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IMST

Report

Dosimetric Assessment of the Mobile Phone Fujitsu F-022

According to the
- International Standard IEC 62209-1
- European Basic Standard EN 62209-1
- IEEE Std 1528-2003

April 13, 2011

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Executive Summary

The device F-022 is a mobile phone from Fujitsu operating in the 850 MHz, 900 MHz, 1800 MHz, 1900 MHz and 1950 MHz frequency range. The device has an integrated antenna. The system concepts used are the GSM 850, GSM 900, DCS 1800, PCS 1900, WCDMA I (FDD) and WCDMA V (FDD) standards.

The objective of the measurements done by IMST was the dosimetric assessment of one device in the GSM 900, DCS 1800 and WCDMA (FDD) standards. The examinations have been carried out with the dosimetric assessment system „DASY4“.

The measurements were made according to the International Standard IEC 62209-1 [IEC 62209-1], the European Basis Standard EN 62209-1 [EN 62209-1] and the IEEE Std 1528-2003 [IEEE 1528-2003] for evaluating compliance of mobile phones with the European Product Standard EN 50360 [EN 50360], the ARPANSA Radiation Protection Standard: Maximum Exposure Levels to Radiofrequency Fields- 3 KHz to 300 GHz [ARPANSA] and the IEEE Standard C95.1-2005 [IEEE C95.1-2005].

The Fujitsu F-022 mobile phone is in compliance with the following standards:

- **European Product Standard EN 50360**
- **ARPANSA Radiation Protection Standard**
- **European Council Recommendation [1999 519 EC]**
- **ICNIRP guidelines for general public exposure [ICNIRP 1998]**
- **IEEE Standard C95.1-2005 for the lower tier / action level**

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1 Subject of Investigation

The device F-022 is a mobile phone from Fujitsu operating in the 850 MHz, 900 MHz, 1800 MHz, 1900 MHz and 1950 MHz frequency range. The device has an integrated antenna. The system concepts used are the GSM 850, GSM 900, DCS 1800, PCS 1900, WCDMA I (FDD) and WCDMA V (FDD) standards.

Fig. 1: Pictures of the device under test.

The objective of the measurements done by IMST was the dosimetric assessment of one device in the GSM 900, DCS 1800 and WCDMA (FDD) standards. The examinations have been carried out with the dosimetric assessment system „DASY4“.

2 European, Australian and IEEE Safety Levels

2.1 The ICNIRP 1998 Guidelines and the European Council Recommendation

In 1998 ICNIRP (International Commission on Non-Ionizing Radiation Protection) published its guidelines covering the frequency range up to 300 GHz [ICNIRP 1998]. In 1999 this guidelines were adopted by the European Union in terms of the European Council Recommendation.
The basic restrictions as specified in the European Council Recommendation and the ICNIRP guidelines were defined in 2001 as exposure limits for the European Product Standard EN 50360.

2.2 The Australian Radiofrequency Field Exposure Standard

In May 2002 the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) published a the new Radiation Protection Standard: Maximum Exposure Levels to Radiofrequency Fields - 3 KHz to 300 GHz [ARPANSA], with the recommendation to the Australian authorities and regulatory bodies to adopt this standard into their legal processes. This standard was adopted from the Australian Communications Authority as compliance criteria in March 2003. It sets limits for human exposure to radiofrequency fields in the frequency range 3 kHz to 300 GHz. The limits specified in the Standard are also based on the published ICNIRP guidelines.

In July 2005 the Australian Communications Authority (ACA) became part of the Australian Communications and Media Authority (ACMA), based on the Australian Communications and Media Authority ACT 2005 all ACA work is adopt by ACMA as of July 1, 2005.

2.3 The IEEE Standard C95.1-2005

In the USA the recent IEEE Standard C95.1-2005 was published in April 2006. It sets limits for human exposure to radio frequency electromagnetic fields in the frequency range 3 kHz to 300 GHz and replaces the C95.1-1999 edition [IEEE C95.1-1999].

The current version presents two separate sets of rules to limit human exposure. The *upper tier*, which is protective for all with an acceptable margin of safety, applies to exposure of person in controlled environment. These are areas where the occupancy and activity of those within is subject to control and accountability as established by an RF safety program for the purpose of protection from RF exposure hazards. *The lower tier*, with an additional safety factor, recognizes public concerns and also supports the process of harmonization with other standards. It is valid for the general public which is defined as individuals of all ages and varying health status which may not be aware of their exposure. Additional the lower tier defines the exposure level above which implementation of an RF safety program is recommended, and therefore also called *action level*. As for the Australian standard the specified limits are also based on the published ICNIRP guidelines.

2.4 Distinction Between Exposed Population, Duration of Exposure and Frequencies

The ICNIRP Guidelines distinguish between occupational and general public exposure. The occupationally exposed population consists of adults who are generally exposed under known conditions and are trained to be aware of potential risk and to take appropriate precautions. By contrast, the general public comprises individuals of all ages and of varying health status, and may include particularly susceptible groups or individuals. In many cases, members of the public are unaware of their exposure to electromagnetic fields. Moreover, individual members of the public cannot reasonably be expected to take precautions to minimise or avoid exposure.

In the ICNIRP Guidelines the general public exposure limits are derived from values one fifth those of occupational exposure.

In addition the duration of exposure is considered. A limit is made at 6 minutes exposure time. For short-term exposure below a duration of 6 minutes, higher field strengths are admissible.

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.

2.5 Basic Restrictions and Reference Levels

The biological relevant parameter describing the effects of electromagnetic fields in the frequency range of interest (300 MHz – 3 GHz) 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 σ and the mass density ρ of the biological tissue:

$$SAR = \sigma \frac{E^2}{\rho} = c \frac{\partial T}{\partial t}\bigg|_{t \to 0+} \quad . \tag{1}$$

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 in terms of basic restrictions 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), a set of more readily measurable reference levels in terms of external electric *E* and magnetic field strength *H* and power density *S*, derived from the SAR limits, is defined. The limits for *E*, *H* and *S* have been fixed so that even under worst-case conditions, the basic restrictions for the specific absorption rate SAR are not exceeded.

The reference levels may be exceeded if the exposure can be shown by appropriate techniques to produce SAR values below the corresponding basic restrictions.

2.6 SAR Limits

In this report the comparison between the measured data and the exposure limits defined in the ICNIRP Guidelines 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 general public exposure and for exposure times longer than 6 minutes [ICNIRP 1998]. According to Table 1 the SAR values have to be averaged over a mass of 10 g (SAR_{10g}) with the shape of a cube.

Standard	Status	SAR limit [W/kg]
ICNIRP 1998	Guidelines	2.0

Table 1: Relevant spatial peak SAR limit averaged over a mass of 10 g.

3 The European, IEC and IEEE Measurement Procedures

In 2001 CENELEC has published the European Basic Standard EN 50361 for evaluating compliance of mobile phones with the European Product Standard EN 50360. In 2005 the IEC has released the standard IEC 62209-1 which provides a procedure to determine the SAR for hand-held devices used in close proximity of the human ear within the frequency range from 300 MHz to 3 GHz. This standard was ratified by the European Committee for Electrotechnical Standardization in 2006 as EN 62209-1 and replaced the above mentioned EN 50361. All topics of the EN 50361 were covered completely by the new EN 62209-1.

In 2003 the now withdrawn EN50361 was also adopt from the Australian Communications Authority (now the Australian Communications and Media Authority) for the SAR compliance measurements of mobile phones. Since the ACMA will adopt the new EN 622091-1 as required measurement procedure, it is usable to show compliance with the safety limits within the ARPANSA Radiation Protection Standard.

IEEE has published a recommended practice for determining the peak spatial-average specific absorption rate (SAR) in the human body due to wireless communications devices [IEEE 1528-2003] for evaluating compliance of mobile phones with different safety levels. The standard defines protocols of the measurement of the specific absorption rate (SAR) inside a simplified model of the head of users. It applies to mobile telecommunication equipment in the frequency range from 300 MHz to 3 GHz intended to be operated while held next to the ear.

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 18 °C to 25 °C with a maximum variation from ± 2 °C during the test.

3.2 Phantom Requirements

The phantom is a simplified representation of the human anatomy as a shaped container for the brain simulating liquid. 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.

The shell of the phantom shall be made of low loss and low permittivity material and the thickness tolerance shall be ± 0.2 mm. Additionally the phantom shall enable to simulate both right and left hand operation. For the measurements the Specific Anthropomorphic Mannequin (SAM), which meet these requirements, shall be used.

3.3 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 standards require two test positions. For an exact description helpful geometrical definitions are introduced and shown in Fig. 2 - 4.

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 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 horizontal line is also tangential to the face of the handset at point A. The two lines intersect at point A.

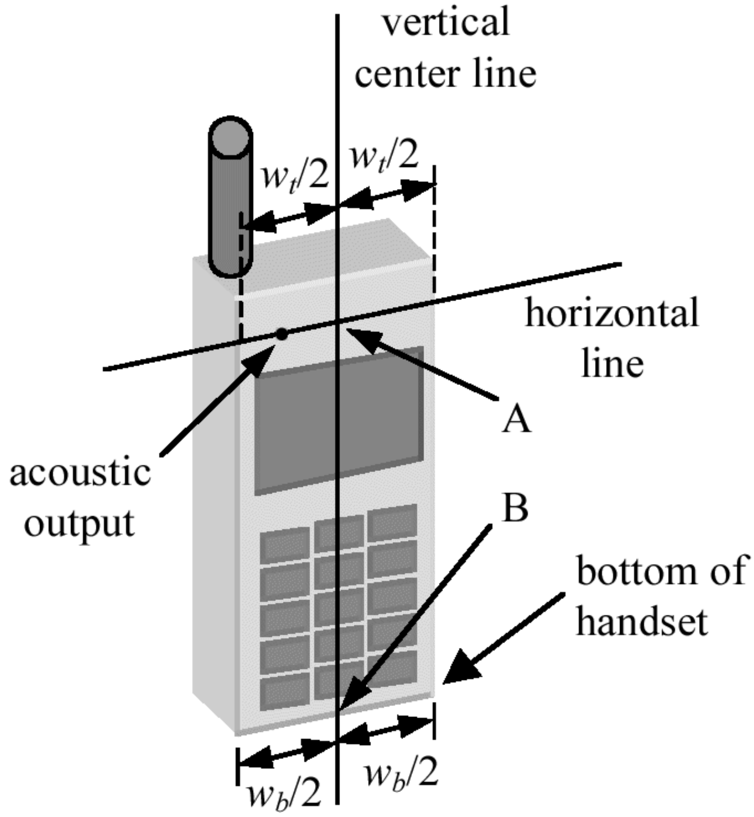

Fig. 2: Geometrical definitions on the telephone (bar phone).

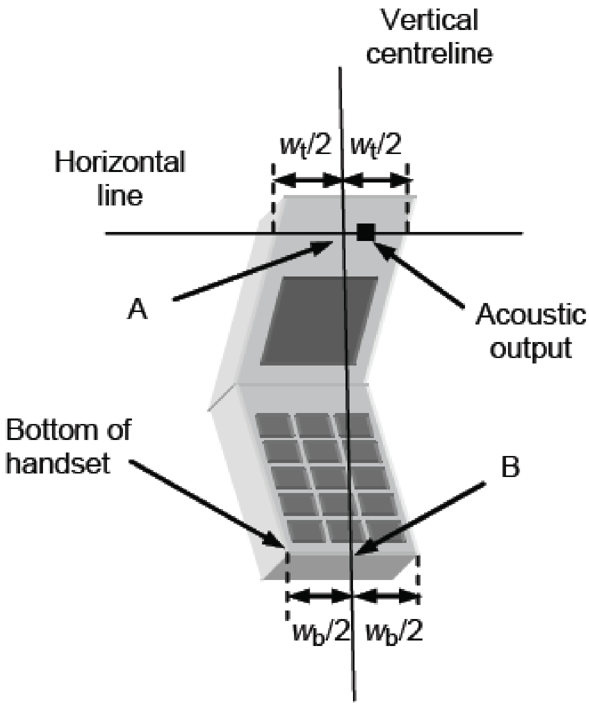

Fig. 3: Geometrical definitions on the telephone (clam shell or flip).

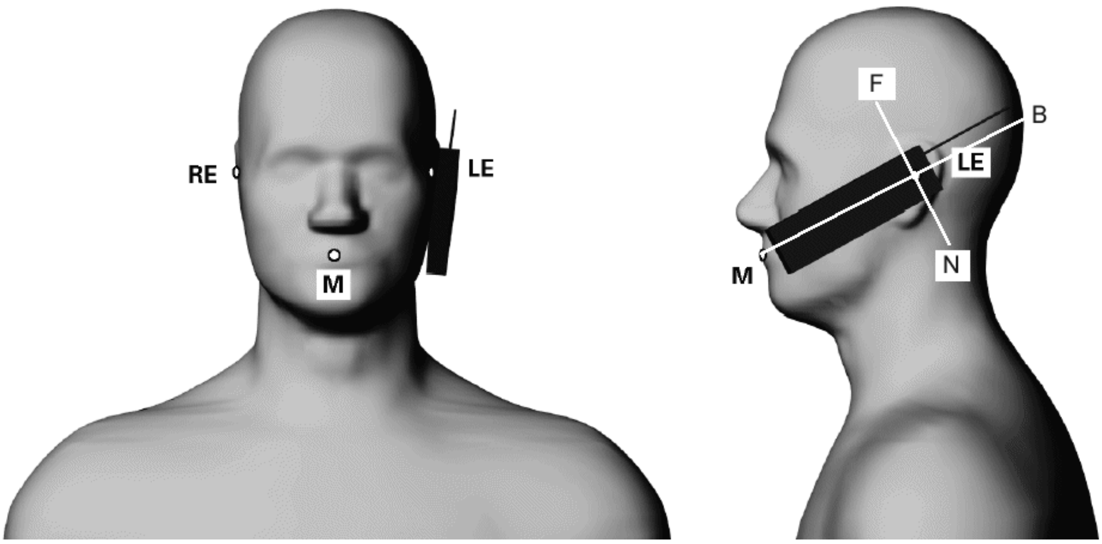

Fig. 4: Geometrical definitions on the phantom.

According to Fig. 4 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. 4. The plane passing through the two ear canals and M is defined as the reference plane. The line NF (Neck-Front), also called the reference pivoting line, is along the front truncated edge of the ear and not perpendicular to the reference plane. With this definitions the test positions are given by (Fig. 5 - 6):

3.3.1 Cheek Position

- The NF line is the plane defined by the handset vertical and horizontal line
- The vertical centreline from the headset is in the reference plane
- Position the handset close to the surface of the phantom such that point A meets the line through the reference points (RE) and (LE)
- Move the handset towards the phantom along the line through RE and LE until point A touches the pinna at RE or LE
- While keeping point A on the line through LE and RE and maintaining the handset in contact with the pinna, rotate it about the NF line until any point on the handset is in contact with the phantom below the pinna

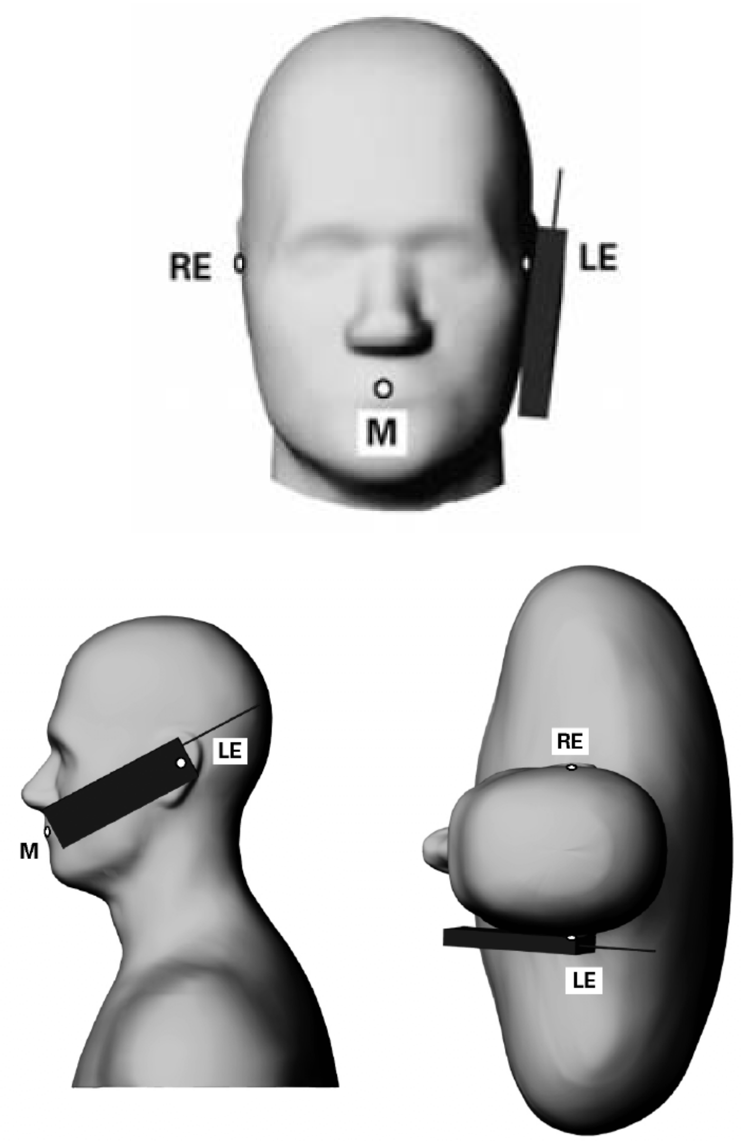

Fig. 5: The cheek position.

3.3.2 Tilted Position

- Repeat the above steps for the cheek position
- While maintaining the orientation of the handset, remove the handset from the pinna along the RE - LE line until a free rotation of the handset around the horizontal line is possible
- Rotate the handset by 15° and move it back along the RE- LE line until any part touches the ear
- For the case that contact occurs at any position other than the pinna, the rotation should be reduced so that the device has contact with the ear and any additional point of the phantom

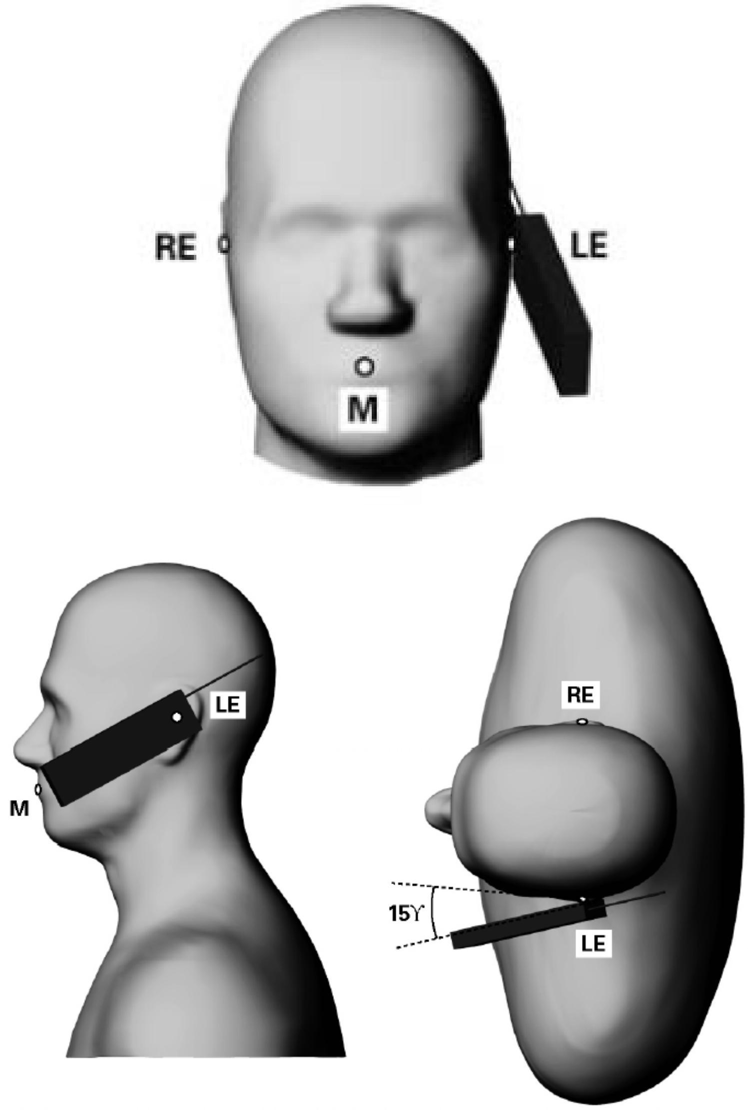

Fig. 6: The tilted position.

3.4 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. First the SAR test shall be performed using the center frequency of each available operating band and mode with the maximum peak power level. At the device position with highest SAR (cheek or tilted, left or right), the test is repeated at the lowest and highest frequency. In addition, for all other device positions respectively configurations where the spatial peak SAR value is within 3dB of the 2.0 W/kg limit, the lowest and highest frequencies should be tested.

For devices with retractable antenna all of the tests described above shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure should 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.

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. The DASY4 system consists of the following items as shown in Fig. 7.

- Fully compliant with IEC 62209-1, EN 62209-1 and IEEE 1528 as stated in Fig. 33
- High precision robot with controller
- Measurement server (for surveillance of the robot operation and signal filtering)
- Data acquisition electronics DAE (for signal amplification and filtering)
- Field probes calibrated for use in liquids
- Electro-optical converter EOC (conversion from the optical into a digital signal)
- Light Beam (improving of the absolute probe positioning accuracy)
- Two SAM phantoms filled with tissue simulating liquid
- DASY4 software
- SEMCAD

Fig. 8 shows the equipment, similar to the installations in other laboratories.

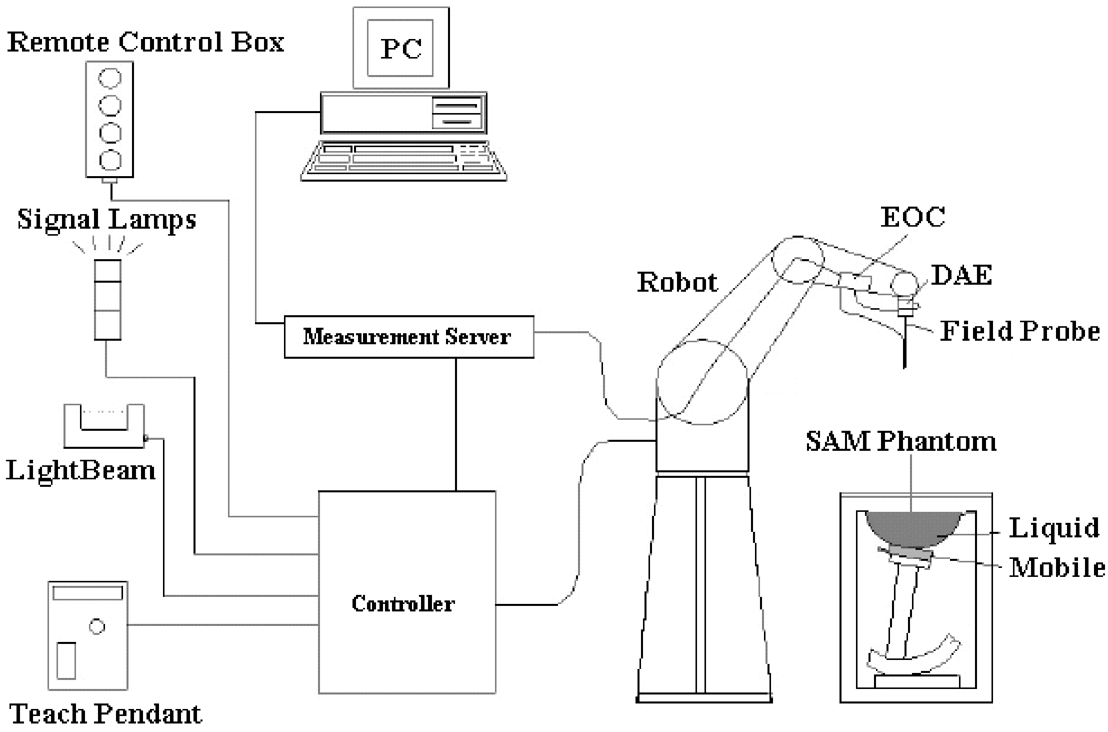

Fig. 7: The DASY4 measurement system.

Fig. 8: The measurement set-up with two phantoms containing tissue simulating liquid.

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 mm ± 0.2 mm. It enables the dosimetric evaluation of left and right hand phone usage and includes an additional flat phantom part for the system 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. 34.

4.2 Probes

For the measurements the Dosimetric E-Field Probes ET3DV6 or EX3DV4, manufactured and calibrated annually by Schmid & Partner Engineering AG with following specifications are used.

ET3DV6:

- Dynamic range: 5µW/g to > 100mW/g
- Tip diameter: 6.8 mm
- Probe linearity: ± 0.2 dB (30 MHz to 3 GHz)
- Axial isotropy: ± 0.2 dB
- Spherical isotropy: ± 0.4 dB
- Distance from probe tip to dipole centers: 2.7 mm
- Calibration range: 900MHz / 1850MHz for head and body simulating liquid

EX3DV4:

- Dynamic range: 10µW/g to > 100mW/g (noise typically < 1µW/g)
- Tip diameter: 2.5 mm
- Probe linearity: ± 0.2 dB (30 MHz to 6 GHz)
- Axial isotropy: ± 0.2 dB
- Spherical isotropy: ± 0.4 dB
- Distance from probe tip to dipole centers: 1.0 mm
- Calibration range: 1950 MHz / 2450MHz / 3500 MHz / 5200 MHz / 5500 MHz / 5800 MHz for head and body simulating liquid

4.3 Measurement Procedure

The mobile phone operating at the maximum power level is placed by a non metallic device holder 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 σ and the mass density ρ of the tissue in the SEMCAD software. The software is able to determine the averaged SAR values (averaging region 1 g or 10 g) for compliance testing.

The measurements are done by two scans: first a coarse scan determines the region of the maximum SAR, afterwards the averaged SAR is measured in a second scan within the shape of a cube. The measurement time takes about 20 minutes.

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. Since the sensors can not directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With this values the area of the maximum SAR is calculated by a interpolation scheme (combination of a least-square fitted function and a weighted average method). Additional all peaks within 3 dB of the maximum SAR are searched.
- Around this points, 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 can be calculated within the SEMCAD software.
- The used extrapolation and interpolation routines are all based on the modified Quadratic Shepard´s method [DASY4].
- 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 ± 0.21dB.

4.4 Uncertainty Assessment

Table 2 includes the worst case uncertainty budget suggested by IEC 62209-1, EN 62209-1, IEEE 1528 and determined by Schmid & Partner Engineering AG. The expanded uncertainty (K=2) is assessed to be ± 21.9 %. The requirements for the validity and the Certificate of conformity can be found in Fig. 33.

Error Sources	Uncertainty Value	Probability Distribution	Divisor	c_i	Standard Uncertainty	v_i^2 or v_{eff}
Measurement Equipment						
Probe Calibration	± 5.9 %	Normal	1	1	± 5.9 %	∞
Axial Isotropy	± 4.7 %	Rectangular	√3	0.7	± 1.9 %	∞
Hemispherical Isotropy	± 9.6 %	Rectangular	√3	0.7	± 3.9 %	∞
Linearity	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
Detection limits	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Readout Electronics	± 0.3 %	Normal	1	1	± 0.3 %	∞
Boundary effects	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Response time	± 0.8 %	Normal	1	1	± 0.8 %	∞
RF Ambient Noise	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Reflections	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
Integration time	± 2.6 %	Normal	1	1	± 2.6 %	∞
Probe Positioner	± 0.4 %	Rectangular	√3	1	± 0.2 %	∞
Probe Positioning	± 2.9 %	Rectangular	√3	1	± 1.7 %	∞
Algorithms for Max. SAR Eva.	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Test Sample						
Device Holder	± 3.6 %	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0 %	Rectangular	√3	1	± 2.9 %	145
Positioning of the device	± 2.9%	Normal	1	1	± 2.9 %	145
Physical Parameters						
Phantom Uncertainty	± 4.0 %	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (target)	± 5.0 %	Rectangular	√3	0.5	± 1.4 %	∞
Liquid conductivity (meas.)	± 4.3 %	Rectangular	√3	0.5	± 1.2 %	∞
Liquid permittivity (target)	± 5.0 %	Rectangular	√3	0.5	± 1.4 %	∞
Liquid permittivity (meas.)	± 2.5 %	Rectangular	√3	0.5	± 1.2 %	∞
Combined Uncertainty					**± 11.0 %**	

Table 2: Uncertainty budget of DASY4.

5 SAR Results

The Tables below contain the measured SAR values averaged over a mass of 10 g.

Phantom Configuration	Test Position	SAR_{10g} [W/kg]		
		Channel 975 880.2 MHz	Channel 038 897.6 MHz	Channel 124 914.8 MHz
Left Side of Head	Cheek	0.330	0.389	0.382
	Tilted		0.139	
Right Side of Head	Cheek		0.369	
	Tilted		0.129	

Table 3: Measurement results for GSM 900 for the Fujitsu F-022.

Phantom Configuration	Test Position	SAR_{10g} [W/kg]		
		Channel 512 1850.2 MHz	Channel 661 1880.0 MHz	Channel 810 1909.8 MHz
Left Side of Head	Cheek	0.243	0.276	0.357
	Tilted		0.094	
Right Side of Head	Cheek		0.143	
	Tilted		0.087	

Table 4: Measurement results for DCS 1800 for the Fujitsu F-022.

Phantom Configuration	Test Position	SAR_{10g} [W/kg]		
		Channel 9613 1922.6 MHz	Channel 9750 1950.0 MHz	Channel 9887 1977.4 MHz
Left Side of Head	Cheek	0.987	1.050	0.863
	Tilted		0.394	
Right Side of Head	Cheek		0.661	
	Tilted		0.379	

Table 5: Measurement results for WCDMA I (FDD) for the Fujitsu F-022.

6 Evaluation

In Fig. 9 - 11 the SAR results for GSM 900, DCS 1800 and WCDMA I (FDD) given in Table 3 - 5 are summarised and compared to the limit.

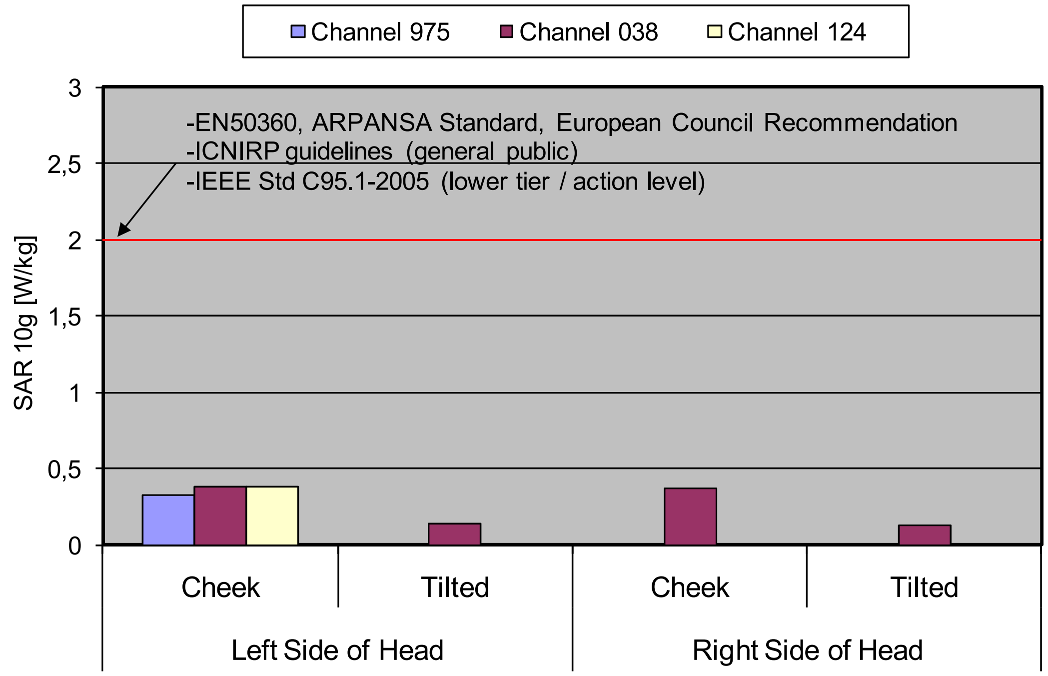

Fig. 9: The measured SAR values for the Fujitsu F-022 (GSM 900) in comparison to the EN50360, ARPANSA Standard, European Council Recommendation, ICNIRP guidelines and IEEE Std C95.1-2005.

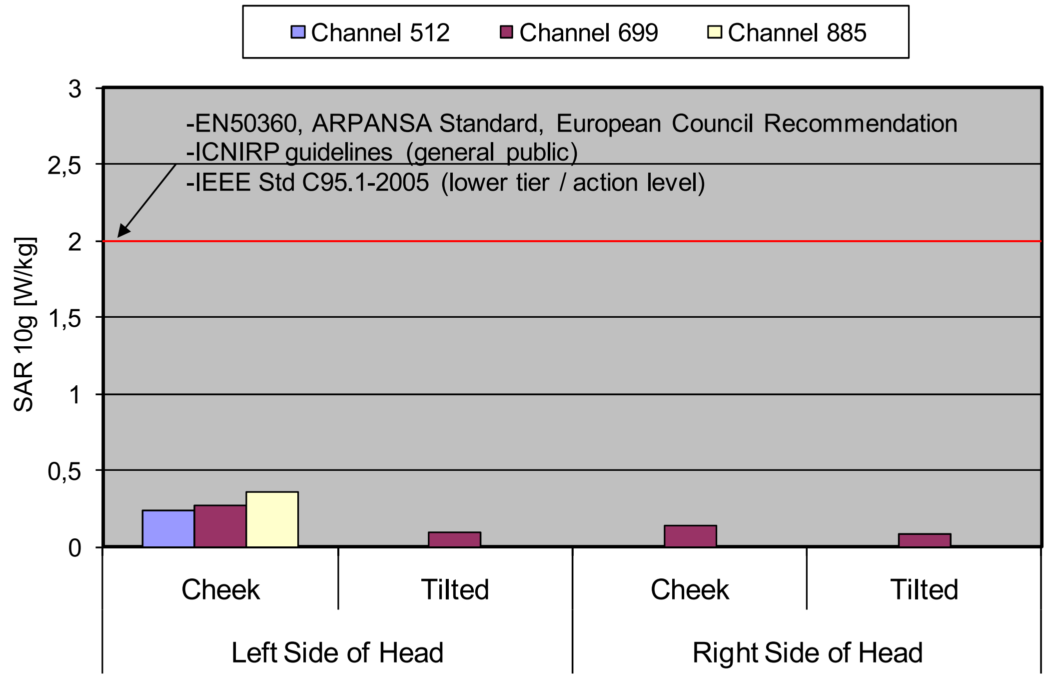

Fig. 10: The measured SAR values for the Fujitsu F-022 (DCS 1800) in comparison to the EN50360, ARPANSA Standard, European Council Recommendation, ICNIRP guidelines and IEEE Std C95.1-2005.

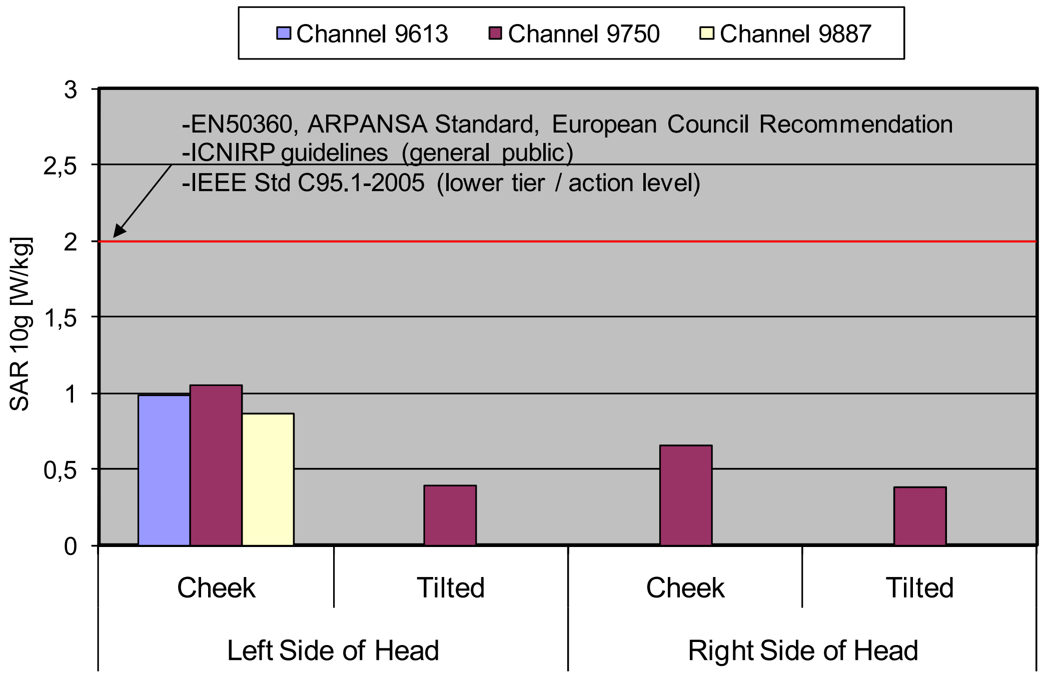

Fig. 11: The measured SAR values for the Fujitsu F-022 (WCDMA I) in comparison to the EN50360, ARPANSA Standard, European Council Recommendation, ICNIRP guidelines and IEEE Std C95.1-2005.

The Fujitsu F-022 mobile phone is in compliance with the following standards:

- **European Product Standard EN 50360**
- **ARPANSA Radiation Protection Standard**
- **European Council Recommendation [1999 519 EC]**
- **ICNIRP guidelines for general public exposure [ICNIRP 1998]**
- **IEEE Standard C95.1-2005 for the lower tier / action level**

Figure 12 - 29 show the SAR distribution plots for GSM 900, DCS 1800 and WCDMA I (FDD).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yglm_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: GSM 900

Communication System: GSM 900; Frequency: 897.6 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 897.6 MHz; σ = 0.98 mho/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(6.23, 6.23, 6.23); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Sugar 1341; Type: QD 000 P40 CB; Serial: TP-1341
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.637 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.45 V/m; Power Drift = -0.161 dB
Peak SAR (extrapolated) = 0.923 W/kg
SAR(1 g) = 0.612 mW/g; SAR(10 g) = 0.389 mW/g
Maximum value of SAR (measured) = 0.661 mW/g

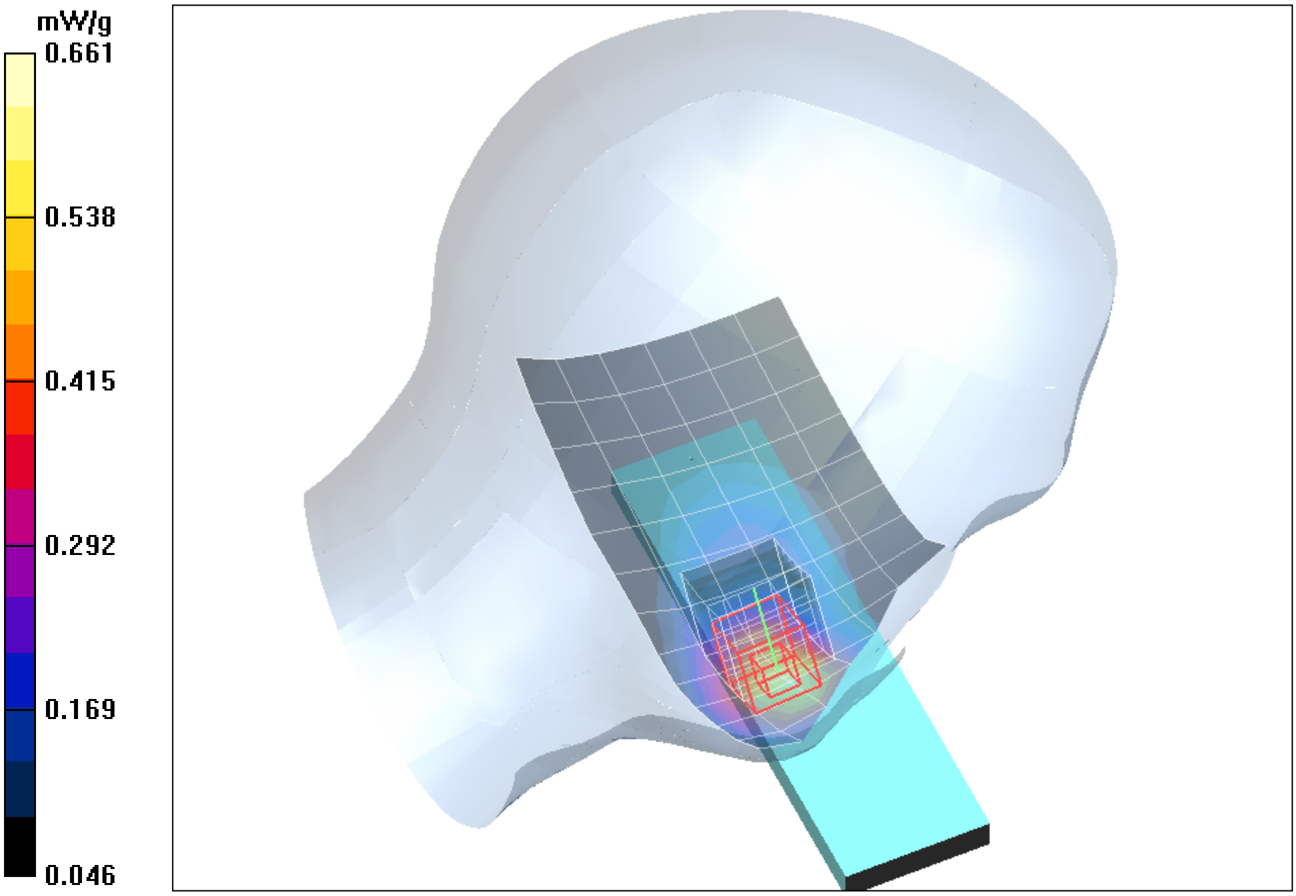

Fig. 12: SAR distribution plot for GSM 900 for the Fujitsu F-022 (channel 038, cheek position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yglm_2.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: GSM 900

Communication System: GSM 900; Frequency: 897.6 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 897.6 MHz; σ = 0.98 mho/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(6.23, 6.23, 6.23); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Sugar 1341; Type: QD 000 P40 CB; Serial: TP-1341
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Tilted Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.207 mW/g
Tilted Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.4 V/m; Power Drift = -0.110 dB
Peak SAR (extrapolated) = 0.248 W/kg
SAR(1 g) = 0.194 mW/g; SAR(10 g) = 0.139 mW/g

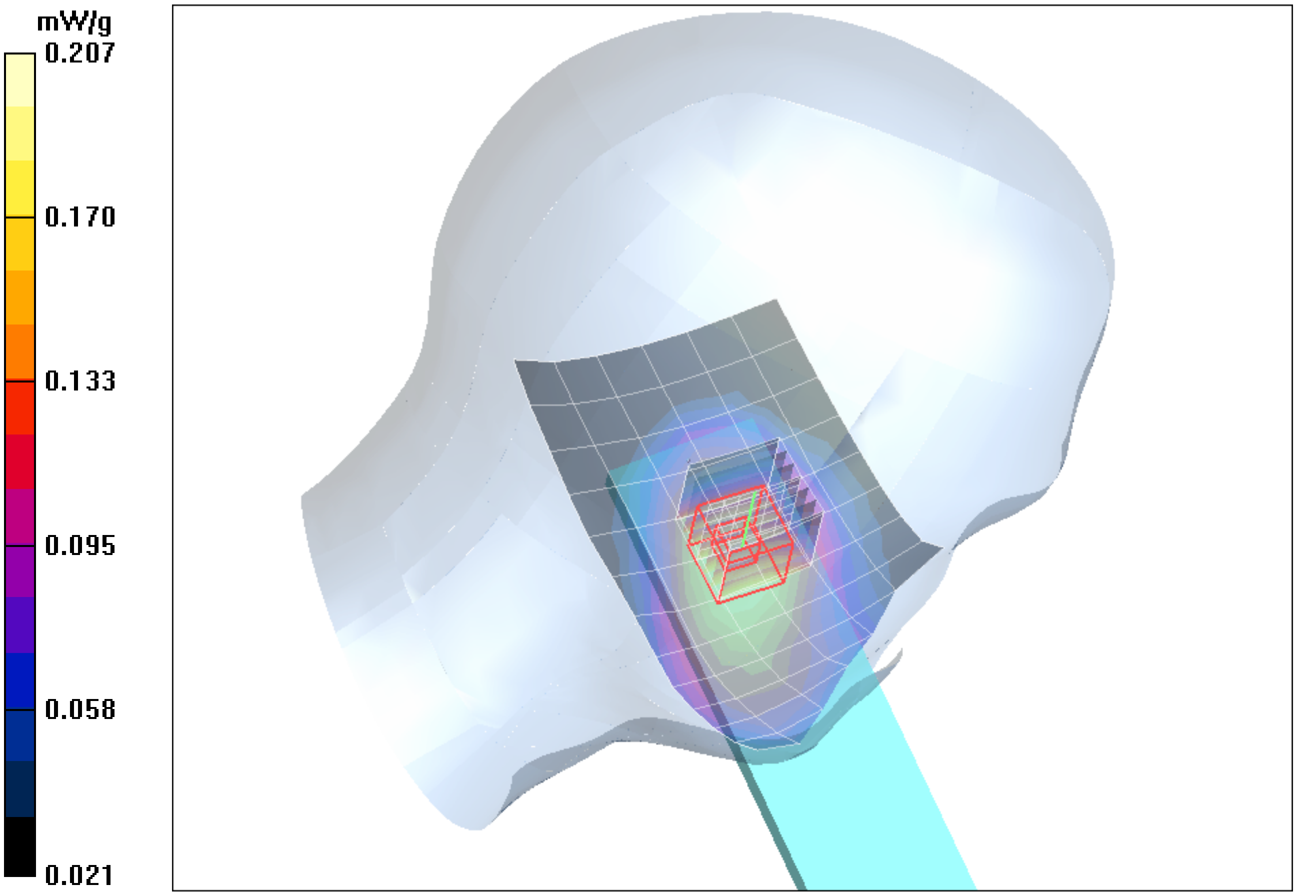

Fig. 13: SAR distribution plot for GSM 900 for the Fujitsu F-022 (channel 038, tilted position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ygrm_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: GSM 900

Communication System: GSM 900; Frequency: 897.6 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 897.6 MHz; σ = 0.98 mho/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(6.23, 6.23, 6.23); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Sugar 1341; Type: QD 000 P40 CB; Serial: TP-1341
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Right/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.611 mW/g
Cheek Right/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.02 V/m; Power Drift = 0.181 dB
Peak SAR (extrapolated) = 0.858 W/kg
SAR(1 g) = 0.605 mW/g; SAR(10 g) = 0.369 mW/g
Maximum value of SAR (measured) = 0.656 mW/g

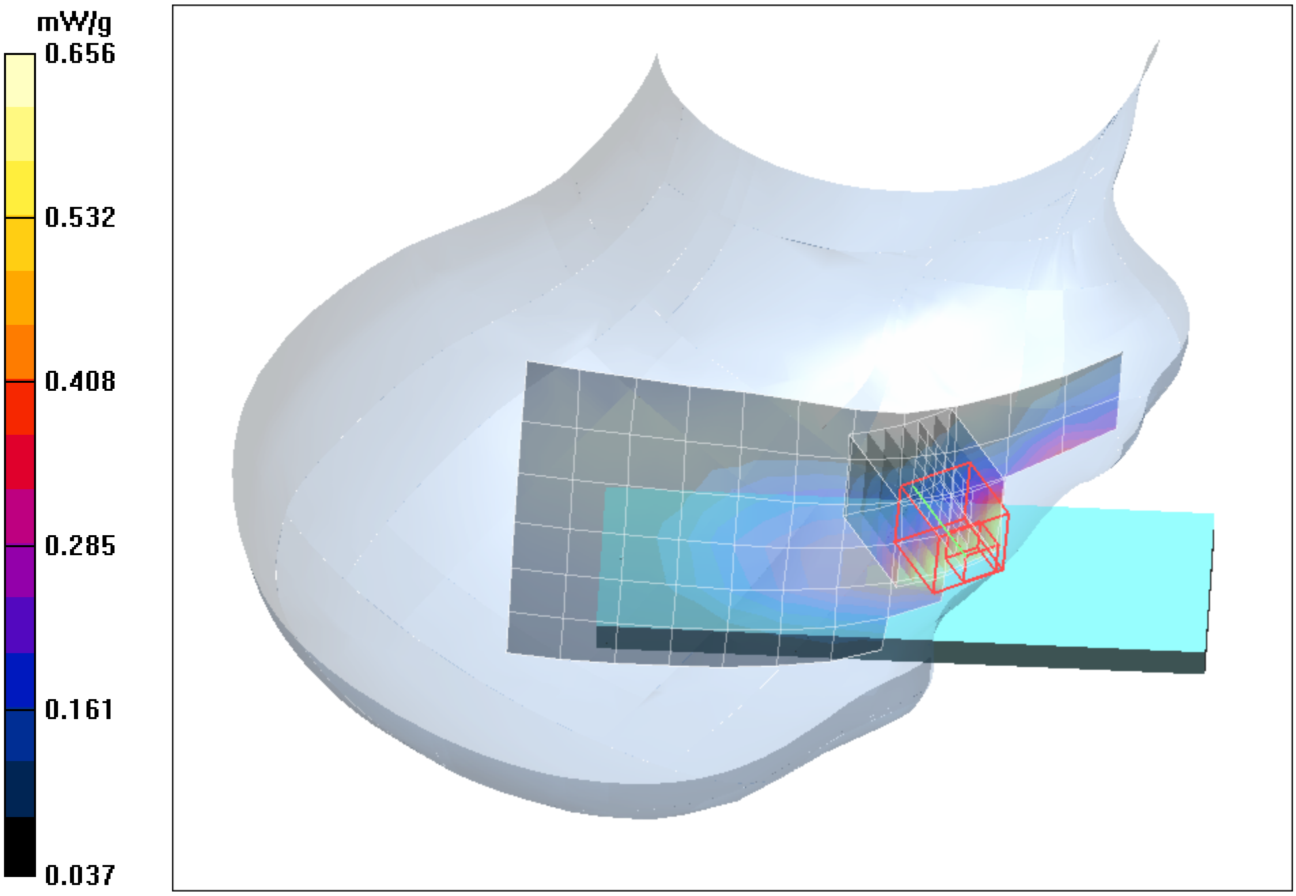

Fig. 14: SAR distribution plot for GSM 900 for the Fujitsu F-022 (channel 038, cheek position, right side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ygrm_2.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: GSM 900

Communication System: GSM 900; Frequency: 897.6 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 897.6 MHz; σ = 0.98 mho/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(6.23, 6.23, 6.23); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Sugar 1341; Type: QD 000 P40 CB; Serial: TP-1341
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Tilted Right/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.189 mW/g
Tilted Right/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.68 V/m; Power Drift = -0.101 dB
Peak SAR (extrapolated) = 0.231 W/kg
SAR(1 g) = 0.179 mW/g; SAR(10 g) = 0.129 mW/g
Maximum value of SAR (measured) = 0.193 mW/g

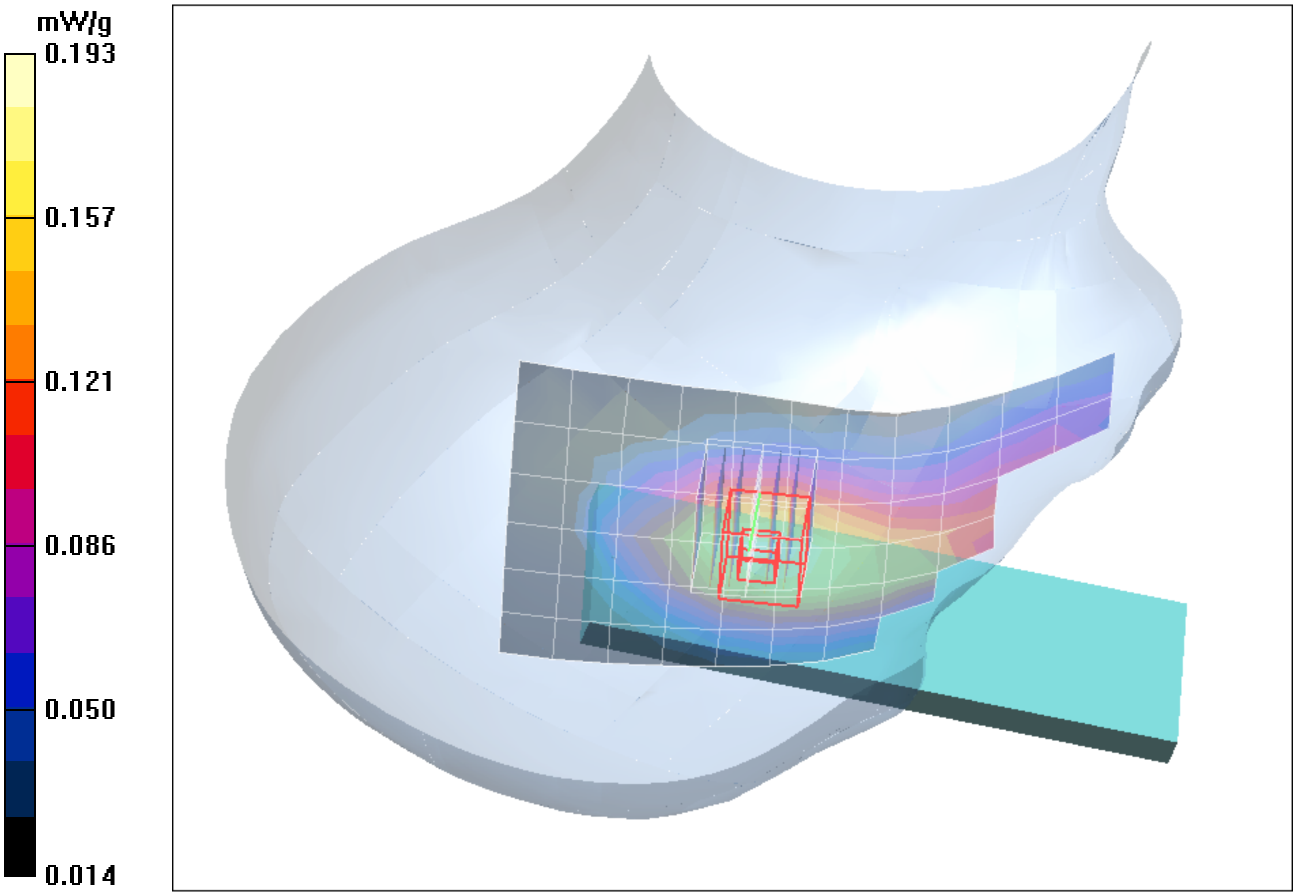

Fig. 15: SAR distribution plot for GSM 900 for the Fujitsu F-022 (channel 038, tilted position, right side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ygll_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: GSM 900

Communication System: GSM 900; Frequency: 880.2 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 880.2 MHz; σ = 0.97 mho/m; ε_r = 42; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(6.23, 6.23, 6.23); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Sugar 1341; Type: QD 000 P40 CB; Serial: TP-1341
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.538 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.93 V/m; Power Drift = -0.161 dB
Peak SAR (extrapolated) = 0.786 W/kg
SAR(1 g) = 0.512 mW/g; SAR(10 g) = 0.330 mW/g
Maximum value of SAR (measured) = 0.560 mW/g

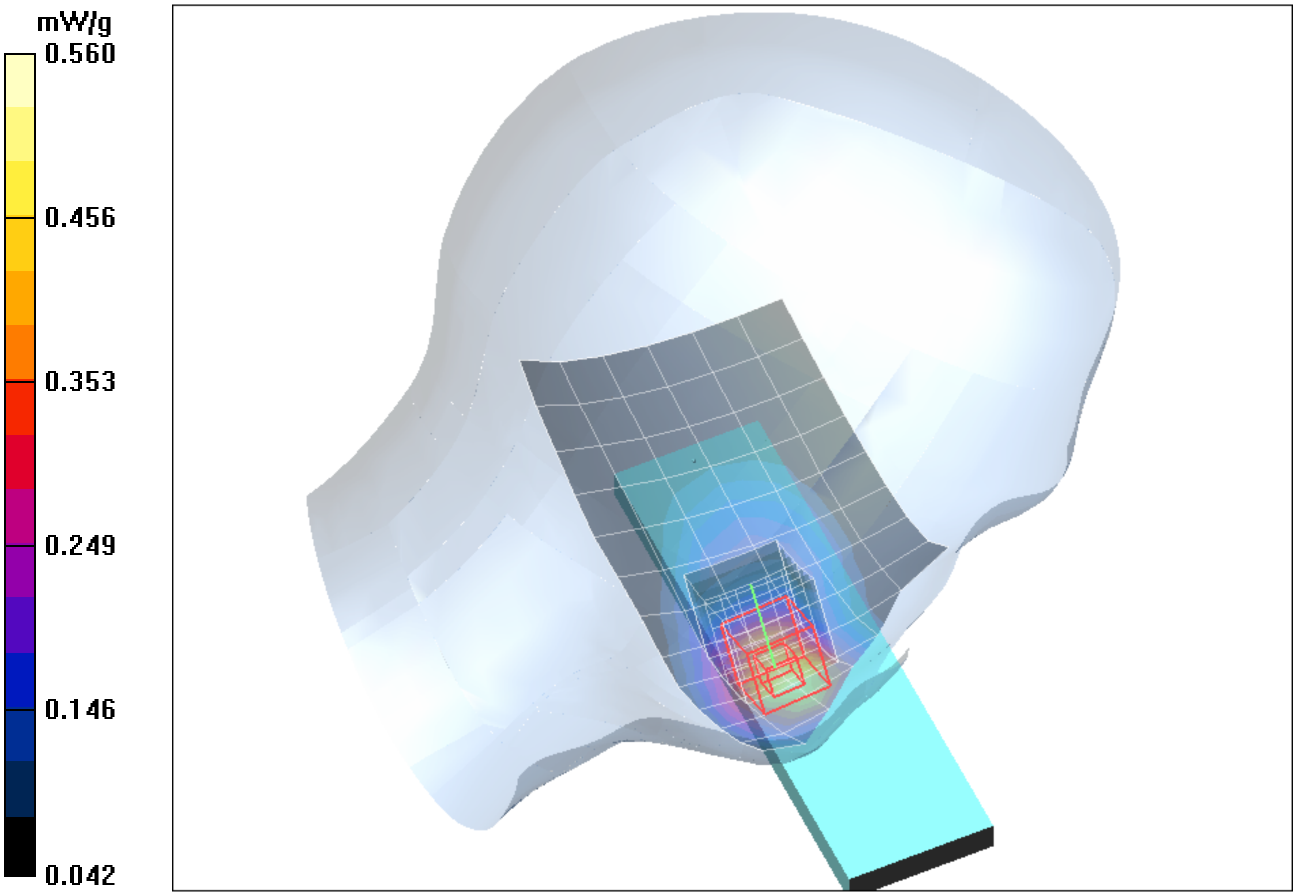

Fig. 16: SAR distribution plot for GSM 900 for the Fujitsu F-022 (channel 975, cheek position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yglh_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: GSM 900

Communication System: GSM 900; Frequency: 914.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 914.8 MHz; σ = 1 mho/m; ε_r = 41.2; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(6.23, 6.23, 6.23); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Sugar 1341; Type: QD 000 P40 CB; Serial: TP-1341
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.626 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.79 V/m; Power Drift = 0.010 dB
Peak SAR (extrapolated) = 0.911 W/kg
SAR(1 g) = 0.593 mW/g; SAR(10 g) = 0.382 mW/g
Maximum value of SAR (measured) = 0.646 mW/g

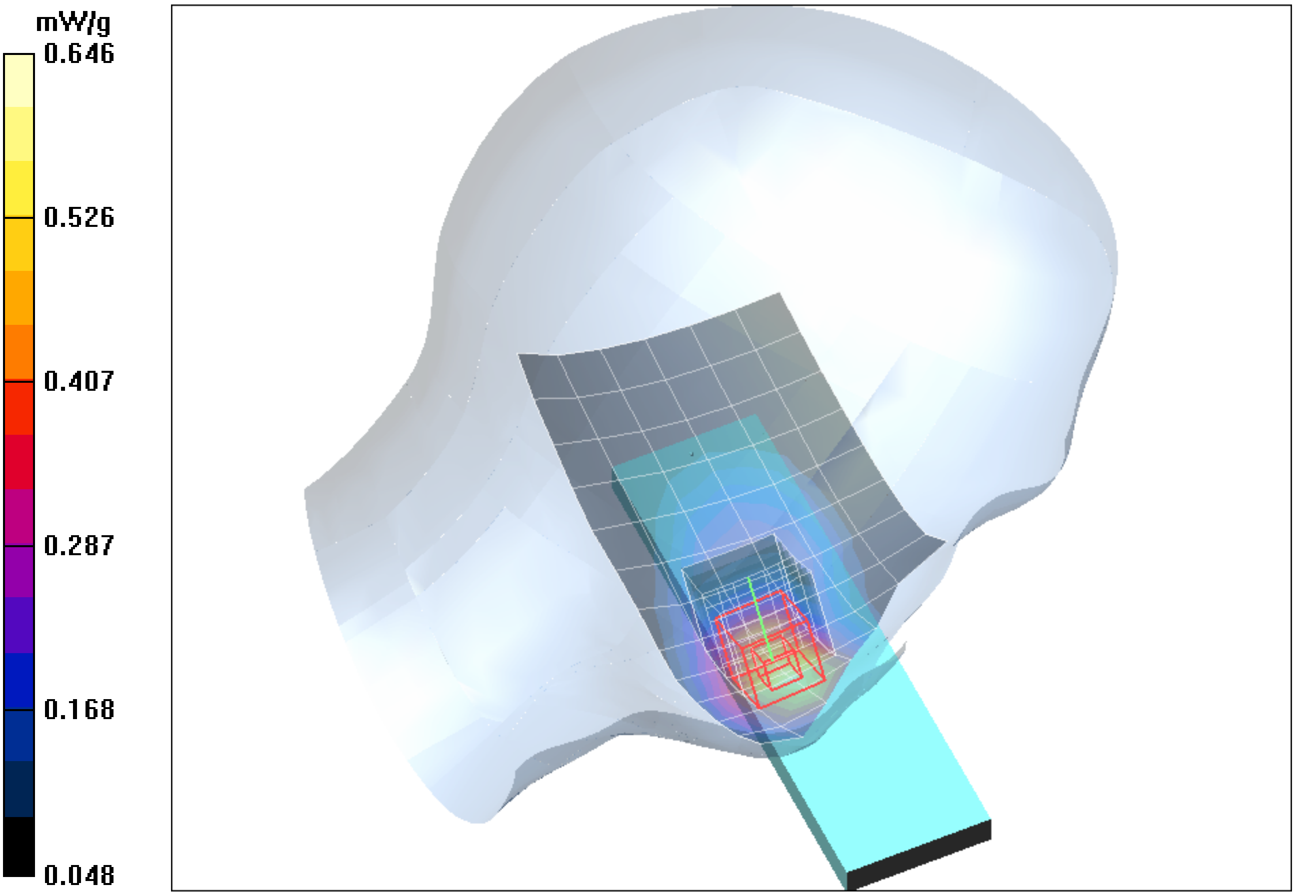

Fig. 17: SAR distribution plot for GSM 900 for the Fujitsu F-022 (channel 124, cheek position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ydlm_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: DCS 1800

Communication System: GSM 1800; Frequency: 1747.6 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1747.6 MHz; σ = 1.37 mho/m; ε_r = 41.1; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.34, 5.34, 5.34); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.496 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.96 V/m; Power Drift = -0.137 dB
Peak SAR (extrapolated) = 0.698 W/kg
SAR(1 g) = 0.480 mW/g; SAR(10 g) = 0.276 mW/g
Maximum value of SAR (measured) = 0.530 mW/g

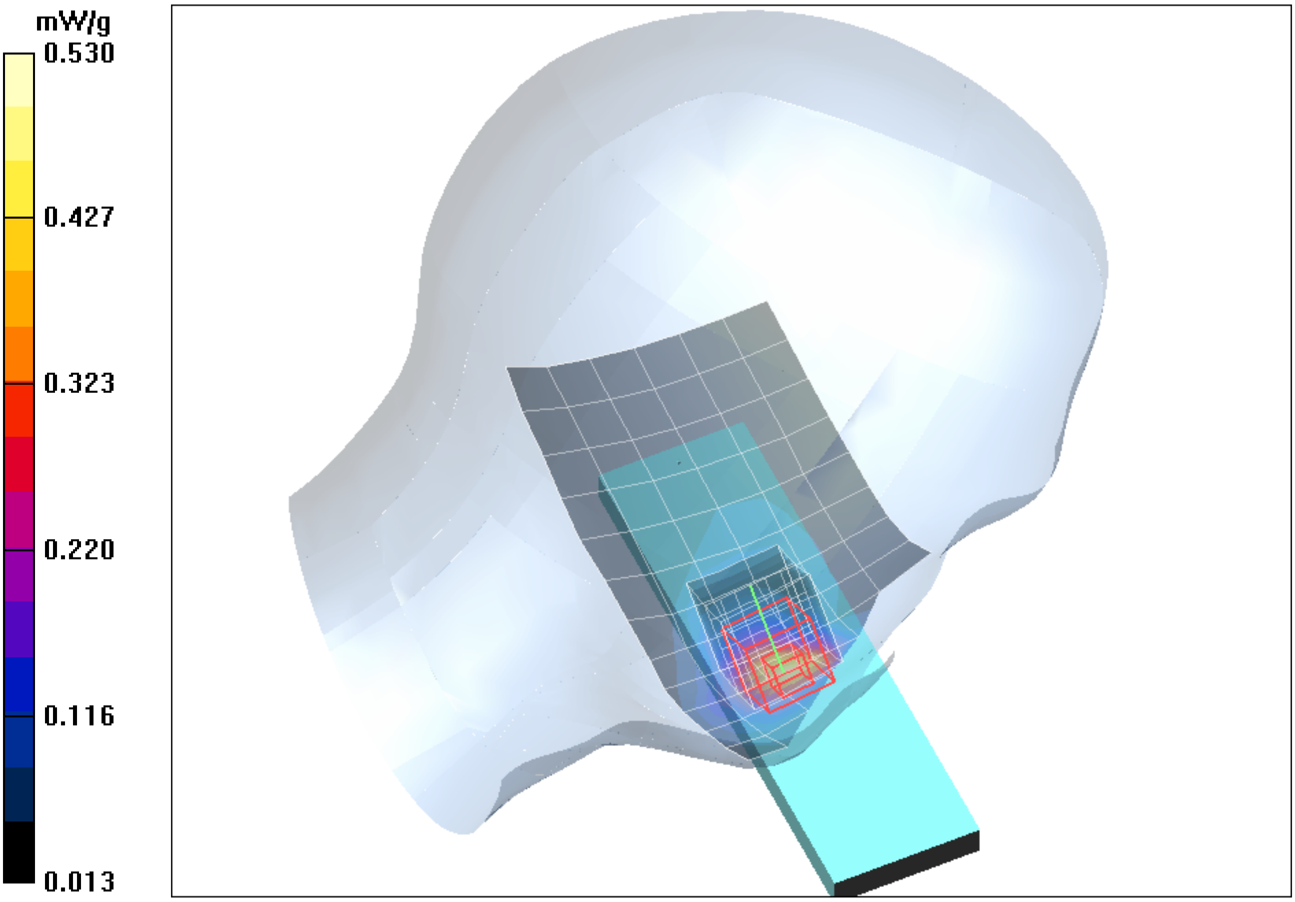

Fig. 18: SAR distribution plot for DCS 1800 for the Fujitsu F-022 (channel 699, cheek position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ydlm_2.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: DCS 1800

Communication System: GSM 1800; Frequency: 1747.6 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1747.6 MHz; σ = 1.37 mho/m; ε_r = 41.1; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.34, 5.34, 5.34); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Tilted Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.142 mW/g
Tilted Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.83 V/m; Power Drift = -0.020 dB
Peak SAR (extrapolated) = 0.217 W/kg
SAR(1 g) = 0.150 mW/g; SAR(10 g) = 0.094 mW/g
Maximum value of SAR (measured) = 0.163 mW/g

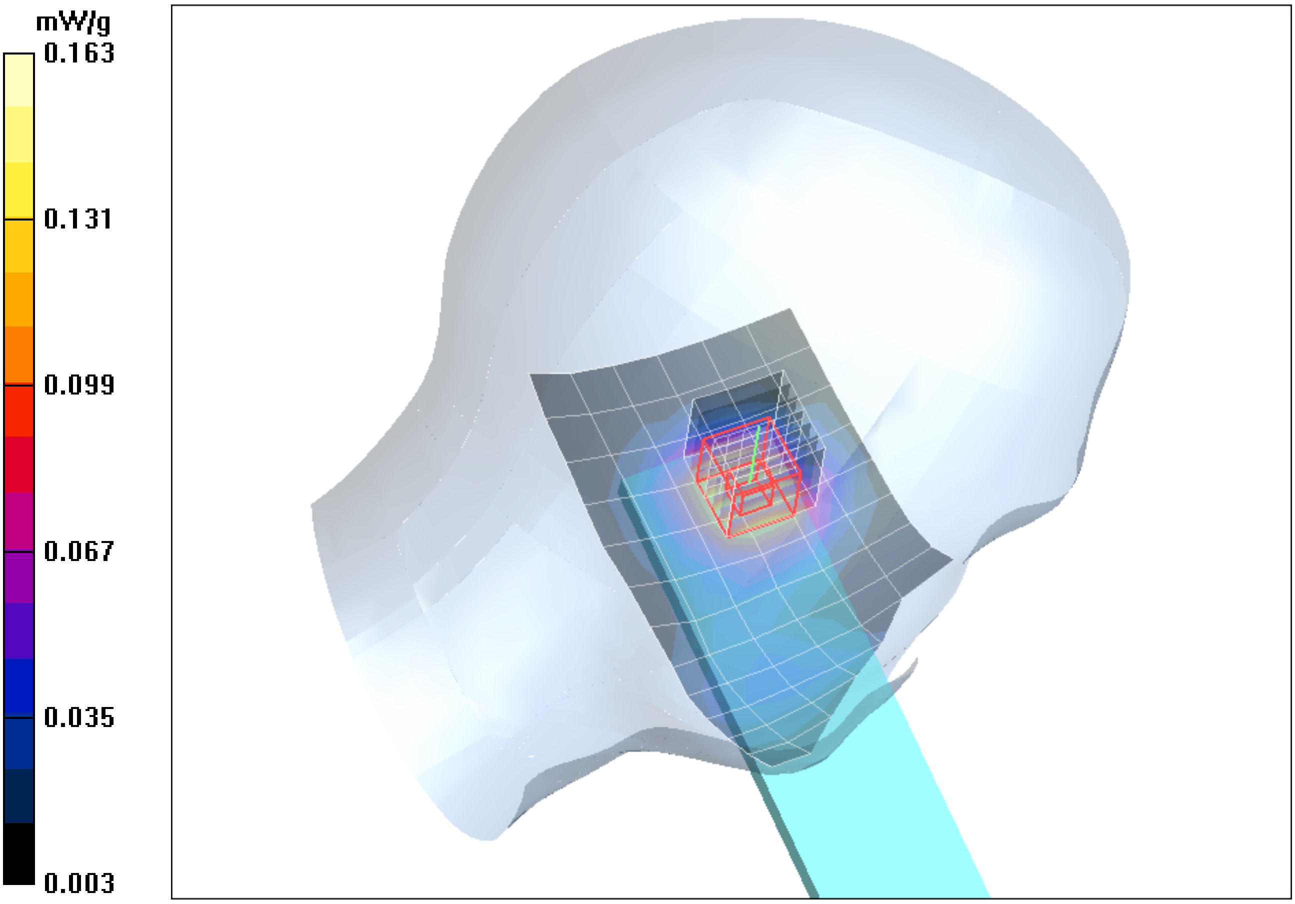

Fig. 19: SAR distribution plot for DCS 1800 for the Fujitsu F-022 (channel 699, tilted position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ydrm_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: DCS 1800

Communication System: GSM 1800; Frequency: 1747.6 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1747.6 MHz; σ = 1.37 mho/m; ε_r = 41.1; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.34, 5.34, 5.34); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Right/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.401 mW/g
Cheek Right/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.32 V/m; Power Drift = -0.087 dB
Peak SAR (extrapolated) = 0.576 W/kg
SAR(1 g) = 0.278 mW/g; SAR(10 g) = 0.143 mW/g
Maximum value of SAR (measured) = 0.427 mW/g

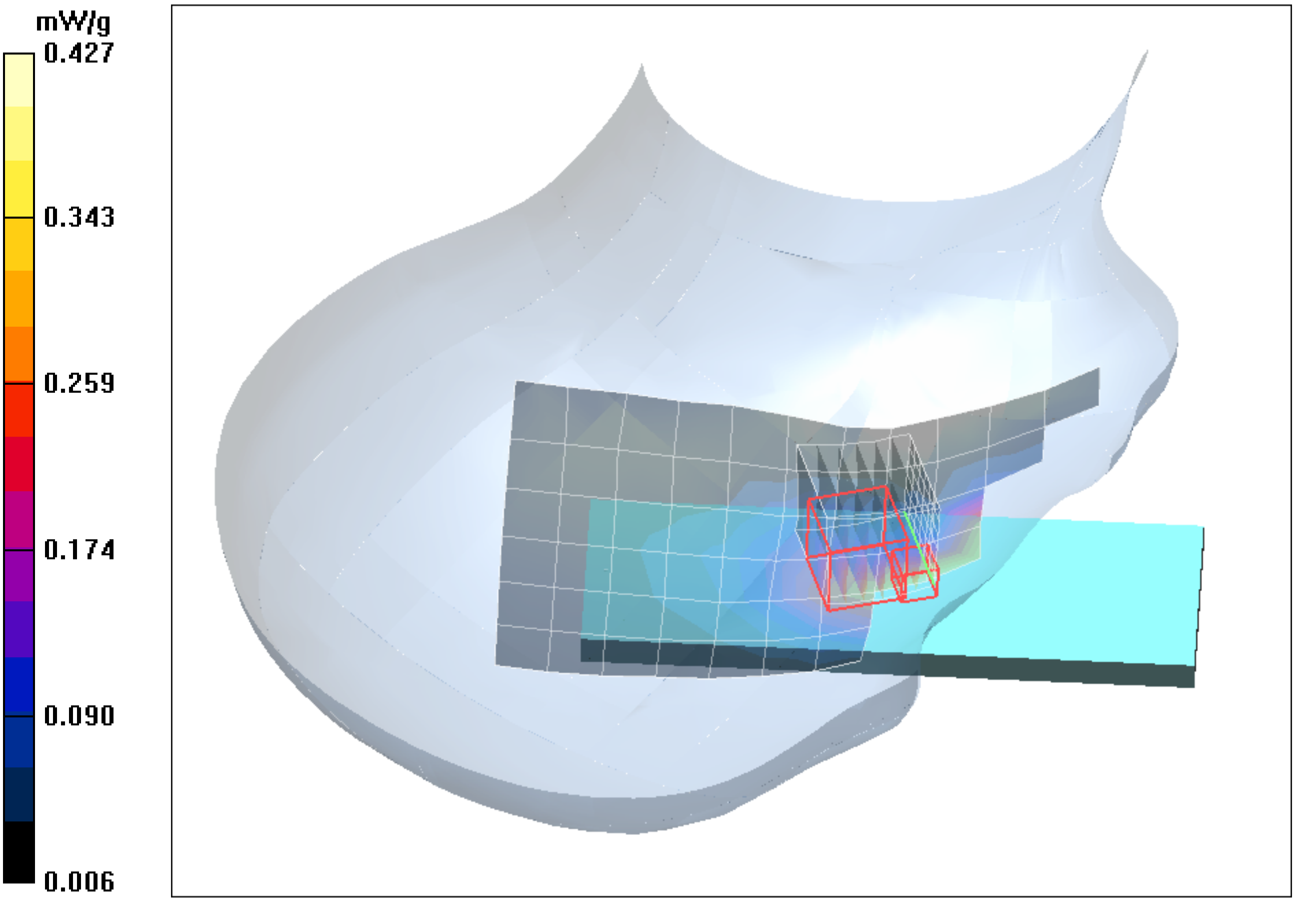

Fig. 20: SAR distribution plot for DCS 1800 for the Fujitsu F-022 (channel 699, cheek position, right side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ydrm_2.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: DCS 1800

Communication System: GSM 1800; Frequency: 1747.6 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1747.6 MHz; σ = 1.37 mho/m; ε_r = 41.1; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.34, 5.34, 5.34); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Tilted Right/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.146 mW/g
Tilted Right/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.04 V/m; Power Drift = 0.023 dB
Peak SAR (extrapolated) = 0.203 W/kg
SAR(1 g) = 0.144 mW/g; SAR(10 g) = 0.087 mW/g
Maximum value of SAR (measured) = 0.156 mW/g

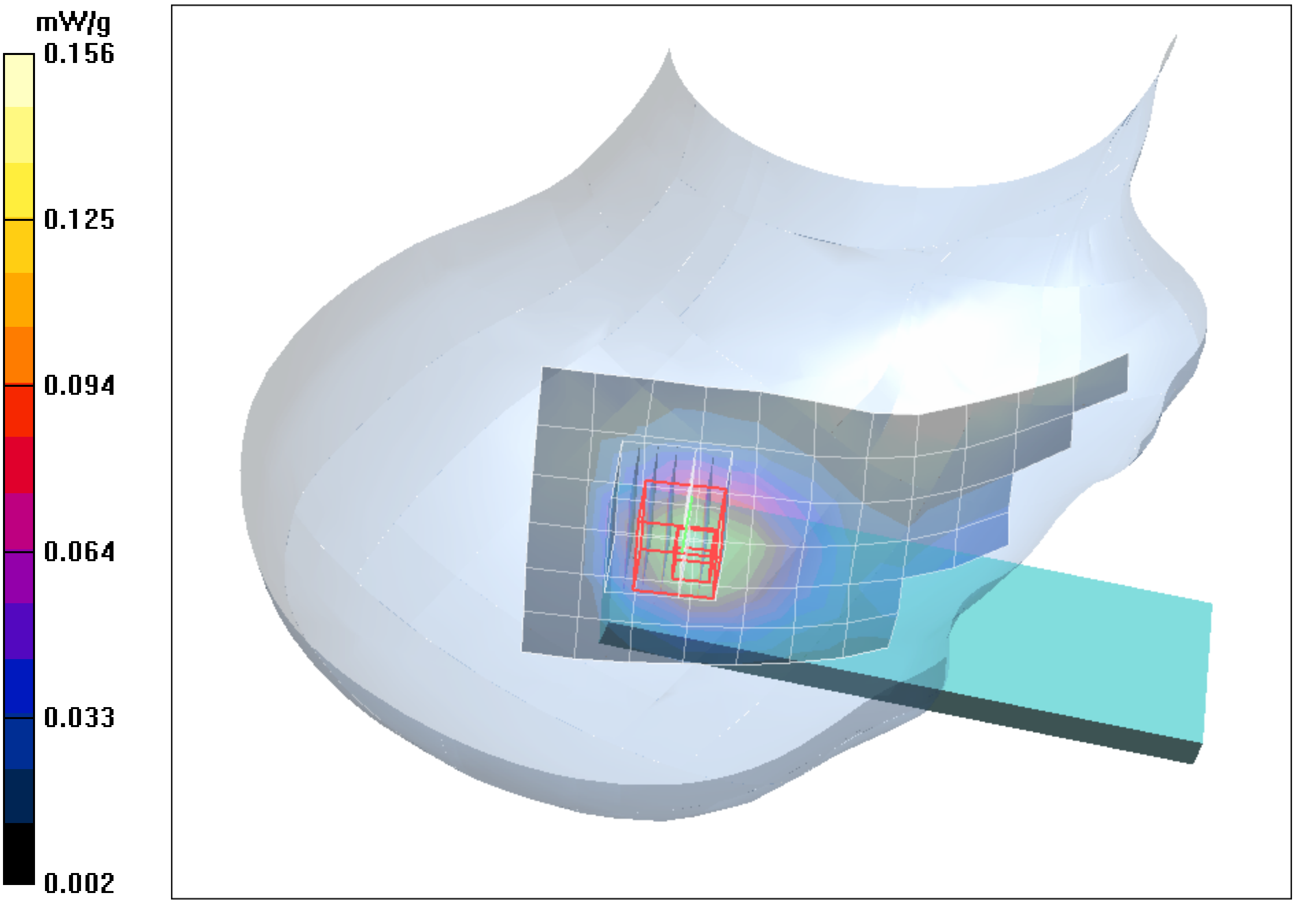

Fig. 21: SAR distribution plot for DCS 1800 for the Fujitsu F-022 (channel 699, tilted position, right side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ydll_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: DCS 1800

Communication System: GSM 1800; Frequency: 1710.2 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1710.2 MHz; σ = 1.31 mho/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.34, 5.34, 5.34); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.471 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.38 V/m; Power Drift = -0.077 dB
Peak SAR (extrapolated) = 0.625 W/kg
SAR(1 g) = 0.423 mW/g; SAR(10 g) = 0.243 mW/g
Maximum value of SAR (measured) = 0.472 mW/g

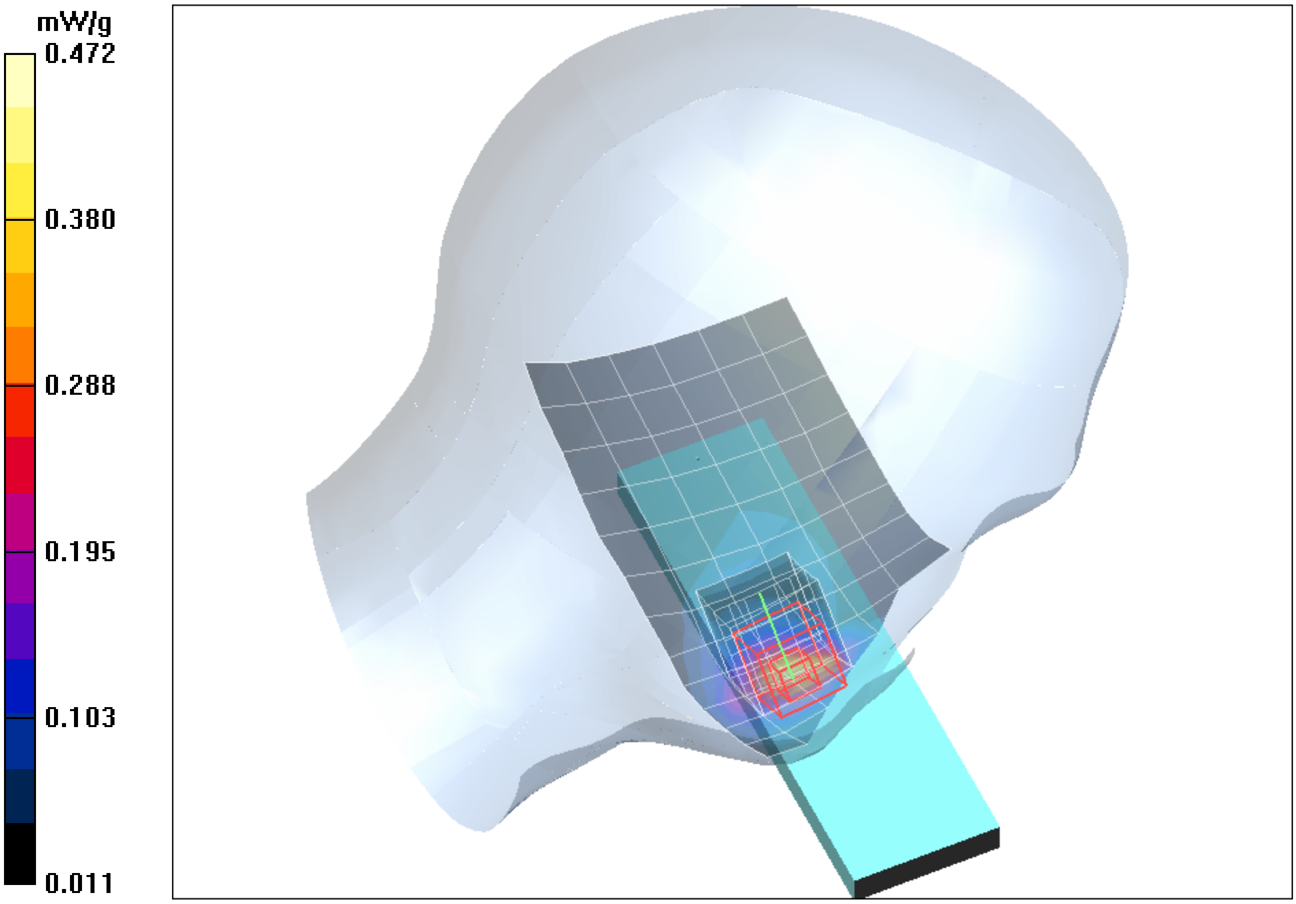

Fig. 22: SAR distribution plot for DCS 1800 for the Fujitsu F-022 (channel 512, cheek position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_ydlh_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: DCS 1800

Communication System: GSM 1800; Frequency: 1784.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1784.8 MHz; σ = 1.42 mho/m; ε_r = 41.3; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.34, 5.34, 5.34); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.692 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.85 V/m; Power Drift = -0.098 dB
Peak SAR (extrapolated) = 0.930 W/kg
SAR(1 g) = 0.625 mW/g; SAR(10 g) = 0.357 mW/g
Maximum value of SAR (measured) = 0.694 mW/g

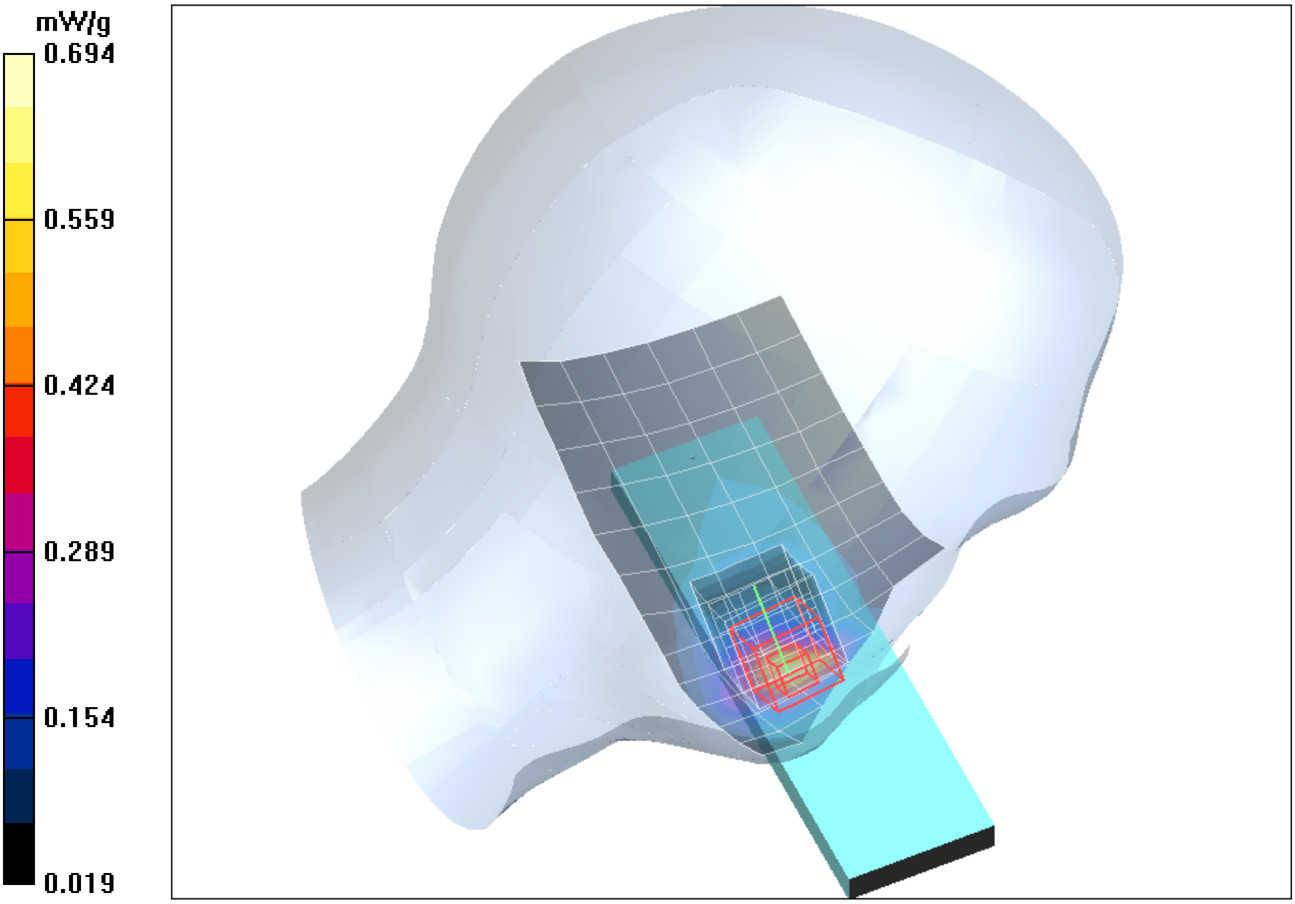

Fig. 23: SAR distribution plot for DCS1800 for the Fujitsu F-022 (channel 885, cheek position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yulm_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: WCDMA I

Communication System: WCDMA FDD ; Frequency: 1950 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1950 MHz; σ = 1.46 mho/m; ε_r = 39.4; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.77, 7.77, 7.77); Calibrated: 16.09.2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 17.09.2010
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.14 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.45 V/m; Power Drift = -0.051 dB
Peak SAR (extrapolated) = 3.13 W/kg
SAR(1 g) = 1.9 mW/g; SAR(10 g) = 1.05 mW/g
Maximum value of SAR (measured) = 2.09 mW/g

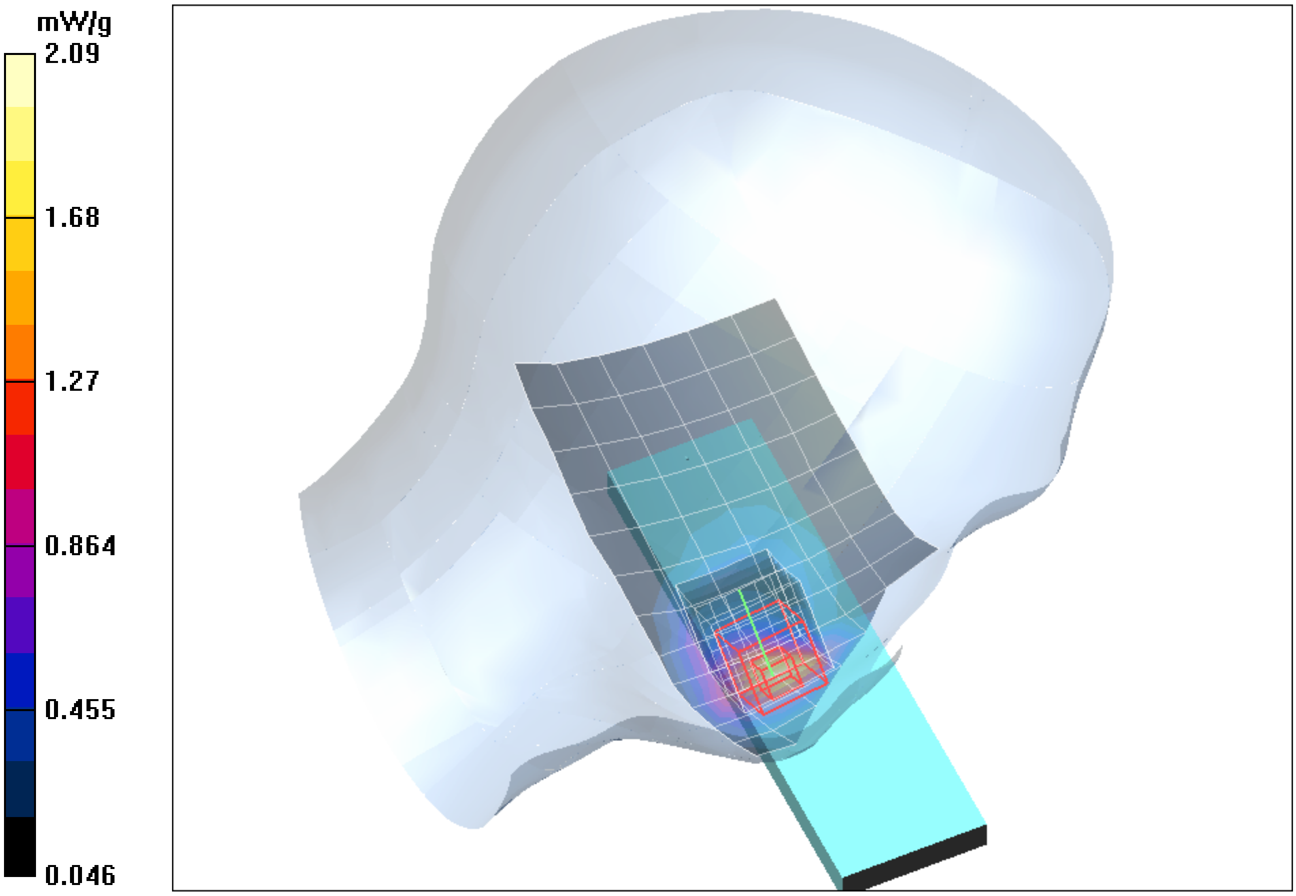

Fig. 24: SAR distribution plot for WCDMA (FDD) for the Fujitsu F-022 (channel 9750, cheek position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yulm_2.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: WCDMA I

Communication System: WCDMA FDD ; Frequency: 1950 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1950 MHz; σ = 1.46 mho/m; ε_r = 39.4; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.77, 7.77, 7.77); Calibrated: 16.09.2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 17.09.2010
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Tilted Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.690 mW/g
Tilted Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 16.5 V/m; Power Drift = 0.125 dB
Peak SAR (extrapolated) = 1.10 W/kg
SAR(1 g) = 0.686 mW/g; SAR(10 g) = 0.394 mW/g
Maximum value of SAR (measured) = 0.745 mW/g

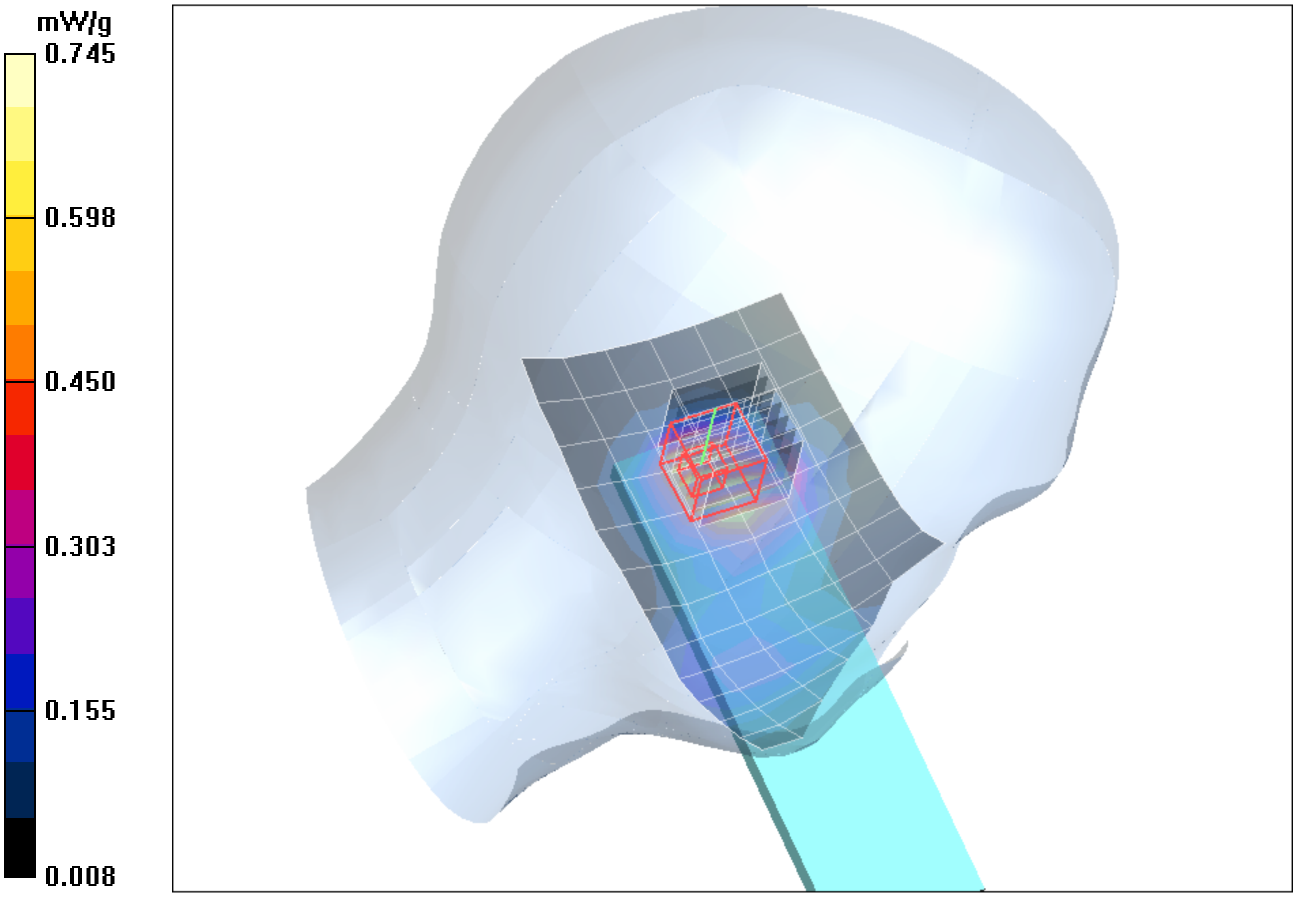

Fig. 25: SAR distribution plot for WCDMA (FDD) for the Fujitsu F-022 (channel 9750, tilted position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yurm_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: WCDMA I

Communication System: WCDMA FDD ; Frequency: 1950 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1950 MHz; σ = 1.46 mho/m; ε_r = 39.4; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.77, 7.77, 7.77); Calibrated: 16.09.2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 17.09.2010
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Right/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.41 mW/g
Cheek Right/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.82 V/m; Power Drift = -0.101 dB
Peak SAR (extrapolated) = 1.99 W/kg
SAR(1 g) = 1.11 mW/g; SAR(10 g) = 0.661 mW/g
Maximum value of SAR (measured) = 1.32 mW/g

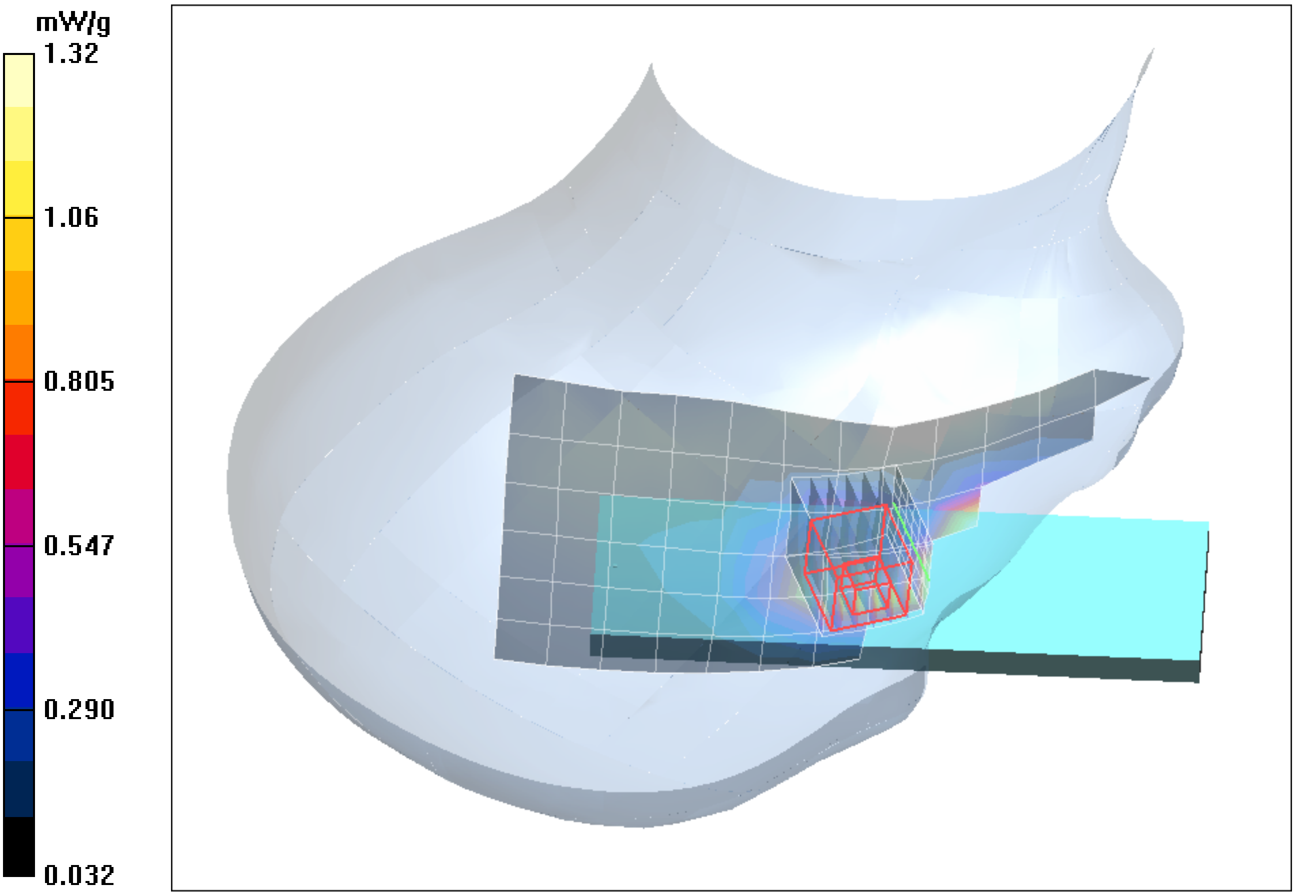

Fig. 26: SAR distribution plot for WCDMA (FDD) for the Fujitsu F-022 (channel 9750, cheek position, right side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yurm_2.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: WCDMA I

Communication System: WCDMA FDD ; Frequency: 1950 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1950 MHz; σ = 1.46 mho/m; ε_r = 39.4; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.77, 7.77, 7.77); Calibrated: 16.09.2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 17.09.2010
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Tilted Right/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.685 mW/g
Tilted Right/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.4 V/m; Power Drift = 0.016 dB
Peak SAR (extrapolated) = 1.12 W/kg
SAR(1 g) = 0.683 mW/g; SAR(10 g) = 0.379 mW/g
Maximum value of SAR (measured) = 0.756 mW/g

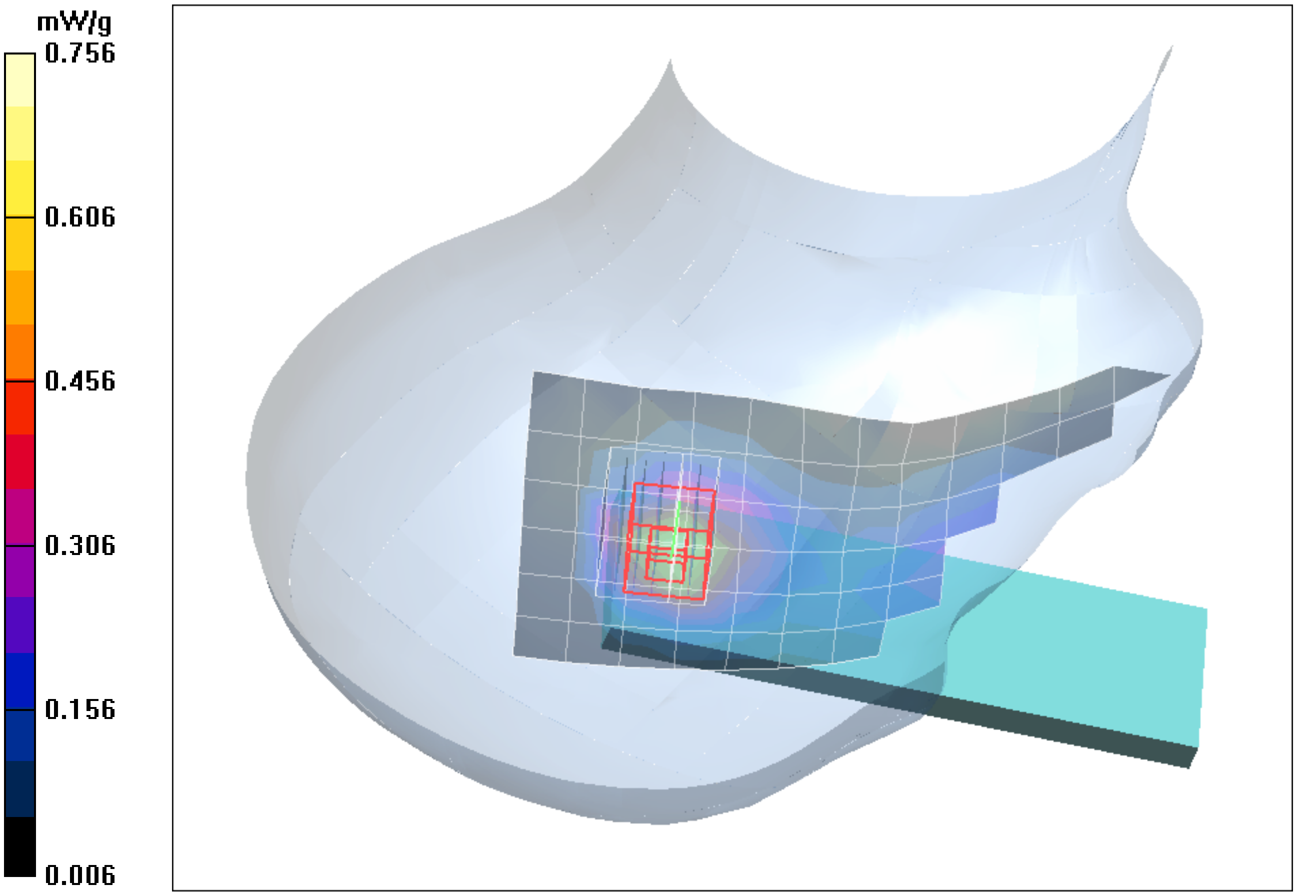

Fig. 27: SAR distribution plot for WCDMA (FDD) for the Fujitsu F-022 (channel 9750, tilted position, right side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yull_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: WCDMA I

Communication System: WCDMA FDD ; Frequency: 1922.6 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1922.6 MHz; σ = 1.45 mho/m; ε_r = 39.7; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.77, 7.77, 7.77); Calibrated: 16.09.2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 17.09.2010
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.95 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.22 V/m; Power Drift = 0.125 dB
Peak SAR (extrapolated) = 2.92 W/kg
SAR(1 g) = 1.78 mW/g; SAR(10 g) = 0.987 mW/g
Maximum value of SAR (measured) = 1.97 mW/g

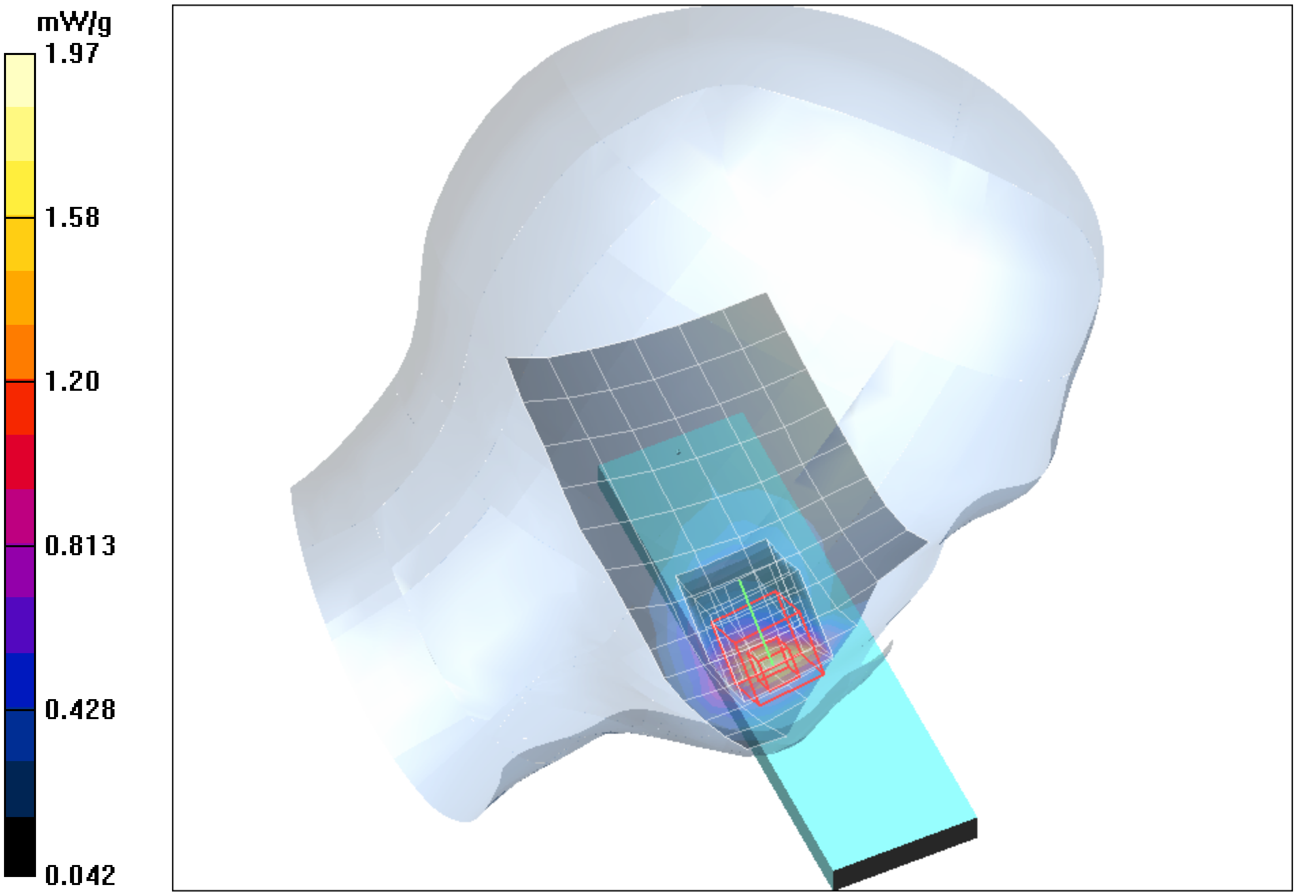

Fig. 28: SAR distribution plot for WCDMA (FDD) for the Fujitsu F-022 (channel 9613, cheek position, left side of head).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 991_yulh_1.da4

DUT: Fujitsu; Type: Folli Follie; Serial: 354224040010991
Program Name: WCDMA I

Communication System: WCDMA FDD ; Frequency: 1977.6 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1977.6 MHz; σ = 1.47 mho/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.77, 7.77, 7.77); Calibrated: 16.09.2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 17.09.2010
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Cheek Left/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.75 mW/g
Cheek Left/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.63 V/m; Power Drift = 0.012 dB
Peak SAR (extrapolated) = 2.63 W/kg
SAR(1 g) = 1.57 mW/g; SAR(10 g) = 0.863 mW/g
Maximum value of SAR (measured) = 1.74 mW/g

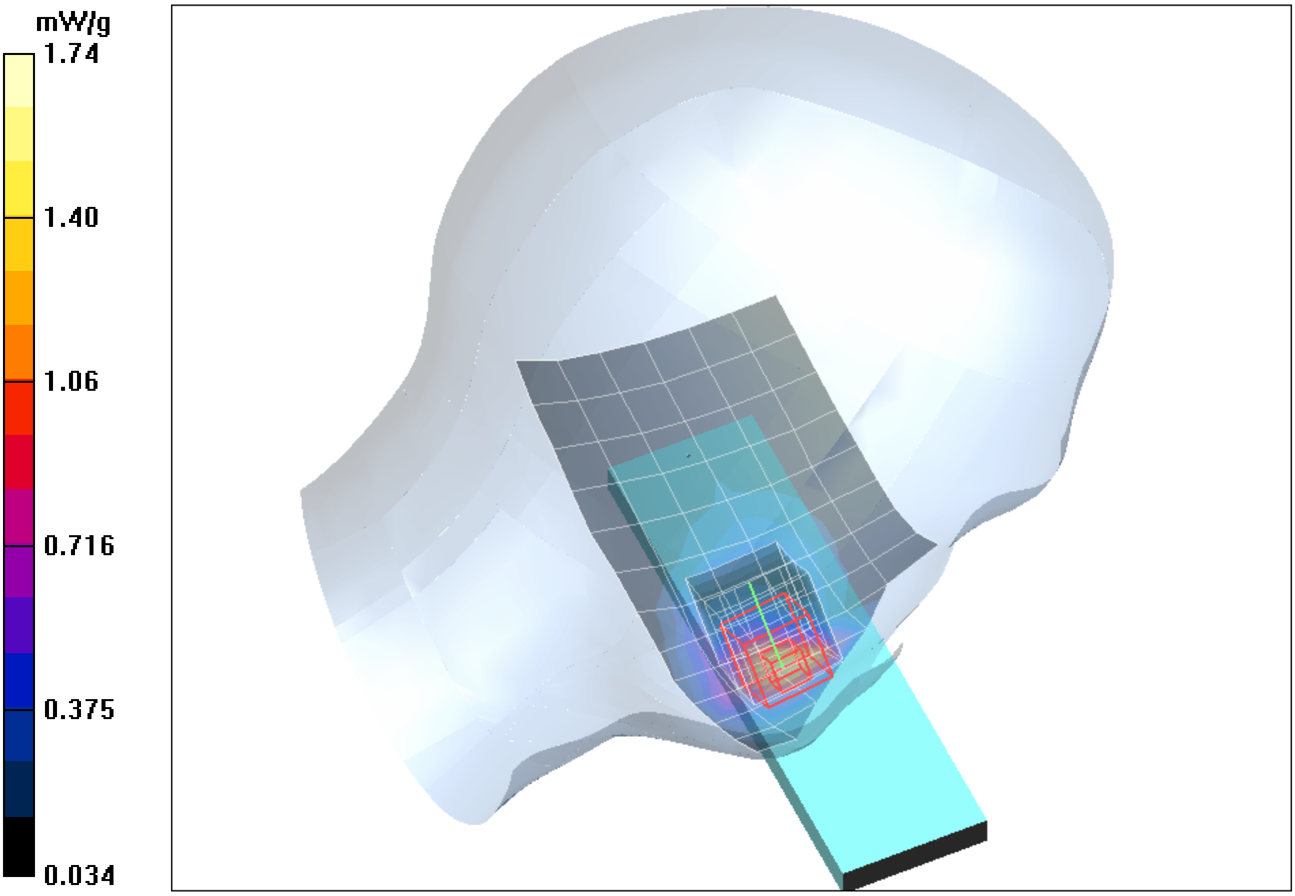

Fig. 29: SAR distribution plot for WCDMA (FDD) for the Fujitsu F-022 (channel 9887, cheek position, left side of head).

7 Appendix

7.1 Administrative Data

Date of validation:	900 MHz:	March 21, 2011
	1800 MHz:	March 24, 2011
	1900 MHz	March 18, 2011
Date of measurement:	March 18, 2011 - March 24, 2011	
Data stored:	7layers_6620_841	

7.2 Device under Test and Test Conditions

MTE:	Fujitsu F-022	
Date of receipt:	March 15, 2011	
IMEI:	354224040010991	
Power supply:	Internal Battery	
Supplied Antenna:	integrated	
Standard:	GSM 900, DCS 1800 and WCDMA (FDD)	
Operational Mode Class:	B (GPRS and GSM, but not simultaneously)	
GPRS Multislot Class:	8	
WCDMA Mode:	12.2 kbps RMC in Test Loop Mode 1	
Modulation:	GSM: GMSK; WCDMA (FDD): QPSK	
Crest Factor:	GSM: 8; WCDMA (FDD): 1	
TX range	GSM 900:	880.2 MHz – 914.8 MHz
	DCS 1800:	1710.2 MHz – 1784.8 MHz
	WCDMA (FDD):	1922.6 MHz – 1977.4 MHz
RX range:	GSM 900:	925.2 MHz – 959.8 MHz
	DCS 1800	1805.2 MHz – 1879.8 MHz
	WCDMA (FDD)	2112.6 MHz – 2167.4 MHz
Used TX Channels:	GSM 900:	low: ch. 975, center: ch. 038, high: ch. 124
	DCS 1800:	low: ch. 512, center: ch. 699, high: ch. 885
	WCDMA (FDD):	low: ch.9613, center: ch.9750, high: ch.9887
Power Class:	GSM 900:	4, tested with power level 5
	DCS 1800:	1, tested with power level 0
	WCDMA (FDD):	3, tested with max. allow. UE Power of 33dBm
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.

900 MHz:	56.63%	Sugar
	40.71%	De-Ionized Water
	1.48%	Salt
	0.99%	Hydroxyetyl-cellulose
	0.19%	Preventol D7
1750 MHz:	45.65%	Diethylenglykol-monobutylether
	54.00%	De-Ionized Water
	0.35%	Salt
1900 MHz:	45.65%	Diethylenglykol-monobutylether
	54.00%	De-Ionized Water
	0.35%	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. The measured values should be within ± 5% of the recommended values given by the EN 62209-1, IEC 62209-1 and IEEE Std 1528.

Frequency		ε_r	σ [S/m]
900 MHz Head	Recommended Value	39.90 – 43.60	0.94 – 1.02
	Measured Value (Validation)	41.50	0.98
	Measured Value (CH 975)	42.00	0.97
	Measured Value (CH 038)	41.50	0.98
	Measured Value (CH 124)	41.20	1.00
1750 MHz Head	Recommended Value	38.20 – 42.00	1.31 –1.43
	Measured Value (Validation)	41.10	1.37
	Measured Value (CH 512)	41.50	1.31
	Measured Value (CH 699)	41.10	1.37
	Measured Value (CH 885)	41.30	1.42
1900 MHz Head (WCDMA)	Recommended Value	38.00 – 42.00	1.33 - 1.47
	Measured Value (Validation)	39.50	1.43
	Measured Value (CH 9613)	39.70	1.45
	Measured Value (CH 9750)	39.40	1.46
	Measured Value (CH 9887)	38.90	1.47

Table 6: Parameters of the tissue simulating liquid.

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 and they were placed under the flat part of the SAM phantoms. The target and measured results are listed in the table 7 - 8 and shown in figure 30 - 32. The target values were adopted from the calibration certificates.

Available Dipoles		SAR_{10g} [W/kg]	ε_r	σ [S/m]
D900V2, SN #006	Target Values Head	1.85	42.70	0.97
D1750V2, SN #1005		4.79	41.20	1.37
D1900V2, SN #5d051		4.76	40.30	1.45

Table 7: Dipole target results.

Used Dipoles		SAR_{10g} [W/kg]	ε_r	σ [S/m]
900 MHz, SN: #006	Measured Values Head	1.74	41.50	0.98
1750 MHz, SN: #1005		4.85	41.10	1.37
1900 MHz, SN: #5d051		5.00	39.50	1.43

Table 8: Measured dipole validation results.

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 210310_y_1669.da4

DUT: Dipole 900 MHz SN:006; Type: D900V2; Serial: D900V2 - SN:006
Program Name: System Performance Check at 900 MHz

Communication System: CW; Frequency: 900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 900 MHz; σ = 0.98 mho/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(6.23, 6.23, 6.23); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Sugar 1341; Type: QD 000 P40 CB; Serial: TP-1341
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.95 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.6 V/m; Power Drift = 0.044 dB
Peak SAR (extrapolated) = 3.94 W/kg
SAR(1 g) = 2.71 mW/g; SAR(10 g) = 1.74 mW/g

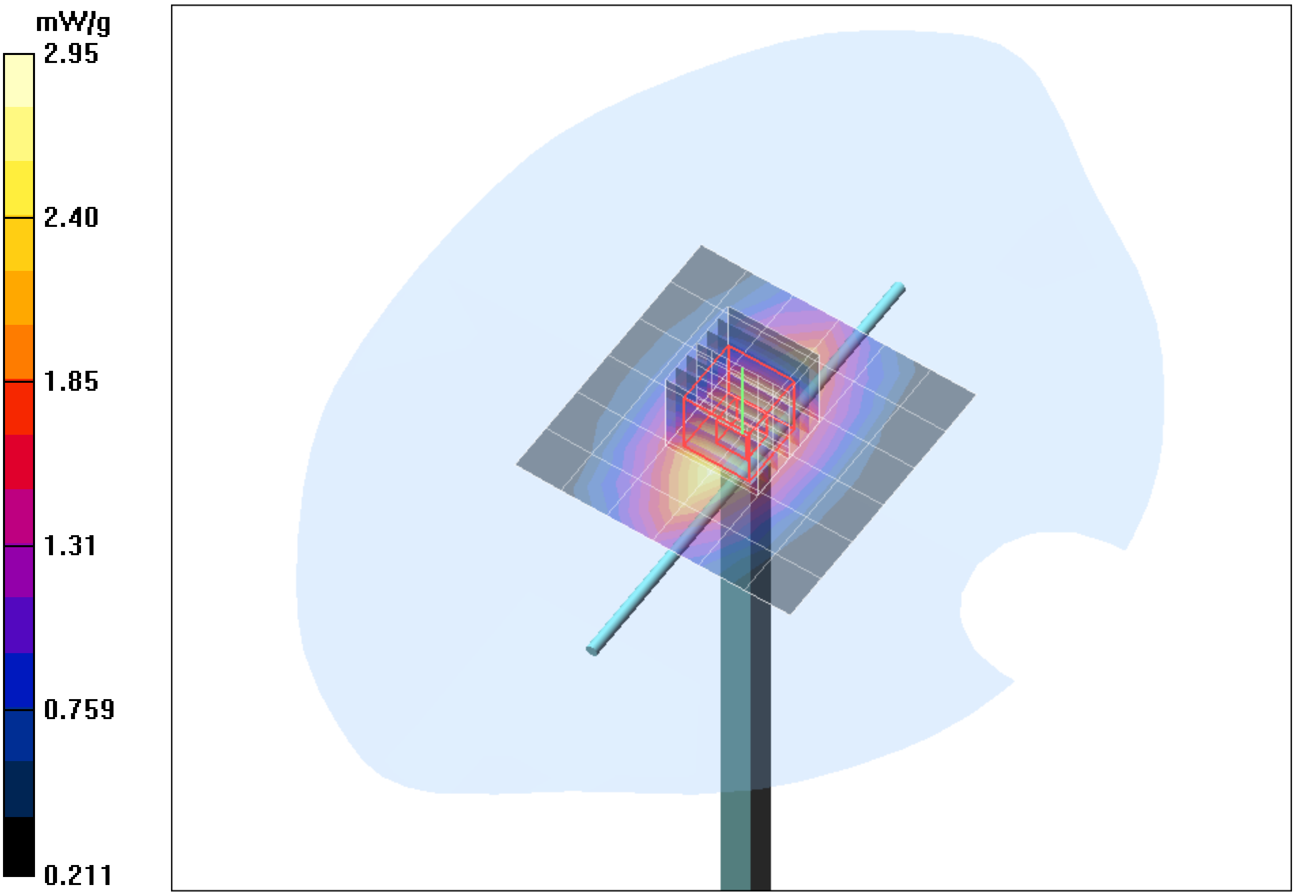

Fig. 30: Validation measurement 900 MHz.

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 240311_y_1669.da4

DUT: Dipole 1750 MHz SN: 1005; Type: D1750V2; Serial: D1750V2 - SN:1005
Program Name: System Performance Check at 1750 MHz

Communication System: CW; Frequency: 1750 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1750 MHz; σ = 1.37 mho/m; ε_r = 41.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.34, 5.34, 5.34); Calibrated: 21.02.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 22.02.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 10.1 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.6 V/m; Power Drift = 0.010 dB
Peak SAR (extrapolated) = 15.7 W/kg
SAR(1 g) = 9.07 mW/g; SAR(10 g) = 4.85 mW/g
Maximum value of SAR (measured) = 10.3 mW/g

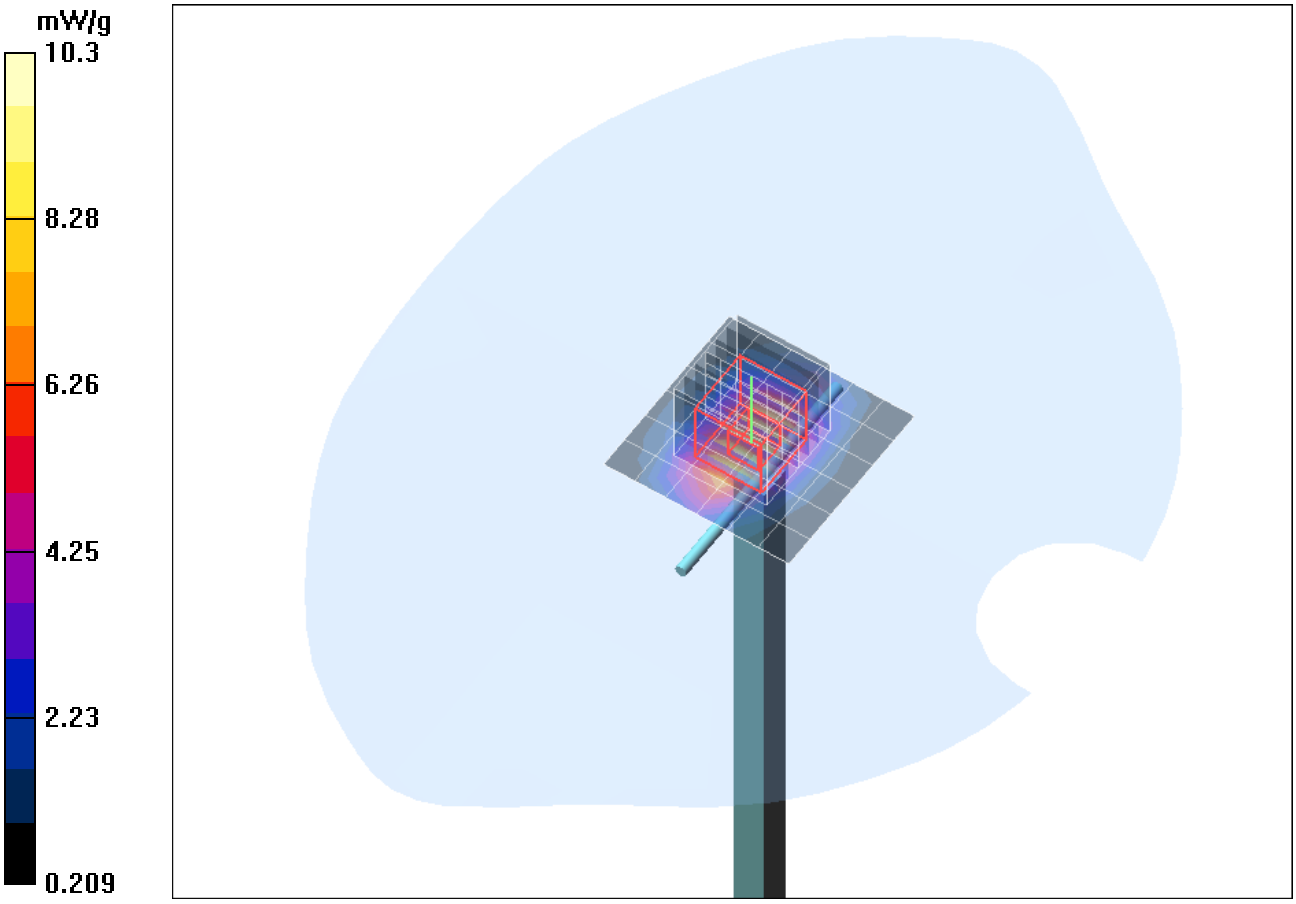

Fig. 31: Validation measurement 1750 MHz (DCS 1800).

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: 180311_y_3536.da4

DUT: Dipole 1900 MHz SN: 5d051; Type: D1900V2; Serial: D1900V2 - SN5d051
Program Name: System Performance Check at 1900 MHz

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.43 mho/m; ε_r = 39.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.77, 7.77, 7.77); Calibrated: 16.09.2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 17.09.2010
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 10.9 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.8 V/m; Power Drift = -0.009 dB
Peak SAR (extrapolated) = 19.1 W/kg
SAR(1 g) = 9.81 mW/g; SAR(10 g) = 5 mW/g
Maximum value of SAR (measured) = 11.0 mW/g

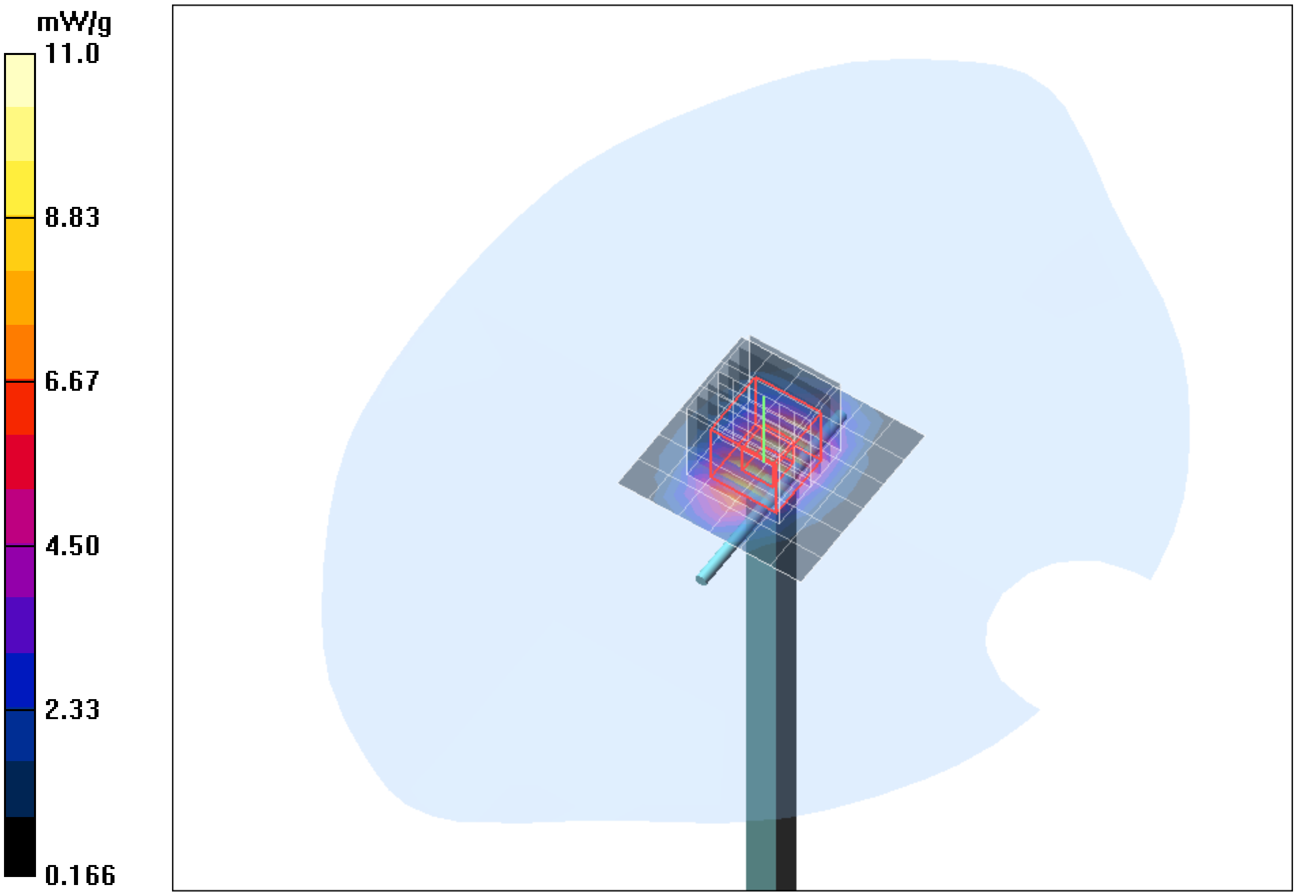

Fig. 32: Validation measurement 1900 MHz (WCDMA).

7.6 Environment

Ambient temperature: 23 °C ± 1 °C
Liquid temperature: 22 °C ± 1 °C
Humidity: 37 % ± 5 %

7.7 Test Equipment

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
DASY4 Systems				
Software Versions DASY4	V4.7	N/A	N/A	N/A
Software Versions SEMCAD	V1.8	N/A	N/A	N/A
Dosimetric E-Field Probe	ET3DV6	1669	02/2011	02/2012
Dosimetric E-Field Probe	EX3DV4	3536	09/2010	09/2011
Data Acquisition Electronics	DAE 3	335	02/2011	02/2012
Data Acquisition Electronics	DAE 4	631	09/2010	09/2011
Phantom	SAM	1059	N/A	N/A
Phantom	SAM	1176	N/A	N/A
Phantom	SAM	1340	N/A	N/A
Phantom	SAM	1341	N/A	N/A
Dipoles				
Validation Dipole	D900V2	006	09/2009	09/2011
Validation Dipole	D1750V2	1005	02/2010	02/2012
Validation Dipole	D1900V2	5d051	09/2009	09/2011
Material Measurement				
Network Analyzer	E5071C	MY46103220	08/2009	08/2011
Dielectric Probe Kit	HP85070B	US33020263	N/A	N/A

Table 9: SAR equipment.

Test Equipment	Model	Serial Number	Last Calibration	Next Calibration
Power Meters				
Power Meter, Agilent	E4416A	GB41050414	12/2010	12/2012
Power Meter, Agilent	E4417A	GB41050441	12/2010	12/2012
Power Meter, Anritsu	ML2487A	6K00002319	12/2009	12/2011
Power Meter, Anritsu	ML2488A	6K00002078	12/2009	12/2011
Power Sensors				
Power Sensor, Agilent	E9301H	US40010212	12/2010	12/2012
Power Sensor, Agilent	E9301A	MY41495584	12/2010	12/2012
Power Sensor, Anritsu	MA2481B	031600	12/2009	12/2011
Power Sensor, Anritsu	MA2490A	031565	12/2009	12/2011
RF Sources				
Network Analyzer	E5071C	MY46103220	08/2009	08/2011
Rohde & Schwarz	SME300	100142	N/A	N/A
Amplifiers				
Mini Circuits	ZHL-42	D012296	N/A	N/A
Mini Circuits	ZHL-42	D031104#01	N/A	N/A
Ciao Wireless	CA26-451	102	N/A	N/A
Radio Tester				
Rohde & Schwarz	CMU200	835305/050	N/A	N/A

Table 10: Test equipment, General.

7.8 Certificates of Conformity

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Certificate of conformity

Item	Dosimetric Assessment System DASY4
Type No	SD 000 401A, SD 000 402A
Software Version No	DASY 4.7
Manufacturer / Origin	Schmid & Partner Engineering AG Zeughausstrasse 43, CH-8004 Zürich, Switzerland

References

[1] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
[2] EN 50361:2001, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)", July 2001
[3] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005
[4] IEC 62209 – 2, Draft Version 0.9, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures
Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", December 2004
[5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
[6] ANSI-C63.19-2006, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", June 2006
[7] ANSI-C63.19-2007, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", June 2007

Conformity

We certify that this **system is designed to be fully compliant** with the standards [1 – 7] for RF emission tests of wireless devices.

Uncertainty

The uncertainty of the measurements with this system was evaluated according to the above standards and is documented in the applicable chapters of the DASY4 system handbook.
The uncertainty values represent current state of methodology and are subject to changes. They are applicable to all laboratories using DASY4 provided the following requirements are met (responsibility of the system end user):

1) the system is used by an experienced engineer who follows the manual and the guidelines taught during the training provided by SPEAG,
2) the probe and validation dipoles have been calibrated for the relevant frequency bands and media within the requested period,
3) the DAE has been calibrated within the requested period,
4) the "minimum distance" between probe sensor and inner phantom shell and the radiation source is selected properly,
5) the system performance check has been successful,
6) the operational mode of the DUT is CW, CDMA, FDMA or TDMA (GSM, DCS, PCS, IS136, PDC) and the measurement/integration time per point is ≥ 500 ms,
7) if applicable, the probe modulation factor is evaluated and applied according to field level, modulation and frequency,
8) the dielectric parameters of the liquid are conformant with the standard requirement,
9) the DUT has been positioned as described in the manual.
10) the uncertainty values from the calibration certificates, and the laboratory and measurement equipment dependent uncertainties, are updated by end user accordingly.

Date 24.4.2008 **Signature / Stamp**

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Fig. 33: Certificate of conformity for the used DASY4 system.

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 Hauptstr. 69 CH-8559 Fruthwilen 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 Relative permittivity < 5 Loss tangent < 0.05.	Material sample 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

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Fig. 34: Certificate of conformity for the used SAM phantom.

7.9 Test Positions for the Device under Test

Figure 35 - 38 show the test positions for the SAR measurements for the Fujitsu F-022.

Fig. 35: Cheek position, left side.

Fig. 36: Tilted position, left side.

Fig. 37: Cheek position, right side.

Fig. 38: Tilted position, right side.

8 References

[ARPANSA] Australian Radiation Protection and Nuclear Safety Agency: Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz. Radiation Protection Series No. 3, May 2002.

[EN 62209-1] European Standard EN 62209-1: Human exposure to radio frequency fields from hand-held and body mounted wireless communication devices – Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz). EN 62209-1:2006

[IEC 62209-1] International Standard CEI IEC 62209-1: Human exposure to radio frequency fields from hand-held and body mounted wireless communication devices – human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz). CEI/IEC 62209-1:2005

[EN 50360] European Standard EN 50360: Product Standard to Demonstrate the Compliance of Mobile Phones with the Basic Restrictions Related to Human Exposure to Electromagnetic Fields (300 MHz – 3 GHz), CENELEC, Brussels, July 2001.

[EN 50361] European Standard EN 50361: Basic Standard for the Measurement of Specific Absorption Rate Related to Human Exposure to Electromagnetic Fields from Mobile Phones (300 MHz – 3 GHz), CENELEC, Brussels, July 2001.

[ICNIRP 1998] ICNIRP: Guidelines for Limiting Exposure to Time-varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), In: Health Physics, Vol. 74, No. 4, 494-522, 1998.

[IEEE C95.1-1999] IEEE Std C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., 1999.

[IEEE C95.1-2005] IEEE Std C95.1-2005: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., 2005.

[IEEE 1528-2003] IEEE Std 1528-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques. 1528-2003, December 19, 2003, The Institute of Electrical and Electronics Engineers.

[1999 519 EC] European Council Recommendation (1999/519/EC): Council Recommendation of July 12 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz), Official Journal L 199, 30/07/1999, 0059-0070.

[DASY4] Schmid & Partner Engineering AG: DASY4 Manual. April 2008