Features: Signal Amplifier, multiplexer, A/D converter, and control logic
Software: DASY4 software
Connecting Lines: Optical downlink for data and status info.
Optical uplink for commands and clock

5 CHARACTERISTICS OF THE TEST

5.1 Applicable Limit Regulations

EN 50360–2001: Product standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones.

It specifies the maximum exposure limit of **2.0 W/kg** as averaged over any 10 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

5.2 Applicable Measurement Standards

EN 50361–2001: Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones.

IEEE 1528–2003: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

OET Bulletin 65 (Edition 97-01) and Supplement C (Edition 01-01): Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits.

IEC 62209-1-2005: 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)

IEC 62209-2 (Draft): Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 2: Procedure to determine the Specific Absorption Rate (SAR)in the head and body for 30MHz to 6GHz Handheld and Body-Mounted Devices used in close proximity to the body.

They specify the measurement method for demonstration of compliance with the SAR limits for such equipments.

6 LABORATORY ENVIRONMENT

Table 6: The Ambient Conditions during EMF Test

Temperature	Min. = 15 °C, Max. = 30 °C
Relative humidity	Min. = 30%, Max. = 70%
Ground system resistance	< 0.5 Ω
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

7 CONDUCTED OUTPUT POWER MEASUREMENT

7.1 Summary

During the process of testing, the EUT was controlled via Rhode & Schwarz Digital Radio Communication tester (CMU-200) to ensure the maximum power transmission and proper modulation. This result contains conducted output power and ERP for the EUT. In all cases, the measured peak output power should be greater and within 5% than EMI measurement.

7.2 Conducted Power

7.2.1 Measurement Methods

The EUT was set up for the maximum output power. The channel power was measured with Agilent Spectrum Analyzer E4440A. These measurements were done at 3 channels, 512, 661 and 810 before SAR test and after SAR test.

7.2.2 Measurement result

Table 7: Conducted Power Measurement Results

	Conducted Power		
	Channel 512 (1850.2MHz)	**Channel 661 (1880MHz)**	**Channel 810 (1909.8MHz)**
Before Test (dBm)	29.2	29.9	29.1
After Test (dBm)	29.2	29.85	29.15

7.2.3 Power Drift

To control the output power stability during the SAR test, DASY4 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 Table 11 to Table 14 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

8 TEST RESULTS

8.1 Dielectric Performance

Table 8: Dielectric Performance of Head Tissue Simulating Liquid

Measurement is made at temperature 23.3 °C and relative humidity 49%. Liquid temperature during the test: 22.5°C			
/	**Frequency**	**Permittivity ε**	**Conductivity σ (S/m)**
Target value	1900MHz	40.0	1.40
Measurement value (Average of 10 tests)	1900MHz	39.3	1.37

Table 9: Dielectric Performance of Body Tissue Simulating Liquid

Measurement is made at temperature 23.3 °C and relative humidity 49%. Liquid temperature during the test: 22.5°C			
/	**Frequency**	**Permittivity ε**	**Conductivity σ (S/m)**
Target value	1900MHz	53.3	1.52
Measurement value (Average of 10 tests)	1900MHz	52.1	1.53

8.2 System Validation

Table 10: System Validation

Measurement is made at temperature 23.3 °C, relative humidity 49%, input power 250 mW. Liquid temperature during the test: 22.5°C							
Liquid parameters		**Frequency**		**Permittivity ε**		**Conductivity σ (S/m)**	
		1900 MHz		39.3		1.37	
Verification results	**Frequency**	**Target value (W/kg)**		**Measured value (W/kg)**		**Deviation**	
		10 g Average	**1 g Average**	**10 g Average**	**1 g Average**	**10 g Average**	**1 g Average**
	1900 MHz	5.09	9.73	5.27	9.91	3.3%	1.9%

Note: Target values are the data of the dipole validation results, please check Annex F for the Dipole Calibration Certificate.

8.3 Summary of Measurement Results (PCS1900MHz)

Table 11: SAR Values (Head, 1900 MHz Band)

Limit of SAR (W/kg)	10 g Average	1 g Average	Power Drift (dB)
	2.0	1.6	
Test Case	Measurement Result (W/kg)		
	10 g Average	1 g Average	
Left hand, Touch cheek, Top frequency(See Fig.1)	0.180	0.298	-0.138
Left hand, Touch cheek, Mid frequency(See Fig.3)	0.203	0.334	0.114
Left hand, Touch cheek, Bottom frequency(See Fig.5)	0.234	0.385	-0.087
Left hand, Tilt 15 Degree, Top frequency(See Fig.7)	0.026	0.040	0.151
Left hand, Tilt 15 Degree, Mid frequency(See Fig.9)	0.029	0.043	0.001
Left hand, Tilt 15 Degree, Bottom frequency(See Fig.11)	0.035	0.051	-0.026
Right hand, Touch cheek, Top frequency(See Fig.13)	0.169	0.269	-0.079
Right hand, Touch cheek, Mid frequency(See Fig.15)	0.203	0.320	0.135
Right hand, Touch cheek, Bottom frequency(See Fig.17)	0.231	0.364	-0.200
Right hand, Tilt 15 Degree, Top frequency(See Fig.19)	0.016	0.026	-0.163
Right hand, Tilt 15 Degree, Mid frequency(See Fig.21)	0.00947	0.019	-0.082
Right hand, Tilt 15 Degree, Bottom frequency(See Fig.23)	0.017	0.030	-0.176

Table 12: SAR Values (Body, 1900 MHz Band with GPRS)

Limit of SAR (W/kg)	10 g Average	1 g Average	Power Drift (dB)
	2.0	1.6	
Test Case	Measurement Result (W/kg)		
	10 g Average	1 g Average	
Body, Towards Ground, Top frequency(See Fig.25)	0.011	0.029	-0.091
Body, Towards Ground, Mid frequency(See Fig.27)	0.017	0.041	-0.103
Body, Towards Ground, Bottom frequency(See Fig.29)	0.014	0.027	-0.053

Table 13: SAR Values (Body, 1900 MHz Band with EGPRS)

Limit of SAR (W/kg)	10 g Average	1 g Average	Power Drift (dB)
	2.0	1.6	
Test Case	Measurement Result (W/kg)		
	10 g Average	1 g Average	
Body, Towards Ground, Mid frequency (See Fig.31)	0.00625	0.018	-0.118

8.4 Summary of Measurement Results (with Bluetooth function)

Since the EUT is tested in body position with the dominant transmitter ON and co-located Bluetooth transmitter OFF first, with the results in section 8.3 Table 12. After that, the worst case can be derived, and the test is repeated with dominant transmitter and co-located Bluetooth transmitter both ON under the same conditions. The following result is derived from the EUT with its Bluetooth function under the same conditions with the worst cases.

Table 14: SAR Values (Body, 1900 MHz Band with Bluetooth)

Limit of SAR (W/kg)	**10 g Average**	**1 g Average**	**Power Drift (dB)**
	2.0	1.6	
Test Case	**Measurement Result (W/kg)**		
	10 g Average	**1 g Average**	
Body, Towards Ground, Mid frequency (See Fig.33)	0.011	0.024	-0.162

8.5 Conclusion

Localized Specific Absorption Rate (SAR) of this portable wireless device has been measured in all cases requested by the relevant standards cited in Clause 5.2 of this report. Maximum localized SAR is below exposure limits specified in the relevant standards cited in Clause 5.1 of this test report.

The maximum SAR values are obtained at the case of **Left hand, Touch cheek, Bottom frequency (Table 11),** and the value are: **0.234 (10g) 0.385(1g).**

9 Measurement Uncertainty

SN	a	Type	c	d	e = f(d,k)	f	h = c x f / e	k
	Uncertainty Component		Tol. (± %)	Prob. Dist.	Div.	c_i (1 g)	1 g u_i (±%)	v_i
1	System repetivity	A	0.5	N	1	1	0.5	9
	Measurement System							
2	Probe Calibration	B	5	N	2	1	2.5	∞
3	Axial Isotropy	B	4.7	R	√3	$(1\text{-}cp)^{1/2}$	4.3	∞
4	Hemispherical Isotropy	B	9.4	R	√3	$\sqrt{c_p}$		∞
5	Boundary Effect	B	0.4	R	√3	1	0.23	∞
6	Linearity	B	4.7	R	√3	1	2.7	∞
7	System Detection Limits	B	1.0	R	√3	1	0.6	∞
8	Readout Electronics	B	1.0	N	1	1	1.0	∞

9	RF Ambient Conditions	B	3.0	R	√3	1	1.73	∞
10	Probe Positioner Mechanical Tolerance	B	0.4	R	√3	1	0.2	∞
11	Probe Positioning with respect to Phantom Shell	B	2.9	R	√3	1	1.7	∞
12	Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	B	3.9	R	√3	1	2.3	∞
	Test sample Related							
13	Test Sample Positioning	A	4.9	N	1	1	4.9	N-1
14	Device Holder Uncertainty	A	6.1	N	1	1	6.1	N-1
15	Output Power Variation - SAR drift measurement	B	5.0	R	√3	1	2.9	∞
	Phantom and Tissue Parameters							
16	Phantom Uncertainty (shape and thickness tolerances)	B	1.0	R	√3	1	0.6	∞
17	Liquid Conductivity - deviation from target values	B	5.0	R	√3	0.64	1.7	∞
18	Liquid Conductivity - measurement uncertainty	B	5.0	N	1	0.64	1.7	M
19	Liquid Permittivity - deviation from target values	B	5.0	R	√3	0.6	1.7	∞
20	Liquid Permittivity - measurement uncertainty	B	5.0	N	1	0.6	1.7	M
	Combined Standard Uncertainty			RSS			11.25	
	Expanded Uncertainty (95% CONFIDENCE INTERVAL)			K=2			22.5	

10 MAIN TEST INSTRUMENTS

Table15: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	HP 8753E	US38433212	August 30,2006	One year
02	Power meter	NRVD	101253	June 21, 2007	One year
03	Power sensor	NRV-Z5	100333		
04	Power sensor	NRV-Z6	100011	September 2, 2006	One year
05	Signal Generator	E4433B	US37230472	September 4, 2006	One Year
06	Amplifier	VTL5400	0505	No Calibration Requested	
07	BTS	CMU 200	105948	August 16, 2007	One year
08	E-field Probe	SPEAG ET3DV6	1736	December 1, 2006	One year
09	DAE	SPEAG DAE3	536	July 12, 2007	One year
10	Dipole Validation Kit	SPEAG D1900V2	541	February 20, 2007	Two years

11 TEST PERIOD

The test is performed from August 17th, 2007.

12 TEST LOCATION

The test is performed at Radio Communication & Electromagnetic Compatibility Laboratory of Telecommunication Metrology Center

END OF REPORT BODY

ANNEX A MEASUREMENT PROCESS

The evaluation was performed with the following procedure:

Step 1: Measurement of the SAR value at a fixed location above the reference point was measured and was used as a reference value for assessing the power drop.

Step 2: The SAR distribution at the exposed side of the phantom was measured at a distance of 3.9 mm from the inner surface of the shell. The area covered the entire dimension of the flat phantom and the horizontal grid spacing was 10 mm x 10 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.

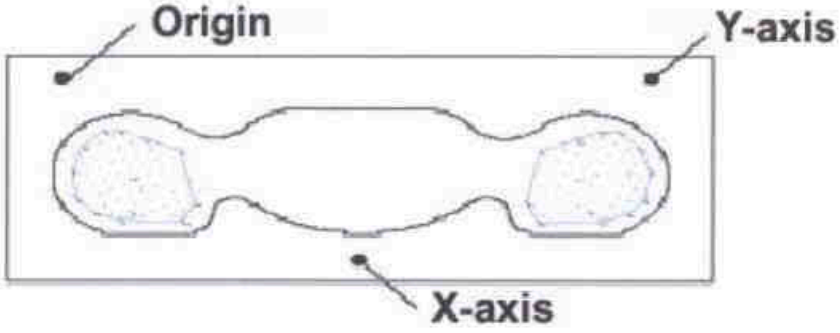
Step 3: Around this point, a volume of 30 mm x 30 mm x 30 mm was assessed by measuring 7 x 7x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

a. The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

b. The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot"-condition (in x ~ y and z-directions). The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

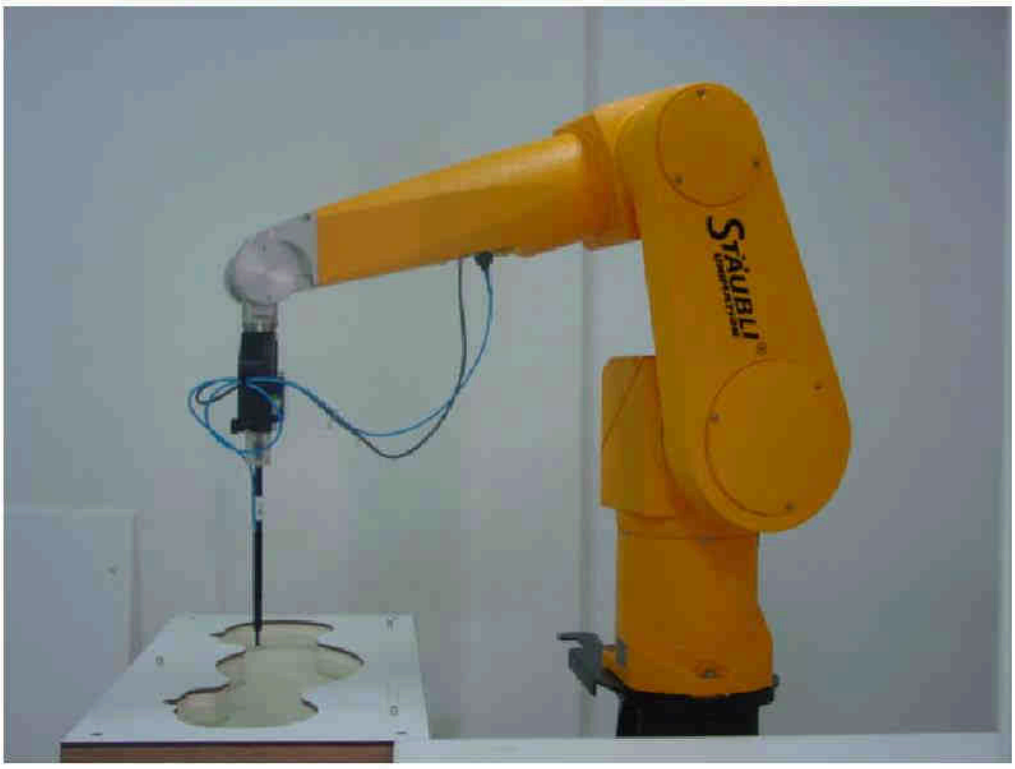
c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Step 4: Re-measurement the SAR value at the same location as in Step 1. If the value changed by more than 5%, the evaluation is repeated.

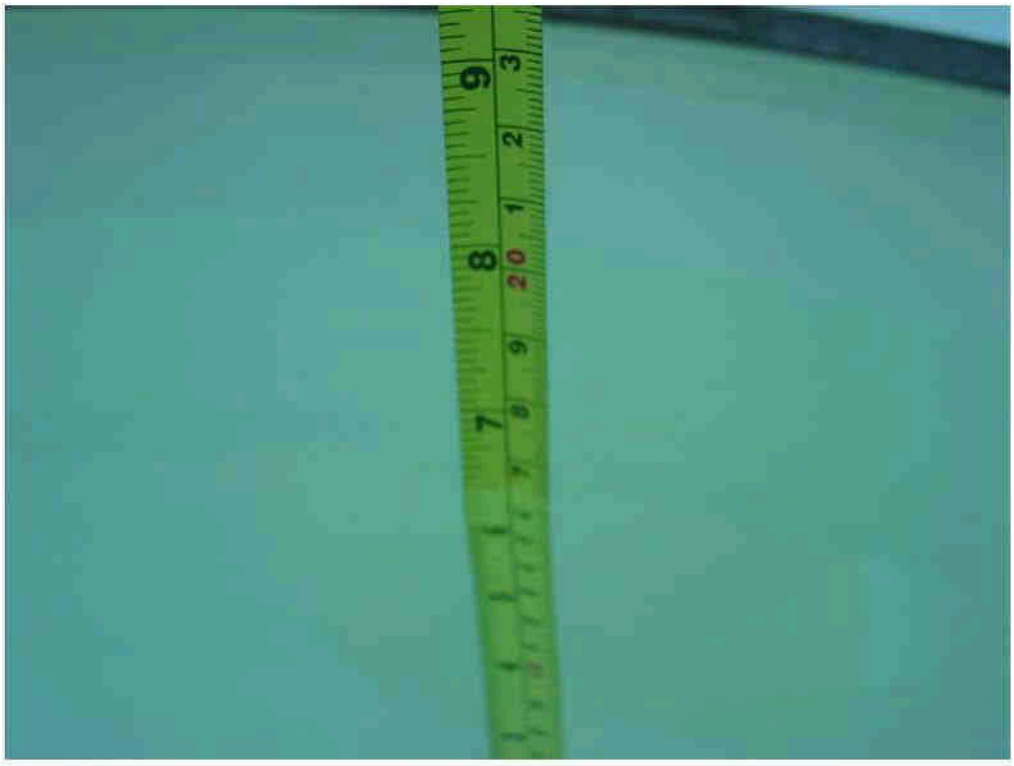


Picture A: SAR Measurement Points in Area Scan

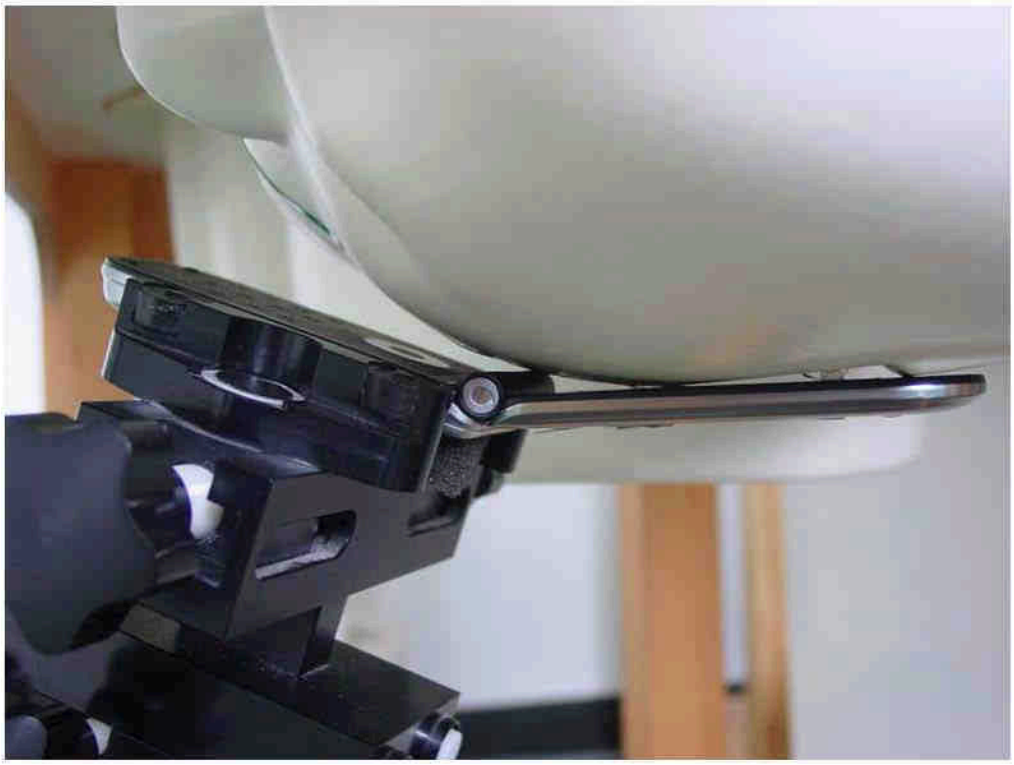
ANNEX B TEST LAYOUT



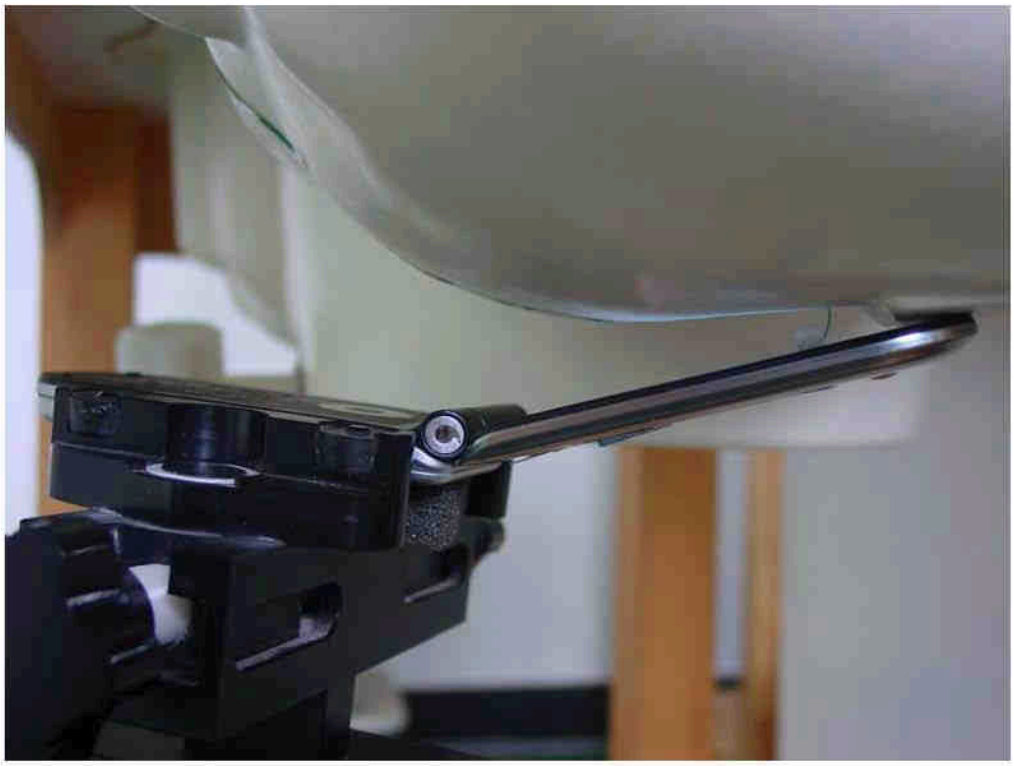
Picture B1: Specific Absorption Rate Test Layout



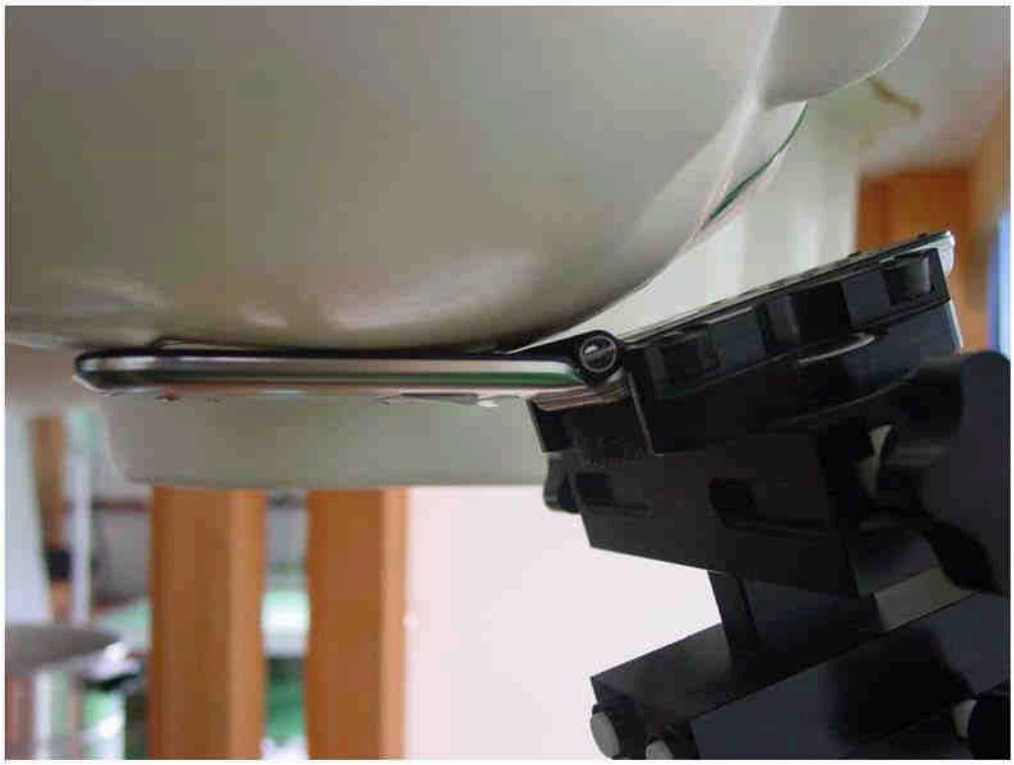
Picture B2: Liquid depth in the Flat Phantom (PCS 1900MHz)



Picture B3: Left Hand Touch Cheek Position

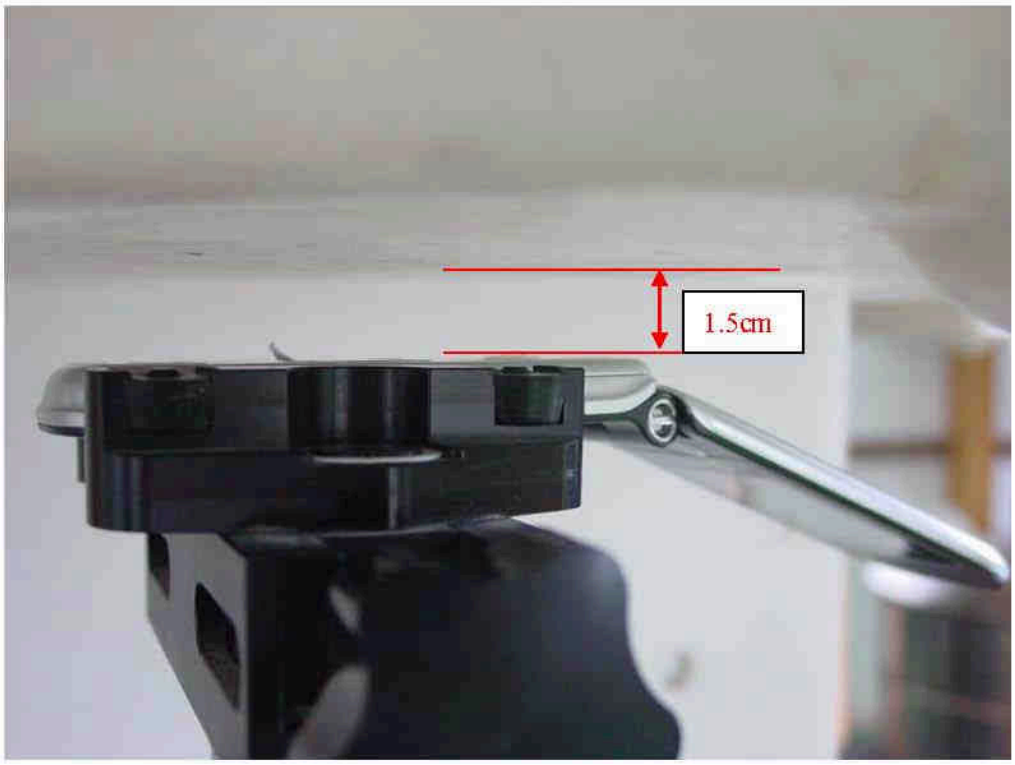


Picture B4: Left Hand Tilt 15° Position



Picture B5: Right Hand Touch Cheek Position

Picture B6: Right Hand Tilt 15° Position



Picture B9: Body-worn Position (towards ground, the distance from handset to the bottom of the Phantom is 1.5cm)

Picture B10: Body-worn Position with Bluetooth transmitter on (the distance from handset to the bottom of the Phantom is 1.5cm)

ANNEX C GRAPH RESULTS

1900 Left Cheek High
Electronics: DAE3 Sn536
Medium: Head 1900 MHz

Medium parameters used: f = 1910 MHz; σ = 1.38 mho/m; ε_r = 39.3; ρ = 1000 kg/m^3

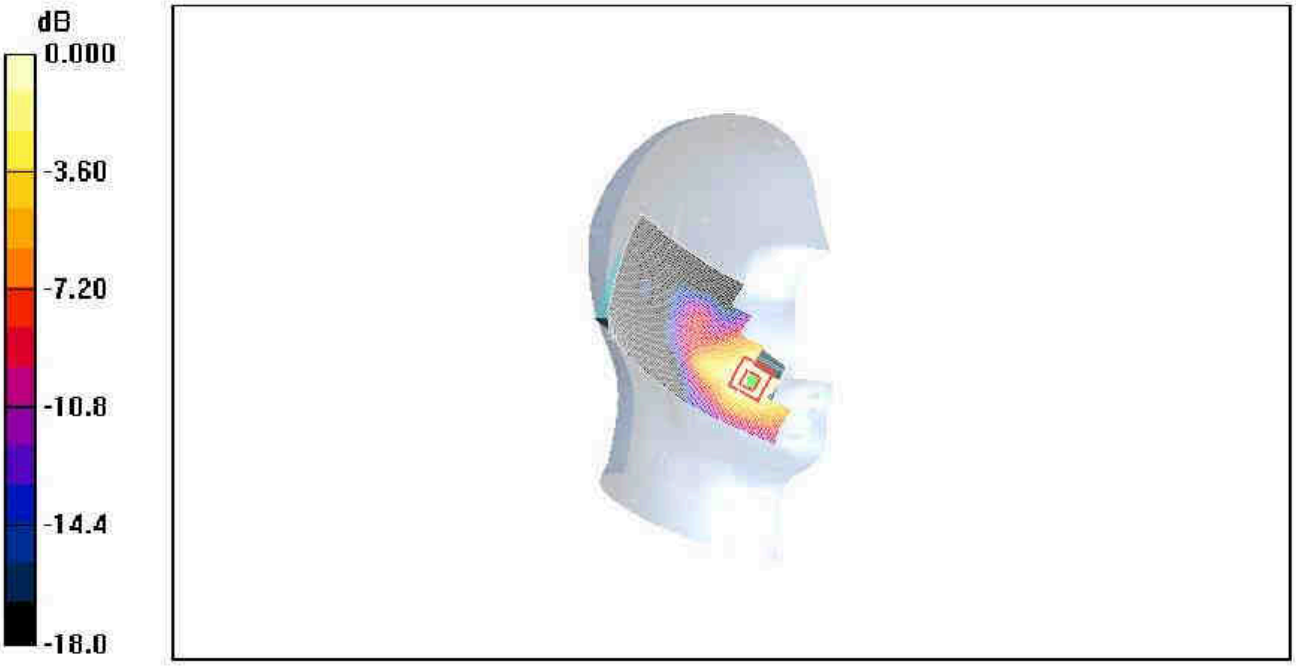
Ambient Temperature:23.3°C Liqiud Temperature: 22.5°C

Communication System: GSM 1900MHz new Frequency: 1909.8 MHz Duty Cycle: 1:8.3

Probe: ET3DV6 - SN1736 ConvF(5.4, 5.4, 5.4)

Cheek High/Area Scan (61x131x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.341 mW/g

Cheek High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.81 V/m; Power Drift = -0.138 dB
Peak SAR (extrapolated) = 0.453 W/kg
SAR(1 g) = 0.298 mW/g; SAR(10 g) = 0.180 mW/g
Maximum value of SAR (measured) = 0.309 mW/g



0 dB = 0.309mW/g

Fig. 1 Left Hand Touch Cheek PCS 1900MHz CH810

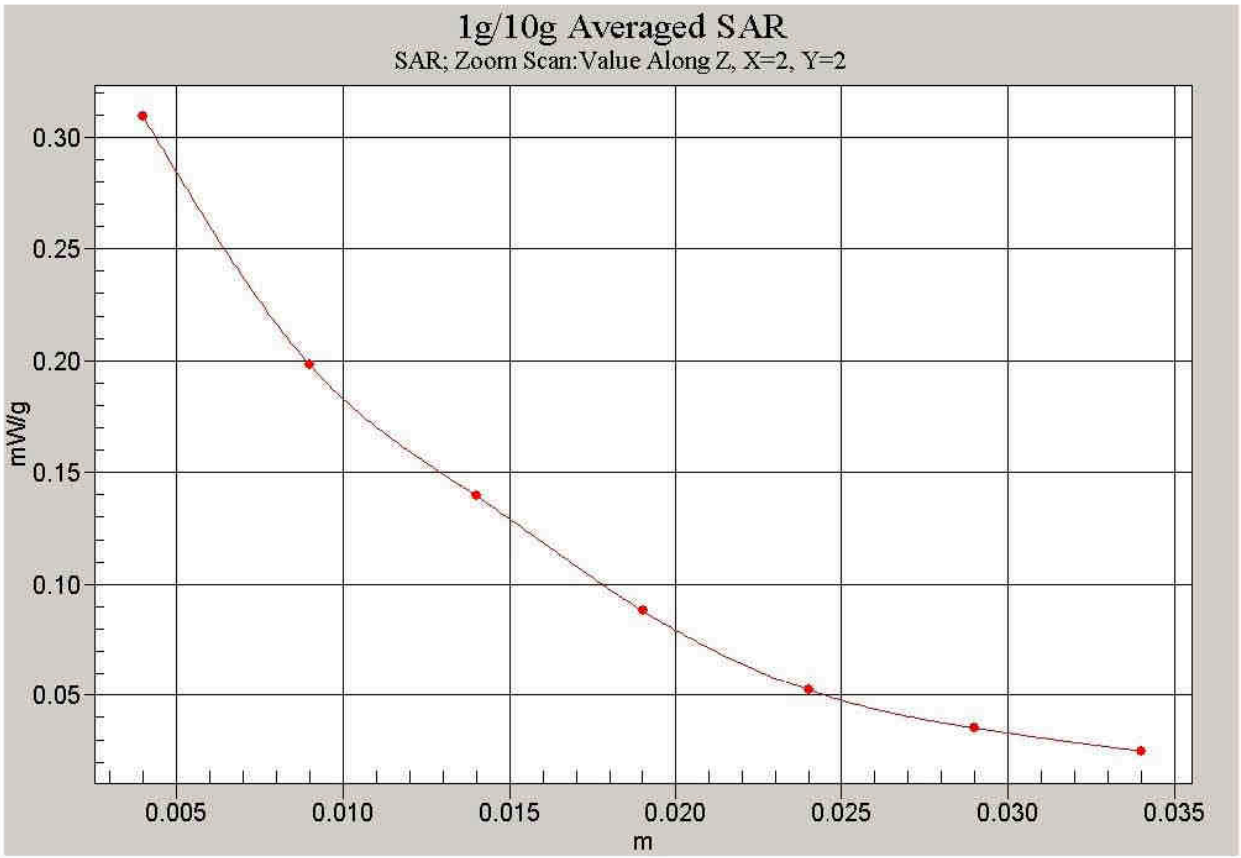


Fig. 2 Z-Scan at power reference point (PCS 1900MHz CH810)

1900 Left Cheek Middle
Electronics: DAE3 Sn536
Medium: Head 1900 MHz

Medium parameters used: f = 1880 MHz; σ = 1.35 mho/m; ε_r = 39.4; ρ = 1000 kg/m^3

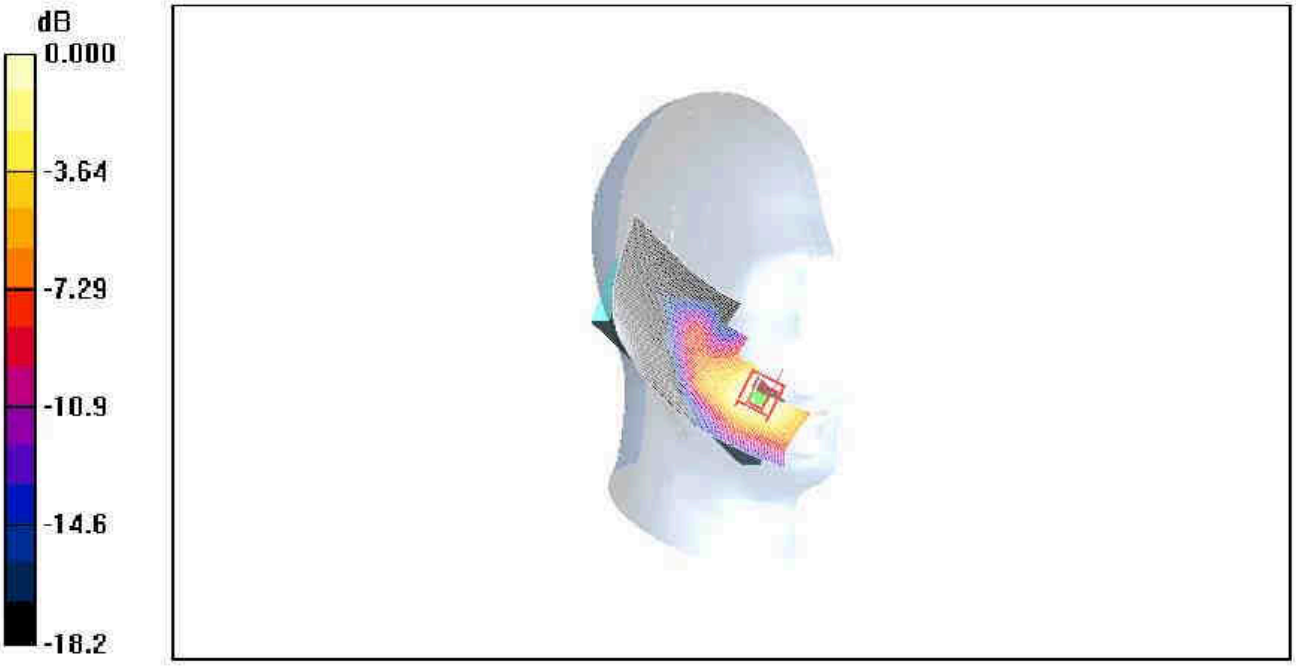
Ambient Temperature:23.3°C Liqiud Temperature: 22.5°C

Communication System: GSM 1900MHz new Frequency: 1880 MHz Duty Cycle: 1:8.3

Probe: ET3DV6 - SN1736 ConvF(5.4, 5.4, 5.4)

Cheek Middle/Area Scan (61x131x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.407 mW/g

Cheek Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.86 V/m; Power Drift = 0.114 dB
Peak SAR (extrapolated) = 0.533 W/kg
SAR(1 g) = 0.334 mW/g; SAR(10 g) = 0.203 mW/g
Maximum value of SAR (measured) = 0.356 mW/g



0 dB = 0.356mW/g

Fig. 3 Left Hand Touch Cheek PCS 1900MHz CH661

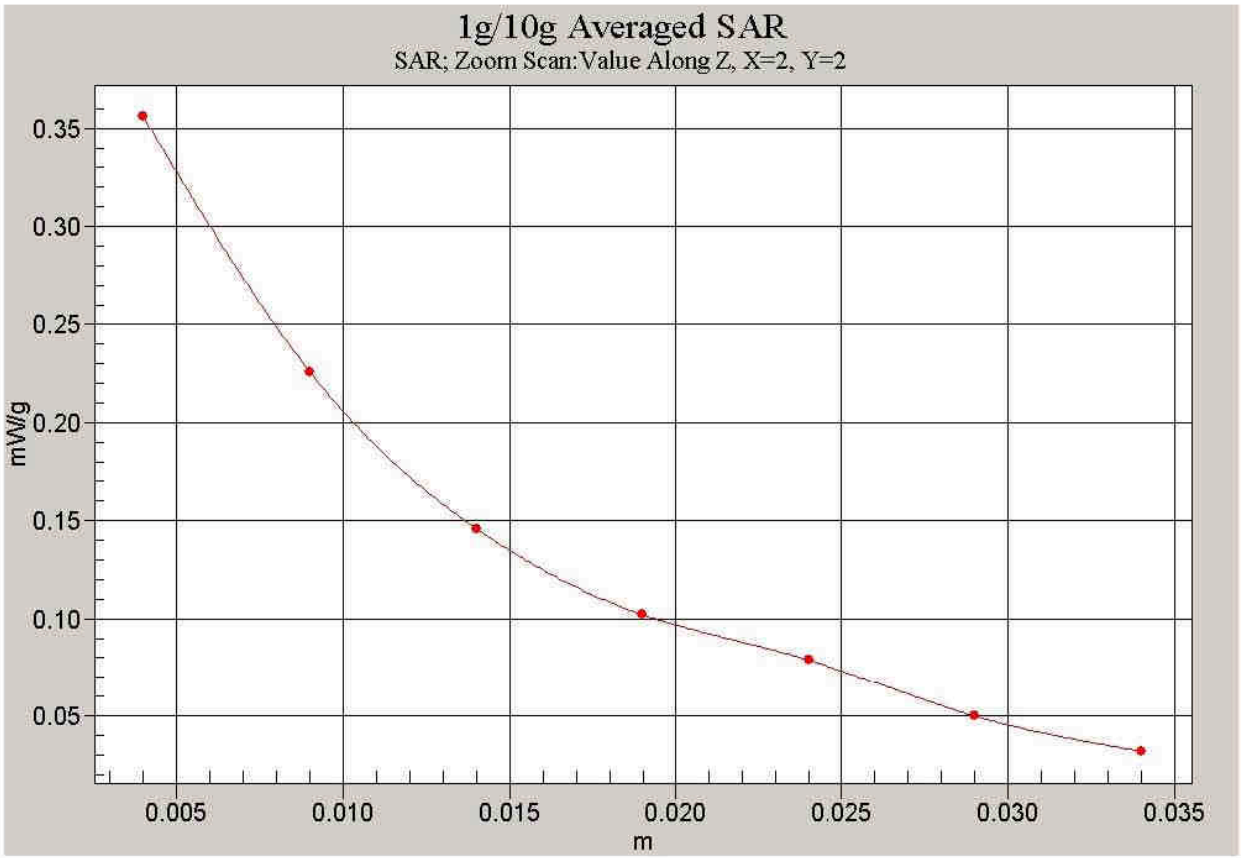


Fig. 4 Z-Scan at power reference point (PCS 1900MHz CH661)

1900 Left Cheek Low
Electronics: DAE3 Sn536
Medium: Head 1900 MHz

Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.32 mho/m; ε_r = 39.4; ρ = 1000 kg/m^3

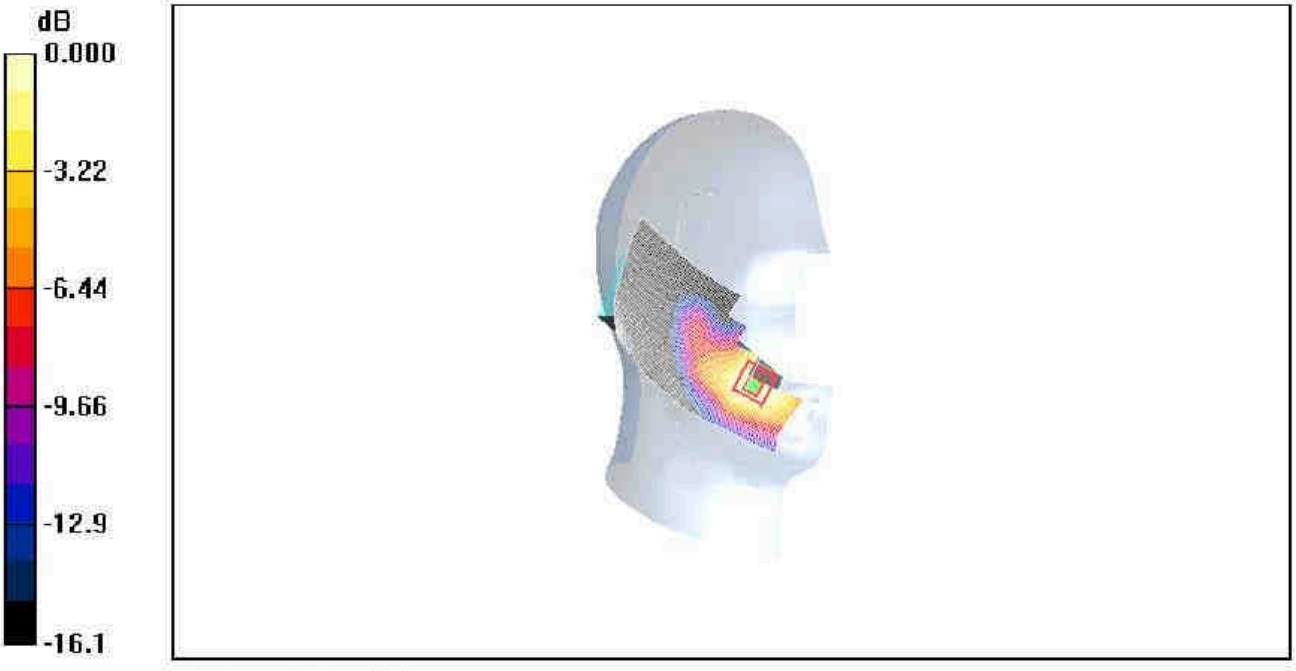
Ambient Temperature:23.3°C Liqiud Temperature: 22.5°C

Communication System: GSM 1900MHz new Frequency: 1850.2 MHz Duty Cycle: 1:8.3

Probe: ET3DV6 - SN1736 ConvF(5.4, 5.4, 5.4)

Cheek Low/Area Scan (61x131x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.457 mW/g

Cheek Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.16 V/m; Power Drift = -0.087 dB
Peak SAR (extrapolated) = 0.569 W/kg
SAR(1 g) = 0.385 mW/g; SAR(10 g) = 0.234 mW/g
Maximum value of SAR (measured) = 0.398 mW/g



0 dB = 0.398mW/g

Fig. 5 Left Hand Touch Cheek PCS 1900MHz CH512

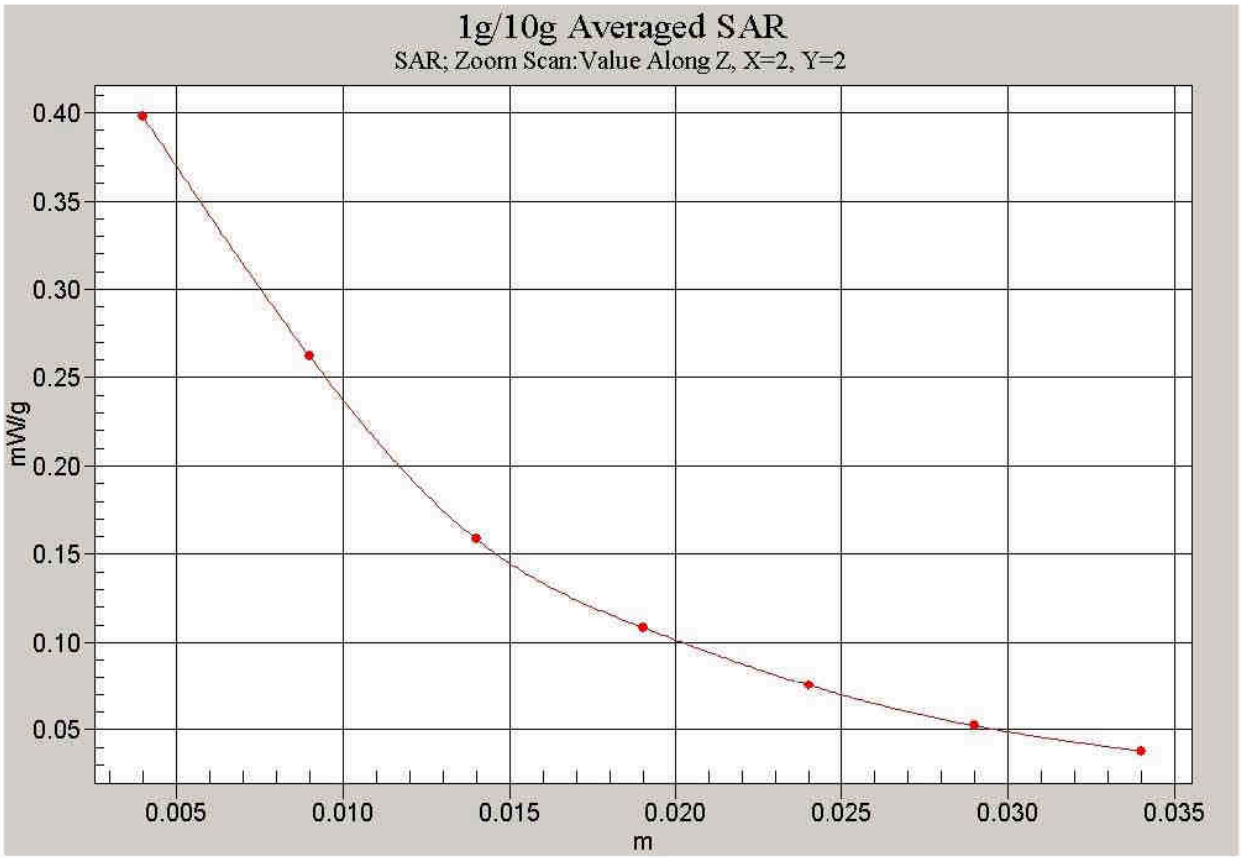


Fig. 6 Z-Scan at power reference point (PCS 1900MHz CH512)

1900 Left Tilt High
Electronics: DAE3 Sn536
Medium: Head 1900 MHz

Medium parameters used: f = 1910 MHz; σ = 1.38 mho/m; ε_r = 39.3; ρ = 1000 kg/m^3

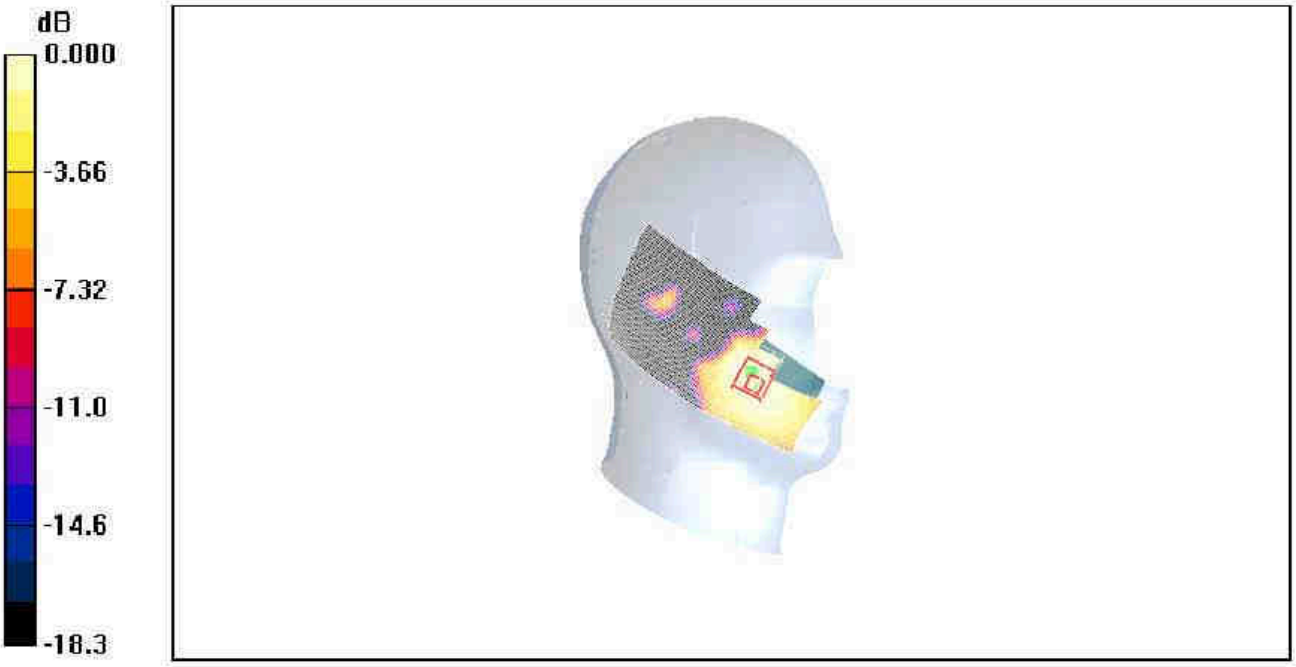
Ambient Temperature:23.3°C Liqiud Temperature: 22.5°C

Communication System: GSM 1900MHz new Frequency: 1909.8 MHz Duty Cycle: 1:8.3

Probe: ET3DV6 - SN1736 ConvF(5.4, 5.4, 5.4)

Tilt High/Area Scan (61x131x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.041 mW/g

Tilt High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.94 V/m; Power Drift = 0.151 dB
Peak SAR (extrapolated) = 0.063 W/kg
SAR(1 g) = 0.040 mW/g; SAR(10 g) = 0.026 mW/g
Maximum value of SAR (measured) = 0.044 mW/g



0 dB = 0.044mW/g

Fig. 7 Left Hand Tilt 15° PCS 1900MHz CH810

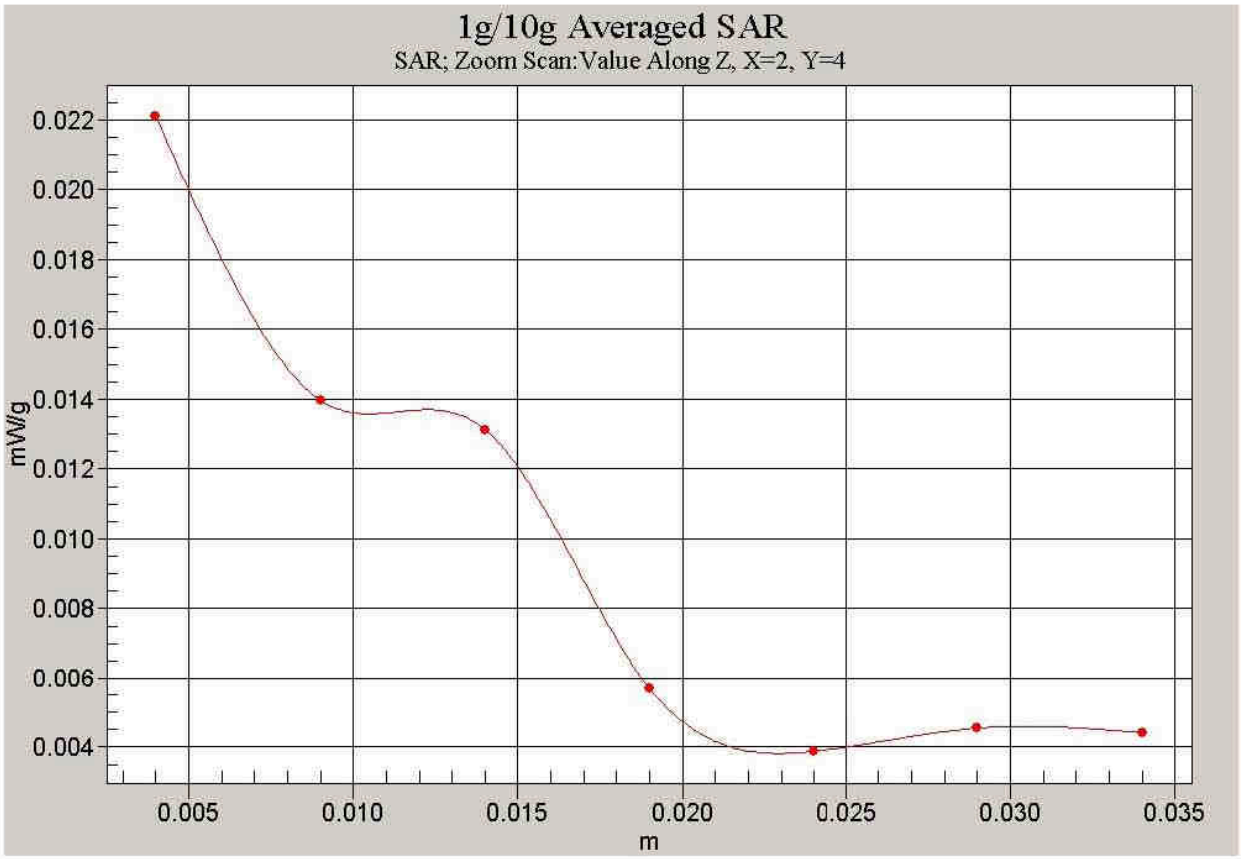


Fig. 8 Z-Scan at power reference point (PCS 1900MHz CH810)