0.6            | $\pm 1.7 \%$         | $\infty$             |
| Liquid permittivity (meas.)  | $\pm 5.0 \%$      | Rectangular              | $\sqrt{3}$ | 0.6            | $\pm 1.7 \%$         | $\infty$             |
| <b>Combined Uncertainty</b>  |                   |                          |            |                | $\pm 13.6 \%$        |                      |

Table 2: Uncertainty budget of DASY3.

## 5 SAR Results

The Tables below contain the measured SAR values averaged over a mass of 1 g.

| Phantom Configuration<br>(Liquid depth = 16.4 cm) | Test Position | SAR <sub>1g</sub> [W/kg] (Drift[dB]) |                                      |                                      | Temperature      |                 |
|---------------------------------------------------|---------------|--------------------------------------|--------------------------------------|--------------------------------------|------------------|-----------------|
|                                                   |               | Channel 128<br>824.2 MHz<br>32.5 dBm | Channel 190<br>836.6 MHz<br>32.3 dBm | Channel 251<br>848.8 MHz<br>32.0 dBm | Ambient<br>[° C] | Liquid<br>[° C] |
| Left Side                                         | Cheek         |                                      | 0.763 (-0.06)                        |                                      | 22.0             | 20.7            |
|                                                   | Tilted        |                                      | 0.502 (-0.07)                        |                                      | 22.2             | 20.5            |
| Right Head                                        | Cheek         |                                      | 0.686 (-0.04)                        |                                      | 22.3             | 20.7            |
|                                                   | Tilted        |                                      | 0.511 (-0.04)                        |                                      | 22.4             | 20.7            |

Table 3: Measured head phantom results for GSM 850 for the Siemens A56.

| Phantom Configuration<br>(Liquid depth = 16.4 cm) | Test Position | SAR <sub>1g</sub> [W/kg] (Drift[dB])  |                                       |                                       | Temperature      |                 |
|---------------------------------------------------|---------------|---------------------------------------|---------------------------------------|---------------------------------------|------------------|-----------------|
|                                                   |               | Channel 512<br>1850.2 MHz<br>29.1 dBm | Channel 661<br>1880.0 MHz<br>29.0 dBm | Channel 810<br>1909.8 MHz<br>29.0 dBm | Ambient<br>[° C] | Liquid<br>[° C] |
| Left Side                                         | Cheek         |                                       | 0.223* (-0.09)                        |                                       | 22.5             | 20.9            |
|                                                   | Tilted        |                                       | 0.166 (-0.03)                         |                                       | 22.5             | 20.9            |
| Right Head                                        | Cheek         |                                       | 0.229* (-0.05)                        |                                       | 22.7             | 20.8            |
|                                                   | Tilted        |                                       | 0.208 (0.04)                          |                                       | 22.6             | 20.9            |

Table 4: Measured head phantom results for PCS 1900 for the Siemens A56 (\* Max Cube).

| Accessory<br>(Liquid depth = 15.5 cm)          | SAR <sub>1g</sub> [W/kg] (Drift[dB]) |                                      |                                      | Temperature      |                 |
|------------------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|------------------|-----------------|
|                                                | Channel 128<br>824.2 MHz<br>32.5 dBm | Channel 190<br>836.6 MHz<br>32.3 dBm | Channel 251<br>848.8 MHz<br>32.0 dBm | Ambient<br>[° C] | Liquid<br>[° C] |
| A56 with Belt Clip and Headset (Talk mode)     |                                      | 0.334 (0.06)                         |                                      | 22.1             | 20.7            |
| A56 with Belt Clip without Headset (GPRS mode) |                                      | 0.464 (0.01)                         |                                      | 22.2             | 20.7            |

Table 5: Measurement results in body-worn configuration with Belt Clip for GSM 850 for the Siemens A56, 1 TX slot.

| Accessory<br>(Liquid depth = 15.5 cm)         | SAR <sub>1g</sub> [W/kg] (Drift[dB]) |                                      |                                      | Temperature      |                 |
|-----------------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|------------------|-----------------|
|                                               | Channel 128<br>824.2 MHz<br>32.5 dBm | Channel 190<br>836.6 MHz<br>32.3 dBm | Channel 251<br>848.8 MHz<br>32.0 dBm | Ambient<br>[° C] | Liquid<br>[° C] |
| A56 with Tour Case and Headset (Display down) |                                      | 0.284 (-0.02)                        |                                      | 22.2             | 20.5            |
| A56 with Tour Case and Headset (Display up)   |                                      | 0.137 (-0.09)                        |                                      | 22.4             | 20.7            |

Table 6: Measurement results in body-worn configuration with Tour Case and Headset (Talk Mode) for GSM 850 for the Siemens A56, 1 TX slot.

| Accessory<br>(Liquid depth = 15.5 cm)             | SAR <sub>1g</sub> [W/kg] (Drift[dB]) |                                      |                                      | Temperature      |                 |
|---------------------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|------------------|-----------------|
|                                                   | Channel 128<br>824.2 MHz<br>32.5 dBm | Channel 190<br>836.6 MHz<br>32.3 dBm | Channel 251<br>848.8 MHz<br>32.0 dBm | Ambient<br>[° C] | Liquid<br>[° C] |
| A56 with Tour Case without Headset (Display down) |                                      | 0.351 (0.03)                         |                                      | 22.4             | 20.7            |
| A56 with Tour Case without Headset (Display up)   |                                      | 0.340 (0.00)                         |                                      | 22.4             | 20.7            |

Table 7: Measurement results in body-worn configuration with Tour Case without Headset (GPRS mode) for GSM 850 for the Siemens A56, 1 TX slot.

| Accessory<br>(Liquid depth = 16.2 cm)          | SAR <sub>1g</sub> [W/kg] (Drift[dB])  |                                       |                                       | Temperature      |                 |
|------------------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|------------------|-----------------|
|                                                | Channel 512<br>1850.2 MHz<br>29.1 dBm | Channel 661<br>1880.0 MHz<br>29.0 dBm | Channel 810<br>1909.8 MHz<br>29.0 dBm | Ambient<br>[° C] | Liquid<br>[° C] |
| A56 with Belt Clip and Headset (Talk mode)     |                                       | 0.301 (0.02)                          |                                       | 22.1             | 20.7            |
| A56 with Belt Clip without Headset (GPRS mode) |                                       | 0.329 (0.05)                          |                                       | 22.1             | 20.7            |

Table 8: Measurement results in body-worn configuration with Belt Clip for PCS 1900 for the Siemens A56, 1 TX slot.

| Accessory<br>(Liquid depth = 16.2 cm)         | SAR <sub>1g</sub> [W/kg] (Drift[dB])  |                                       |                                       | Temperature      |                 |
|-----------------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|------------------|-----------------|
|                                               | Channel 512<br>1850.2 MHz<br>29.1 dBm | Channel 661<br>1880.0 MHz<br>29.0 dBm | Channel 810<br>1909.8 MHz<br>29.0 dBm | Ambient<br>[° C] | Liquid<br>[° C] |
| A56 with Tour Case and Headset (Display down) |                                       | 0.2810 (-0.01)                        |                                       | 22.2             | 20.6            |
| A56 with Tour Case and Headset (Display up)   |                                       | 0.0724 (0.09)                         |                                       | 22.1             | 20.6            |

Table 9: Measurement results in body-worn configuration with Tour Case and Headset (Talk Mode) for PCS 1900 for the Siemens A56, 1 TX slot.

| Accessory<br>(Liquid depth = 16.2 cm)             | SAR <sub>1g</sub> [W/kg] (Drift[dB])  |                                       |                                       | Temperature      |                 |
|---------------------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|------------------|-----------------|
|                                                   | Channel 512<br>1850.2 MHz<br>29.1 dBm | Channel 661<br>1880.0 MHz<br>29.0 dBm | Channel 810<br>1909.8 MHz<br>29.0 dBm | Ambient<br>[° C] | Liquid<br>[° C] |
| A56 with Tour Case without Headset (Display down) |                                       | 0.2500 (0.02)                         |                                       | 22.2             | 20.6            |
| A56 with Tour Case without Headset (Display up)   |                                       | 0.0737 (-0.02)                        |                                       | 22.2             | 20.7            |

Table 10: Measurement results in body-worn configuration with Tour Case without Headset (GPRS mode) for PCS 1900 for the Siemens A56, 1 TX slot.

The “\* Max Cube” labeling indicates that during the grid scanning an additional peak was found which was within 2.0 dB of the highest peak. The value of the highest cube is given in the tables above, the value from the second assessed cube is given in the SAR distribution plots (appendix).

The labeling Display down/ Display up indicates the position of the mobile phone in the Tour Case. Display down mean that the Display of the mobile is oriented towards the ground. Display up stand for Display oriented towards the SAM phantom.

The above mentioned power values are conducted measured values. The power output was measured by the manufacturer Siemens Information & Communication Mobile LLC, San Diego.

To control the output power stability during the SAR test the used DASY3 system calculates the power drift by measuring the e-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in the above tables labeled as: (Drift[dB]). This ensures that the power drift during one measurement is within 5%.

Before the measurements the test side conditions were checked and ambient noise was not detectable. The measured SAR plot is given in the appendix.

## 6 Evaluation

In Fig. 7 - 8 the head phantom SAR results for GSM 850 and PCS 1900 given in Table 3 - 4 are summarized and compared to the limit. In Fig. 9 - 14 the SAR results in body-worn configuration for GSM 850 and PCS 1900 given in Table 5 - 10 are summarized and compared to the limit.

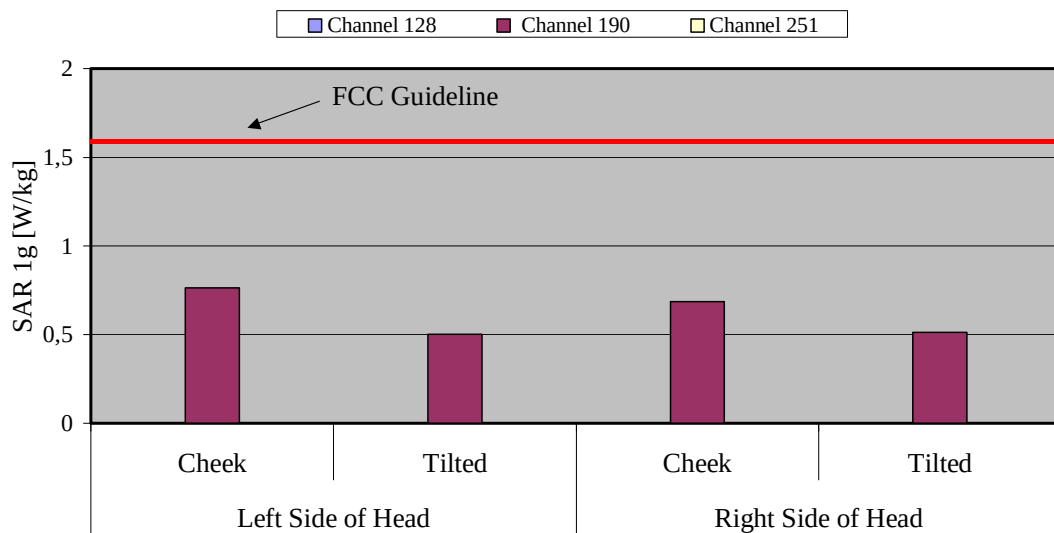


Fig. 7: The measured head phantom SAR values for the Siemens A56 for GSM 850 in comparison to the FCC exposure limit.

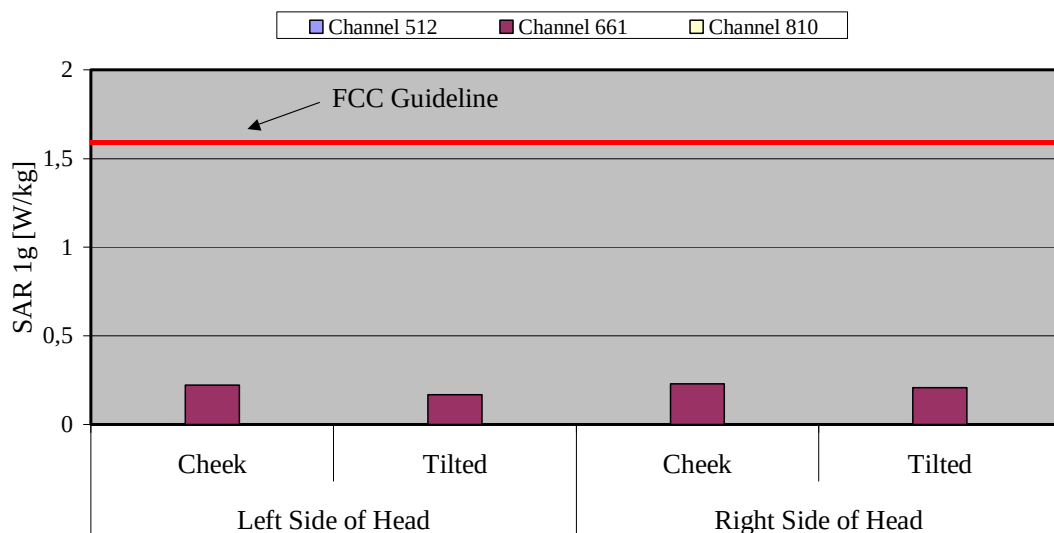


Fig. 8: The measured head phantom SAR values for the Siemens A56 for PCS 1900 in comparison to the FCC exposure limit.

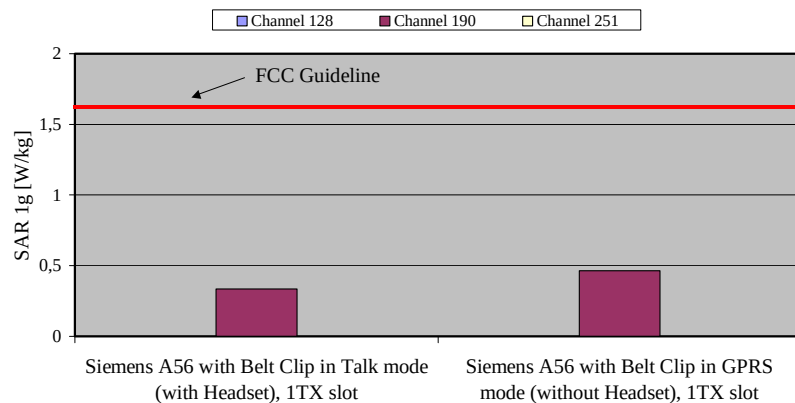


Fig. 9: The measured SAR values in body-worn configuration with Belt Clip for the Siemens A56 for GSM 850 in comparison to the FCC exposure limit.

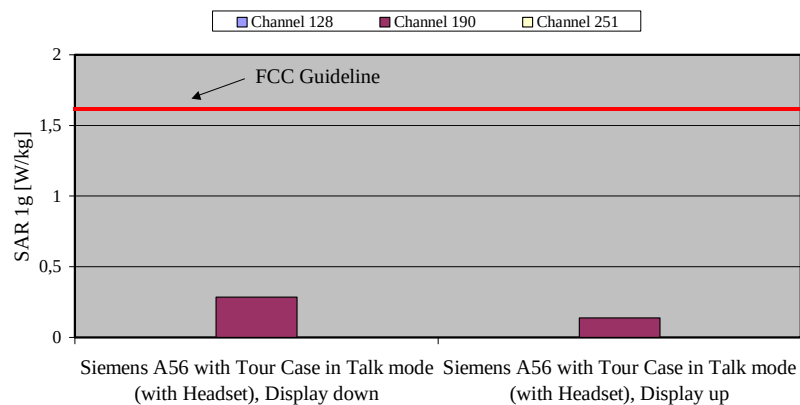


Fig. 10: The measured SAR values in body-worn configuration with Tour Case and Headset (Talk mode) for the Siemens A56 for GSM 850 in comparison to the FCC exposure limit.

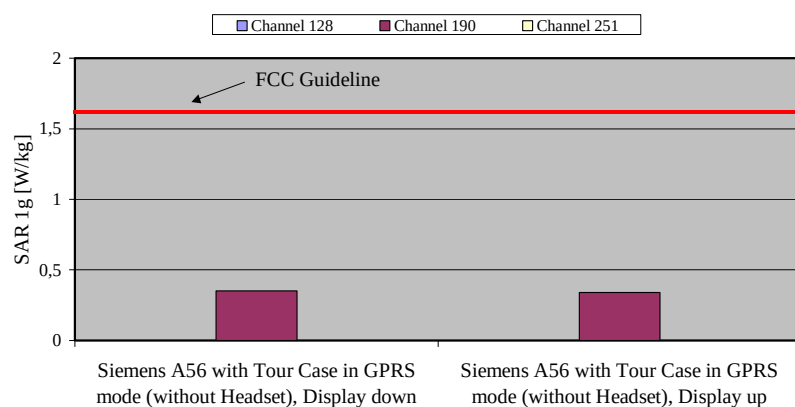


Fig. 11: The measured SAR values in body-worn configuration with Tour Case without Headset (GPRS mode) for the Siemens A56 for GSM 850 in comparison to the FCC exposure limit.

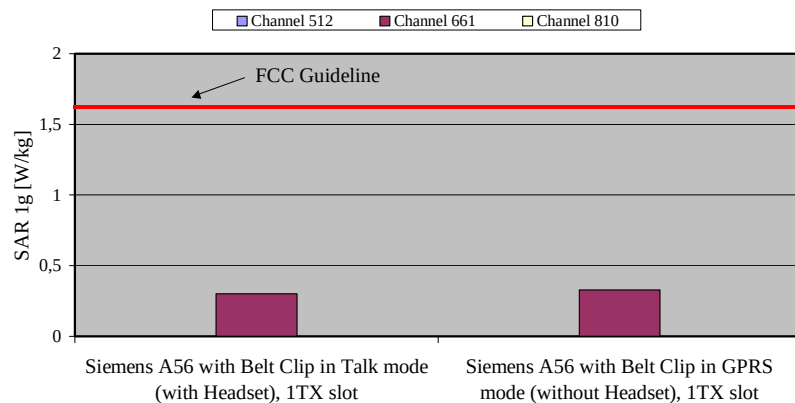


Fig. 12: The measured SAR values in body-worn configuration with Belt Clip for the Siemens A56 for PCS 1900 in comparison to the FCC exposure limit.

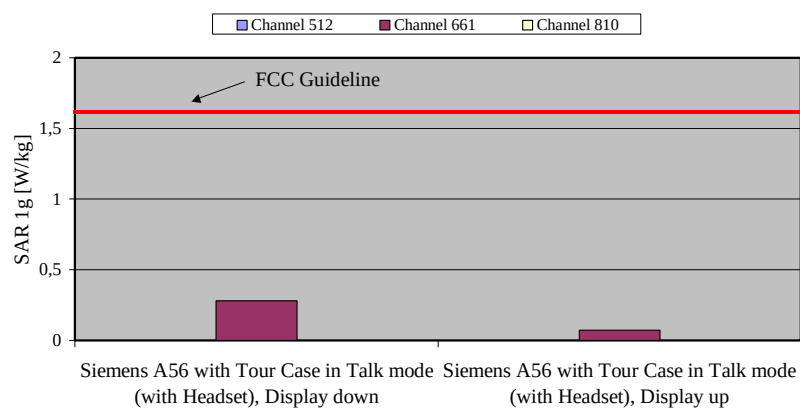


Fig. 13: The measured SAR values in body-worn configuration with Tour Case and Headset (Talk mode) for the Siemens A56 for PCS 1900 in comparison to the FCC exposure limit.

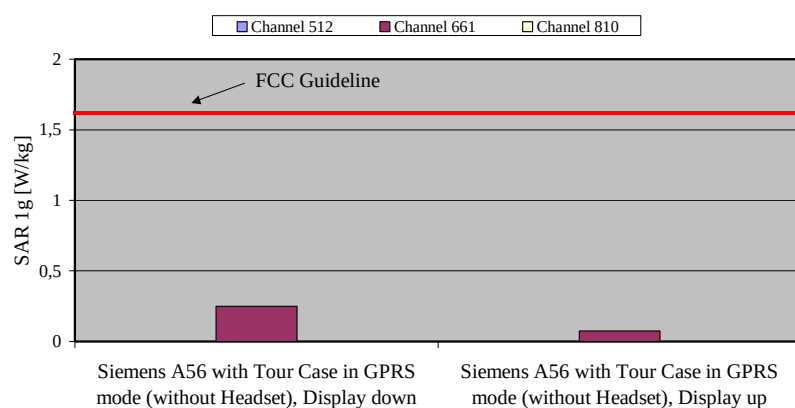


Fig. 14: The measured SAR values in body-worn configuration with Tour Case without Headset (GPRS mode) for the Siemens A56 for PCS 1900 in comparison to the FCC exposure limit.

**The Siemens A56 mobile phone (FCC ID: PWX-A56) is in compliance with the Federal Communications Commission (FCC) Guidelines [FCC 2001] for uncontrolled exposure. The phone was tested in the Body Worn configuration with the following accessories and combinations: “Belt Clip” with “Headset” and “Tour Case” with “Headset” for normal Talk mode (1 TX slot). “Belt Clip” without “Headset” and “Tour Case” without “Headset” for GPRS mode (1 TX slot).**

**A larger Belt Clip (plastic, with no metal components) is also available, but since it dictates a larger distance than the tested Belt Clip, additional measurements are not required. The additionally available Leather Case was not tested since it is only a carry case, to establish or to answer a call is not possible because there are no apertures for a headset.**

## 7 Appendix

### 7.1 Administrative Data

Date of validation: 835 MHz, Head: October 14, 2002  
 835 MHz, Body: October 16, 2002  
 1900 MHz, Head: October 14, 2002  
 1900 MHz, Body: October 15, 2002  
 Date of measurement: GSM 850, Head: October 14, 2002  
 GSM 850, Body: October 16, 2002  
 PCS 1900, Head: October 14, 2002  
 PCS 1900, Body: October 15, 2002  
 Data stored: Siemens\_6575\_272

### 7.2 Device under Test and Test Conditions

MTE: Siemens A56, Production Line Unit  
 Date of receipt: October 14, 2002  
 IMEI: 001002000132857  
 FCC ID: PWX-A56  
 Equipment class: Portable device  
 Power Class: GSM 850: 4, tested with power level 5  
 PCS 1900: 1, tested with power level 0  
 RF exposure environment: General Population/Uncontrolled  
 Power supply: Internal Battery (Other batteries not available)  
 Antenna: Antenna Typ: Integrated  
 Tested Accessories: Belt Clip (plastic with no metal components), Tour Case, Headset  
 Available Accessories: Large Belt Clip (plastic with no metal components), Leather Case (Carry case only, since there are no apertures for a headset. To establish or to answer a call the mobile has to be removed)  
 Measured Standards: GSM 850, PCS 1900  
 Method to establish a call: GSM 850: Basestation simulator, using the air interface  
 PCS 1900: Basestation simulator, using the air interface  
 Modulation: GMSK  
 Crest Factor: 8  
 TX range: GSM 850 : 824.2 MHz – 848.8 MHz  
 PCS 1900 : 1850.2 MHz – 1909.8 MHz  
 RX range: GSM 850 : 869.2 MHz – 893.8 MHz  
 PCS 1900 : 1930.2 MHz – 1989.8 MHz  
 Used TX Channels: GSM 850: low: ch. 128, center: ch. 190, high: ch. 251  
 PCS 1900: low: ch. 512, center: ch. 661, high: ch. 810  
 Used Phantom: SAM Twin Phantom V4.0, as defined by the IEEE SCC-34/SC2 group and delivered by Schmid & Partner Engineering AG

### 7.3 Tissue Recipes

The following recipes are provided in percentage by weight.

|                 |                                       |
|-----------------|---------------------------------------|
| 835 MHz, Head:  | 41.45 % De-Ionized Water              |
|                 | 1.45 % Salt                           |
|                 | 56.00 % Sugar                         |
|                 | 00.10 % Preventol D7                  |
|                 | 1.00 % Hydroxyetyl-Cellulose          |
| 835 MHz, Body:  | 52.40 % De-Ionized Water              |
|                 | 1.50 % Salt                           |
|                 | 45.00 % Sugar                         |
|                 | 00.10 % Preventol D7                  |
|                 | 1.00 % Hydroxyetyl-Cellulose          |
| 1900 MHz, Head: | 45.65% Diethylenglykol-monobutylether |
|                 | 54.00% De-Ionized Water               |
|                 | 0.35% Salt                            |
| 1900 MHz, Body: | 29.68% Diethylenglykol-monobutylether |
|                 | 70.00% De-Ionized Water               |
|                 | 0.32% Salt                            |

## 7.4 Material Parameters

For the measurement of the following parameters the HP 85070B dielectric probe kit is used, representing the open-ended coaxial probe measurement procedure.

| Frequency          |                   | $\epsilon_r$     | $\sigma$ [S/m]  | Temperature      |                 |
|--------------------|-------------------|------------------|-----------------|------------------|-----------------|
|                    |                   |                  |                 | Ambient<br>[° C] | Liquid<br>[° C] |
| 835 MHz<br>(Head)  | Recommended Value | $41.50 \pm 2.08$ | $0.90 \pm 0.05$ | 20.0 - 26.0      | -               |
|                    | Measured Value    | $43.00 \pm 2.10$ | $0.91 \pm 0.09$ | 21.8             | 20.6            |
| 835 MHz<br>(Body)  | Recommended Value | $55.20 \pm 2.76$ | $0.97 \pm 0.05$ | 20.0 - 26.0      | -               |
|                    | Measured Value    | $54.40 \pm 2.70$ | $1.00 \pm 0.10$ | 21.8             | 20.9            |
| 1900 MHz<br>(Head) | Recommended Value | $40.00 \pm 2.00$ | $1.40 \pm 0.07$ | 20.0 - 26.0      | -               |
|                    | Measured Value    | $39.00 \pm 1.90$ | $1.44 \pm 0.14$ | 22.7             | 20.7            |
| 1900 MHz<br>(Body) | Recommended Value | $53.30 \pm 2.67$ | $1.52 \pm 0.08$ | 20.0 - 26.0      | -               |
|                    | Measured Value    | $51.00 \pm 2.50$ | $1.54 \pm 0.15$ | 22.2             | 20.9            |

Table 11: Parameters of the tissue simulating liquids.

## 7.5 Simplified Performance Checking

The simplified performance check was realized using the dipole validation kits. The input power of the dipole antennas were 250 mW (cw signal) and they were placed under the flat part of the SAM phantom. The results are listed in the Table 12-13 and shown in Fig. 15-18. The target values were adopted from the manufactures calibration certificates which are attached in the appendix.

| Frequency         |                | $SAR_{1g}$ [W/kg] | $\epsilon_r$ | $\sigma$ [S/m] | Temperature      |                 |
|-------------------|----------------|-------------------|--------------|----------------|------------------|-----------------|
|                   |                |                   |              |                | Ambient<br>[° C] | Liquid<br>[° C] |
| 835 MHz<br>(Head) | Target Value   | 2.67              | 43.00        | 0.91           | 20.0 - 26.0      | -               |
|                   | Measured Value | 2.58              | 43.00        | 0.91           | 21.8             | 20.6            |
| 835 MHz<br>(Body) | Target Value   | 2.57              | 55.30        | 0.92           | 20.0 - 26.0      | -               |
|                   | Measured Value | 2.64              | 54.40        | 1.00           | 21.8             | 20.9            |

Table 12: Validation results, 835 MHz.

| Frequency          |                | SAR <sub>1g</sub> [W/kg] | $\epsilon_r$ | $\sigma$ [S/m] | Temperature      |                 |
|--------------------|----------------|--------------------------|--------------|----------------|------------------|-----------------|
|                    |                |                          |              |                | Ambient<br>[° C] | Liquid<br>[° C] |
| 1900 MHz<br>(Head) | Target Value   | 10.8                     | 39.20        | 1.47           | 20.0 - 26.0      | -               |
|                    | Measured Value | 11.5                     | 39.00        | 1.44           | 22.7             | 20.7            |
| 1900 MHz<br>(Body) | Target Value   | 10.2                     | 53.50        | 1.46           | 20.0 - 26.0      | -               |
|                    | Measured Value | 11.0                     | 51.00        | 1.54           | 22.2             | 20.3            |

Table 13: Validation results, 1900 MHz.

Dipole 835 MHz

SAM GSM850; Flat  
Probe: ET3DV6 - SN1579; ConvF(6.80,6.80,6.80); Crest factor: 1.0; Brain 835 MHz:  $\sigma = 0.91$  mho/m  $\epsilon_r = 43.0$   $\rho = 1.00$  g/cm<sup>3</sup>  
Cubes (2): Peak: 404 mW/g  $\pm 0.07$  dB, SAR (1g) 2.58 mW/g  $\pm 0.06$  dB, SAR (10g): 1.65 mW/g  $\pm 0.06$  dB, (Worst-case extrapolation)  
Penetration depth: 12.0 (11.1, 13.3) [mm]  
Powerdrift: 0.00 dB  
October 14, 2002; Ambient Temperature: 21.8 °C; Liquid Temperature: 20.6 °C



Fig. 15: Validation measurement 835 MHz Head, coarse grid.

Dipole 835 MHz

SAM GSM830; Flat  
Probe: ET3DV6 - SN1579; ConvF(6.60,6.60); Crest factor: 1.0; body 835 MHz:  $\sigma = 1.00 \text{ mho/m}$   $\epsilon_r = 54.4$   $\rho = 1.00 \text{ g/cm}^3$   
Cubes (2): Peak:  $4.16 \text{ mW/g} \pm 0.06 \text{ dB}$ , SAR (1g):  $2.64 \text{ mW/g} \pm 0.06 \text{ dB}$ , SAR (10g):  $1.68 \text{ mW/g} \pm 0.06 \text{ dB}$ , (Worst-case extrapolation)  
Penetration depth:  $12.0 (11.0, 13.3) [\text{mm}]$   
Powerdrift: 0.01 dB  
October 16, 2002; Ambient Temperature:  $21.8^\circ\text{C}$ ; Liquid Temperature:  $20.9^\circ\text{C}$

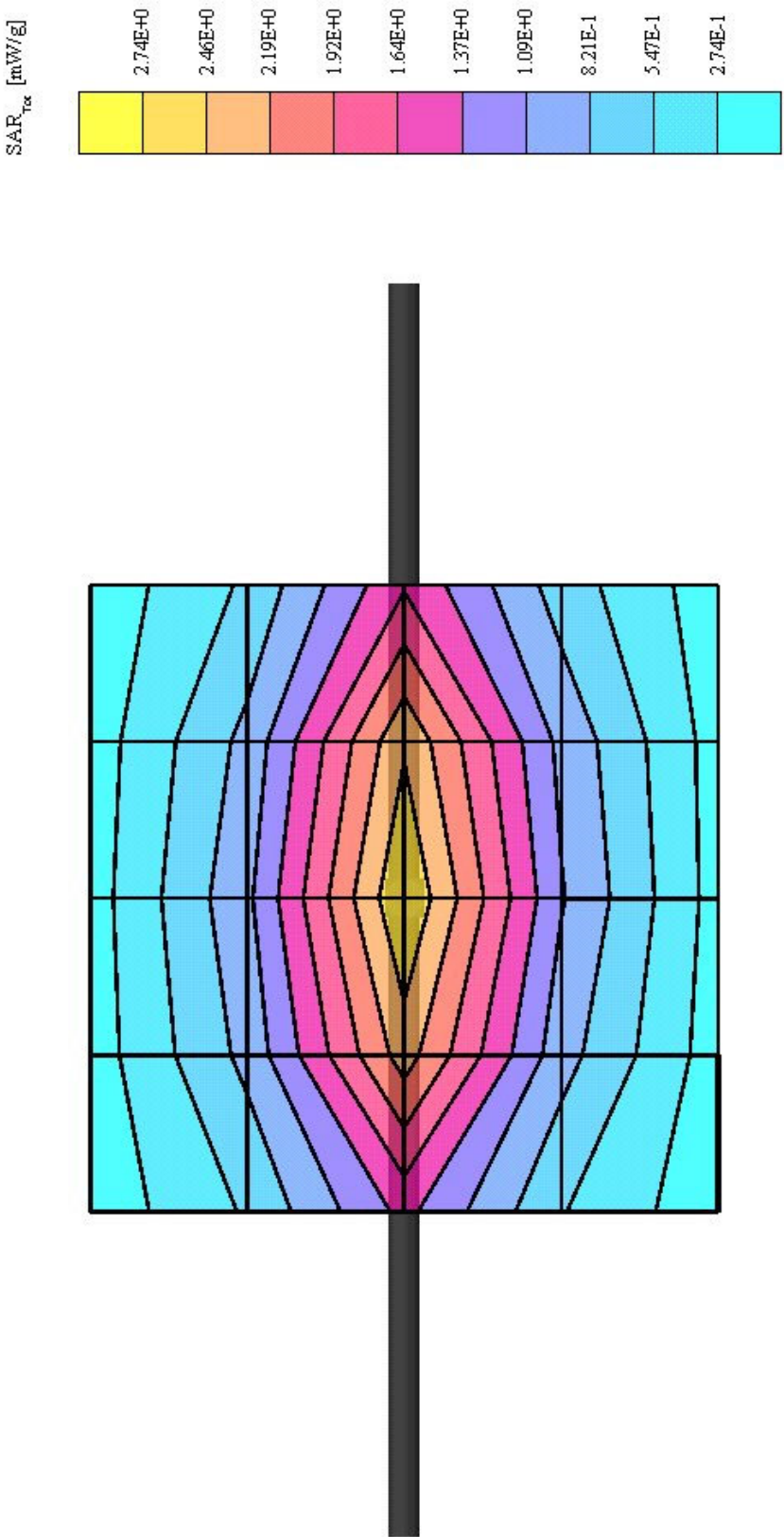


Fig. 16: Validation measurement 835 MHz Body, coarse grid.

Dipole 1900 MHz

SAM PCS1900; Flat  
Probe: ET3DV6 - SN1579; ConvF(5.20,5.20,5.20); Crest factor: 1.0; Brain 1900MHz:  $\sigma = 1.44 \text{ mho/m}$ ,  $\epsilon_r = 39.0$ ,  $\rho = 1.00 \text{ g/cm}^3$   
Cubes (2): Peak:  $22.2 \text{ mW/g} \pm 0.11 \text{ dB}$ , SAR (1g):  $11.5 \text{ mW/g} \pm 0.10 \text{ dB}$ , SAR (10g):  $5.81 \text{ mW/g} \pm 0.09 \text{ dB}$ , (Worst-case extrapolation)  
Penetration depth:  $7.8 (7.4, 8.6) [\text{mm}]$   
Powerdrift:  $0.05 \text{ dB}$   
October 14, 2002; Ambient Temperature:  $22.7^\circ\text{C}$ ; Liquid Temperature:  $20.7^\circ\text{C}$

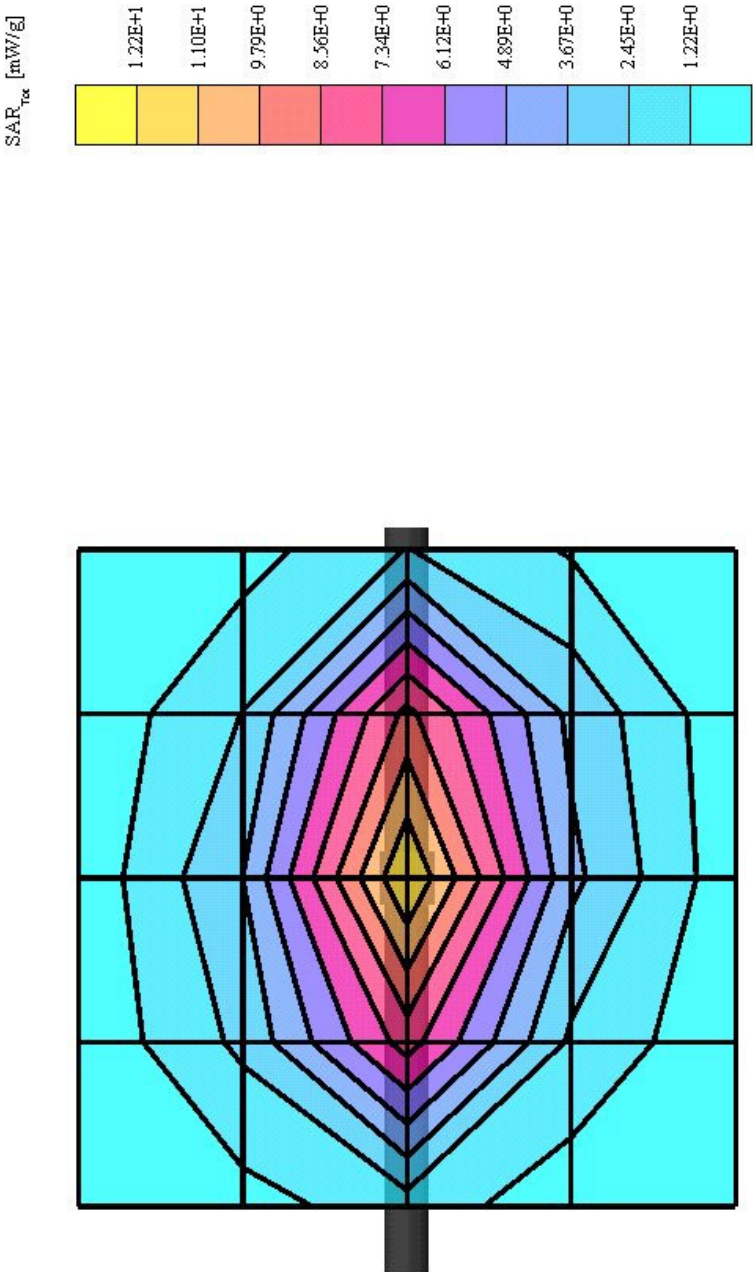


Fig. 17: Validation measurement 1900 MHz Head, coarse grid.

**Dipole 1900 MHz**  
SAM PCS1900; Flat  
Probe: ET3DV6 - SN1579; ConvF(480,480,480); Crest factor: 1.0; body 1900 MHz;  $\sigma = 1.54 \text{ mho/m}$   $\epsilon_r = 51.0$   $\rho = 1.00 \text{ g/cm}^3$   
Cubes (2): Peak: 20.9 mW/g  $\pm 0.08 \text{ dB}$ , SAR (1g): 11.0 mW/g  $\pm 0.07 \text{ dB}$ , SAR (10g): 5.61 mW/g  $\pm 0.06 \text{ dB}$ , (Worst-case extrapolation)  
Penetration depth: 8.4 (7.8, 9.7) [mm]  
Powerdrift: 0.01 dB  
October 14, 2002, Ambient Temperature: 22.2 °C; Liquid Temperature: 20.9 °C

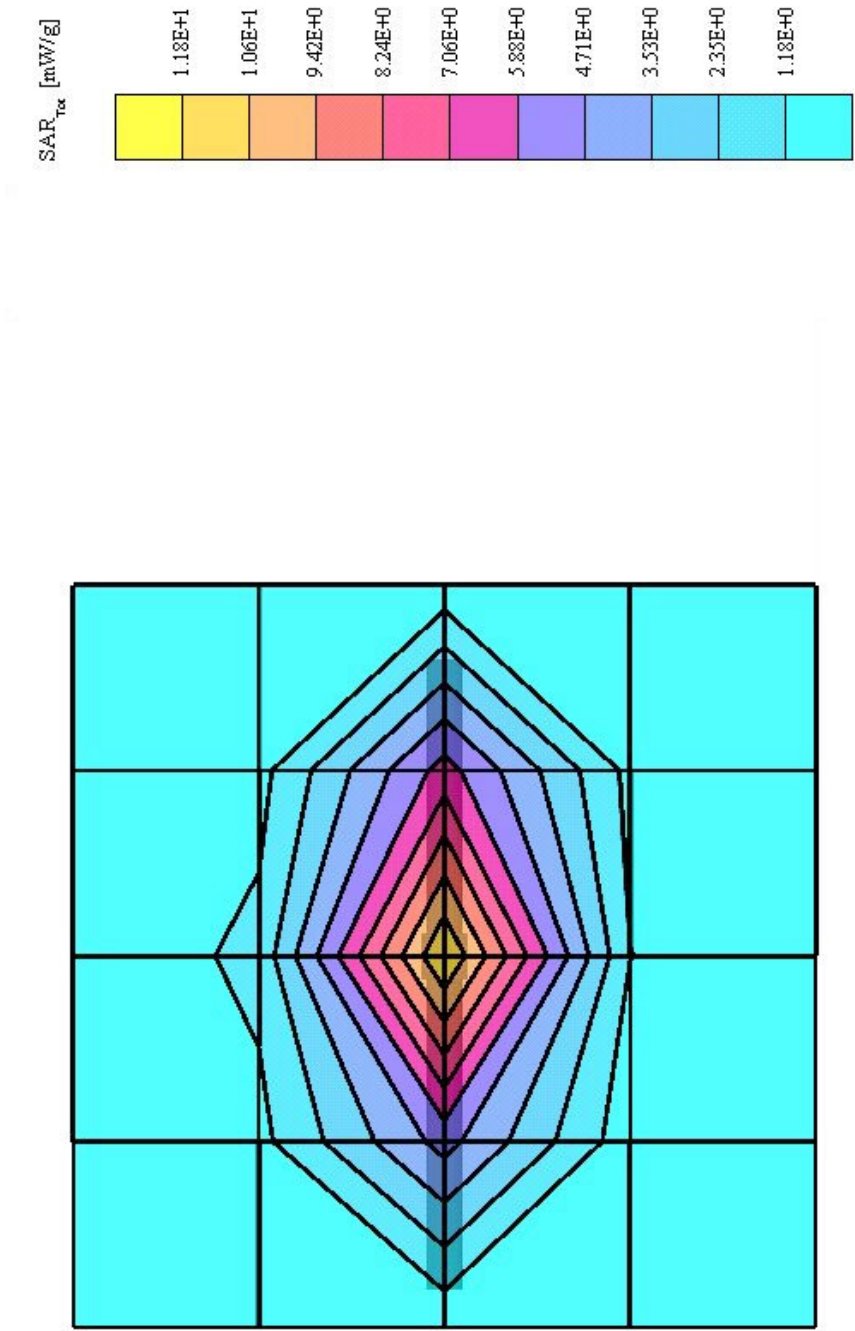


Fig. 18: Validation measurement 1900 Body, coarse grid.

## 7.6 Environment

Humidity: 40 % ± 5 %

## 7.7 Test Equipment

| Test Equipment                  | Model    | Serial Number | Last Calibration | Next Calibration |
|---------------------------------|----------|---------------|------------------|------------------|
| <b>DASY3 System</b>             |          |               |                  |                  |
| Software Version                | V3.1D    | N/A           | N/A              | N/A              |
| Dosimetric E-Field Probe        | ET3DV6   | 1579          | 05/2002          | 05/2003          |
| Data Acquisition Electronics    | DAE3 V1  | 335           | 05/2002          | 05/2003          |
| Phantom                         | SAM      | 1059          | N/A              | N/A              |
| Phantom                         | SAM      | 1176          | N/A              | N/A              |
| <b>Performance Checking</b>     |          |               |                  |                  |
| System Validation Dipole, Head  | D835V2   | 437           | 04/2001          | 04/2003          |
| System Validation Dipole, Body  | D835V2   | 437           | 08/2001          | 04/2003          |
| System Validation Dipole, Head  | D1900V2  | 535           | 04/2001          | 04/2003          |
| System Validation Dipole, Body  | D1900V2  | 535           | 08/2001          | 04/2003          |
| Power Meter, Agilent            | E4426A   | GB41050414    | 12/2001          | 12/2002          |
| Power Sensor, Agilent           | E9301H   | U40010212     | 12/2001          | 12/2002          |
| Power Meter, Gigatronics        | 8541B    | 1830892       | 12/2001          | 12/2002          |
| Power Sensor, Gigatronics       | 80401A   | 1829437       | 01/2002          | 12/2002          |
| RF Source (Network Analyzer)    | HP8753D  | 3410A06555    | 12/2001          | 12/2002          |
| RF Amplifier, Mini-Circuits     | ZHL-42   | D012296       | N/A              | N/A              |
| <b>Material Measurement</b>     |          |               |                  |                  |
| Network Analyzer                | HP8753D  | 3410A06555    | 12/2001          | 12/2002          |
| Dielectric Probe Kit            | HP85070B | US33020263    | N/A              | N/A              |
| <b>General</b>                  |          |               |                  |                  |
| Base Station Simulator, Wavetek | 4032     | 1388073       | N/A              | N/A              |
| Radio Tester, Rohde & Schwarz   | CMU200   | 835305/050    | 01/2002          | 01/2003          |

Table 14: Test equipment.

## 7.8 Phantom Certificate

### Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

#### Certificate of conformity / First Article Inspection

|                       |                                                                          |
|-----------------------|--------------------------------------------------------------------------|
| Item                  | SAM Twin Phantom V4.0                                                    |
| Type No               | QD 000 P40 BA                                                            |
| Series No             | TP-1002 and higher                                                       |
| Manufacturer / Origin | Untersee Composites<br>Hauptstr. 69<br>CH-8559 Fruthwilen<br>Switzerland |

#### Tests

The series production process used allows the limitation to test of first articles.  
Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

| Test                 | Requirement                                                                             | Details                                                              | Units tested                |
|----------------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------|
| Shape                | Compliance with the geometry according to the CAD model.                                | IT'IS CAD File (*)                                                   | First article, Samples      |
| Material thickness   | Compliant with the requirements according to the standards                              | 2mm +/- 0.2mm in specific areas                                      | First article, Samples      |
| Material parameters  | Dielectric parameters for required frequencies                                          | 200 MHz – 3 GHz<br>Relative permittivity < 5<br>Loss tangent < 0.05. | Material sample<br>TP 104-5 |
| Material resistivity | The material has been tested to be compatible with the liquids defined in the standards | Liquid type HSL 1800 and others according to the standard.           | Pre-series, First article   |

#### Standards

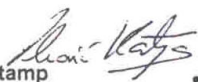
- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9
- (\*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

#### Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 18.11.2001

Signature / Stamp



**Schmid & Partner  
Engineering AG**

Zeughausstrasse 43, CH-8004 Zurich  
Tel. +41 1 245 97 00, Fax +41 1 245 97 79



Doc No 881 – QD 000 P40 BA – B

Page 1 (1)

Fig. 19: Certificate of conformity

## 7.9 Pictures of the device under test

Fig. 20 – 28 show the device under test and the used accessories.



Fig. 20: Front and back view of the device.



Fig. 21: Side views of the device.



Fig. 22: Phone with used Belt Clip which dictates the closest distance to the body.



Fig. 23: Phone with used Tour Case, talk mode with headset and Belt Clip which dictates the closest distance to the body.



Fig. 24: Phone with used Tour Case, GPRS mode without headset and Belt Clip which dictates the closest distance to the body.



Fig. 25: Additionally available Belt Clip (right) which dictates an larger distance to the body, therefore measurements are not required. Both Belt Clips have no metal components.



Fig. 26: Used Tour Case and Belt Clip which dictates the closest distance to the body.



Fig. 27: Additionally available Leather Case which is only a carry case since there are no apertures for a headset, therefore measurements are not required (to establish or to answer a call the mobile has to be removed). The case is usable with both belt clips.



Fig. 28: Used headset.

### 7.10 Test Positions for the Device under Test

Fig. 29 – 38 show the test positions for the SAR measurements.



Fig. 29: Cheek position, left side.



Fig. 30: Tilted position, left side.



Fig. 31: Cheek position, right side.



Fig. 32: Tilted position, right side.

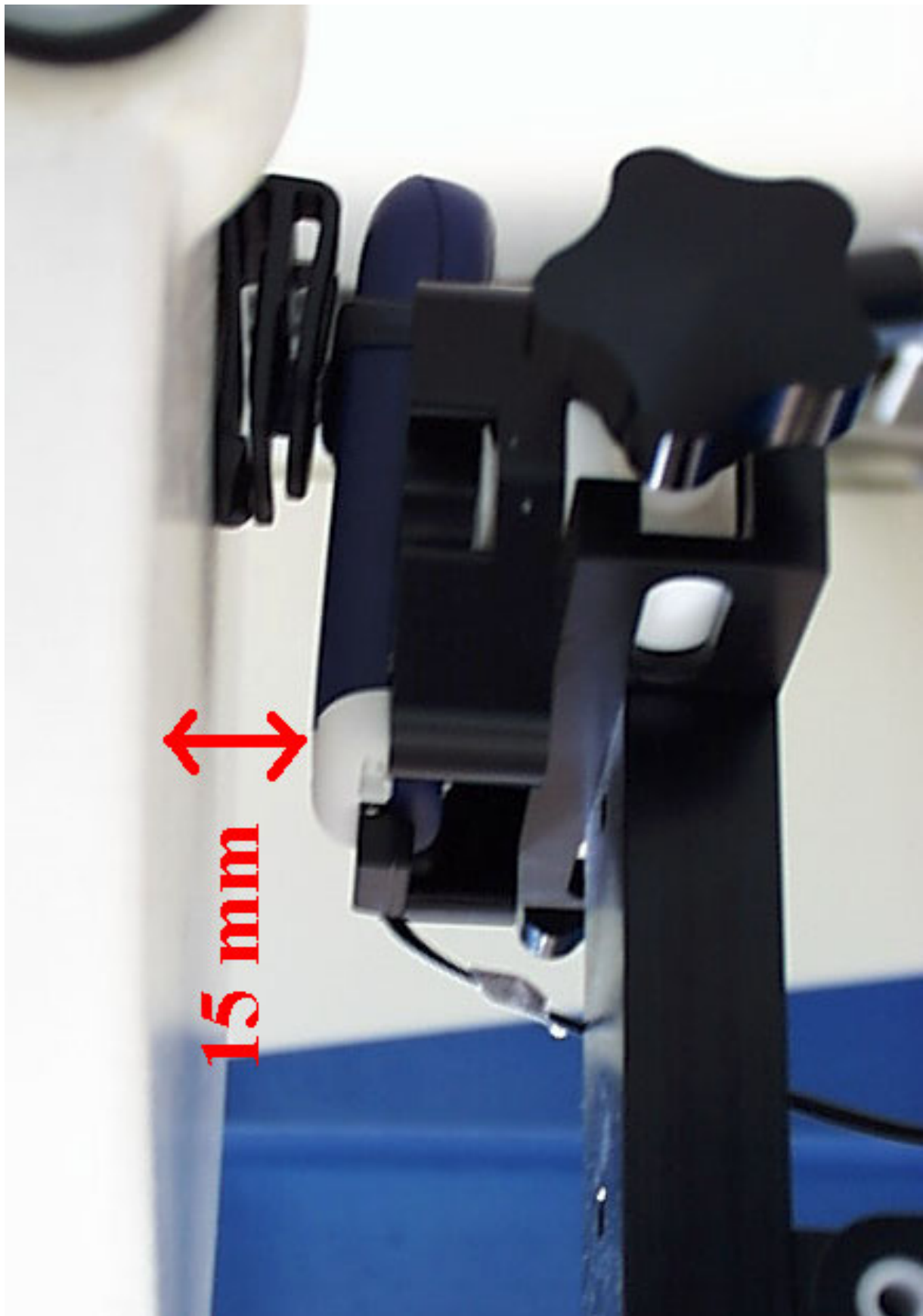


Fig. 33: Body worn configuration, Belt Clip with Headset, talk mode (1 TX slot).

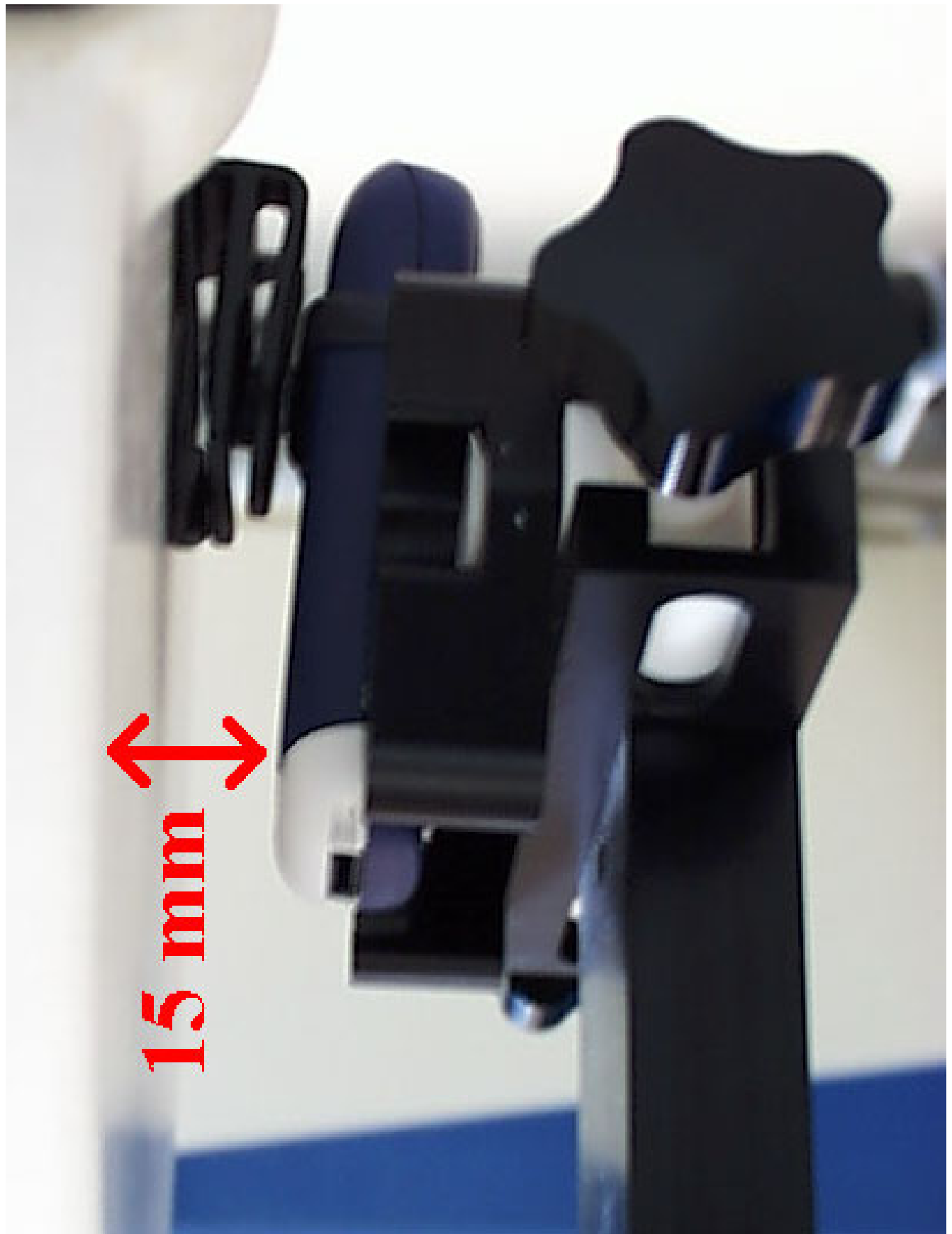


Fig. 34: Body worn configuration, Belt Clip without Headset, GPRS mode (1 TX slot).

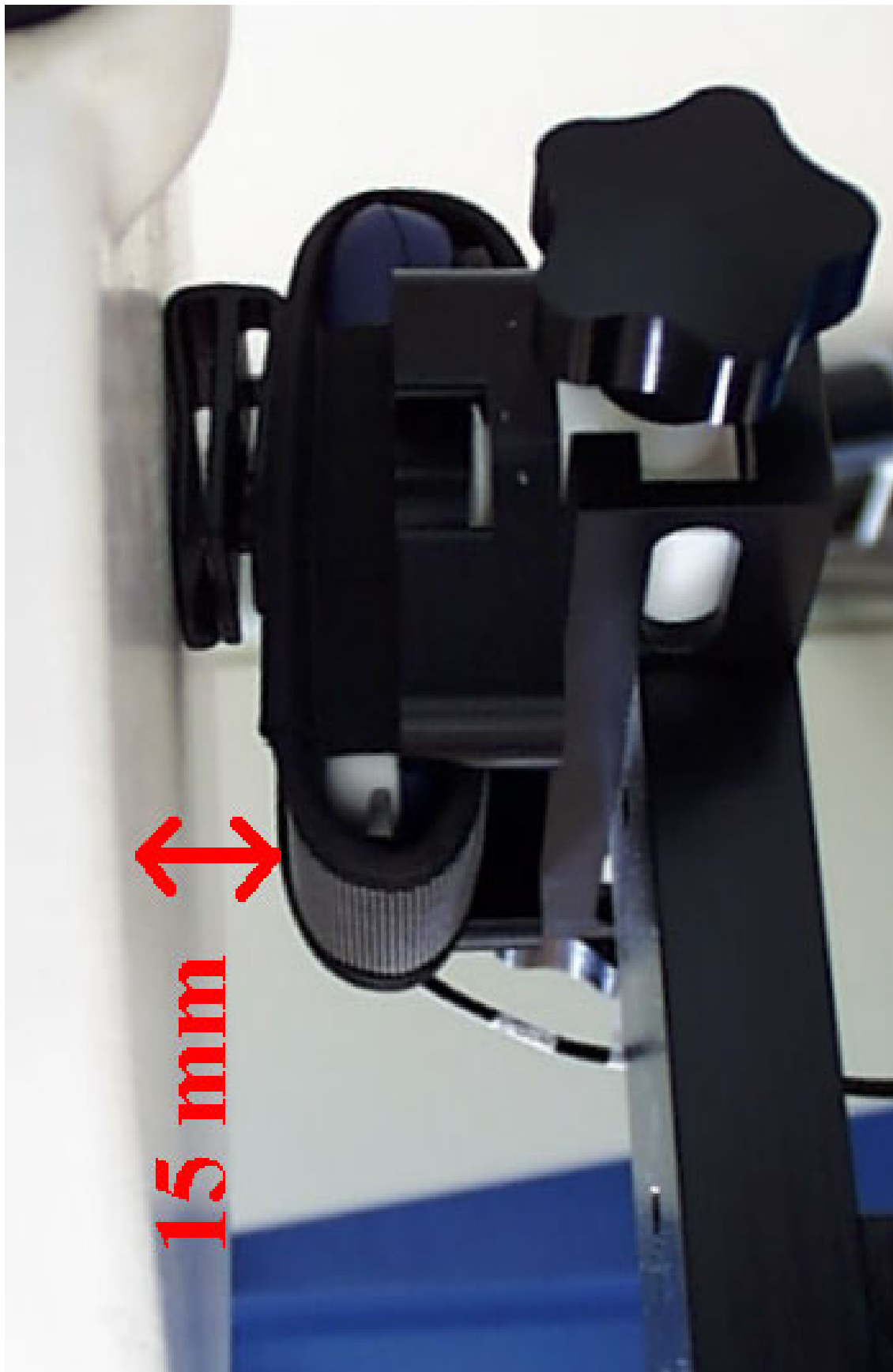


Fig. 35: Body worn configuration, Tour Case with Headset, Talk mode (1 TX slot), Display down.

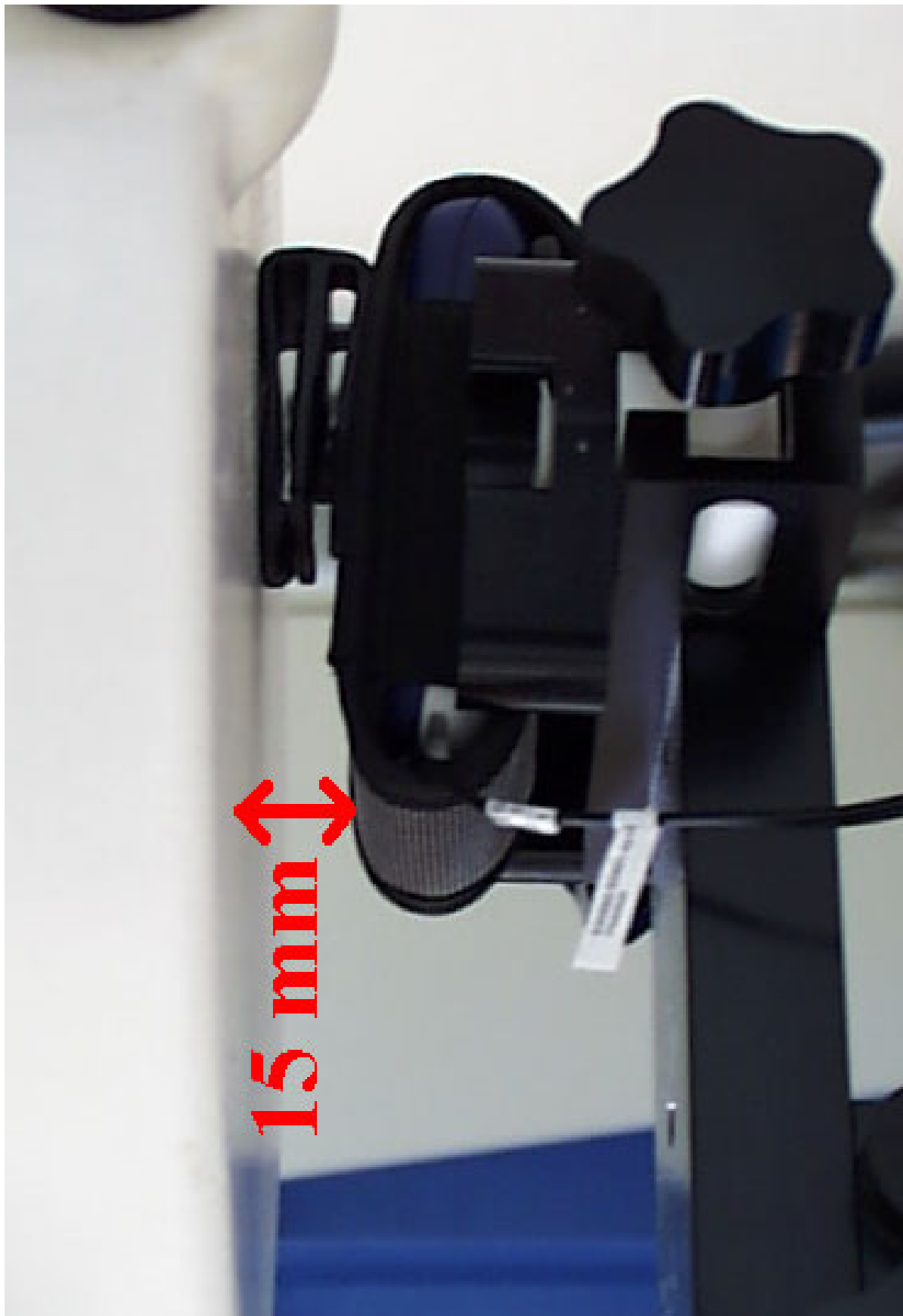


Fig. 36: Body worn configuration, Tour Case with Headset, Talk mode (1 TX slot), Display up.

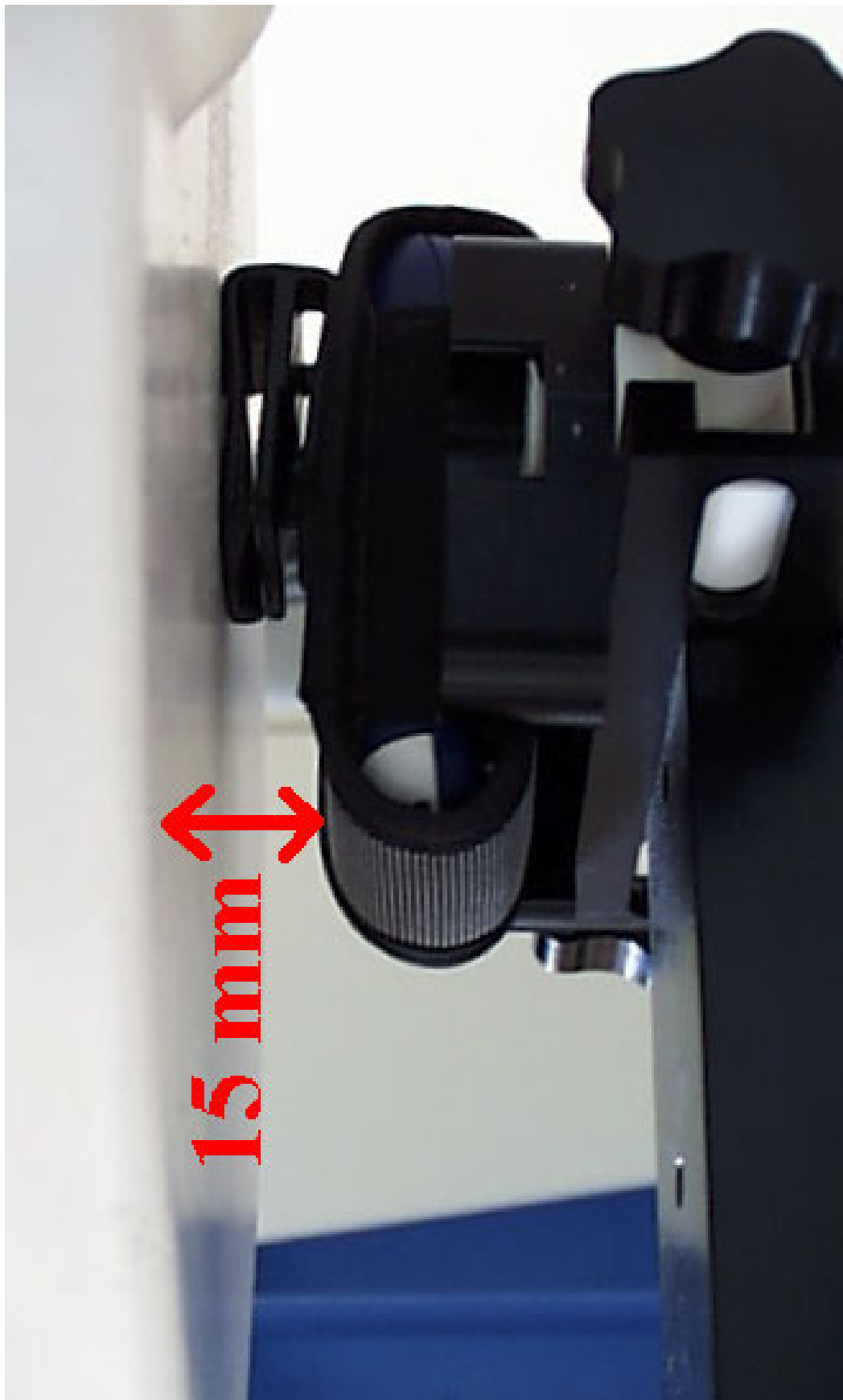


Fig. 37: Body worn configuration, Tour Case without Headset, GPRS mode (1 TX slot), Display down.



Fig. 38: Body worn configuration, Tour Case without Headset, GPRS mode (1 TX slot), Display up.

### 7.11 Pictures to demonstrate the required liquid depth

Fig. 39 – 40 show the liquid depth in the used SAM phantoms.

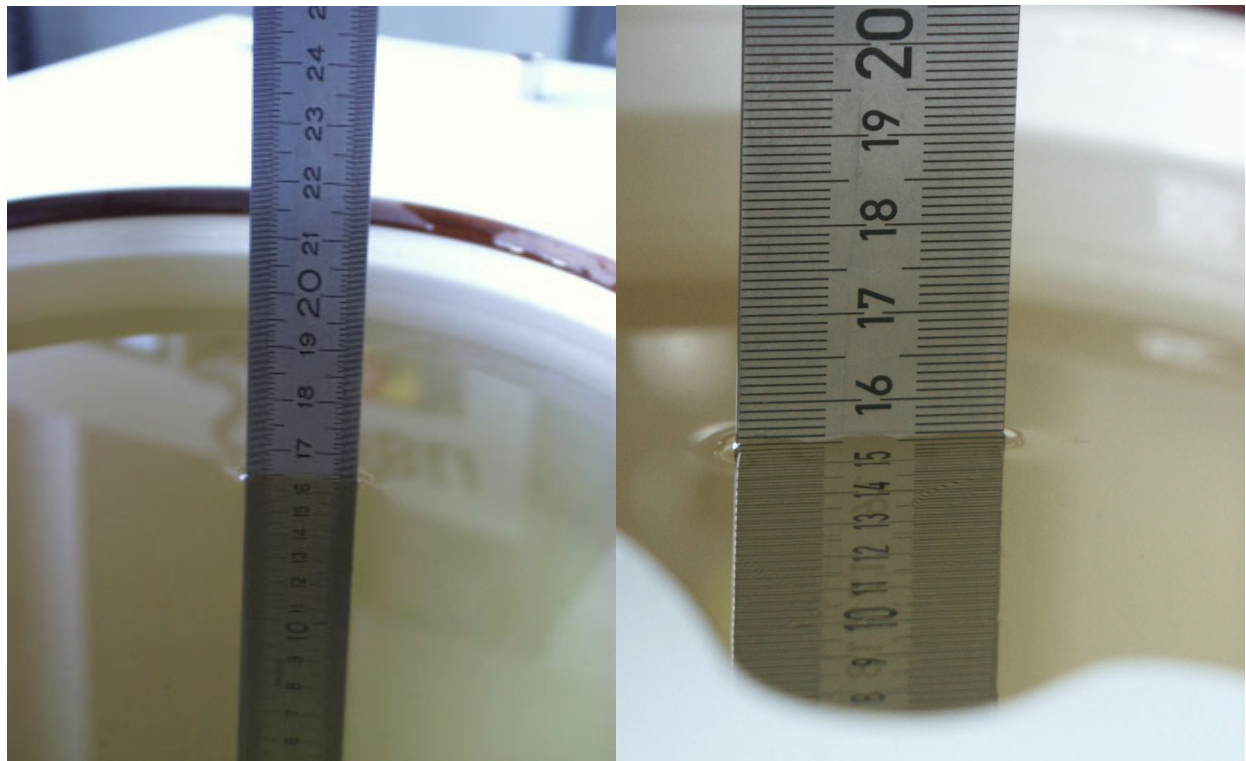


Fig. 39: Liquid depth for GSM 850 Head and Body measurements.



Fig. 40: Liquid depth for PCS 1900 Head and Body measurements.

## 8 References

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