Kyocera Wireless Corp.
QCP 6035

SPECIFIC ABSORPTION RATE (SAR)

REPORT

CONTENTS

1 INTRODUCTION

This test report describes an environmental evaluation measurement of specific absorption rate (SAR) distribution in simulated human head tissues exposed to radio frequency (RF) radiation from a wireless portable device manufactured by Kyocera Wireless Corp. (KWC). These measurements were performed for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC). The testing was performed in August 2000 in the KWC SAR Test Facility. The wireless device is described as follows;

EUT Type:	*Trimode, CDMA(PCS), CDMA and Analog (Cellular) Phone*
Trade Name:	*Kyocera Wireless Corp.*
Model:	*QCP-6035*
Tx Frequency :	*824.04 – 848.97 and 1851.25 – 1908.75 MHz*
Max. Output Power:	*28.27 dBm ERP Analog (in cellular band)* *28.12 dBm ERP Digital (in cellular band)* *27.44 dBm EIRP Digital (in PCS band)*
Modulation:	*CDMA and Analog*
Antenna:	*Retracting whip w/ helix*
FCC Classification:	*Non-Broadcast Transmitter Held to Ear*
Application Type:	*Certification*
Serial Number :	*X00193D0292*
Place of Test:	*KWC, San Diego, CA, USA*
Date of Test:	*August 1-4, 2000*
FCC Rule Part:	*47 CFR 2.1093; OET Bulletin 65, Sup. C; 47 CFR 22; 47 CFR 24*

2 SAR TEST FACILITY

SAR tests were performed in the KWC SAR Test Facility located at the following address:

QCP Inc.
Building AA.
10290 Campus Point Drive
San Diego CA 92121-1522

3 APPLICABLE REGULATIONS

The QCP-6035 is designed to comply with the specific absorption rate SAR limits for distances within 20 cm of the transmitting elements of the mobile phone, and with general public uncontrolled environment Maximum Permissible Exposure (MPE) limits at distances greater than 20 cm from the transmitting elements of the device, as required by Sections 1.1307 through 1.1310, 2.1091 and 2.1093 of the 47 C.F.R. (1997). These FCC RF safety limits, which are based on a hybrid combination of the SAR and MPE requirements from ANSI/IEEE C95.1-1992 and the National Council on Radiation Protection and Measurements (NCRP) report no. 86, are also consistent with the RF safety limits defined in the IRPA Guidelines on Protection Against Non-Ionizing Radiation which are reportedly in the process of being adopted in Europe, as codified in European Pre-Standard ENV 59166-2 approved by CENELEC (1994). This test report pertains specifically to the following limit from the Code of Federal Regulations 47, Part 2 "Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube)."

4 SAR TEST RESULTS SUMMARY

This device has been tested for localised specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1 ~ 1992 and has been tested in accordance with the measurement procedures specified in ANSI/IEEE Std. C95.3 ~ 1992 . Normal antenna operating positions were incorporated, with the device transmitting at frequencies consistent with normal usage of the device. The device has been shown to be capable of compliance for localised specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE std. C95.1-1992

5 TECHNICAL DESCRIPTION

The test sample consisted of a KWC QCP-6035. This model will operate in CDMA PCS, CDMA and analog cellular mode. The CDMA PCS mode is designed to transmit in the 1851.25 – 1908.75 MHz band at a maximum EIRP of 27.44 dBm. The cellular FM AMPS mode is designed to transmit in the 824.04 – 848.97 MHz band at a maximum ERP of 28.27 dBm. The cellular CDMA mode is designed to transmit in the 824.04 – 848.97 MHz band at a maximum output power of 28.12 dBm.

The QCP-6035 is a tri-mode and dual band cellular/PCS phone. The antenna is a standard retracting whip antenna tuned for dual frequency, with a helix antenna that is at the base of the whip which gets activated when the whip is retracted. Since either position is possible during use, both retracted and extended were tested, at the low, middle, and high frequencies of each band.

The QCP-6035 has provision for headset and body-worn holster to allow hands-free operation. The SAR for such operating condition was also measured at the low, middle, and high frequencies of each band.

5.1 DESCRIPTION OF KWC SAR TEST FACILITY

All tests were performed under the following environmental conditions:

Temperature Range:	15 - 35 Degrees C	(Actual 20 C)
Humidity Range:	25 - 75 %	(Actual 38 %)
Pressure:	860 - 1060 mbar	(Actual 1015 mB)

The SAR tests were performed using the following facilities:

All KWC dosimetry equipment is operated within a shielded screen room manufactured by Lindgren RF Enclosures to provide isolation from external EM fields.

The E-field probes of the DASY 3 system are capable of detecting signals as low as 5μW/g in the liquid dielectric, and so external fields are minimised by the screen room, leaving the phone as the dominate radiation source. The floor of the screen room is reflective, so four two-foot square ferrite panels are placed beneath the phantom area of the DASY system to minimise reflected energy that would otherwise re-enter the phantom and combine constructively or destructively with the desired fields. These ferrite panels provide roughly 12 to 13 dB of attenuation in the frequency range of 900 MHz, and 7 to 8 dB of attenuation in the frequency range of 1.9 GHz. Space beneath the DASY system limits the absorber type to ferrite tiles, although this attenuation combined with scattering of the energy is sufficient to bring the system validation within the acceptable tolerance.

DOSIMETRY SYSTEM The dosimetry equipment consists of a complete DASY3 V1.0 dosimetry system manufactured and calibrated by Schmid & Partner Engineering AG of Zurich, Switzerland, it is currently a state of the art system and from our research, it appears to be the best available at this time. The DASY3 system consists of a six axis robot, a robot controller, a teach pendant, automation software on a Pentium 200 MHz computer, data acquisition system, isotropic e-field probe, and validation kit**.**

E-FIELD PROBE This test was performed using an E-field probe with conversion factors determined by Schmid & Partner (S & P). The probe is the most important part of the system, so will be discussed in section 5.2.

PHANTOM The phantom was the so called “generic phantom” supplied by S & P, and consists of a left and right side head for simulating phone usage on both sides of the head. The phantom is constructed of fibreglass with 2 +/- 0.1 mm shell thickness. The shape of the shell is based on data from an anatomical study of a group of 33 men and 19 women to determine the maximum exposure in approximately 90% of all users. The DASY system uses a homogeneous tissue phantom based on studies concerning energy absorption of the human head, and the different absorption rates between adults and children. These studies indicated that a homogeneous phantom should overestimate SAR by no more than 15% for 1 g averages and should not underestimate SAR. In similar studies, it was found that a typical ear thickness is approximately 4 mm, so a 4 mm rubber ring is attached to the phantom at the ear area.

LIQUID DIELECTRIC The tissue simulating liquid which fills the phantom is supplied by QCP Inc.. There are two separate formulas for the two frequencies 900 MHz and 1800 MHz.

This is necessary because the water molecules raise the conductivity to approximately 1.65 +/- 10% at the 1800 MHz frequency, without the addition of salt, so no salt is needed. Before the test, the permitivity and conductivity were measured with an automated Hewlett Packard 85070B dielectric probe in conjunction with a HP 8752C network analyser to monitor permitivity change due to evaporation. The electromagnetic parameters of the liquid were maintained as shown in table 1. The target values were obtained from the FCC web page for Tissue Dielectric Properties with internet address www.fcc.gov/fcc-bin/dielec.sh . The 1800 MHz liquid prepared has no salt or any conductive additive (the chemical/physical properties of the water, preservative, and sugar molecules alone provide too much conductivity). It is impossible to lower the conductivity to 1.15 S/m without a new formula with different ingredients. In other words, we would have to locate an ingredient to replace the sugar/water/preservative ingredients with materials providing similar density, permitivity, and optical properties (for the optical surface detection) but having lower conductivity at 1800 MHz. It was determined that using the 1800 MHz fluid from Schmid & Partner would overestimate the SAR by a small margin, and maintain maximum confidence.

FREQUENCY	PERMITIVITY	CONDUCTIVITY	DENSITY
900 MHz	41.8 +/- 5%	.82 +/- 10% mho/m	1 g/cm^3
1800 MHz	42.3 +/- 5%	1.62 +/- 10% mho/m	1 g/cm^3

Table 1

Schmid & Partner has supplied us with data that can be used to show the error in SAR caused by using higher conductivity. In general higher conductivity, *over estimates* measured SAR values. So by using a higher conductivity in the 1800 MHz band we were measuring SAR values higher than would exist in the human brain. This data is provided here in Table 2.

Distance of radiator from liquid surface	***Frequency MHz***	*Avg. volume gram*	*Increase of SAR per Increase in conductivity*	*Relative. permitivity*	*Conductivity of liquid S/m*	*Density of liquid g/cm^3*
10 mm	900	1	+ 0 .62	41.5	0.85	1
10 mm	900	10	+ 0.39	41.5	0.85	1
15 mm	900	1	+ 0.63	41.5	0.85	1
15 mm	900	10	+ 0.39	41.5	0.85	1
30 mm	900	1	+0.63	41.5	0.85	1
30 mm	900	10	+0.39	41.5	0.85	1
10 mm	1500	1	+ 0.55	40.5	1.2	1
10 mm	1500	10	+ 0.27	40.5	1.2	1
15 mm	1500	1	+ 0.55	40.5	1.2	1
15 mm	1500	10	+ 0.27	40.5	1.2	1
30 mm	1500	1	+ 0.54	40.5	1.2	1
30 mm	1500	10	+ 0.26	40.5	1.2	1
10 mm	1800	1	+ 0.43	40.0	1.65	1
10 mm	1800	10	+ 0.13	40.0	1.65	1
15 mm	1800	1	+0. 42	40.0	1.65	1
15 mm	1800	10	+ 0.13	40.0	1.65	1
30 mm	1800	1	+ 0.41	40.0	1.65	1
30 mm	1800	10	+ 0.12	40.0	1.65	1

Table 2

The E-field probe is calibrated by the manufacturer in brain simulating tissue at frequencies of 900 MHz, and 1.8 GHz, accurate to +/- 8%. Linearity is said by the manufacturer to be +/- .2 dB from 30 MHz to 3 GHz. Dynamic range is said by the manufacturer to be 5 µW/gm to > 100 mW/g. The probe contains 3 small dipoles positioned symmetrically on a triangular core to provide for isotropic detection of the field. Each dipole contains a diode at the feed point that converts the RF signal to DC, which is conducted down a high impedance line to the data acquisition system.

The data acquisition system amplifies the signals, and converts them to digital values so that they may be sent to the computer. The inputs to the signal amplifiers are auto zeroed after every measurement to prevent charge build up on the lines, which could lead to errors.

5.2 SAR SYSTEM THEORY

The human body absorbs energy from a radiating cell phone by ionic motion and oscillation of polar molecules. The human head is in the near field of the device where polarisation and field intensity are very complex. Also the human head can cause large reflections and scattering, so it is more practical to measure the field absorbed inside the head, than to measure incident power before it enters the head. Inside the lossy brain tissue, the power per unit volume is given by (next page):

$$P_v = \tfrac{1}{2}\ \mathbf{J} \bullet \mathbf{E}^* = \tfrac{1}{2}\,\sigma\,|E|^2 \quad W/m^3$$

where **J** is current density

σ is conductivity of human tissue due to conductive and lossy displacement currents.

E is the electric field

But since SAR is the absorption of RF power per unit mass

$$P_g = \tfrac{1}{2}\ \sigma/\boldsymbol{p}\ |E|^2 \ W/kg$$

where ***p*** is density of the tissue in kilograms per cubic meter.

In this equation, σ is a function of frequency, and so it must be measured at the frequency of the test. It is measured in terms of the real and imaginary components of the complex permitivity;

$$\varepsilon = \varepsilon_0\,(\varepsilon' - j\varepsilon'')$$

$$\sigma = 2\pi f \times (8.854 \times 10^{-12}) \times \varepsilon''$$

$$\textbf{Loss Tangent} \equiv \tan\delta = \varepsilon''/\varepsilon'$$

In order to measure the E field strength without distorting the field, the E field probe(shown here) is made as described by Schmid, Egger, and Kuster in [3].


E-field Probe

A major concern is that secondary coupling of the EUT radiated fields to the feed lines of the probe are minimised. This is done by making the feed lines of high impedance “twin-line” transmission line, printed very close together. In the probe tip there are three orthogonal dipoles, electrically small to minimise field distortion from coupling. The electrically small dipoles have source impedance’s of 5 to 8 MΩ due to their small size, the high resistive feed lines, and the distributed filters on the lines. This high impedance makes them less sensitive so a sophisticated Data Acquisition Electronics (DAE) box is needed to amplify, multiplex, and digitize the signals. The DAE is installed on top of the robot arm. It also detects the proximity of the phantom surface with a fiber-optic cable. It provides for multiplexing between the three dipoles, and between 1X gain and 100X amplification, and it provides some filtering that will remove unwanted signals picked up by the probe. The DAE also provides a fast digital link to the robot for stopping in the event of a touch detection. It samples the probe output for 2600 complete E field measurements per dipole, per second. These samples are used to determine the amplification needed, 1X or 100X, and the magnitude determines what diode compression correction factor should be used. These factors as well as sensitivity factors of the specific probe, which are stored in the program, are used to determine the actual field strength for the test point.

The substrate on which the dipoles are printed, has been shaped to align each dipole with the E-field *after* the field lines are distorted by the permitivity of the substrate. In other words, since the substrate and the liquid dielectric have different permitivities, the E-field will diffract as it passes through the interface, and so the dipoles have been positioned to align with the fields *after* this distortion is accounted for.

The dipole elements in the probe are offset from the tip of the probe approximately 2.7 mm so unfortunately the field strength cannot be measured at the surface of the phantom, where it is likely to be maximum. The magnitude of the field at the surface must therefore be calculated with interpolation by using the data points stepped away from the surface and curve fitting, this is done automatically by the software.

6 TEST SAMPLE OPERATION

The wireless device was made to transmit maximum power that is allowed by the software (KWC phone control software, named phone_t) in the device. The software was used to force the device to transmit maximum power for the duration of the SAR tests. The DASY 3 system checks E field strength at a fixed location before and after each scan, and checks for drift due to draining of the battery or some other effect. This shows up as “drift” on the report and if it is too high the test is repeated.

Power settings –

The nominal manufacture power levels were used for EMC tests required in 47 CFR Part 22 and Part 24. For SAR test discussed in this RF exposure test report, the conducted power level was set 0.7 dB higher than the nominal power level to include the manufacture tolerance. The radiated power (ERP/EIRP) corresponding to the conducted power level used for SAR tests was measured in the antenna range (fully anechonic chamber). The measurement procedures and technique are described in the Part 22 and Part 24 test report.

The conducted power levels and corresponding ERP/EIRP for SAR test are listed in following tables.

Table 3: Conducted power used for SAR test - Cellular

		RF output power (W or dBm) - Cellular	
		Measured	
carrier frequency (MHz)	channel	FM	CDMA
824.04	991	0.419 W / 26.22 dBm	
824.7	1013		0.401 W / 26.03 dBm
836.49	383	0.420 W / 26.23 dBm	0.398 W / 26 dBm
848.31	777		0.398 W / 26 dBm
848.97	799	0.419 W / 26.22 dBm	
Maximum Power over Band		**26.23 dBm**	**26.03 dBm**

Table 4: Conducted power used for SAR test - PCS

		RF output power (W) - PCS
carrier frequency (MHz)	channel	CDMA
		measured
1851.25	25	0.253 W / 24.03 dBm
1880	600	0.265 W / 24.23 dBm
1908.75	1175	0.265 W / 24.24 dBm
Maximum Power over Band		**24.24 dBm**

Table 5: Radiated power (ERP) corresponding to Table 3 - Cellular

		RF output power ERP (W or dBm) – Cellular	
		Measured	
carrier frequency (MHz)	channel	FM	CDMA
824.04	991	28.27 dBm	
824.7	1013		28.12 dBm
836.49	383	27.97 dBm	27.84 dBm
848.31	777		27.98 dBm
848.97	799	28.07 dBm	
Max power over band		**28.27 dBm**	**28.12 dBm**

Table 6: Radiated power (EIRP) corresponding to Table 4 - PCS

		RF output power EIRP (W or dBm) - PCS
carrier frequency (MHz)	channel	CDMA
		measured
1851.25	25	27.09 dBm
1880	600	27.44 dBm
1908.75	1175	26.88 dBm
Max power over band		**27.44 dBm**

7 SAR TEST SYSTEM VALIDATION

We performed the validation test by using a dipole before the SAR tests. The following plots are the results of validation tests. The muscle tissues were calibrated by using HP85070B dielectric measurement system. The data sheets are attached below. The original validation results provided by the system manufacturer for cellular and PCS band are attached as well.

Manufacturer Validation Data

Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 08 60, Fax +41 1 280 08 64

DASY3

Dipole Validation Kit

Type: D1800V2

Serial: 220

Manufactured: December 1997
Calibrated: January 1998

1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom (shell thickness 2mm) filled with brain simulating sugar solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	**39.5**	± 5%
Conductivity	**1.70 mho/m**	± 10%

The DASY3 System (Software version 3.0b) with a dosimetric E-field probe ET3DV4 (SN:1302, conversion factor 4.6) was used for the measurements.

The dipole feedpoint was positioned below the centre marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole centre to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging. The dipole input power (forward power) was 250mW ± 3 %. The results are normalised to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the head phantom according to the measurement conditions described in section 1. The results (see figure) have been normalised to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm^3 (1 g) of tissue:	**39.9 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**20.1 mW/g**

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well. The estimated sensitivities of SAR-values and penetration depths to the liquid parameters are listed in the DASY Application Note 4: 'SAR Sensitivities'.

3. Dipole Impedanc and return loss

The impedance was measured at the SMA-connector with a network analyser and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.178 ns**	(one direction)
Transmission factor:	**0.993**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 1800 MHz:	Re{Z} = **49.5 Ω**
	Im {Z} = **0.6 Ω**
Return Loss at 1800 MHz	**- 42.1 dB**

4. Handling

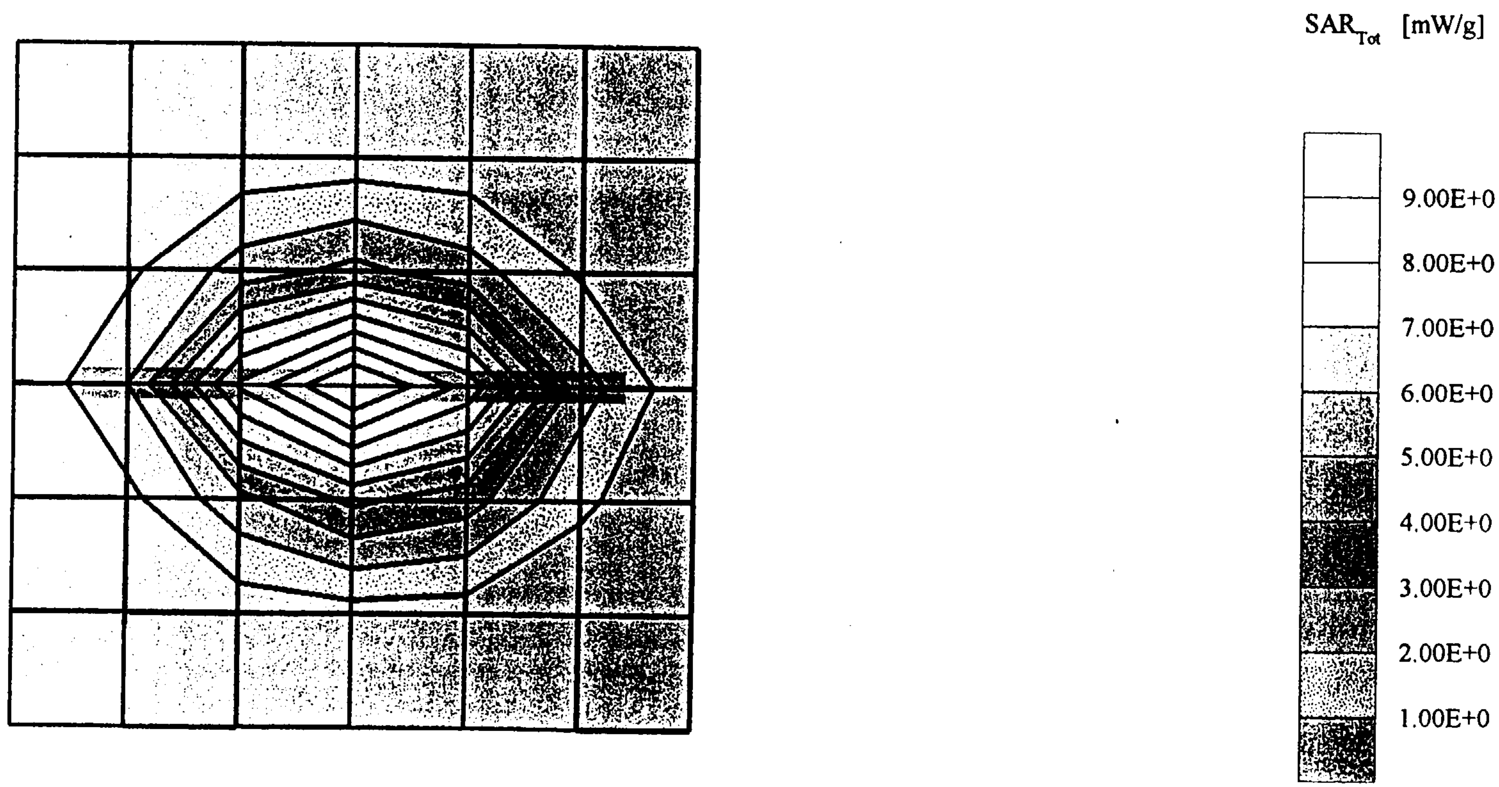
The dipole is made of standard semirigid coaxial cable. The centre conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

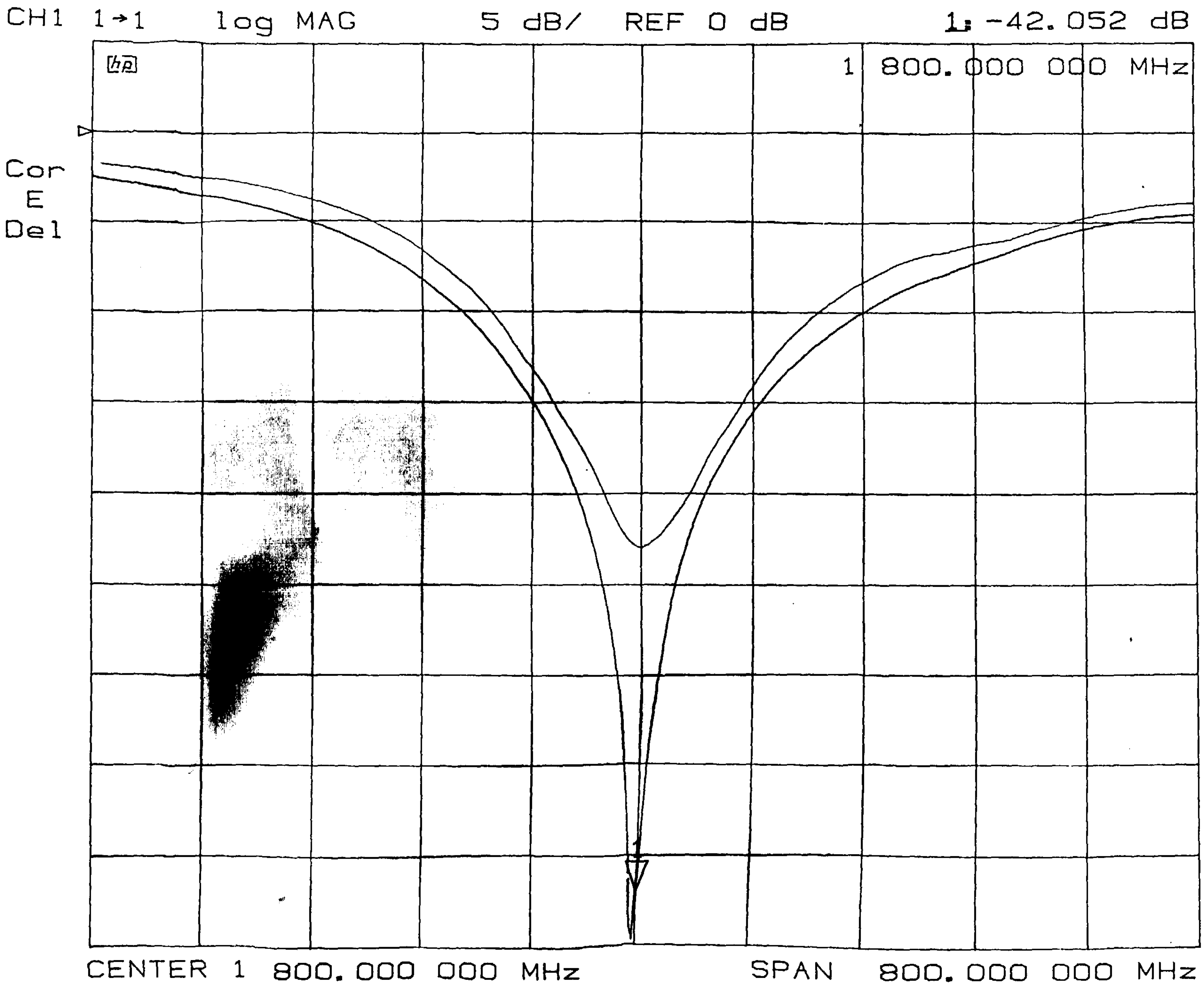
Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

After prolonged use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Validation Dipole D1800V2 SN:220, d = 10mm

Frequency: 1800 [MHz]; Antanna Input Power: 250 [mW]
Generic Twin Phantom; Flat Section; Grid Spacing: Dx = 15.0, Dy = 15.0, Dz = 10.0 [mm]
Probe: ET3DV5 - SN1302 DAE3; ConvF(4.60,4.60,4.60); Crest factor: 1.0; }: σ = 1.70 [mho/m] ε_r = 39.5 ρ = 1.00 [g/cm³]
Cubes (2): Peak: 19.2 [mW/g] ± 0.06 dB, SAR (1g): 9.97 [mW/g] ± 0.05 dB, SAR (10g): 5.02 [mW/g] ± 0.04 dB, (Worst-case extrapolation)
Penetration depth: 7.4 (7.2, 8.0) [mm]
Powerdrift: 0.03 dB





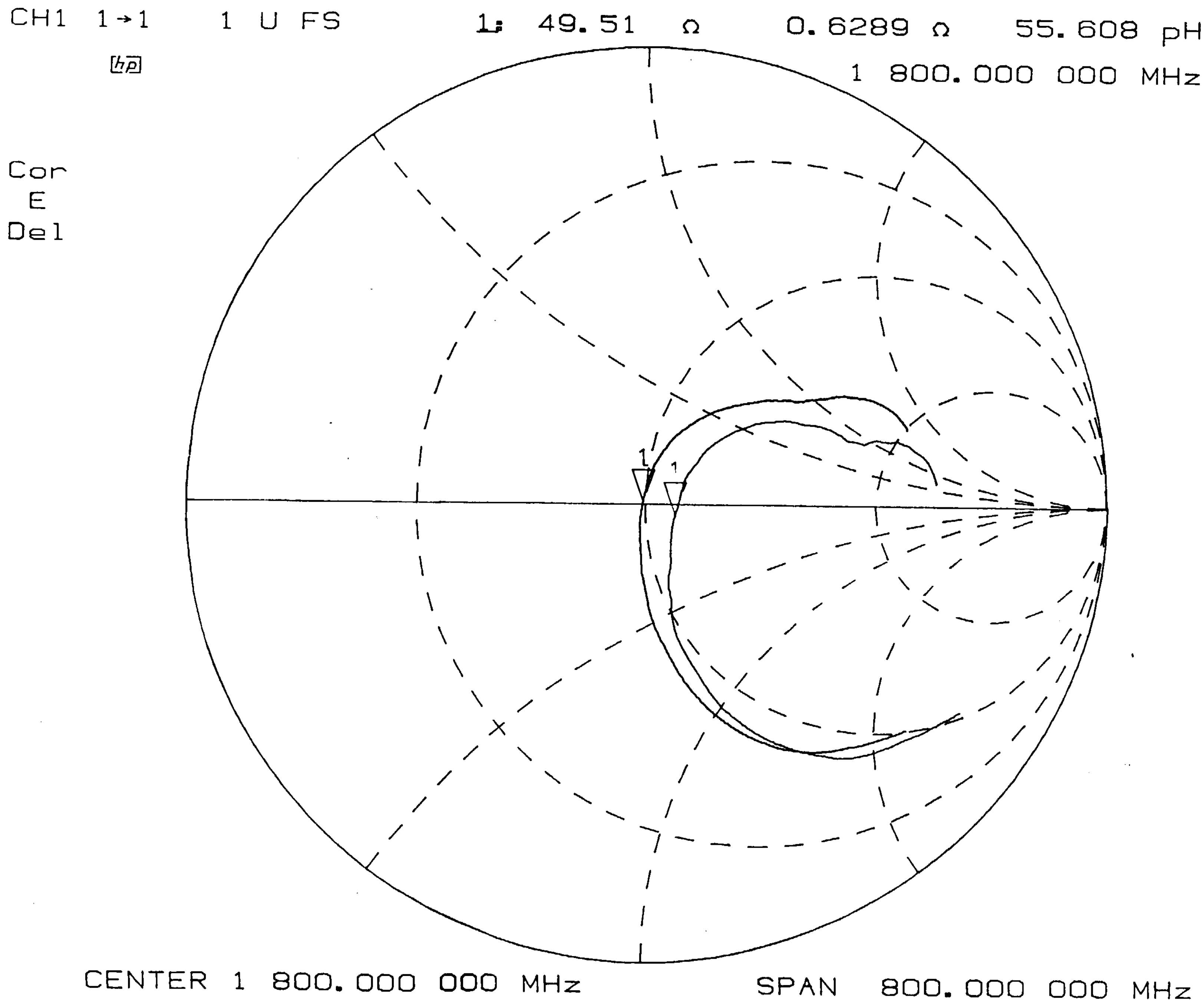
D1800V2 SN

S11

Flat phantom wi
brain simulating
solution

blk: d = 10mm
red: d = 20mm

(distance from dipo
center to solution)



D1800V2 SN

S11

Flat phantom wi
brain simulating
solution

blk: d = 10mm
red: d = 20mm

(distance from dipo
center to solution)

Schmid & Partner
Engineering AG

Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 08 60, Fax +41 1 280 08 64

DASY

Dipole Validation Kit

Type: D900V2

Serial: 024

Manufactured: December 1997
Calibrated: January 1998

1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom (shell thickness 2mm) filled with brain simulating sugar solution of the following electrical parameters at 900 MHz:

Relative Dielectricity	**42.3**	± 5%
Conductivity	**0.85 mho/m**	± 5%

The DASY3 System (Software version 1.0a) with a dosimetric E-field probe ET3DV4 (SN:1302, Conversion factor 5.5) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the centre marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole centre to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging. The dipole input power (forward power) was 250mW ± 3 %. The results are normalised to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 1. The results have been normalised to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm^3 (1 g) of tissue:	**9.44 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**6.16 mW/g**

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well. The estimated sensitivities of SAR-values and penetration depths to the liquid parameters are listed in the DASY Application Note 4: 'SAR Sensitivities'.

3. Dipole Impedance and return loss

The impedance was measured at the SMA-connector with a network analyser and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.397 ns**	(one direction)
Transmission factor:	**0.988**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 900 MHz:	Re{Z} = **50.2 Ω**
	Im {Z} = **-0.0 Ω**
Return Loss at 900 MHz	**- 54.9 dB**

4. Handling

The dipole is made of standard semirigid coaxial cable. The centre conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

After prolonged use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

alidation Dipole D900V2 SN:024, d = 15mm

:quency: 900 [MHz]; Antanna Input Power: 250 [mW]

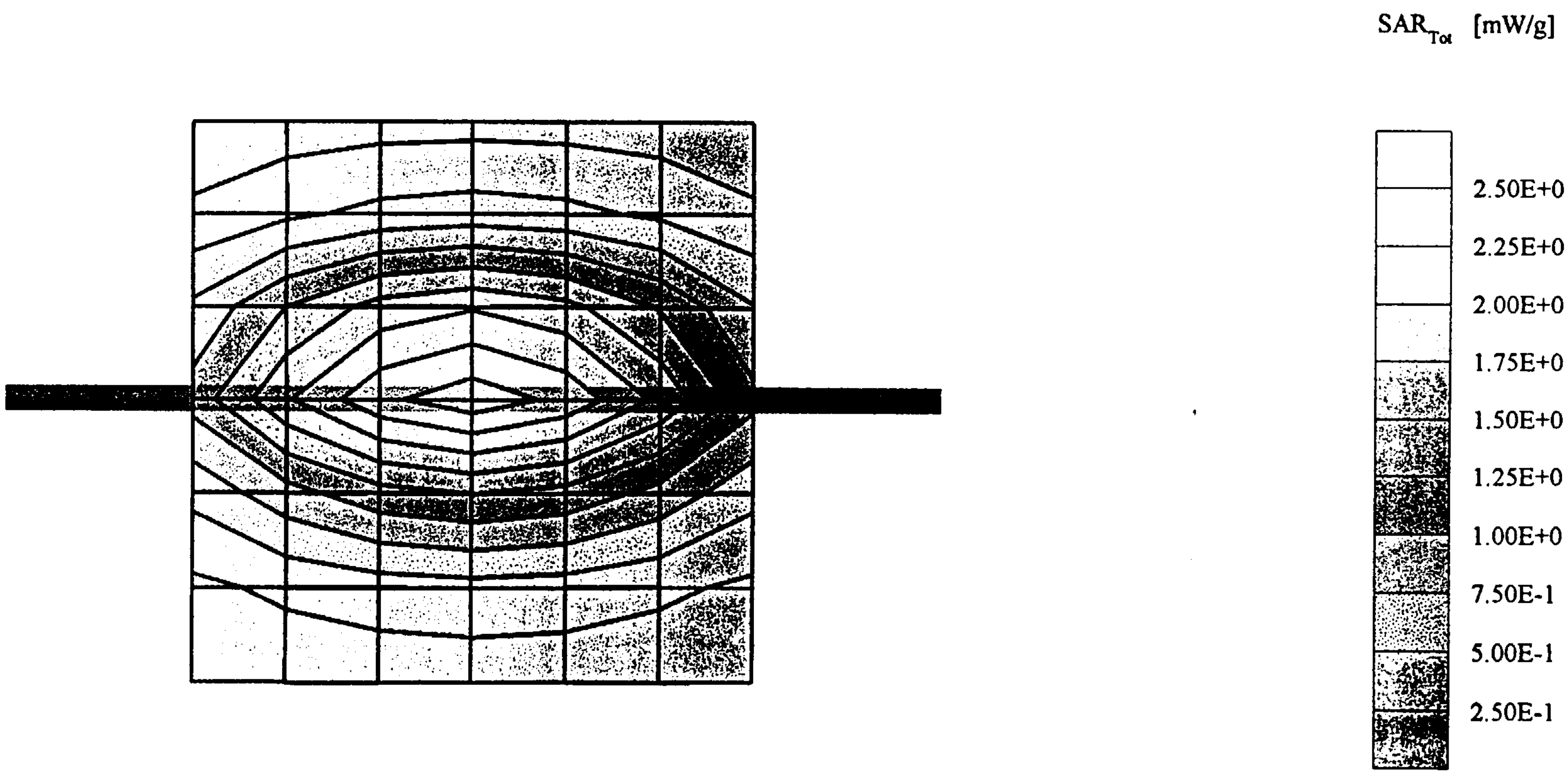
neric Twin Phantom; Flat Section; Grid Spacing: Dx = 15.0, Dy = 15.0, Dz = 10.0 [mm]

›be: ET3DV5 - SN1302 DAE3; ConvF(5.40,5.40,5.40); Crest factor: 1.0; }: σ = 0.85 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm³]

bes (2): Peak: 3.58 [mW/g] ± 0.06 dB, SAR (1g): 2.36 [mW/g] ± 0.05 dB, SAR (10g): 1.54 [mW/g] ± 0.04 dB, (Worst-case extrapolation)

ıetration depth: 13.1 (12.1, 14.4) [mm]

werdrift: 0.03 dB



CH1 1→1 1 U FS 1: 50.16 Ω -21.484 mΩ 8.231 nF

900.000 000 MHz

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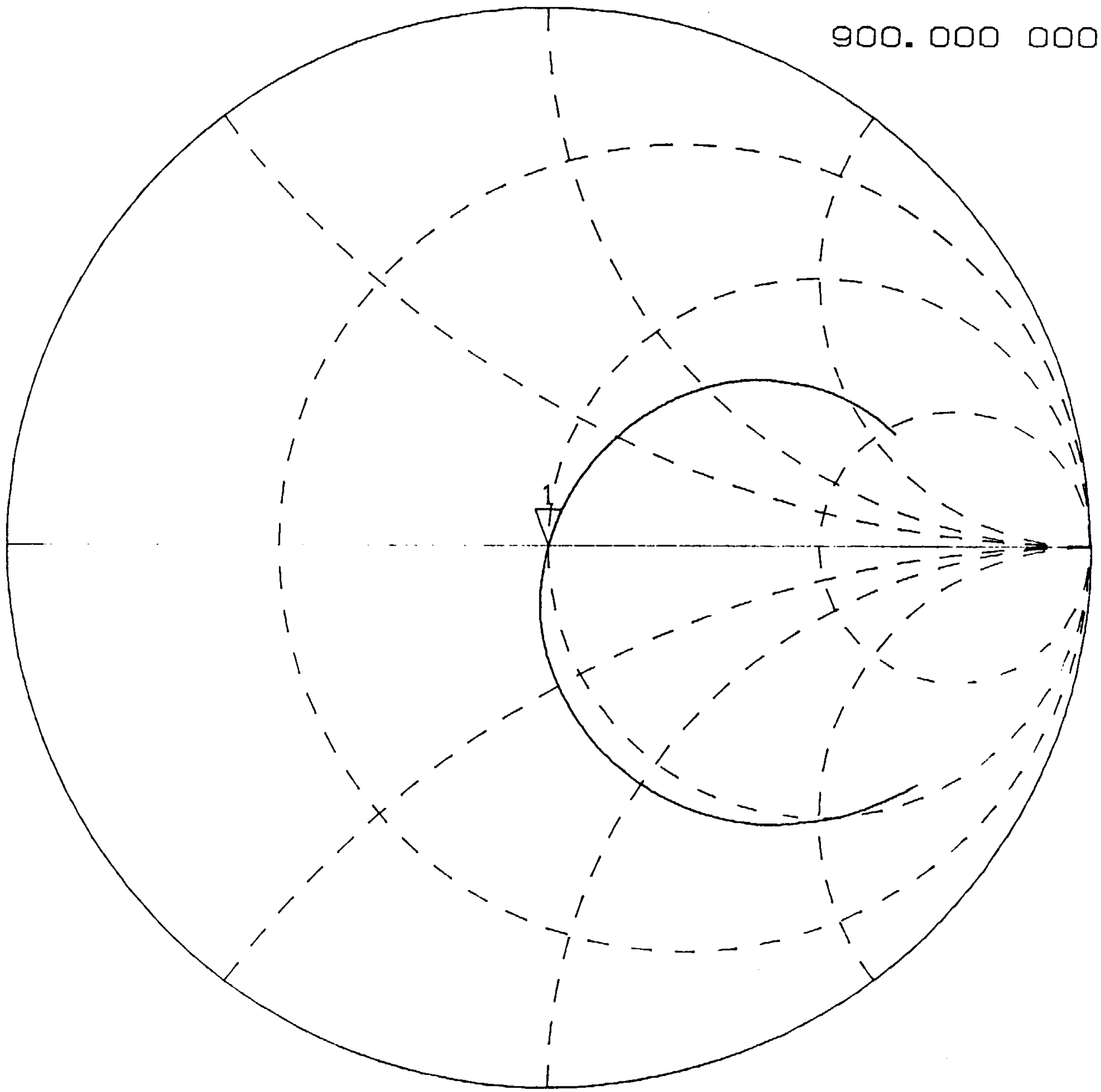


CENTER 900.000 000 MHz SPAN 400.000 000 MHz

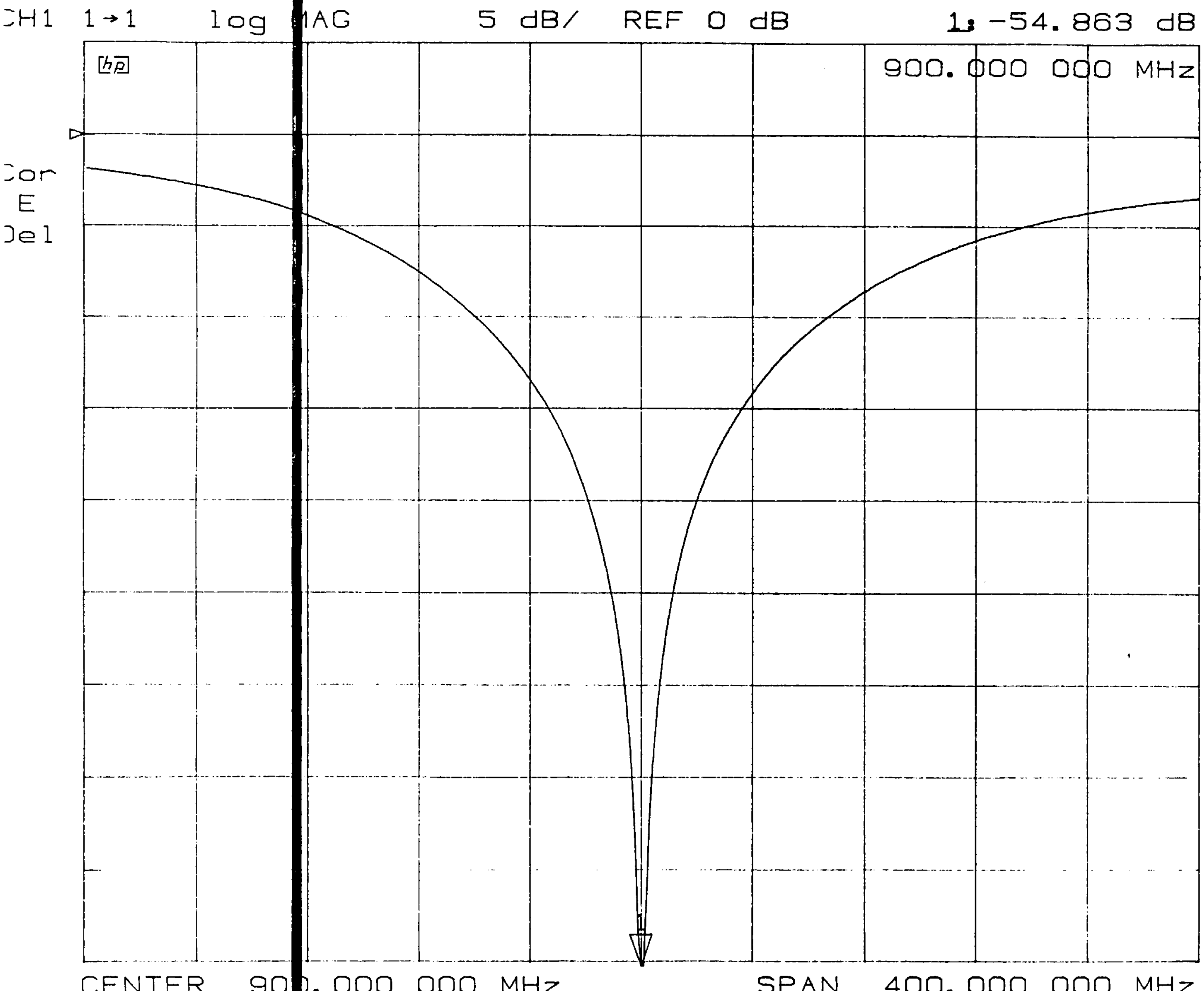
D900V2 SN: 024

S11

Flat phantom with brain simulating solution

d = 15mm

(distance from dipole center to solution)



D900V2 SN: 024

S11

Flat phantom with brain simulating solution

d = 15mm

(distance from dipole center to solution)

Brain Tissue Validation Test Results

Target Value = 0.399 mW/g

SAR (1g): 0.381 [mW/g] ± 0.20 dB, SAR (10g): 0.192 [mW/g] ± 0.22 dB

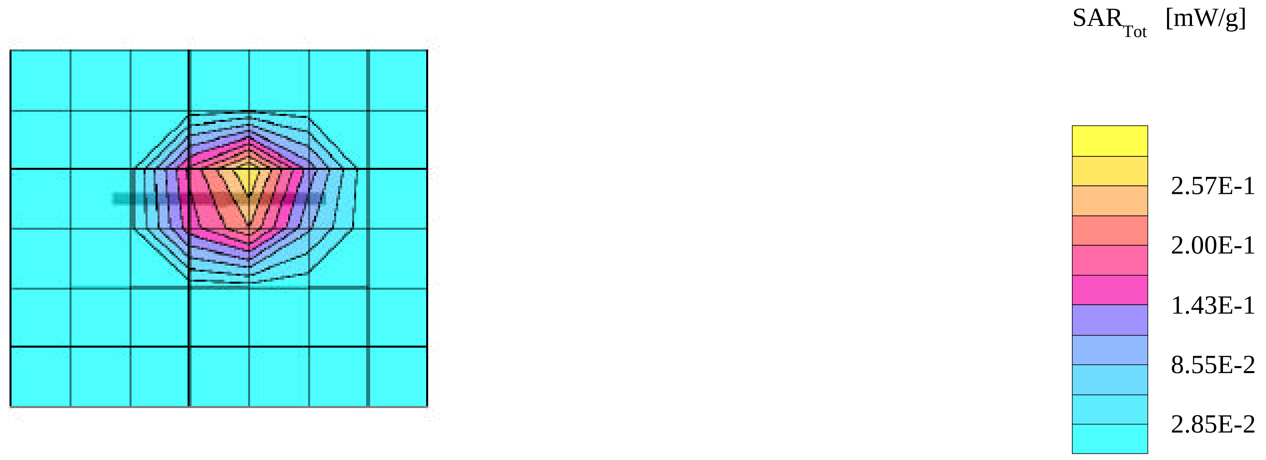
Generic Twin Phantom; Flat Section

Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)

Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]

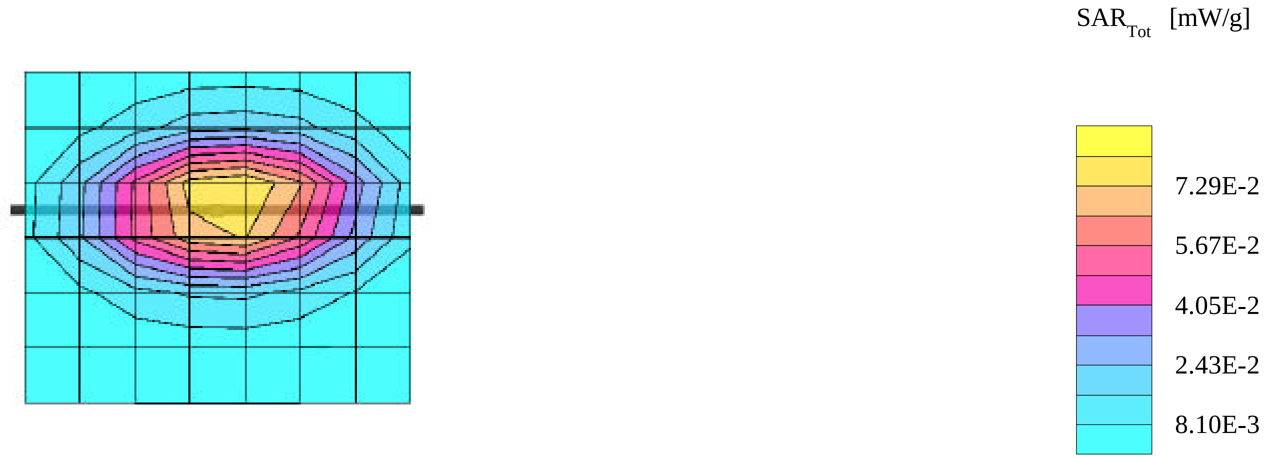
File Name: ValidationFlat 1800MHz 8-1-00.DA3

Powerdrift: -0.15 dB



Target Value = 0.0944 mW/g

SAR (1g): 0.0917 [mW/g] ± 0.19 dB, SAR (10g): 0.0602 [mW/g] ± 0.19 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm³]
File Name: ValidationFlat 900MHz 8-2-00.DA3
Powerdrift: -0.04 dB



Muscle Tissue Calibration Data Sheet

Reference math : OFF   Title: 8-4-00

Pt#	Frequency (GHz)	Data real	Data imag	
1	0.100000000	66.00	60.94	
2	0.114500000	65.65	53.53	
3	0.129000000	65.30	48.74	
4	0.143500000	64.69	44.51	
5	0.158000000	64.72	41.33	
6	0.172500000	64.29	38.54	
7	0.187000000	63.72	36.39	
8	0.201500000	63.67	34.38	
9	0.216000000	63.30	32.61	
10	0.230500000	63.17	30.93	
11	0.245000000	62.91	30.02	
12	0.259500000	62.63	28.85	
13	0.274000000	62.44	27.72	
14	0.288500000	62.42	26.89	
15	0.303000000	62.11	26.17	
16	0.317500000	61.77	25.53	
17	0.332000000	61.70	24.78	
18	0.346500000	61.45	24.43	
19	0.361000000	61.33	23.90	
20	0.375500000	61.04	23.47	
21	0.390000000	60.79	22.98	
22	0.404500000	60.71	22.62	
23	0.419000000	60.48	22.21	
24	0.433500000	60.37	21.95	
25	0.448000000	60.22	21.60	
26	0.462500000	60.06	21.37	
27	0.477000000	59.89	21.15	
28	0.491500000	59.68	20.89	
29	0.506000000	59.51	20.66	
30	0.520500000	59.45	20.52	
31	0.535000000	59.25	20.38	
32	0.549500000	59.11	20.18	
33	0.564000000	58.92	20.06	
34	0.578500000	58.74	19.95	
35	0.593000000	58.59	19.80	
36	0.607500000	58.43	19.69	
37	0.622000000	58.37	19.57	
38	0.636500000	58.18	19.44	
39	0.651000000	58.08	19.41	
40	0.665500000	57.98	19.30	
41	0.680000000	57.81	19.23	
42	0.694500000	57.67	19.15	
43	0.709000000	57.55	19.09	
44	0.723500000	57.37	19.04	
45	0.738000000	57.24	18.99	
46	0.752500000	57.13	18.90	
47	0.767000000	56.97	18.84	
48	0.781500000	56.84	18.83	
49	0.796000000	56.80	18.80	→ σ=0.94 mho/m
50	0.810500000	56.58	18.78	
51	0.825000000	56.45	18.73	
52	0.839500000	56.32	18.71	
53	0.854000000	56.19	18.66	

54	0.868500000	56.09	18.65
55	0.883000000	55.94	18.59
56	0.897500000	55.80	18.62
57	0.912000000	55.69	18.59
58	0.926500000	55.61	18.58
59	0.941000000	55.43	18.54
60	0.955500000	55.36	18.54
61	0.970000000	55.20	18.54
62	0.984500000	55.08	18.51
63	0.999000000	54.94	18.54
64	1.013500000	54.85	18.53
65	1.028000000	54.77	18.54
66	1.042500000	54.63	18.52
67	1.057000000	54.53	18.51
68	1.071500000	54.38	18.52
69	1.086000000	54.28	18.54
70	1.100500000	54.17	18.59
71	1.115000000	54.06	18.57
72	1.129500000	53.94	18.52
73	1.144000000	53.83	18.55
74	1.158500000	53.68	18.53
75	1.173000000	53.59	18.58
76	1.187500000	53.43	18.59
77	1.202000000	53.37	18.55
78	1.216500000	53.25	18.55
79	1.231000000	53.16	18.56
80	1.245500000	53.04	18.57
81	1.260000000	52.92	18.63
82	1.274500000	52.87	18.62
83	1.289000000	52.72	18.62
84	1.303500000	52.63	18.63
85	1.318000000	52.56	18.64
86	1.332500000	52.46	18.62
87	1.347000000	52.34	18.65
88	1.361500000	52.27	18.68
89	1.376000000	52.16	18.72
90	1.390500000	52.06	18.72
91	1.405000000	51.95	18.79
92	1.419500000	51.85	18.79
93	1.434000000	51.70	18.80
94	1.448500000	51.66	18.79
95	1.463000000	51.51	18.81
96	1.477500000	51.42	18.86
97	1.492000000	51.31	18.82
98	1.506500000	51.20	18.86
99	1.521000000	51.11	18.87
100	1.535500000	50.97	18.88
101	1.550000000	50.88	18.87
102	1.564500000	50.82	18.88
103	1.579000000	50.73	18.92
104	1.593500000	50.58	18.92
105	1.608000000	50.53	18.91
106	1.622500000	50.44	18.94
107	1.637000000	50.34	18.92
108	1.651500000	50.25	18.92
109	1.666000000	50.16	18.93
110	1.680500000	50.09	18.98

111	1.695000000	49.99	18.97
112	1.709500000	49.91	18.96
113	1.724000000	49.81	18.98
114	1.738500000	49.75	18.99
115	1.753000000	49.65	19.02
116	1.767500000	49.58	19.03
117	1.782000000	49.48	19.06
118	1.796500000	49.41	19.06
119	1.811000000	49.30	19.07
120	1.825500000	49.22	19.12
121	1.840000000	49.15	19.11
122	1.854500000	49.05	19.11
123	1.869000000	48.98	19.13
124	1.883500000	48.89	19.16
125	1.898000000	48.80	19.14
126	1.912500000	48.70	19.13
127	1.927000000	48.64	19.16
128	1.941500000	48.53	19.17
129	1.956000000	48.47	19.20
130	1.970500000	48.41	19.19
131	1.985000000	48.34	19.23
132	1.999500000	48.25	19.29
133	2.014000000	48.18	19.27
134	2.028500000	48.07	19.29
135	2.043000000	48.00	19.30
136	2.057500000	47.89	19.32
137	2.072000000	47.79	19.34
138	2.086500000	47.71	19.34
139	2.101000000	47.65	19.38
140	2.115500000	47.56	19.37
141	2.130000000	47.49	19.38
142	2.144500000	47.39	19.35
143	2.159000000	47.32	19.37
144	2.173500000	47.23	19.35
145	2.188000000	47.22	19.39
146	2.202500000	47.08	19.40
147	2.217000000	47.04	19.40
148	2.231500000	46.96	19.43
149	2.246000000	46.93	19.41
150	2.260500000	46.87	19.43
151	2.275000000	46.78	19.46
152	2.289500000	46.72	19.52
153	2.304000000	46.65	19.51
154	2.318500000	46.60	19.55
155	2.333000000	46.54	19.55
156	2.347500000	46.46	19.53
157	2.362000000	46.39	19.59
158	2.376500000	46.30	19.61
159	2.391000000	46.23	19.64
160	2.405500000	46.15	19.68
161	2.420000000	46.10	19.71
162	2.434500000	46.02	19.72
163	2.449000000	45.95	19.74
164	2.463500000	45.90	19.79
165	2.478000000	45.80	19.77
166	2.492500000	45.72	19.81
167	2.507000000	45.63	19.81

Reference math : OFF   Title: 8-4-00

Pt#	Frequency (GHz)	Data real	Data imag
1	0.100000000	66.56	3.51
2	0.114500000	66.25	3.94
3	0.129000000	66.16	3.97
4	0.143500000	66.05	4.16
5	0.158000000	65.89	4.27
6	0.172500000	65.92	4.70
7	0.187000000	65.56	4.62
8	0.201500000	65.45	4.91
9	0.216000000	65.26	4.89
10	0.230500000	65.16	5.15
11	0.245000000	65.12	5.38
12	0.259500000	64.95	5.60
13	0.274000000	64.87	5.63
14	0.288500000	64.76	5.81
15	0.303000000	64.71	6.04
16	0.317500000	64.57	6.15
17	0.332000000	64.41	6.31
18	0.346500000	64.37	6.51
19	0.361000000	64.25	6.53
20	0.375500000	64.05	6.70
21	0.390000000	63.86	6.95
22	0.404500000	63.66	7.04
23	0.419000000	63.60	7.18
24	0.433500000	63.43	7.37
25	0.448000000	63.38	7.50
26	0.462500000	63.25	7.64
27	0.477000000	63.23	7.65
28	0.491500000	63.11	7.93
29	0.506000000	62.98	8.01
30	0.520500000	62.86	8.16
31	0.535000000	62.75	8.27
32	0.549500000	62.65	8.44
33	0.564000000	62.53	8.54
34	0.578500000	62.48	8.70
35	0.593000000	62.31	8.82
36	0.607500000	62.21	8.93
37	0.622000000	62.06	9.04
38	0.636500000	61.93	9.15
39	0.651000000	61.89	9.29
40	0.665500000	61.80	9.38
41	0.680000000	61.68	9.53
42	0.694500000	61.59	9.63
43	0.709000000	61.47	9.75
44	0.723500000	61.37	9.85
45	0.738000000	61.20	10.01
46	0.752500000	61.13	10.12
47	0.767000000	61.02	10.16
48	0.781500000	60.93	10.32
49	0.796000000	60.86	10.42
50	0.810500000	60.71	10.49
51	0.825000000	60.65	10.57
52	0.839500000	60.52	10.73
53	0.854000000	60.41	10.80

54	0.868500000	60.33	10.91
55	0.883000000	60.18	11.02
56	0.897500000	60.09	11.13
57	0.912000000	59.97	11.22
58	0.926500000	59.92	11.34
59	0.941000000	59.79	11.42
60	0.955500000	59.73	11.52
61	0.970000000	59.55	11.57
62	0.984500000	59.46	11.66
63	0.999000000	59.38	11.78
64	1.013500000	59.31	11.89
65	1.028000000	59.23	11.98
66	1.042500000	59.15	12.05
67	1.057000000	59.01	12.16
68	1.071500000	58.92	12.22
69	1.086000000	58.83	12.31
70	1.100500000	58.70	12.43
71	1.115000000	58.59	12.53
72	1.129500000	58.51	12.58
73	1.144000000	58.39	12.65
74	1.158500000	58.23	12.72
75	1.173000000	58.19	12.83
76	1.187500000	58.04	12.89
77	1.202000000	57.98	12.96
78	1.216500000	57.90	13.05
79	1.231000000	57.82	13.12
80	1.245500000	57.71	13.20
81	1.260000000	57.62	13.28
82	1.274500000	57.53	13.40
83	1.289000000	57.44	13.46
84	1.303500000	57.34	13.50
85	1.318000000	57.29	13.55
86	1.332500000	57.20	13.63
87	1.347000000	57.08	13.71
88	1.361500000	57.02	13.82
89	1.376000000	56.90	13.92
90	1.390500000	56.84	13.98
91	1.405000000	56.69	14.06
92	1.419500000	56.61	14.13
93	1.434000000	56.49	14.20
94	1.448500000	56.43	14.30
95	1.463000000	56.33	14.36
96	1.477500000	56.23	14.42
97	1.492000000	56.14	14.44
98	1.506500000	56.01	14.53
99	1.521000000	55.96	14.58
100	1.535500000	55.83	14.66
101	1.550000000	55.73	14.71
102	1.564500000	55.66	14.77
103	1.579000000	55.57	14.82
104	1.593500000	55.45	14.88
105	1.608000000	55.36	14.93
106	1.622500000	55.31	14.99
107	1.637000000	55.21	15.00
108	1.651500000	55.11	15.10
109	1.666000000	55.02	15.13
110	1.680500000	54.97	15.21

111	1.695000000	54.88	15.26	
112	1.709500000	54.83	15.27	
113	1.724000000	54.70	15.34	
114	1.738500000	54.66	15.39	
115	1.753000000	54.56	15.44	
116	1.767500000	54.49	15.51	
117	1.782000000	54.38	15.57	
118	1.796500000	54.31	15.61	
119	**1.811000000**	**54.22**	**15.65**	→ $\sigma = 1.56$ mho/m
120	1.825500000	54.12	15.72	
121	1.840000000	54.04	15.78	
122	1.854500000	53.98	15.82	
123	1.869000000	53.89	15.86	
124	1.883500000	53.83	15.92	
125	1.898000000	53.75	15.95	
126	1.912500000	53.65	15.98	
127	1.927000000	53.54	16.05	
128	1.941500000	53.46	16.08	
129	1.956000000	53.40	16.15	
130	1.970500000	53.36	16.15	
131	1.985000000	53.29	16.24	
132	1.999500000	53.20	16.28	
133	2.014000000	53.13	16.34	
134	2.028500000	53.03	16.36	
135	2.043000000	52.97	16.42	
136	2.057500000	52.87	16.45	
137	2.072000000	52.76	16.53	
138	2.086500000	52.69	16.56	
139	2.101000000	52.61	16.59	
140	2.115500000	52.53	16.62	
141	2.130000000	52.44	16.68	
142	2.144500000	52.32	16.69	
143	2.159000000	52.28	16.71	
144	2.173500000	52.20	16.73	
145	2.188000000	52.18	16.77	
146	2.202500000	52.05	16.84	
147	2.217000000	52.03	16.86	
148	2.231500000	51.94	16.89	
149	2.246000000	51.89	16.92	
150	2.260500000	51.83	16.94	
151	2.275000000	51.79	17.00	
152	2.289500000	51.71	17.06	
153	2.304000000	51.64	17.11	
154	2.318500000	51.59	17.16	
155	2.333000000	51.54	17.22	
156	2.347500000	51.46	17.23	
157	2.362000000	51.42	17.26	
158	2.376500000	51.33	17.33	
159	2.391000000	51.25	17.37	
160	2.405500000	51.15	17.46	
161	2.420000000	51.09	17.50	
162	2.434500000	51.01	17.54	
163	2.449000000	50.96	17.59	
164	2.463500000	50.92	17.65	
165	2.478000000	50.84	17.69	
166	2.492500000	50.74	17.73	
167	2.507000000	50.65	17.76	

8 SAR MEASUREMENT PROCEDURE

DEVICE POSITIONING The phone was tested in the primary test position that is described by Supplement C of OET Bulletin 65 from the Office of Engineering & Technology, of the FCC. The procedure places the surface of the phone in contact with the phantom.

9 SAR MEASUREMENT UNCERTAINTY

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

These will be discussed as they are of much importance to the final dosimetric assessment. Every attempt is made to reduce uncertainty, as well as to test for worst case SAR. These uncertainties are likely to be pessimistic, but they should be considered when comparing data taken from one lab to another. Thomas Schmid of Schmid and Partners has performed a study of SAR repeatability due to many different uncertainties, this is likely the most complete study of the topic so it is referred to here.

Device positioning; this uncertainty is due to different operators positioning the device on the phantom differently, it depends on the operators, the device design, the phantom, and the device holder. Repeatability for some devices in Schmid's study was as poor as +/- 30% for the "touch" position. For the "intended use" position the repeatability was approximately +/- 5%, depending on the device tested, overall a figure of +/- 6% was taken as typical device positioning uncertainty. One operator is used at the QUALCOMM lab, trained to place the phone as close as possible to phantom, and the test is performed after the position of maximum SAR is determined. This minimises device positioning error. Typically the phone is clamped in the holder in the horizontal position, and a short wooden dowel is placed in a small hole where the center of the ear speaker resides, this wooden dowel allows the operator to line up the speaker with the ear canal. Once aligned, the tooth pick is removed, and the phone is raised up until it touches the phantom on the ear. Then the cradle is rocked so the phone rocks toward the chin of the phantom, touching as closely as possible without depressing the keypad. This puts the phone as close as possible to the phantom, allowing maximum SAR to be measured, for most positions. In the event that this may not produce maximum SAR, the phone is placed in several other positions and a coarse scan is run for each position. The DASY system has a command called "move to max" which allows the probe to be sent to the point of max field intensity found with the coarse scan. This gives a visual indication of where the maximum surface currents may be, and allows the operator to position this point of the phone as close as possible to the phantom.

Liquid dielectric permittivity and conductivity; The average permittivity of a typical human head was determined by Dr. Gabriel and has been listed by the FCC (OET bulletin 65 supplement C) as 46.1 at 835 MHz and 43.4 at 1800 MHz. The lower permittivity generally gives a slightly higher SAR value, so slightly lower values were used for the test. Since SAR is defined as the time rate of absorption per unit of weight, only the macroscopic simulation of the tissue's permittivity, permeability, and conductivity are required. These electrical properties are obtained with a liquid which uses sugar to raise the permittivity, salt to raise the conductivity, and cellulose to hold the two in suspension. After installing the liquid it is measured with an HP 85070A dielectric probe kit. The achievable accuracy of this device is +/- 5% for the permittivity and +/- 10% for the conductivity. The liquid is also measured at the beginning of each SAR measurement day, to check for evaporation.

FIELD DISTURBANCES Errors due to disturbance of the fields by the probe; because the polarisation of the fields are unknown, the near field probe must measure all polarisation's without disturbing them by being present. Three orthogonal dipoles are located at the tip of a special dielectric support, with diodes at the feed points sensitive to fields as small as 5 microWatt/gm. To prevent secondary coupling of the fields to the feed lines, the lines are high resistance printed lines with distributed filters integrated in the lines, after the diode. Much research has been put into these probe designs, so their uncertainty is considered minimized. There are other uncertainties, such as laboratory setup uncertainty, the reader should refer to attachment 10 of the March 1998 minutes of the IEEE standards coordinating committee, by Thomas Schmid. Mr. Schmid's preliminary uncertainty figure is –12% to +52% for the SAR measurement. As stated before this is possible, but believed to be pessimistic because many of the sources of uncertainty have been reduced or eliminated, at considerable expense. All practical precautionary measures are taken to reduce these errors in the QUALCOMM Inc. SAR lab.

Surface Detection The surface detection on the DASY system is mechanical and optical, it is checked and compared automatically to ensure correct operation. This can indicate that the optical surface detection is not in agreement with the mechanical, which might mean the liquid needs to be stirred. This process insures minimum distance from the surface of the phantom for measurements.

10 TEST DATA SUMMARY

The device, which was tested, is the final production model in both the analogue and digital modes. Both applicable configurations in holding to an ear situation, i.e., with the flip closed and with the flip open (See attached pictures), were tested. The SAR values measured indicate that the device produces SAR levels below the limit of 1.6 mW/g for the one gram average.

Parameters of brain and muscle tissue

	Frequency	Permittivity	Conductivity (S/m)	Notes
Brain	900 MHz	42.5	0.85	specified by DASY3-user manual
Muscle	900 MHz	56.1	0.95	specified by OET bulletin 65, supplemental C and DASY3-user manual
Brain	1800 MHz	40.5	1.65	specified by DASY3-user manual
Muscle	1800 MHz	54	1.45	specified by OET bulletin 65, supplemental C.

ANSI/IEEE C95.1 1992 – SAFETY LIMIT Spatial Peak (Brain) Uncontrolled Exposure/General Population	1.6 W/kg (mW/g)

Brain SAR Test Results

FREQ. MHZ	CH.#	SERIAL NUMBER	CONF.	MODULATION	ANTENNA POSITION	1 GRAM AVG. SAR (MW/G)
824	991	X00193D0292	Flip closed	ANALOG	Ext	0.747
824	991	X00193D0292	Flip closed	ANALOG	Ret	1.23
824	991	X00193D0292	Flip open	ANALOG	Ext	0.951
824	991	X00193D0292	Flip open	ANALOG	Ret	1.35
836.5	383	X00193D0292	Flip closed	ANALOG	Ext	0.915
836.5	383	X00193D0292	Flip closed	ANALOG	Ret	0.710
836.5	383	X00193D0292	Flip open	ANALOG	Ext	1.05
836.5	383	X00193D0292	Flip open	ANALOG	Ret	0.722
849	799	X00193D0292	Flip closed	ANALOG	Ext	0.674
849	799	X00193D0292	Flip closed	ANALOG	Ret	0.932
849	799	X00193D0292	Flip open	ANALOG	Ext	0.774
849	799	X00193D0292	Flip open	ANALOG	Ret	1.04
824.7	1013	X00193D0292	Flip closed	Cellular CDMA	Ext	0.750
824.7	1013	X00193D0292	Flip closed	Cellular CDMA	Ret	1.18
824.7	1013	X00193D0292	Flip open	Cellular CDMA	Ext	0.921
824.7	1013	X00193D0292	Flip open	Cellular CDMA	Ret	1.31
1851.25	25	X00193D0292	Flip closed	PCS CDMA	Ext	1.06
1851.25	25	X00193D0292	Flip closed	PCS CDMA	Ret	1.08
1851.25	25	X00193D0292	Flip open	PCS CDMA	Ext	0.949
1851.25	25	X00193D0292	Flip open	PCS CDMA	Ret	0.960
1880	600	X00193D0292	Flip closed	PCS CDMA	Ext	1.13
1880	600	X00193D0292	Flip closed	PCS CDMA	Ret	1.28
1880	600	X00193D0292	Flip open	PCS CDMA	Ext	0.948
1880	600	X00193D0292	Flip open	PCS CDMA	Ret	1.06
1908.75	1175	X00193D0292	Flip closed	PCS CDMA	Ext	1.23
1908.75	1175	X00193D0292	Flip closed	PCS CDMA	Ret	1.41
1908.75	1175	X00193D0292	Flip open	PCS CDMA	Ext	1.01
1908.75	1175	X00193D0292	Flip open	PCS CDMA	Ret	1.14

The highest SAR (at head) in the cellular band is 1.35 mW/g. The highest SAR (at head) in PCS band is 1.41 mW/g.

The QCP-6035 has provision for headset and body-worn holster to allow hands-free operation. The SAR for such operating condition was measured. The following is the summary of the results.

Body-worn SAR Test Results

FREQ. MHZ	CH.#	SERIAL NUMBER	CONF.	MODULATION	ANTENNA POSITION	1 GRAM AVG. SAR (MW/G)
824	991	X00193D0292	Flip closed	ANALOG	Ext	0.485
824	991	X00193D0292	Flip closed	ANALOG	Ret	0.516
836.5	383	X00193D0292	Flip closed	ANALOG	Ext	0.553
836.5	383	X00193D0292	Flip closed	ANALOG	Ret	0.306
849	799	X00193D0292	Flip closed	ANALOG	Ext	0.552
849	799	X00193D0292	Flip closed	ANALOG	Ret	0.436
1851.25	25	X00193D0292	Flip closed	PCS CDMA	Ext	0.566
1851.25	25	X00193D0292	Flip closed	PCS CDMA	Ret	0.549
1880	600	X00193D0292	Flip closed	PCS CDMA	Ext	0.565
1880	600	X00193D0292	Flip closed	PCS CDMA	Ret	0.638
1908.75	1175	X00193D0292	Flip closed	PCS CDMA	Ext	0.567
1908.75	1175	X00193D0292	Flip closed	PCS CDMA	Ret	0.633

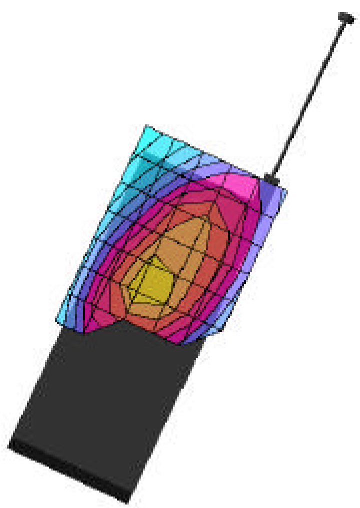
Note, the flip open configuration is not applicable for the body-worn condition.

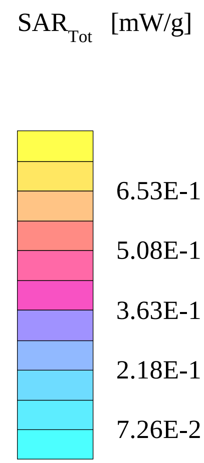
With tested belt-clip (provides 22.75 mm closest separation), the highest body-worn SAR is 0.638 mW/g.

11 SAR PLOTS

QCP-6035, FM ch991, flip closed

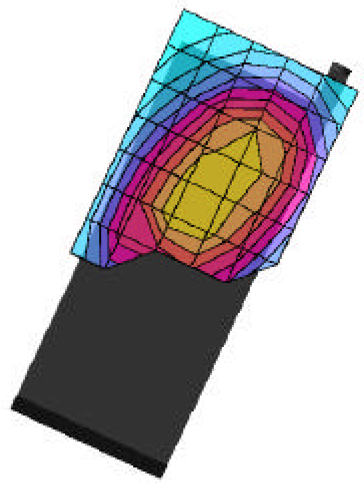
SAR (1g): 0.747 [mW/g] ± 0.14 dB, SAR (10g): 0.575 [mW/g] ± 0.14 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch991, flip closed, 8-2-00.DA3
Powerdrift: -0.01 dB

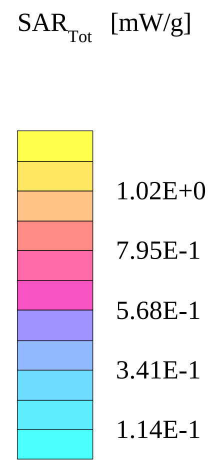




QCP-6035, FM ch991, flip closed

SAR (1g): 1.23 [mW/g] ± 0.27 dB, SAR (10g): 0.956 [mW/g] ± 0.25 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch991, flip closed, 8-2-00.DA3
Powerdrift: -0.12 dB



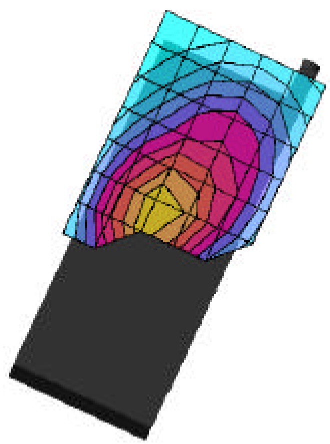


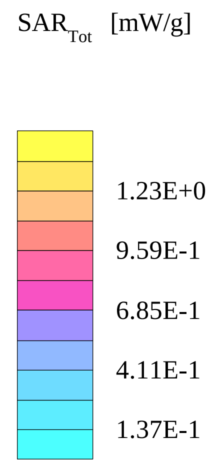
QCP-6035, FM ch991, flip open

SAR (1g): 0.951 [mW/g] ± 0.06 dB, SAR (10g): 0.729 [mW/g] ± 0.08 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, FM ch991, flip open, 8-2-00.DA3
Powerdrift: -0.03 dB

QCP-6035, FM ch991, flip open

SAR (1g): 1.35 [mW/g] ± 0.13 dB, SAR (10g): 1.04 [mW/g] ± 0.14 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, FM ch991, flip open, 8-2-00.DA3
Powerdrift: -0.17 dB



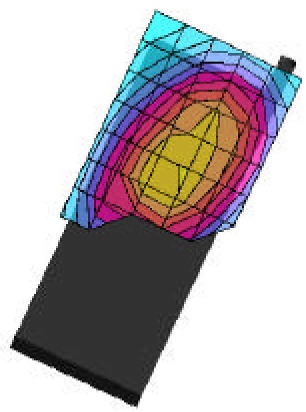


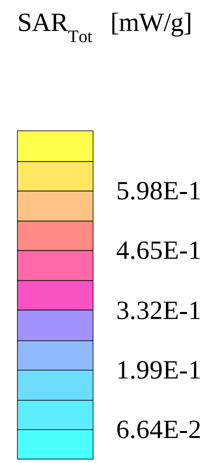
QCP-6035, FM ch383, flip closed

SAR (1g): 0.915 [mW/g] ± 0.21 dB, SAR (10g): 0.694 [mW/g] ± 0.21 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, FM ch383, flip closed, 8-2-00.DA3
Powerdrift: 0.07 dB

QCP-6035, FM ch383, flip closed

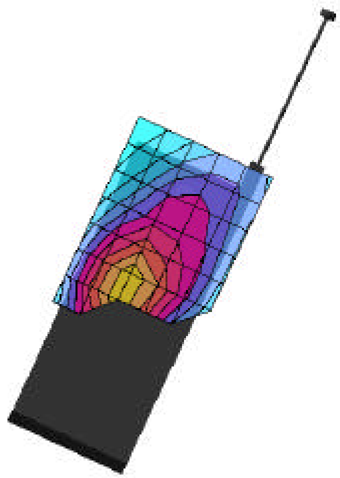
SAR (1g): 0.710 [mW/g] ± 0.20 dB, SAR (10g): 0.546 [mW/g] ± 0.17 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ϵ_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, FM ch383, flip closed, 8-2-00.DA3
Powerdrift: -0.33 dB

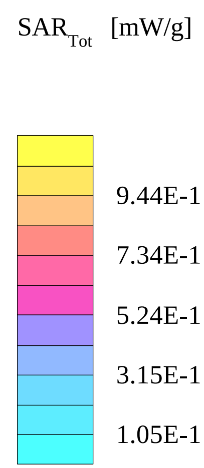




QCP-6035, FM ch383, flip open

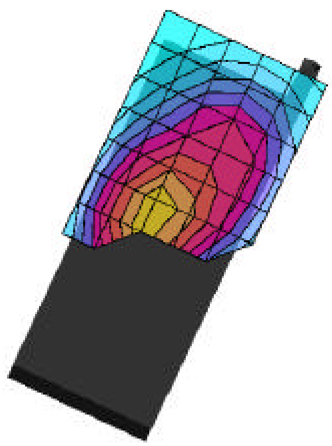
SAR (1g): 1.05 [mW/g] ± 0.13 dB, SAR (10g): 0.807 [mW/g] ± 0.13 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch383, flip open, 8-2-00.DA3
Powerdrift: 0.06 dB

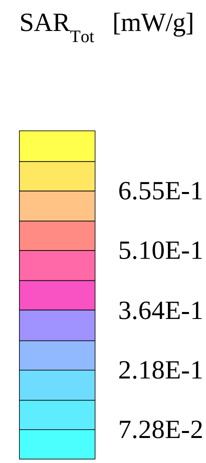




QCP-6035, FM ch383, flip open

SAR (1g): 0.722 [mW/g] ± 0.17 dB, SAR (10g): 0.558 [mW/g] ± 0.17 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, FM ch383, flip open, 8-2-00.DA3
Powerdrift: -0.32 dB





QCP-6035, FM ch799, flip closed

SAR (1g): 0.674 [mW/g] ± 0.19 dB, SAR (10g): 0.521 [mW/g] ± 0.20 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch799, flip closed, 8-2-00.DA3
Powerdrift: 0.02 dB

QCP-6035, FM ch799, flip closed

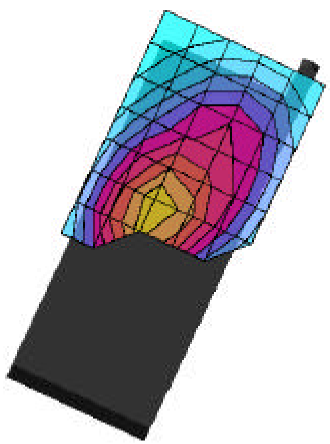
SAR (1g): 0.932 [mW/g] ± 0.19 dB, SAR (10g): 0.718 [mW/g] ± 0.17 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, FM ch799, flip closed, 8-2-00.DA3
Powerdrift: -0.13 dB

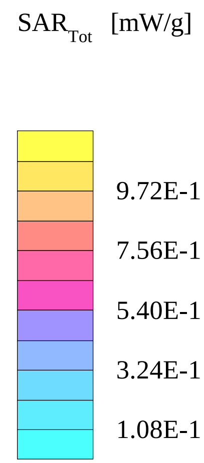
QCP-6035, FM ch799, flip open

SAR (1g): 0.774 [mW/g] ± 0.10 dB, SAR (10g): 0.595 [mW/g] ± 0.13 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch799, flip open, 8-2-00.DA3
Powerdrift: 0.10 dB

QCP-6035, FM ch799, flip open

SAR (1g): 1.04 [mW/g] ± 0.05 dB, SAR (10g): 0.795 [mW/g] ± 0.08 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch799, flip open, 8-2-00.DA3
Powerdrift: -0.46 dB





QCP-6035, CDMA ch1013, flip closed

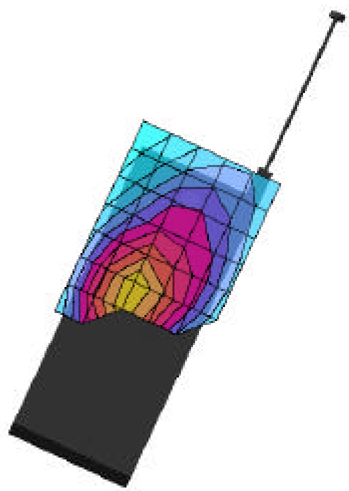
SAR (1g): 0.750 [mW/g] ± 0.25 dB, SAR (10g): 0.575 [mW/g] ± 0.24 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm³]
File Name: T2 #0292, CDMA ch1013, flip closed, 8-2-00.DA3
Powerdrift: 0.02 dB

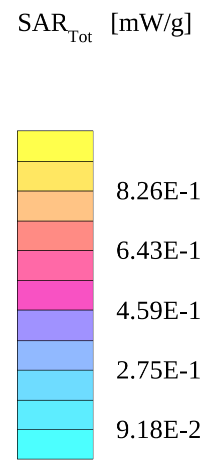
QCP-6035, CDMA ch1013, flip closed

SAR (1g): 1.18 [mW/g] ± 0.19 dB, SAR (10g): 0.913 [mW/g] ± 0.21 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, CDMA ch1013, flip closed, 8-2-00.DA3
Powerdrift: -0.13 dB

QCP-6035, CDMA ch1013, flip open

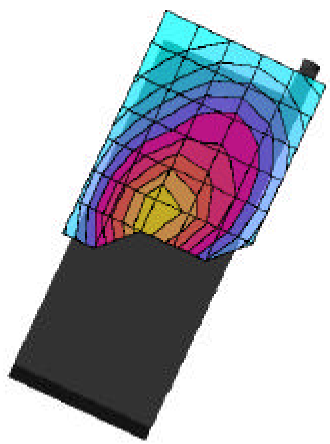
SAR (1g): 0.921 [mW/g] ± 0.09 dB, SAR (10g): 0.707 [mW/g] ± 0.09 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, CDMA ch1013, flip open, 8-2-00.DA3
Powerdrift: 0.00 dB

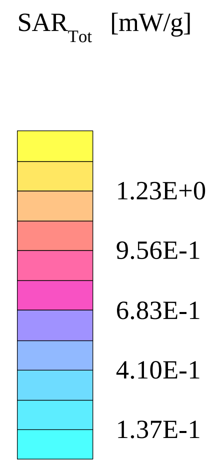




QCP-6035, CDMA ch1013, flip open

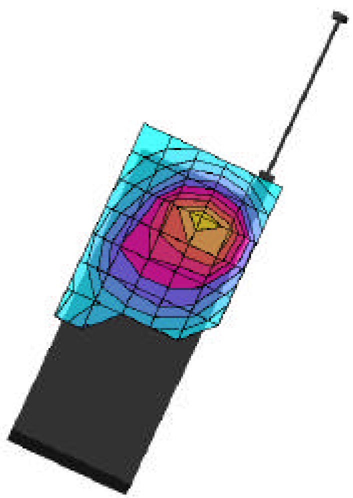
SAR (1g): 1.31 [mW/g] ± 0.08 dB, SAR (10g): 1.02 [mW/g] ± 0.13 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Brain 900Mhz: σ = 0.85 [mho/m] ε_r = 42.6 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, CDMA ch1013, flip open, 8-2-00.DA3
Powerdrift: -0.17 dB

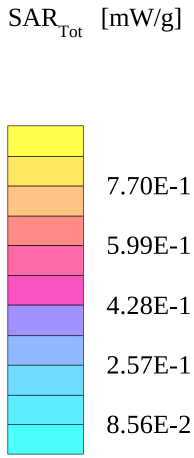




QCP-6035, PCS Ch25, flip closed

SAR (1g): 1.06 [mW/g] ± 0.27 dB, SAR (10g): 0.595 [mW/g] ± 0.20 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch25, flip closed, 8-1-00.DA3
Powerdrift: 0.00 dB





QCP-6035, PCS ch25, flip closed

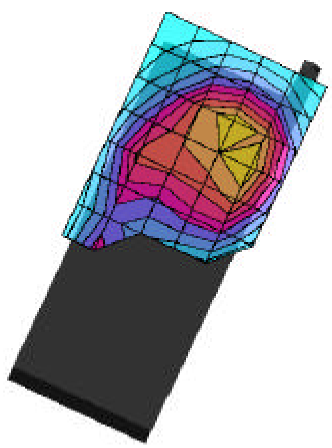
SAR (1g): 1.08 [mW/g] ± 0.19 dB, SAR (10g): 0.608 [mW/g] ± 0.18 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch25, flip closed, 8-1-00.DA3
Powerdrift: -0.19 dB

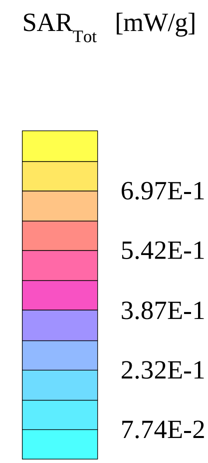
QCP-6035, PCS Ch25, flip open

SAR (1g): 0.949 [mW/g] ± 0.30 dB, SAR (10g): 0.536 [mW/g] ± 0.23 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, PCS ch25, flip open, 8-1-00.DA3
Powerdrift: 0.08 dB

QCP-6035, PCS Ch25, flip open

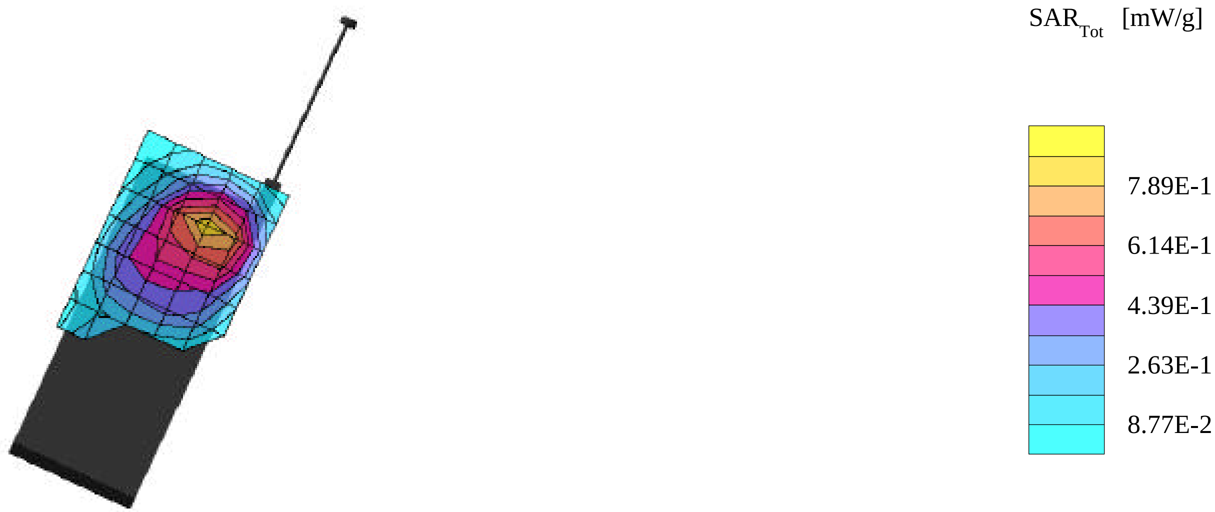
SAR (1g): 0.960 [mW/g] ± 0.22 dB, SAR (10g): 0.545 [mW/g] ± 0.20 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch25, flip open, 8-1-00.DA3
Powerdrift: -0.21 dB





QCP-6035, PCS ch600, flip closed

SAR (1g): 1.13 [mW/g] ± 0.26 dB, SAR (10g): 0.623 [mW/g] ± 0.24 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch600, flip closed, 8-1-00.DA3
Powerdrift: 0.02 dB



QCP-6035, PCS ch600, flip closed

SAR (1g): 1.28 [mW/g] ± 0.28 dB, SAR (10g): 0.707 [mW/g] ± 0.22 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch600, flip closed, 8-1-00.DA3
Powerdrift: -0.04 dB

QCP-6035, PCS ch600, flip open

SAR (1g): 0.948 [mW/g] ± 0.26 dB, SAR (10g): 0.535 [mW/g] ± 0.22 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch600, flip open, 8-1-00.DA3
Powerdrift: 0.01 dB

QCP-6035, PCS ch600, flip open

SAR (1g): 1.06 [mW/g] ± 0.24 dB, SAR (10g): 0.593 [mW/g] ± 0.24 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch600, flip open, 8-1-00.DA3
Powerdrift: -0.08 dB

QCP-6035, PCS ch1175, flip closed

SAR (1g): 1.23 [mW/g] ± 0.26 dB, SAR (10g): 0.673 [mW/g] ± 0.25 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch1175, flip closed, 8-1-00.DA3
Powerdrift: 0.03 dB

QCP-6035, PCS ch1175, flip closed

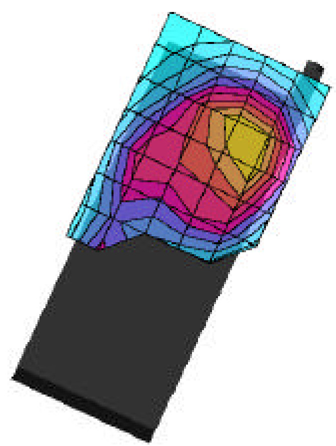
SAR (1g): 1.41 [mW/g] ± 0.23 dB, SAR (10g): 0.779 [mW/g] ± 0.23 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch1175, flip closed, 8-1-00.DA3
Powerdrift: -0.15 dB

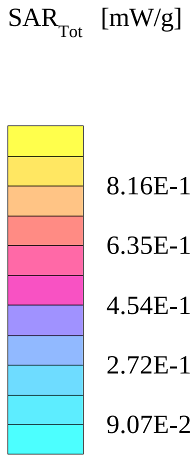
QCP-6035, PCS ch1175, flip open

SAR (1g): 1.01 [mW/g] ± 0.26 dB, SAR (10g): 0.564 [mW/g] ± 0.25 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch1175, flip open, 8-1-00.DA3
Powerdrift: -0.04 dB

QCP-6035, PCS ch1175, flip open

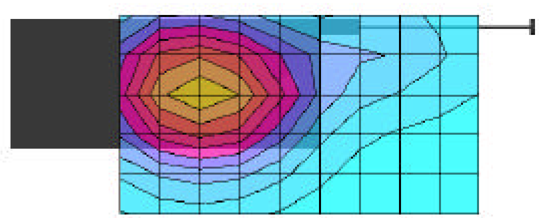
SAR (1g): 1.14 [mW/g] ± 0.23 dB, SAR (10g): 0.639 [mW/g] ± 0.21 dB
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1348; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 40.5 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch1175, flip open, 8-1-00.DA3
Powerdrift: -0.36 dB

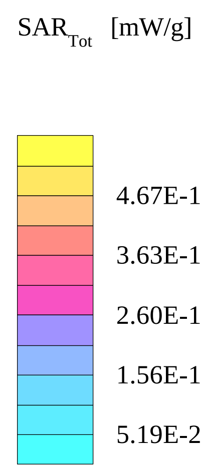




QCP-6035, FM ch991, Waist level

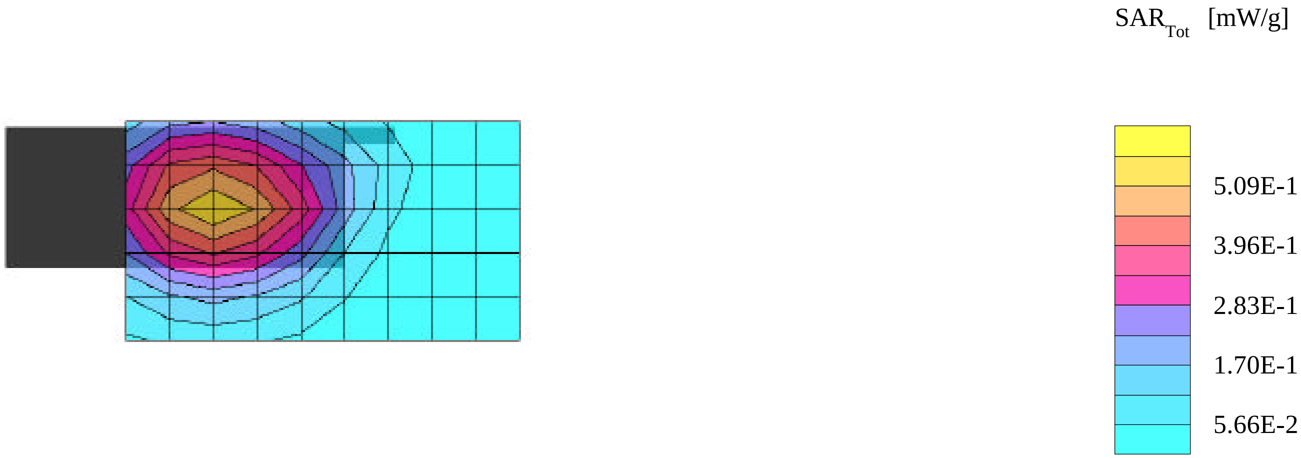
SAR (1g): 0.485 [mW/g] ± 0.18 dB, SAR (10g): 0.363 [mW/g] ± 0.19 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Muscle 900Mhz: σ = 0.93 [mho/m] ε_r = 55.8 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch991, waist level, flip closed, 8-4-00.DA3
Powerdrift: 0.01 dB





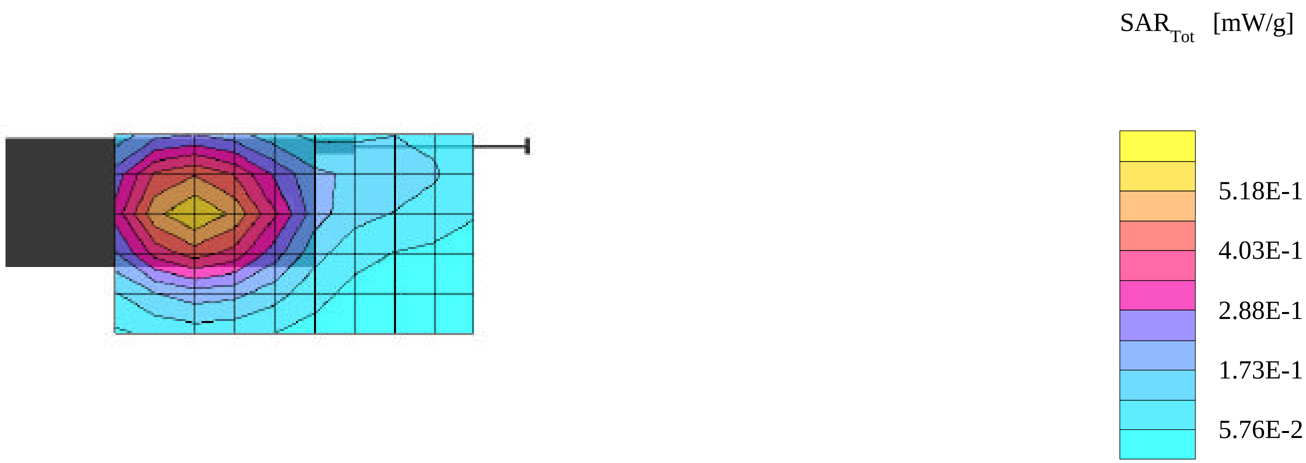
QCP-6035, FM ch991, Waist level

SAR (1g): 0.516 [mW/g] ± 0.29 dB, SAR (10g): 0.387 [mW/g] ± 0.28 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Muscle 900Mhz: σ = 0.93 [mho/m] ε_r = 55.8 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch991, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.13 dB



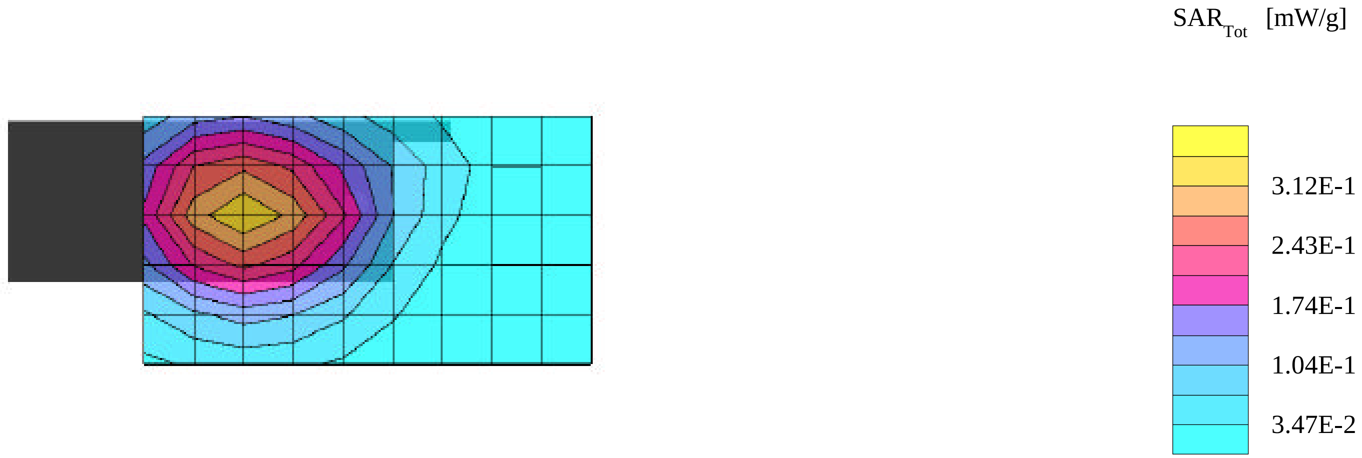
QCP-6035, FM ch383, Waist level

SAR (1g): 0.553 [mW/g] ± 0.23 dB, SAR (10g): 0.415 [mW/g] ± 0.24 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Muscle 900Mhz: σ = 0.93 [mho/m] ε_r = 55.9 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, FM ch383, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.11 dB



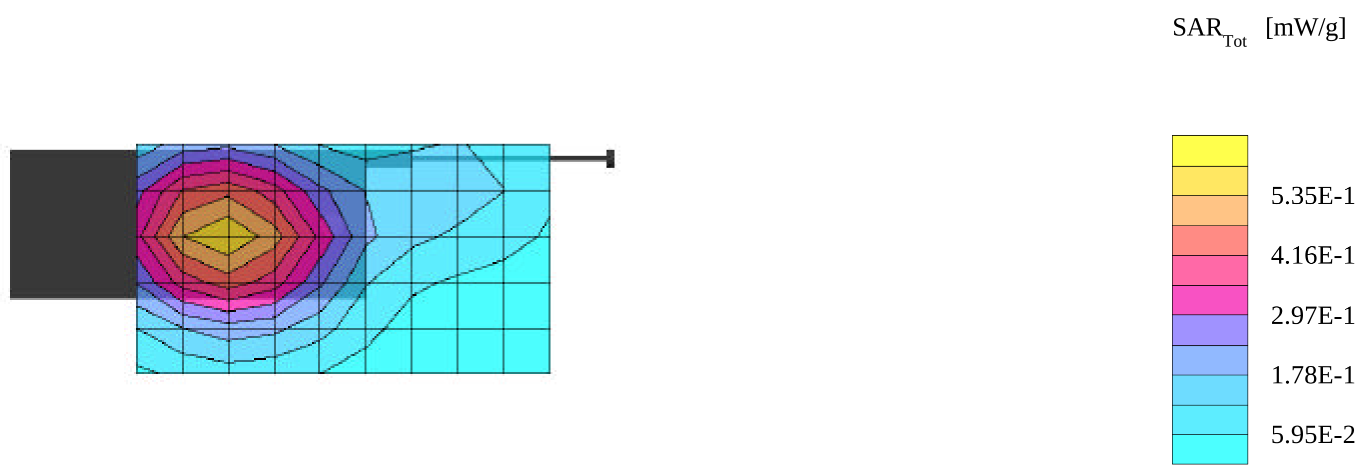
QCP-6035, FM ch383, Waist level

SAR (1g): 0.306 [mW/g] ± 0.22 dB, SAR (10g): 0.229 [mW/g] ± 0.25 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Muscle 900Mhz: σ = 0.93 [mho/m] ε_r = 55.9 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, FM ch383, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.09 dB



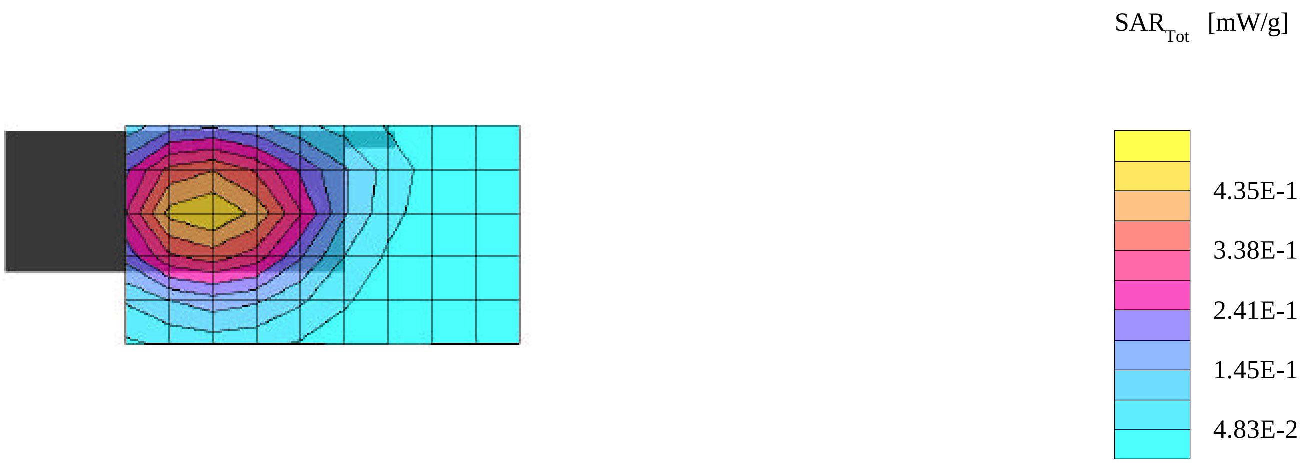
QCP-6035, FM ch799, Waist level

SAR (1g): 0.552 [mW/g] ± 0.23 dB, SAR (10g): 0.410 [mW/g] ± 0.27 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Muscle 900Mhz: σ = 0.93 [mho/m] ε_r = 55.8 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch799, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.00 dB



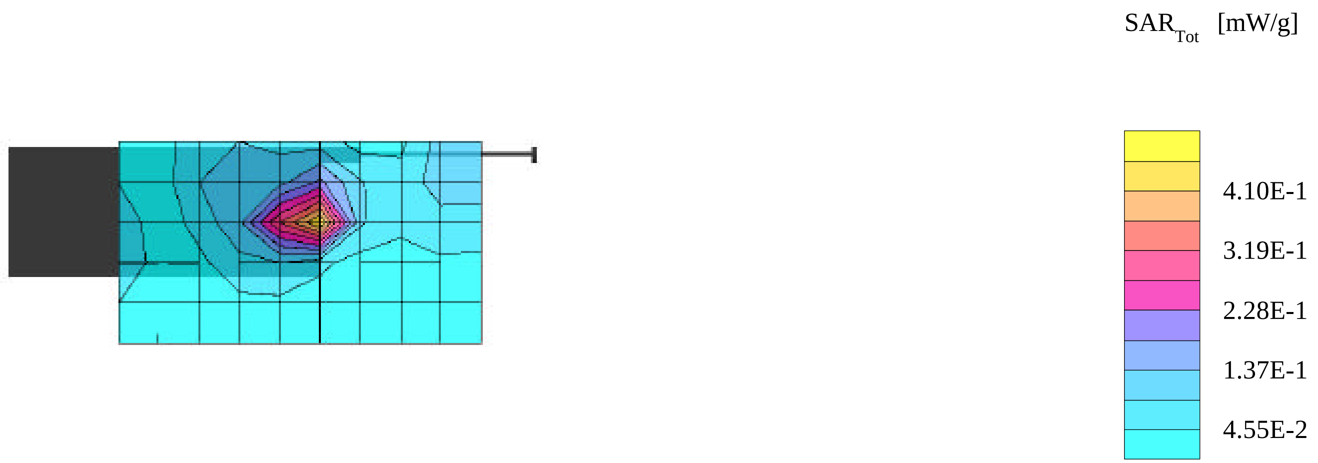
QCP-6035, FM ch799, Waist level

SAR (1g): 0.436 [mW/g] ± 0.26 dB, SAR (10g): 0.325 [mW/g] ± 0.27 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(5.90,5.90,5.90)
Muscle 900Mhz: σ = 0.93 [mho/m] ε_r = 55.8 ρ = 1.00 [g/cm³]
File Name: T2 #0292, FM ch799, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.39 dB



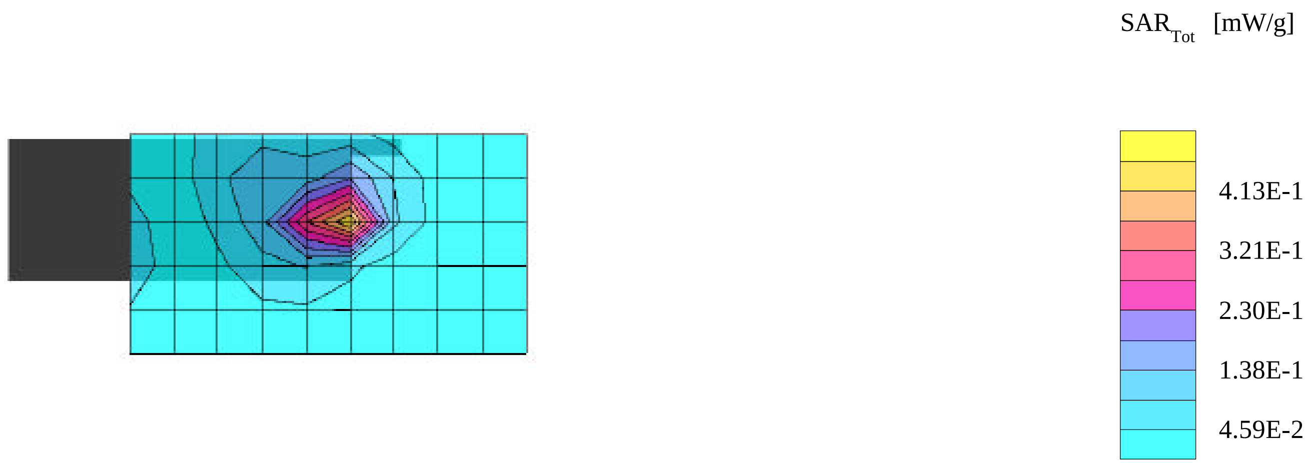
QCP-6035, PCS ch25, Waist level

SAR (1g): 0.566 [mW/g] ± 0.04 dB, SAR (10g): 0.287 [mW/g] ± 0.05 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(4.50,4.50,4.50)
Muscle 1800Mhz: σ = 1.56 [mho/m] ε_r = 54.3 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, PCS ch25, waist level, flip closed, 8-4-00.DA3
Powerdrift: 0.17 dB



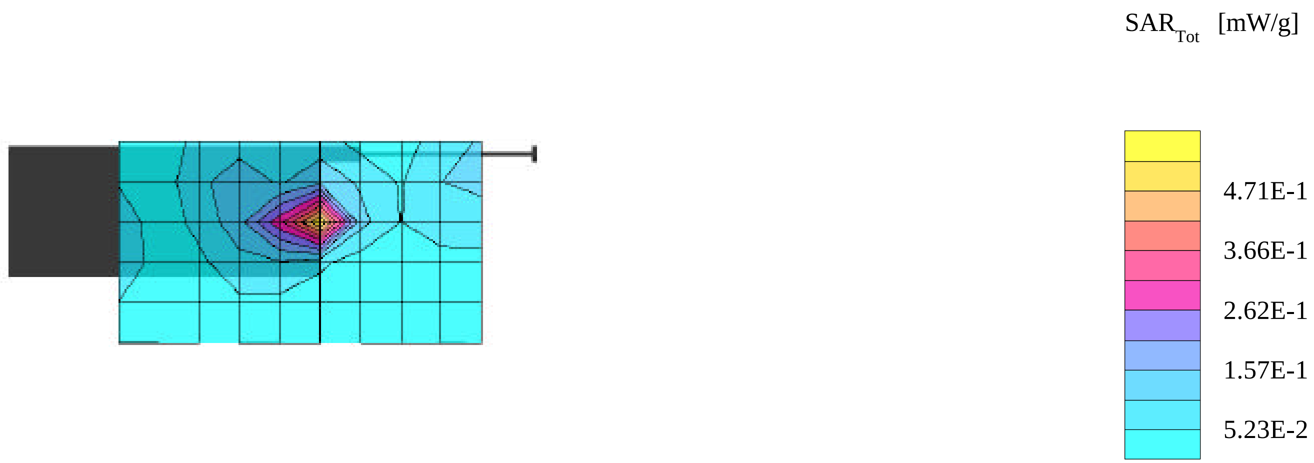
QCP-6035, PCS ch25, Waist level

SAR (1g): 0.549 [mW/g] ± 0.04 dB, SAR (10g): 0.280 [mW/g] ± 0.07 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(4.50,4.50,4.50)
Muscle 1800Mhz: σ = 1.56 [mho/m] ε_r = 54.3 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, PCS ch25, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.17 dB



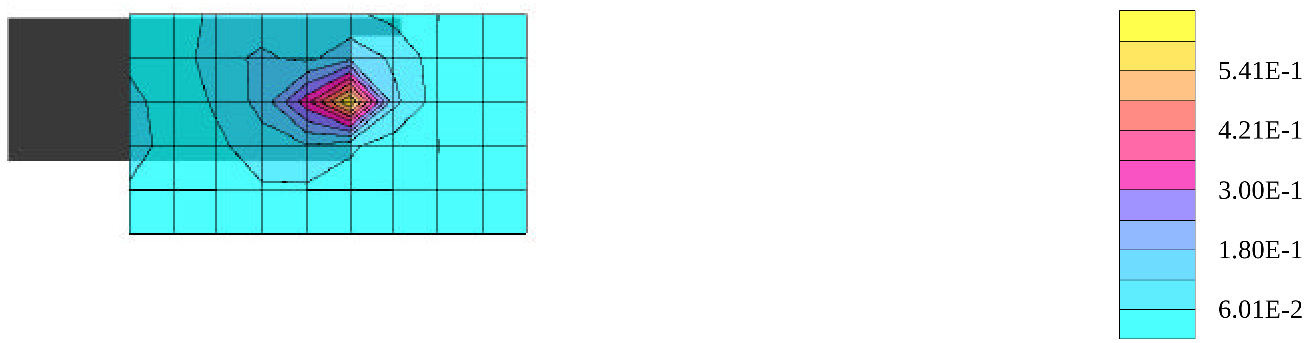
QCP-6035, PCS ch600, Waist level

SAR (1g): 0.565 [mW/g] ± 0.06 dB, SAR (10g): 0.282 [mW/g] ± 0.12 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(4.50,4.50,4.50)
Muscle 1800Mhz: σ = 1.56 [mho/m] ε_r = 54.3 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch600, waist level, flip closed, 8-4-00.DA3
Powerdrift: 0.01 dB



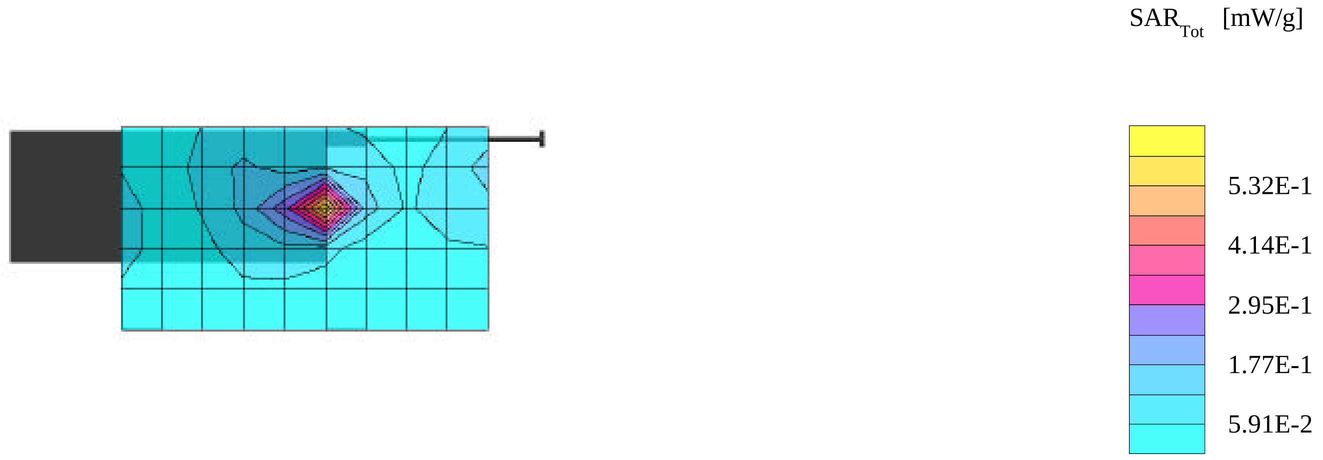
QCP-6035, PCS ch600, Waist level

SAR (1g): 0.638 [mW/g] ± 0.01 dB, SAR (10g): 0.318 [mW/g] ± 0.06 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(4.50,4.50,4.50)
Muscle 1800Mhz: σ = 1.56 [mho/m] ε_r = 54.3 ρ = 1.00 [g/cm³]
File Name: T2 #0292, PCS ch600, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.12 dB



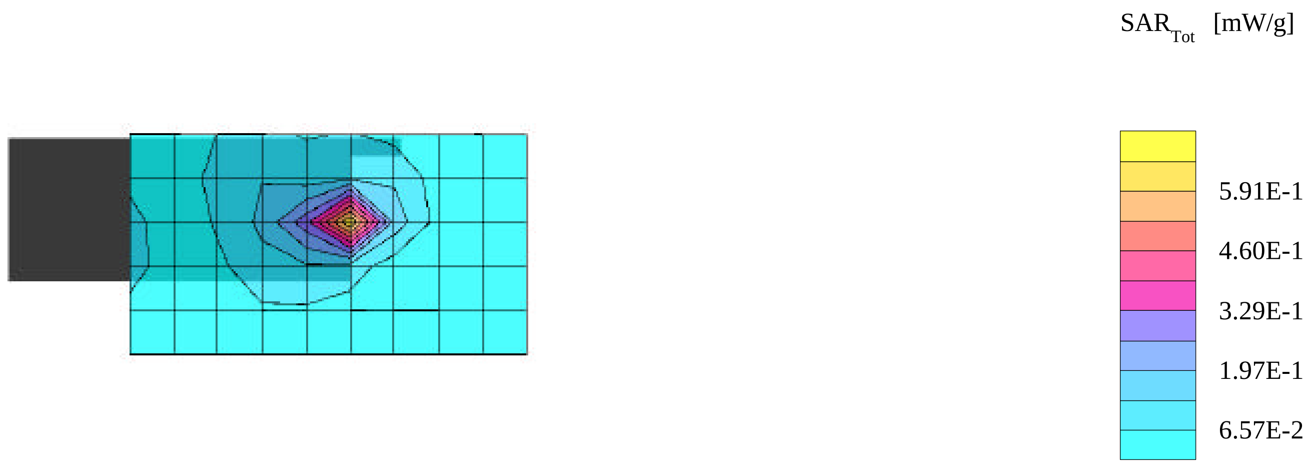
QCP-6035, PCS ch1175, Waist level

SAR (1g): 0.567 [mW/g] ± 0.02 dB, SAR (10g): 0.285 [mW/g] ± 0.08 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(4.50,4.50,4.50)
Muscle 1800Mhz: σ = 1.56 [mho/m] ε_r = 54.3 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, PCS ch1175, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.04 dB



QCP-6035, PCS ch1175, Waist level

SAR (1g): 0.633 [mW/g] ± 0.03 dB, SAR (10g): 0.318 [mW/g] ± 0.08 dB
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1348; ConvF(4.50,4.50,4.50)
Muscle 1800Mhz: σ = 1.56 [mho/m] ε_r = 54.3 ρ = 1.00 [g/cm^3]
File Name: T2 #0292, PCS ch1175, waist level, flip closed, 8-4-00.DA3
Powerdrift: -0.32 dB



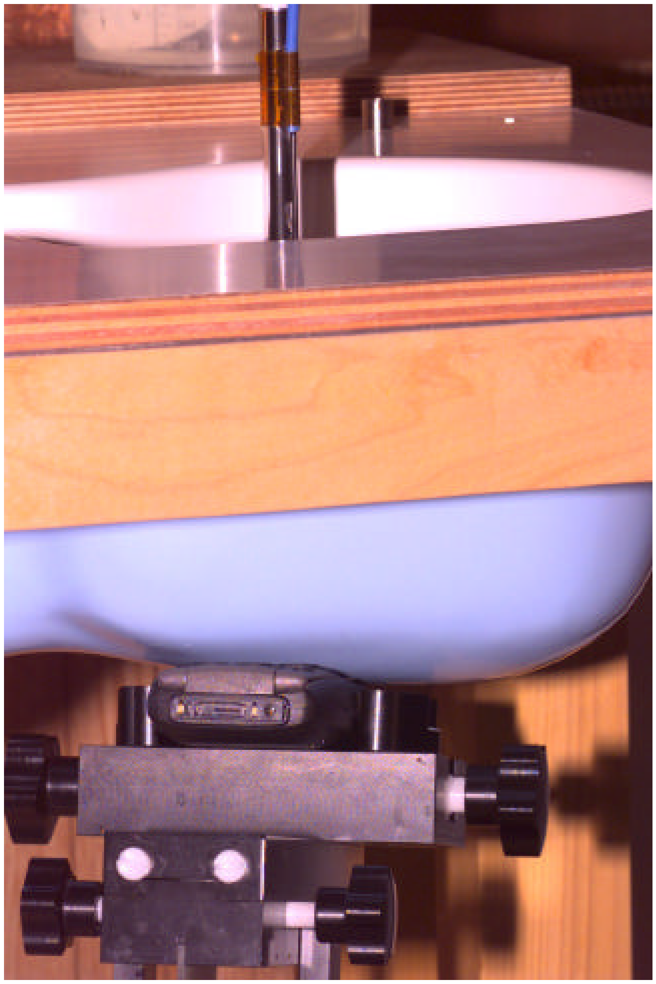
12 PHOTOS

QCP-6035

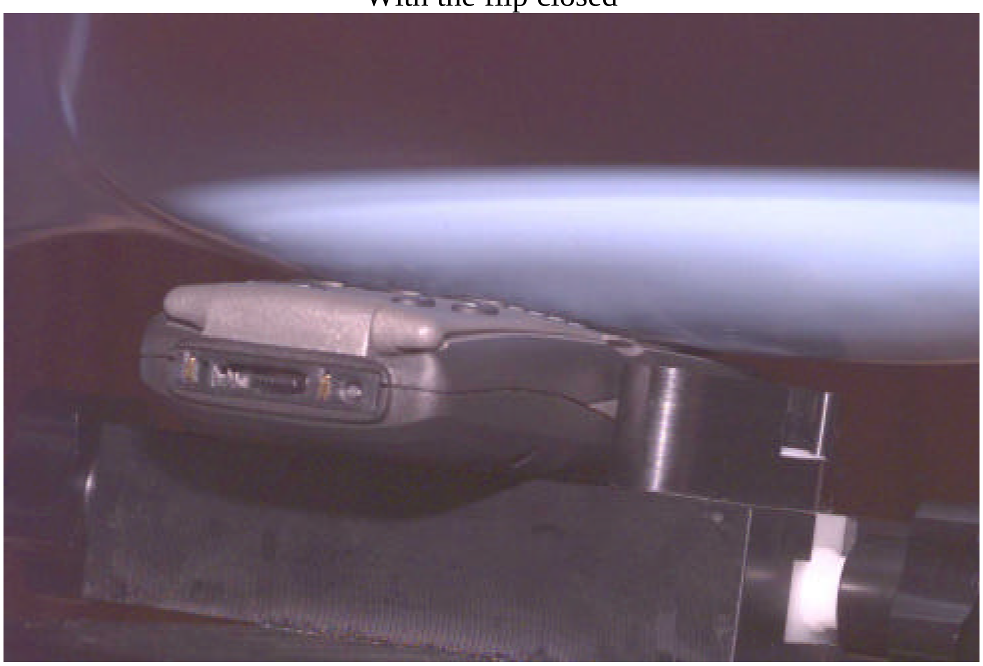
Flip closed

Flip open

Test Setup for SAR at Head

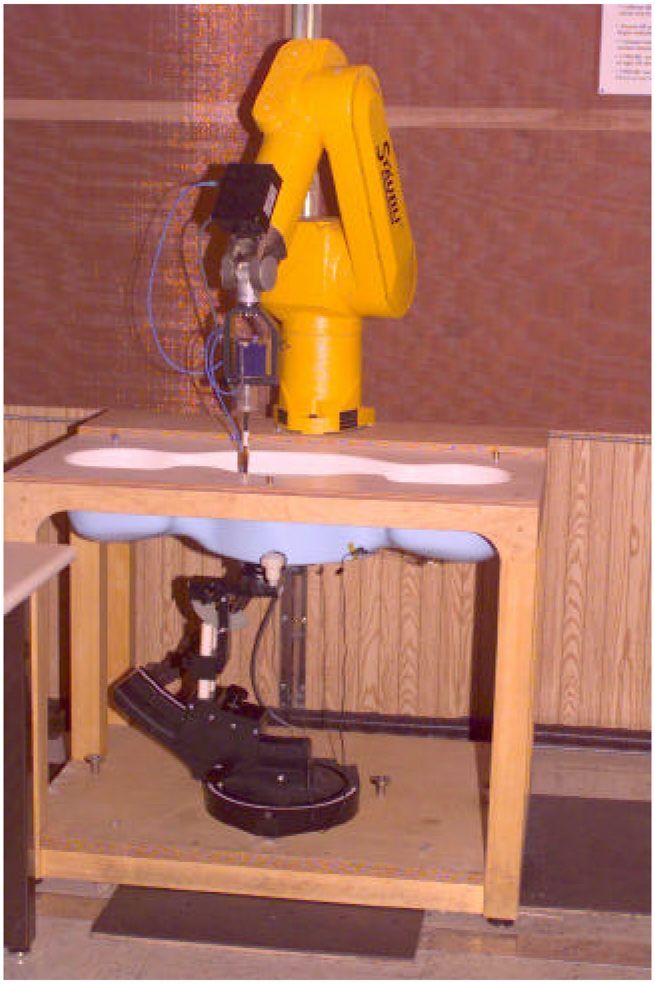


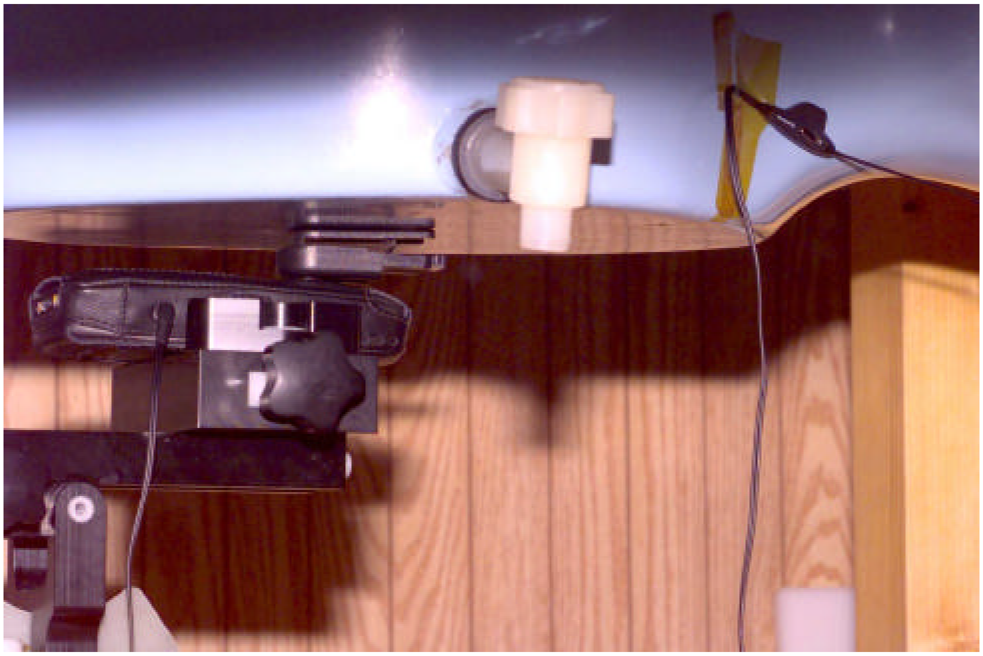
With the flip closed



With the flip open

Test Setup for Body-worn SAR





Probe

References

[1] Klaus Meier, Voker Hombach, Ralf Kastle, Roger Yew-Siow Tay, and Neils Kuster "The dependence of Electromagnetic Energy Absorption upon Human-Head Modeling at 1800 MHz" IEEE Transactions on Microwave Theory and Techniques, Vol. 45 No 11, November 1997

[2] Volker Hombach, Klaus Meier, Michael Burkhardt, Eberhard Kuhn, and Neils Kuster "The Dependence of EM Energy Absorption Upon Human Head Modeling at 900 MHz" " IEEE Transactions on Microwave Theory and Techniques, Vol. 44 No 10, October 1996

[3] Thomas Schmid, Oliver Egger, Niels Kuster "Automated E-Field Scanning System for Dosimetric Assessments" IEEE Transactions on Microwave Theory and Techniques, Vol 44, No 1, January 1996

[4] Niels Kuster, Q. Balzano, and J.C. Lin "Mobile Communications Safety" Chapman & Hall, First edition 1997