Kyocera Wireless Corp.
KWC 2255

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 July 2001 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:	*KWC-2255*
Tx Frequency :	*824.04 – 848.97 and 1851.25 – 1908.75 MHz*
Max. Output Power:	*27.43 dBm ERP Analog (in cellular band)*
	26.5 dBm ERP Digital (in cellular band)
	25.87 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 :	*1S2X0115810873*
Place of Test:	*KWC, San Diego, CA, USA*
Date of Test:	*July 2-6, 2001*
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 KWC-2255 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 2255. 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 25.87 dBm. The cellular FM AMPS mode is designed to transmit in the 824.04 – 848.97 MHz band at a maximum ERP of 27.43 dBm. The cellular CDMA mode is designed to transmit in the 824.04 – 848.97 MHz band at a maximum output power (ERP) of 26.5 dBm.

The KWC-2255 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 KWC-2255 has provision for headset to allow hands-free operation. But Kyocera Wireless Corp. does not provide any body-worn holster. Therefore the SAR for hands-free operating condition was measured with 22.5mm space 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):

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

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

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

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

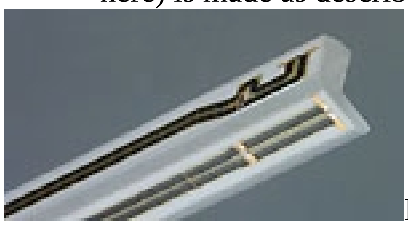
In this equation, σ is a function of frequency, and so it must be measured at the frequency of the test. It is measured in terms of the real and imaginary components of the complex permitivity;

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

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

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	0.398 W / 26.0 dBm	
824.7	1013		0.309 W / 24.9 dBm
836.49	383	0.403 W / 26.05 dBm	0.316 W / 25.0 dBm
848.31	777		0.306 W / 24.86 dBm
848.97	799	0.398 W / 26 dBm	
Maximum Power over Band		**26.05 dBm**	**25.0dBm**

Table 4: Conducted power used for SAR test - PCS

		RF output power (W) - PCS
carrier frequency (MHz)	channel	CDMA
		measured
1851.25	25	0.209 W / 23.2 dBm
1880	600	0.219 W / 23.4 dBm
1908.75	1175	0.205 W / 23.12 dBm
Maximum Power over Band		**23.4 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	27.43 dBm	
824.7	1013		26.5 dBm
836.49	383	26.86 dBm	26.1 dBm
848.31	777		26.06 dBm
848.97	799	26.88 dBm	
Max power over band		**27.43 dBm**	**26.5 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	25.48 dBm
1880	600	25.87 dBm
1908.75	1175	25.41 dBm
Max power over band		**25.87 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

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

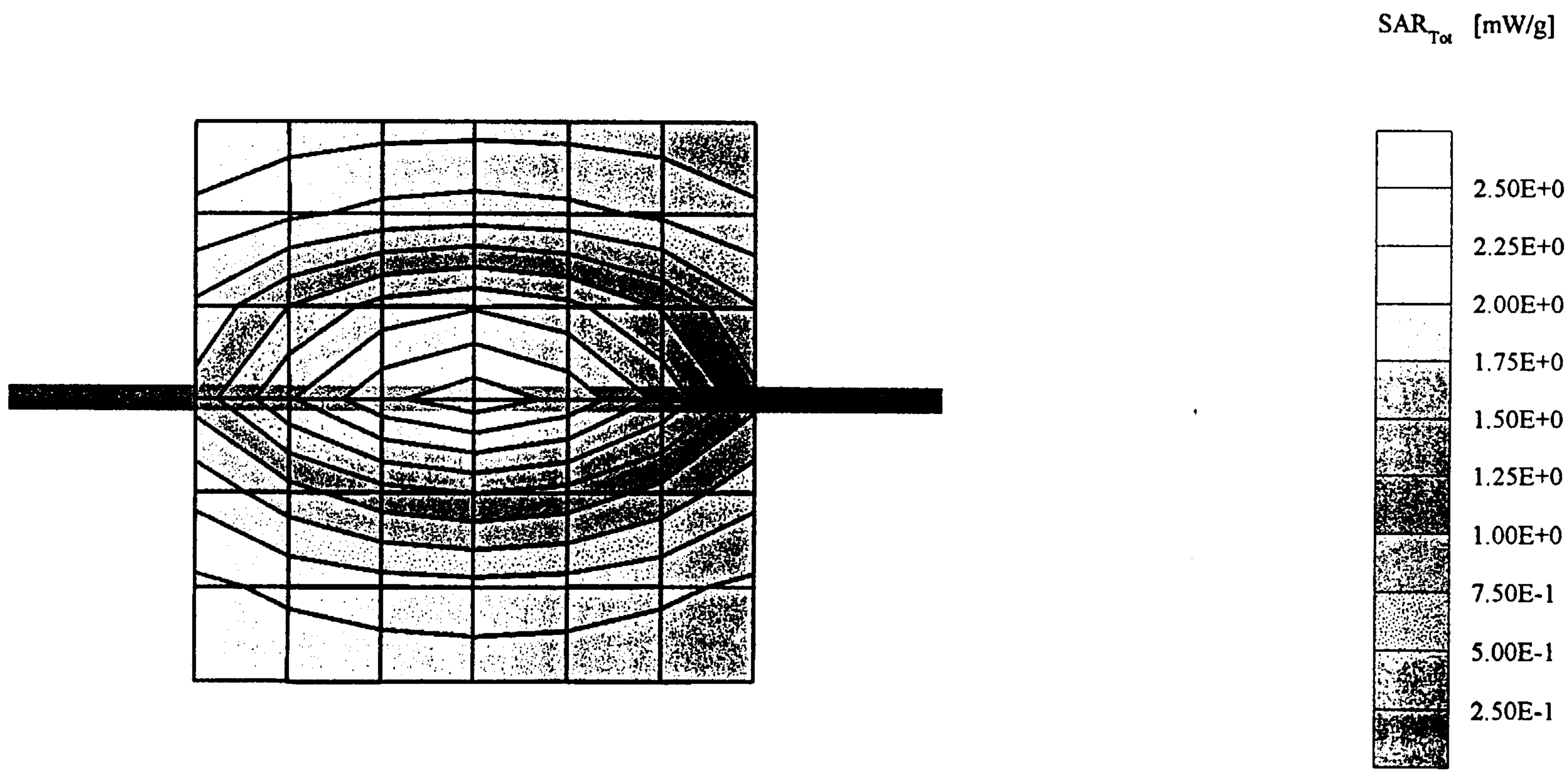
The dipole is made of standard semirigid coaxial cable. The centre conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

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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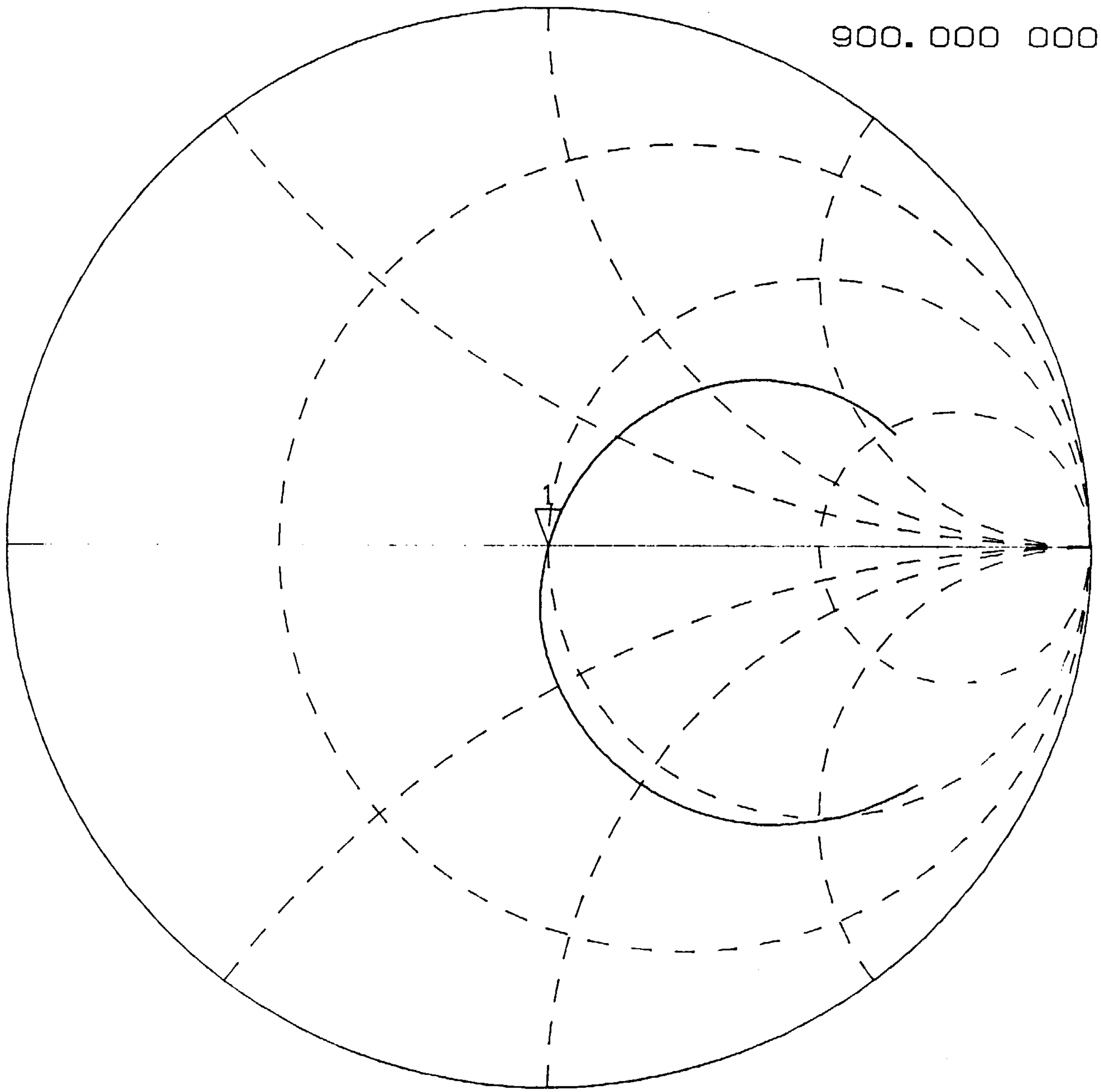


CENTER 900.000 000 MHz SPAN 400.000 000 MHz

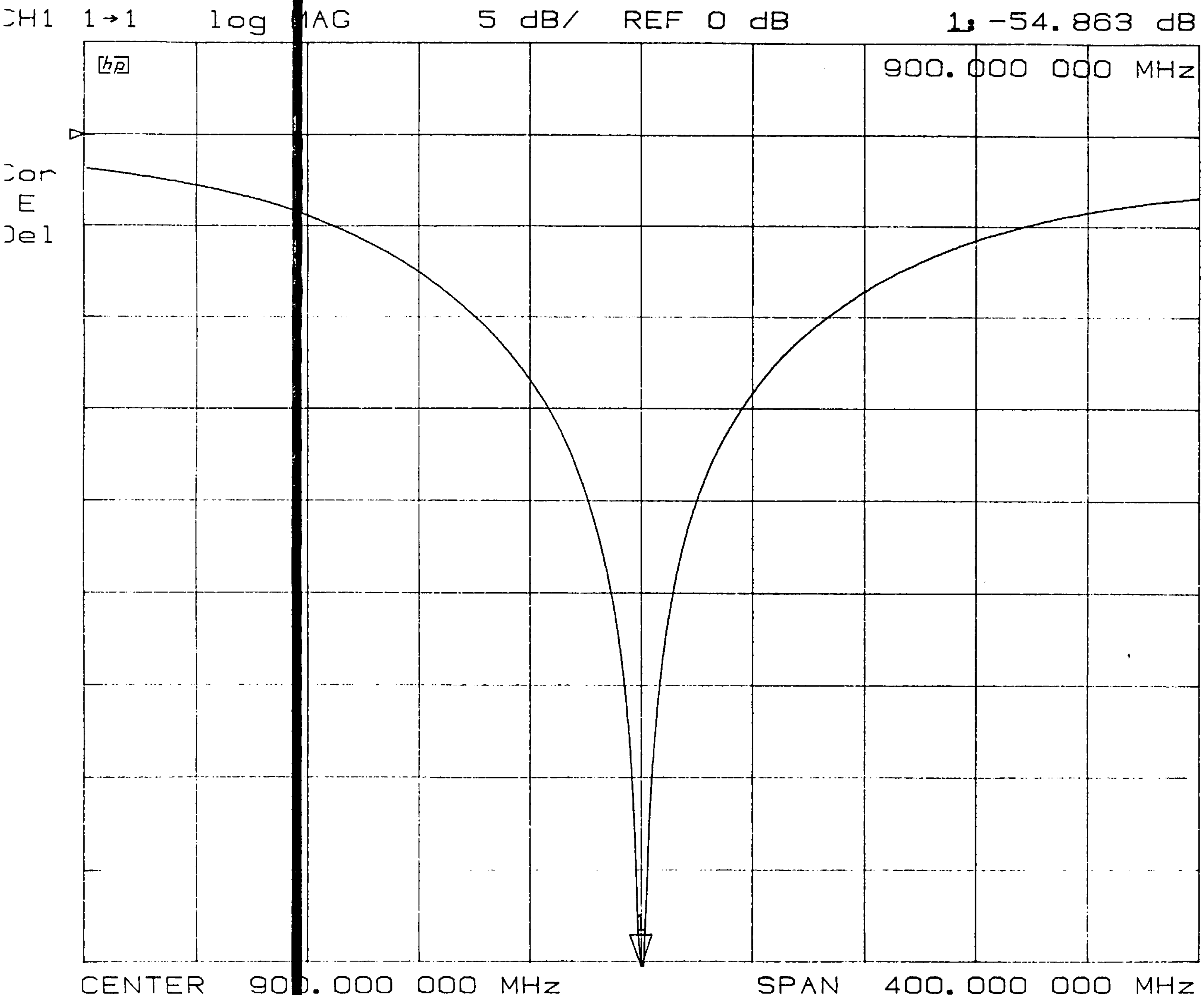
D900V2 SN: 024

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)

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

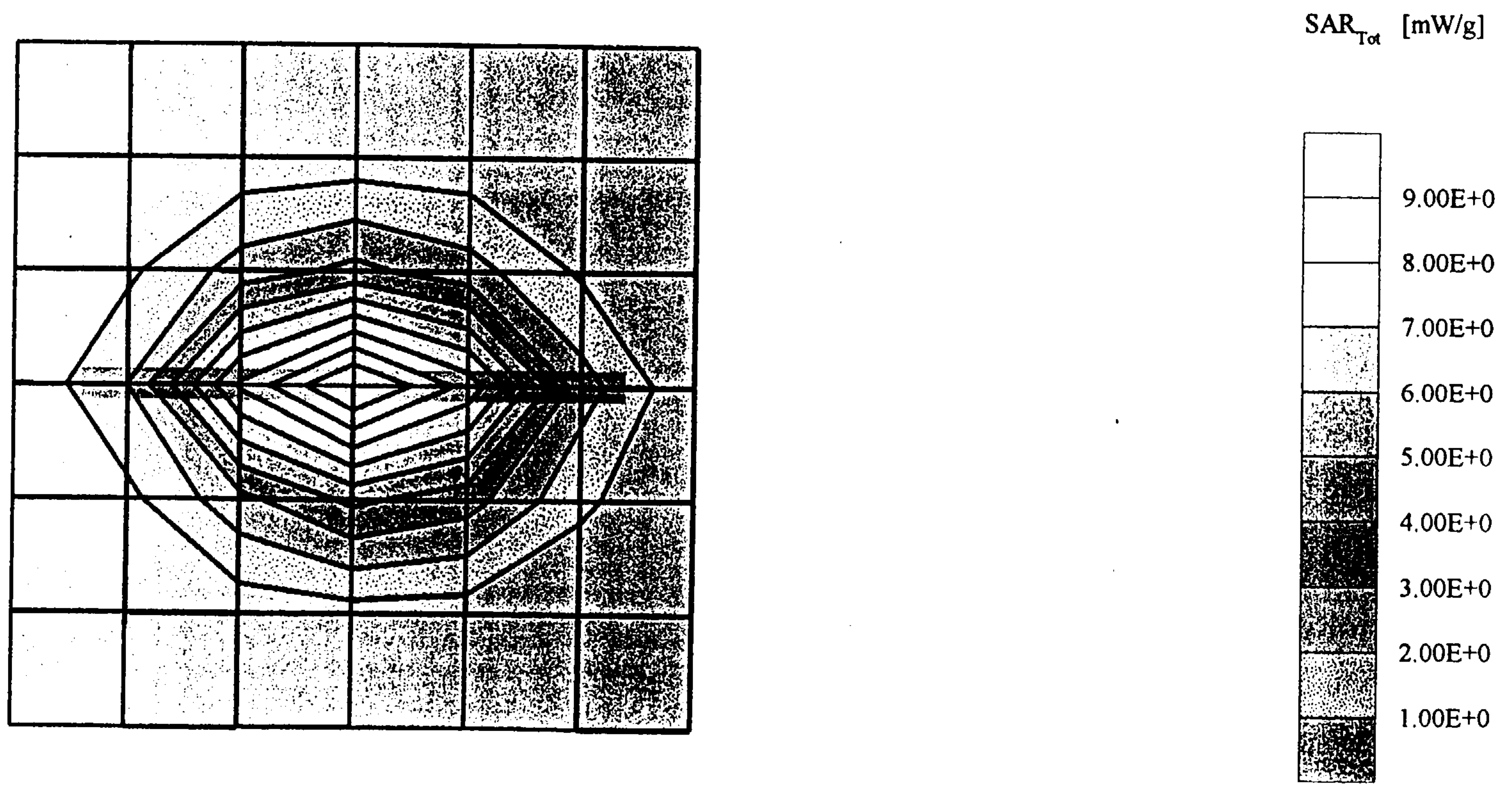
The dipole is made of standard semirigid coaxial cable. The centre conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

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.

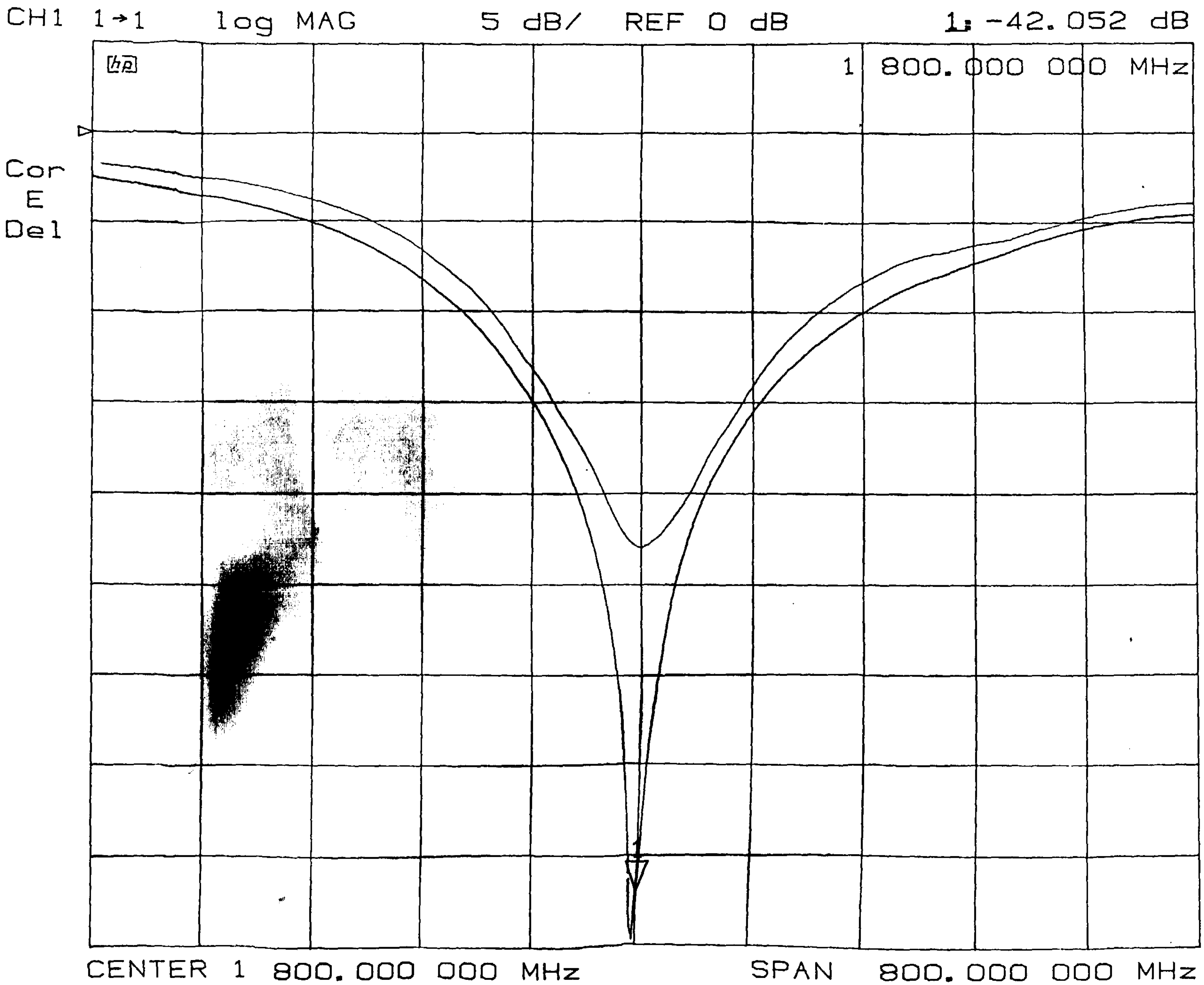
After prolonged use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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



Schmid & Partner Engineering AG, Zürich Switzerland



D1800V2 SN

S11

Flat phantom wi
brain simulating
solution

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

(distance from dipo
center to solution)

CH1 1→1 1 U FS 1: 49.51 Ω 0.6289 Ω 55.608 pH

1 800.000 000 MHz

Cor
E
Del

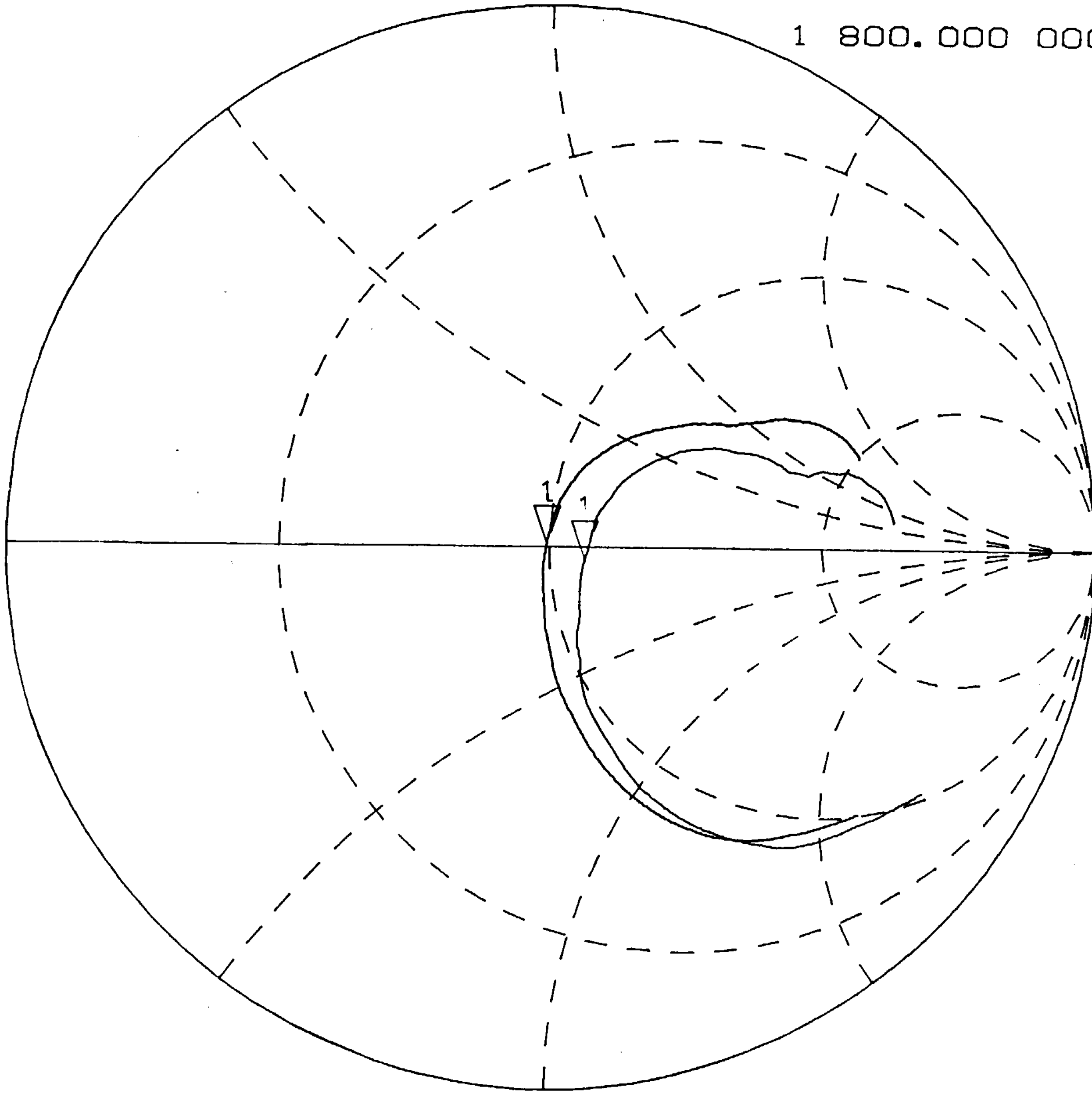
D1800V2 SN

S11

Flat phantom wi
brain simulating
solution

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

(distance from dipo
center to solution)

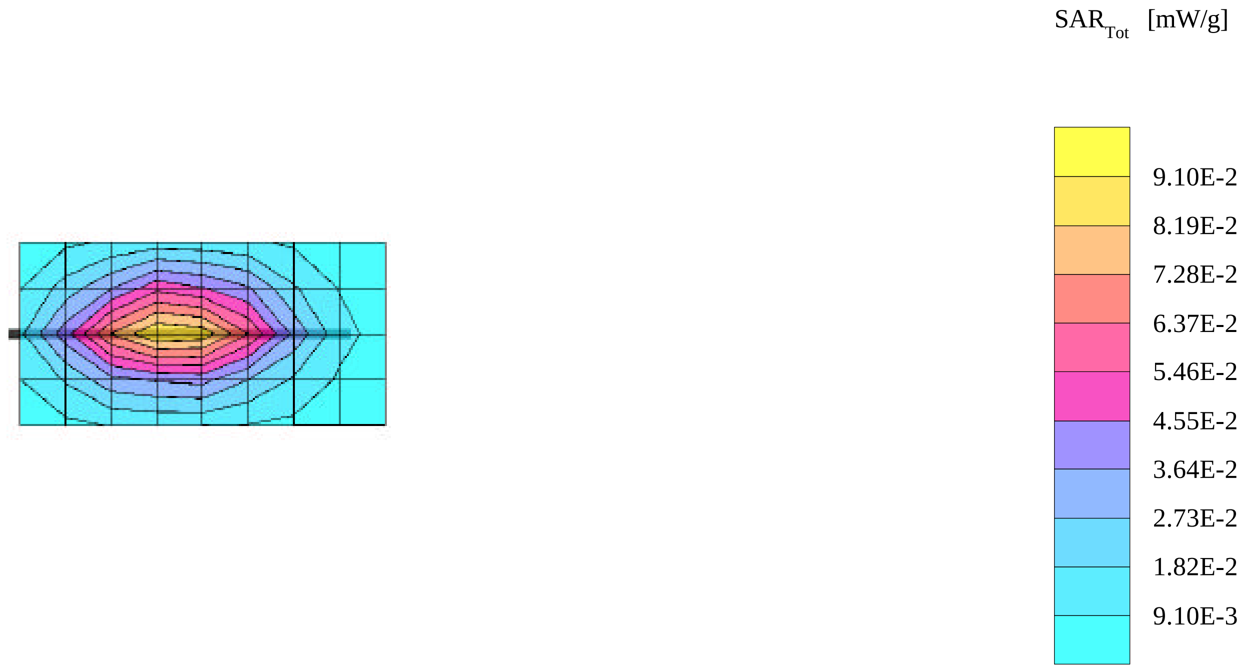


CENTER 1 800.000 000 MHz SPAN 800.000 000 MHz

Brain Tissue Validation Test Results

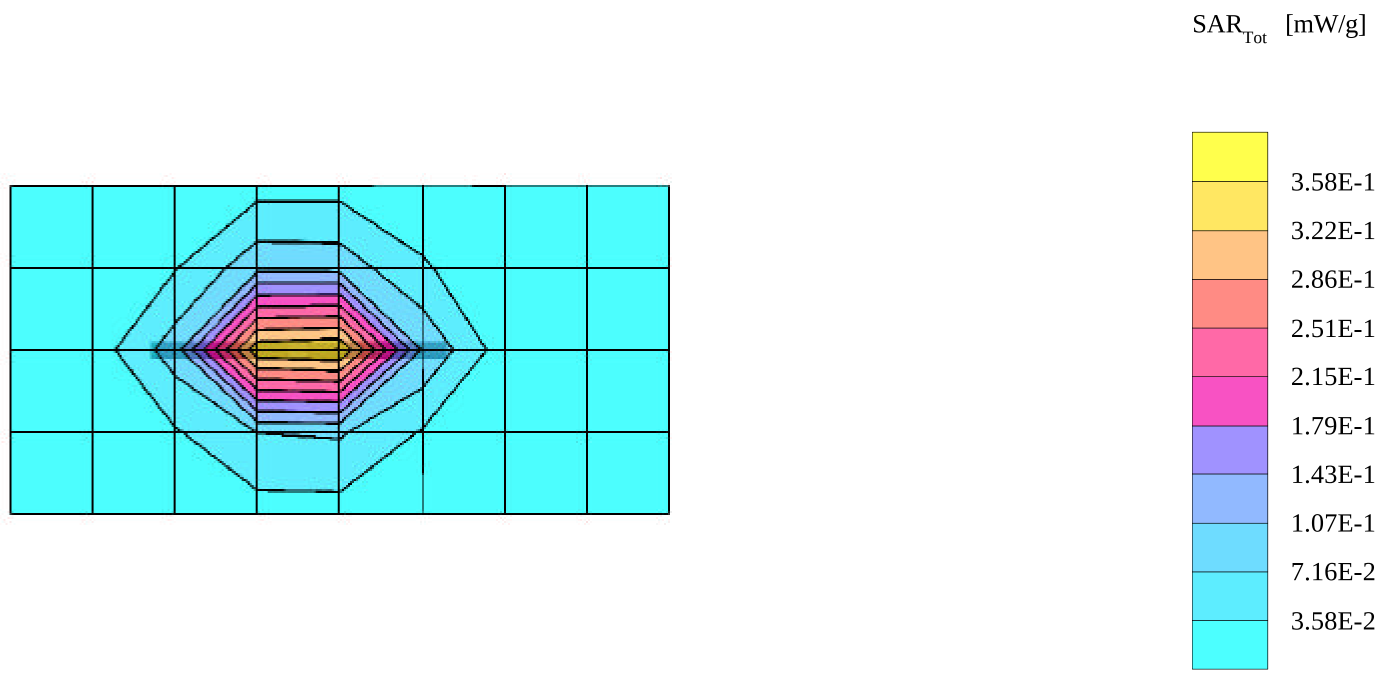
07-03-2001, 900MHz Validation, Target=0.0944mW/g

SAR (1g): 0.0926 [mW/g] ± 0.06 dB, SAR (10g): 0.0625 [mW/g] ± 0.05 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm^3]
File Name: FCC, ValidationFlat 900MHz 07-03-2001.DA3
Operator: DWS



07-05-2001, 1800MHz Validation, Target=0.399mW/g

SAR (1g): 0.393 [mW/g] ± 0.08 dB, SAR (10g): 0.209 [mW/g] ± 0.05 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 41.4 ρ = 1.00 [g/cm^3]
File Name: FCC, ValidationFlat 1800MHz 07-05-2001.DA3
Operator: DWS



Muscle Tissue Calibration Data Sheet

Reference math : OFF   Title: 07-06-01

PCS Muscle

Pt#	Frequency (GHz)	Data real	Data imag
1	0.000030000	244.07	-976.40
2	0.015029850	25.36	2.22
3	0.030029700	67.28	-2.52
4	0.045029550	67.48	-1.18
5	0.060029400	66.99	-0.15
6	0.075029250	67.06	0.55
7	0.090029100	66.80	1.01
8	0.105028950	66.81	1.68
9	0.120028800	66.60	2.12
10	0.135028650	66.44	2.52
11	0.150028500	66.36	2.76
12	0.165028350	65.99	3.07
13	0.180028200	66.05	3.23
14	0.195028050	65.86	3.58
15	0.210027900	65.73	3.77
16	0.225027750	65.58	4.04
17	0.240027600	65.53	4.27
18	0.255027450	65.35	4.49
19	0.270027300	65.24	4.63
20	0.285027150	65.07	4.82
21	0.300027000	64.96	5.03
22	0.315026850	64.89	5.27
23	0.330026700	64.79	5.41
24	0.345026550	64.61	5.62
25	0.360026400	64.56	5.81
26	0.375026250	64.42	5.97
27	0.390026100	64.34	6.16
28	0.405025950	64.20	6.27
29	0.420025800	64.06	6.54
30	0.435025650	64.01	6.63
31	0.450025500	63.89	6.79
32	0.465025350	63.78	6.97
33	0.480025200	63.61	7.11
34	0.495025050	63.57	7.30
35	0.510024900	63.44	7.43
36	0.525024750	63.34	7.57
37	0.540024600	63.22	7.70
38	0.555024450	63.15	7.87
39	0.570024300	63.01	7.98
40	0.585024150	62.88	8.15
41	0.600024000	62.83	8.27
42	0.615023850	62.71	8.41
43	0.630023700	62.59	8.56
44	0.645023550	62.50	8.69
45	0.660023400	62.38	8.82
46	0.675023250	62.29	8.94
47	0.690023100	62.16	9.11
48	0.705022950	62.12	9.23
49	0.720022800	61.96	9.34
50	0.735022650	61.86	9.48
51	0.750022500	61.74	9.59
52	0.765022350	61.64	9.69
53	0.780022200	61.55	9.83
54	0.795022050	61.42	9.97
55	0.810021900	61.33	10.08
56	0.825021750	61.21	10.21

57	0.840021600	61.13	10.31
58	0.855021450	60.99	10.40
59	0.870021300	60.88	10.52
60	0.885021150	60.79	10.62
61	0.900021000	60.70	10.71
62	0.915020850	60.58	10.78
63	0.930020700	60.48	10.92
64	0.945020550	60.41	11.03
65	0.960020400	60.31	11.10
66	0.975020250	60.21	11.19
67	0.990020100	60.16	11.30
68	1.005019950	60.05	11.40
69	1.020019800	59.95	11.52
70	1.035019650	59.84	11.65
71	1.050019500	59.76	11.74
72	1.065019350	59.64	11.85
73	1.080019200	59.54	11.93
74	1.095019050	59.40	12.04
75	1.110018900	59.31	12.14
76	1.125018750	59.20	12.22
77	1.140018600	59.11	12.32
78	1.155018450	59.00	12.40
79	1.170018300	58.90	12.48
80	1.185018150	58.79	12.58
81	1.200018000	58.70	12.65
82	1.215017850	58.59	12.72
83	1.230017700	58.46	12.79
84	1.245017550	58.37	12.87
85	1.260017400	58.31	12.94
86	1.275017250	58.21	12.99
87	1.290017100	58.12	13.09
88	1.305016950	58.05	13.17
89	1.320016800	57.98	13.29
90	1.335016650	57.90	13.39
91	1.350016500	57.81	13.46
92	1.365016350	57.69	13.56
93	1.380016200	57.58	13.65
94	1.395016050	57.48	13.74
95	1.410015900	57.38	13.82
96	1.425015750	57.26	13.90
97	1.440015600	57.17	13.95
98	1.455015450	57.06	14.02
99	1.470015300	56.95	14.11
100	1.485015150	56.84	14.14
101	1.500015000	56.75	14.22
102	1.515014850	56.64	14.27
103	1.530014700	56.55	14.33
104	1.545014550	56.49	14.40
105	1.560014400	56.38	14.43
106	1.575014250	56.29	14.49
107	1.590014100	56.19	14.56
108	1.605013950	56.12	14.63
109	1.620013800	56.05	14.70
110	1.635013650	55.95	14.77
111	1.650013500	55.87	14.84
112	1.665013350	55.78	14.90
113	1.680013200	55.67	14.96
114	1.695013050	55.59	15.03
115	1.710012900	55.50	15.06
116	1.725012750	55.39	15.12

117	1.740012600	55.32	15.18	
118	1.755012450	55.23	15.24	
119	1.770012300	55.13	15.30	
120	1.785012150	55.06	15.35	
121	1.800012000	54.97	15.39	→ σ=1.54 mho/m
122	1.815011850	54.87	15.44	
123	1.830011700	54.80	15.48	
124	1.845011550	54.70	15.51	
125	1.860011400	54.61	15.58	
126	1.875011250	54.53	15.61	
127	1.890011100	54.46	15.67	
128	1.905010950	54.40	15.72	
129	1.920010800	54.32	15.75	
130	1.935010650	54.23	15.81	
131	1.950010500	54.16	15.85	
132	1.965010350	54.09	15.90	
133	1.980010200	54.03	15.96	
134	1.995010050	53.95	15.99	
135	2.010009900	53.87	16.06	
136	2.025009750	53.80	16.12	
137	2.040009600	53.73	16.17	
138	2.055009450	53.65	16.22	
139	2.070009300	53.58	16.28	
140	2.085009150	53.48	16.32	
141	2.100009000	53.39	16.38	
142	2.115008850	53.32	16.43	
143	2.130008700	53.25	16.46	
144	2.145008550	53.16	16.50	
145	2.160008400	53.08	16.52	
146	2.175008250	53.00	16.57	
147	2.190008100	52.91	16.62	
148	2.205007950	52.86	16.67	
149	2.220007800	52.80	16.72	
150	2.235007650	52.73	16.75	
151	2.250007500	52.67	16.79	
152	2.265007350	52.61	16.82	
153	2.280007200	52.53	16.87	
154	2.295007050	52.46	16.92	
155	2.310006900	52.39	16.99	
156	2.325006750	52.34	17.05	
157	2.340006600	52.27	17.09	
158	2.355006450	52.21	17.15	
159	2.370006300	52.13	17.19	
160	2.385006150	52.04	17.24	
161	2.400006000	51.95	17.33	
162	2.415005850	51.88	17.38	
163	2.430005700	51.81	17.43	
164	2.445005550	51.75	17.47	
165	2.460005400	51.65	17.50	
166	2.475005250	51.56	17.54	
167	2.490005100	51.48	17.60	
168	2.505004950	51.39	17.65	
169	2.520004800	51.31	17.70	
170	2.535004650	51.26	17.75	
171	2.550004500	51.17	17.76	
172	2.565004350	51.10	17.81	
173	2.580004200	51.01	17.84	
174	2.595004050	50.93	17.87	
175	2.610003900	50.87	17.91	
176	2.625003750	50.79	17.94	

177	2.640003600	50.72	17.99
178	2.655003450	50.64	18.02
179	2.670003300	50.57	18.08
180	2.685003150	50.50	18.12
181	2.700003000	50.42	18.15
182	2.715002850	50.34	18.19
183	2.730002700	50.27	18.23
184	2.745002550	50.19	18.24
185	2.760002400	50.11	18.29
186	2.775002250	50.03	18.33
187	2.790002100	49.97	18.36
188	2.805001950	49.89	18.41
189	2.820001800	49.83	18.43
190	2.835001650	49.74	18.46
191	2.850001500	49.67	18.49
192	2.865001350	49.60	18.51
193	2.880001200	49.50	18.55
194	2.895001050	49.44	18.59
195	2.910000900	49.38	18.60
196	2.925000750	49.30	18.62
197	2.940000600	49.24	18.65
198	2.955000450	49.16	18.67
199	2.970000300	49.08	18.70
200	2.985000150	49.02	18.74
201	3.000000000	48.96	18.77

Reference math : OFF   Title: 07-06-01

FM MUSCLE

Pt#	Frequency (GHz)	Data real	Data imag
1	0.000030000	2810.29	4029.14
2	0.015029850	227.95	369.40
3	0.030029700	90.91	189.71
4	0.045029550	78.64	127.80
5	0.060029400	72.74	97.34
6	0.075029250	70.65	78.88
7	0.090029100	68.95	67.01
8	0.105028950	67.53	58.46
9	0.120028800	66.88	52.15
10	0.135028650	66.27	47.20
11	0.150028500	65.74	43.15
12	0.165028350	65.15	39.95
13	0.180028200	64.84	37.37
14	0.195028050	64.56	35.18
15	0.210027900	64.08	33.35
16	0.225027750	63.87	31.83
17	0.240027600	63.53	30.43
18	0.255027450	63.30	29.27
19	0.270027300	63.00	28.11
20	0.285027150	62.71	27.18
21	0.300027000	62.52	26.35
22	0.315026850	62.26	25.63
23	0.330026700	62.10	24.95
24	0.345026550	61.89	24.36
25	0.360026400	61.71	23.93
26	0.375026250	61.58	23.41
27	0.390026100	61.28	22.97
28	0.405025950	61.14	22.57
29	0.420025800	60.95	22.24
30	0.435025650	60.72	21.90
31	0.450025500	60.60	21.62
32	0.465025350	60.42	21.36
33	0.480025200	60.24	21.12
34	0.495025050	60.12	20.84
35	0.510024900	59.93	20.60
36	0.525024750	59.79	20.45
37	0.540024600	59.64	20.27
38	0.555024450	59.48	20.13
39	0.570024300	59.34	19.94
40	0.585024150	59.15	19.85
41	0.600024000	59.06	19.71
42	0.615023850	58.91	19.62
43	0.630023700	58.75	19.52
44	0.645023550	58.59	19.41
45	0.660023400	58.43	19.34
46	0.675023250	58.30	19.27
47	0.690023100	58.14	19.18
48	0.705022950	58.04	19.14
49	0.720022800	57.87	19.07
50	0.735022650	57.72	19.00
51	0.750022500	57.57	18.97
52	0.765022350	57.46	18.87
53	0.780022200	57.32	18.88
54	0.795022050	57.17	18.81
55	0.810021900	57.05	18.75
56	0.825021750	56.92	18.73

57	0.840021600	56.79	18.72
58	0.855021450	56.63	18.68
59	0.870021300	56.50	18.68
60	0.885021150	56.38	18.64
61	0.900021000	56.27	18.58 → σ=0.93 mho/m
62	0.915020850	56.15	18.56
63	0.930020700	56.00	18.54
64	0.945020550	55.89	18.55
65	0.960020400	55.79	18.53
66	0.975020250	55.69	18.50
67	0.990020100	55.58	18.53
68	1.005019950	55.48	18.49
69	1.020019800	55.34	18.52
70	1.035019650	55.18	18.55
71	1.050019500	55.10	18.55
72	1.065019350	54.98	18.56
73	1.080019200	54.85	18.55
74	1.095019050	54.71	18.55
75	1.110018900	54.57	18.55
76	1.125018750	54.46	18.56
77	1.140018600	54.35	18.58
78	1.155018450	54.24	18.57
79	1.170018300	54.11	18.58
80	1.185018150	54.01	18.58
81	1.200018000	53.87	18.56
82	1.215017850	53.76	18.57
83	1.230017700	53.62	18.57
84	1.245017550	53.52	18.58
85	1.260017400	53.45	18.59
86	1.275017250	53.34	18.55
87	1.290017100	53.25	18.58
88	1.305016950	53.17	18.58
89	1.320016800	53.07	18.62
90	1.335016650	52.97	18.70
91	1.350016500	52.87	18.71
92	1.365016350	52.75	18.74
93	1.380016200	52.64	18.76
94	1.395016050	52.50	18.77
95	1.410015900	52.39	18.80
96	1.425015750	52.26	18.82
97	1.440015600	52.16	18.83
98	1.455015450	52.04	18.85
99	1.470015300	51.94	18.86
100	1.485015150	51.82	18.82
101	1.500015000	51.71	18.84
102	1.515014850	51.61	18.85
103	1.530014700	51.46	18.86
104	1.545014550	51.40	18.88
105	1.560014400	51.31	18.88
106	1.575014250	51.22	18.87
107	1.590014100	51.13	18.88
108	1.605013950	51.05	18.91
109	1.620013800	50.96	18.93
110	1.635013650	50.85	18.96
111	1.650013500	50.75	18.97
112	1.665013350	50.66	18.99
113	1.680013200	50.54	19.00
114	1.695013050	50.44	19.02
115	1.710012900	50.37	19.02
116	1.725012750	50.27	19.03

117	1.740012600	50.17	19.04
118	1.755012450	50.08	19.07
119	1.770012300	49.99	19.08
120	1.785012150	49.89	19.09
121	1.800012000	49.80	19.09
122	1.815011850	49.71	19.11
123	1.830011700	49.62	19.10
124	1.845011550	49.52	19.08
125	1.860011400	49.44	19.12
126	1.875011250	49.35	19.13
127	1.890011100	49.27	19.15
128	1.905010950	49.21	19.14
129	1.920010800	49.12	19.15
130	1.935010650	49.02	19.18
131	1.950010500	48.96	19.18
132	1.965010350	48.90	19.19
133	1.980010200	48.82	19.22
134	1.995010050	48.75	19.22
135	2.010009900	48.65	19.25
136	2.025009750	48.58	19.28
137	2.040009600	48.50	19.29
138	2.055009450	48.42	19.31
139	2.070009300	48.35	19.34
140	2.085009150	48.25	19.35
141	2.100009000	48.16	19.37
142	2.115008850	48.08	19.39
143	2.130008700	48.00	19.39
144	2.145008550	47.92	19.39
145	2.160008400	47.84	19.39
146	2.175008250	47.75	19.41
147	2.190008100	47.66	19.43
148	2.205007950	47.60	19.45
149	2.220007800	47.55	19.47
150	2.235007650	47.48	19.47
151	2.250007500	47.40	19.48
152	2.265007350	47.34	19.51
153	2.280007200	47.25	19.52
154	2.295007050	47.19	19.54
155	2.310006900	47.13	19.59
156	2.325006750	47.07	19.59
157	2.340006600	46.99	19.61
158	2.355006450	46.92	19.65
159	2.370006300	46.84	19.66
160	2.385006150	46.75	19.70
161	2.400006000	46.69	19.75
162	2.415005850	46.60	19.76
163	2.430005700	46.53	19.78
164	2.445005550	46.45	19.79
165	2.460005400	46.35	19.80
166	2.475005250	46.27	19.85
167	2.490005100	46.20	19.86
168	2.505004950	46.11	19.88
169	2.520004800	46.04	19.90
170	2.535004650	45.97	19.90
171	2.550004500	45.88	19.92
172	2.565004350	45.80	19.94
173	2.580004200	45.72	19.95
174	2.595004050	45.64	19.96
175	2.610003900	45.58	19.97
176	2.625003750	45.51	19.97

177	2.640003600	45.44	20.00
178	2.655003450	45.35	20.02
179	2.670003300	45.28	20.05
180	2.685003150	45.21	20.06
181	2.700003000	45.13	20.07
182	2.715002850	45.07	20.10
183	2.730002700	45.01	20.11
184	2.745002550	44.92	20.12
185	2.760002400	44.83	20.13
186	2.775002250	44.74	20.15
187	2.790002100	44.68	20.18
188	2.805001950	44.62	20.18
189	2.820001800	44.55	20.19
190	2.835001650	44.49	20.19
191	2.850001500	44.39	20.21
192	2.865001350	44.32	20.22
193	2.880001200	44.24	20.22
194	2.895001050	44.16	20.24
195	2.910000900	44.11	20.25
196	2.925000750	44.04	20.25
197	2.940000600	43.96	20.26
198	2.955000450	43.91	20.25
199	2.970000300	43.81	20.26
200	2.985000150	43.75	20.29
201	3.000000000	43.69	20.30

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 QCP Inc. 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 QCP 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 antenna retracted and with the antenna extended, 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	MODULATION	CONDUCTED POWER *BEFORE* TEST	ANTENNA POSITION	1 GRAM AVG.SAR (MW/G)	CONDUCTED POWER *AFTER* TEST
824	991	1S2X0115810873	ANALOG	25.90 dBm	Ext	1.03	25.95 dBm
824	991	1S2X0115810873	ANALOG		Ret	1.06	
836.5	383	1S2X0115810873	ANALOG	25.90 dBm	Ext	0.972	26.0 dBm
836.5	383	1S2X0115810873	ANALOG		Ret	1.11	
849	799	1S2X0115810873	ANALOG	25.90 dBm	Ext	1.05	25.97 dBm
849	799	1S2X0115810873	ANALOG		Ret	1.04	
836.5	383	1S2X0115810873	Cellular CDMA	24.90 dBm	Ext	0.787	25.05 dBm
8236.5	383	1S2X0115810873	Cellular CDMA		Ret	0.887	
1851.25	25	1S2X0115810873	PCS CDMA	23.20 dBm	Ext	1.45	23.22 dBm
1851.25	25	1S2X0115810873	PCS CDMA		Ret	1.45	
1880	600	1S2X0115810873	PCS CDMA	23.29 dBm	Ext	1.34	23.20 dBm
1880	600	1S2X0115810873	PCS CDMA		Ret	1.37	
1908.75	1175	1S2X0115810873	PCS CDMA	23.15 dBm	Ext	1.45	23.20 dBm
1908.75	1175	1S2X0115810873	PCS CDMA		Ret	1.47	

The highest SAR (at head) in the cellular band is 1.11 mW/g. The highest SAR (at head) in PCS band is 1.47 mW/g.

The KWC-2255 has provision for headset to allow hands-free operation. But KWC does not provide any body-worn holster. Therefore, the SAR levels were tested with 22.5 mm air space in both cellular and PCS bands. The following is the summary of the results.

Body-worn SAR Test Results

FREQ. MHZ	CH.#	SERIAL NUMBER	MODULATION	CONDUCTED POWER *BEFORE* TEST	ANTENNA POSITION	1 GRAM AVG.SAR (MW/G)	CONDUCTED POWER *AFTER* TEST
824	991	1S2X0115810873	ANALOG	25.95 dBm	Ext	0.386	25.97 dBm
824	991	1S2X0115810873	ANALOG		Ret	0.562	
836.5	383	1S2X0115810873	ANALOG	25.93 dBm	Ext	0.374	25.98 dBm
836.5	383	1S2X0115810873	ANALOG		Ret	0.521	
849	799	1S2X0115810873	ANALOG	25.94 dBm	Ext	0.359	26.0 dBm
849	799	1S2X0115810873	ANALOG		Ret	0.478	
824.7	1013	1S2X0115810873	Cellular CDMA	24.94 dBm	Ext	0.322	25.05 dBm
824.7	1013	1S2X0115810873	Cellular CDMA		Ret	0.471	
1851.25	25	1S2X0115810873	PCS CDMA	23.18 dBm	Ext	0.400	23.22 dBm
1851.25	25	1S2X0115810873	PCS CDMA		Ret	0.297	
1880	600	1S2X0115810873	PCS CDMA	23.24 dBm	Ext	0.334	23.17 dBm
1880	600	1S2X0115810873	PCS CDMA		Ret	0.292	
1908.75	1175	1S2X0115810873	PCS CDMA	23.20 dBm	Ext	0.335	23.20 dBm
1908.75	1175	1S2X0115810873	PCS CDMA		Ret	0.308	

With 22.5mm separation, the highest body-worn SAR is 0.562 mW/g.

Note, the following statements contain in the User’s Guide.

> *To comply with FCC radiation exposure requirments, accessories used with KWC-2255 for body-worn operations must not contain any metallic components and must provide at least 22.5mm separation distance including the antenna and the user’s body.*

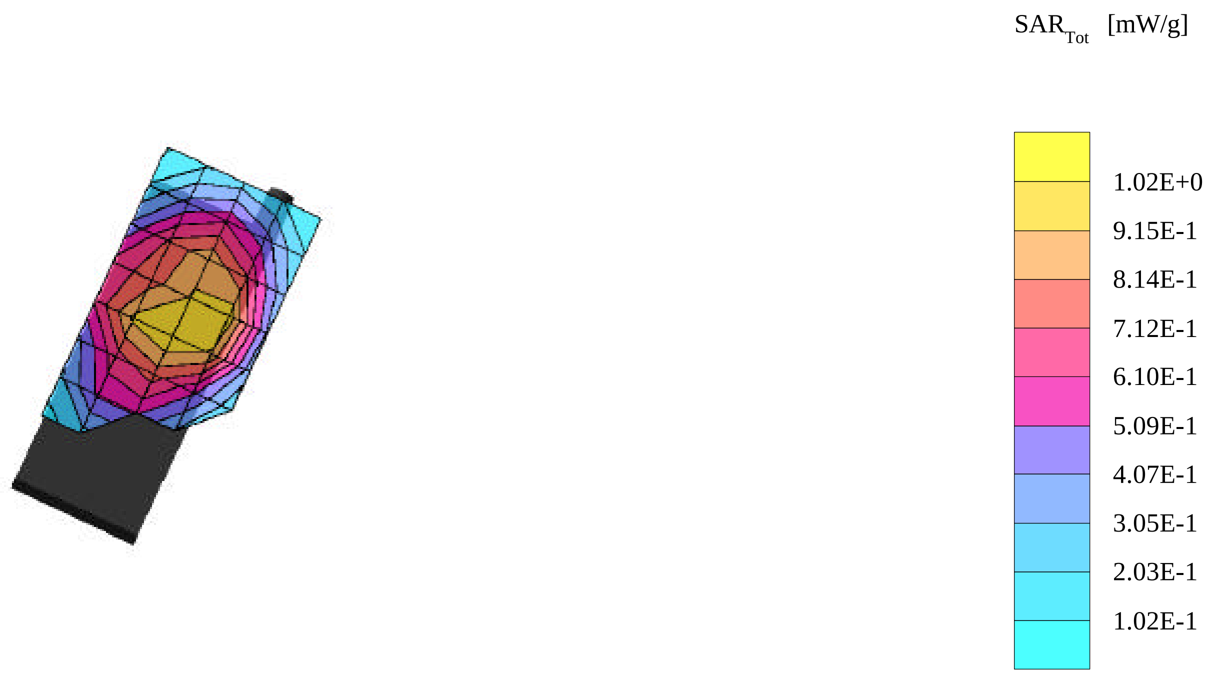
11 SAR PLOTS

KWC-2255, #0873, FM Ch799, conducted power=25.9dBm

SAR (1g): 1.03 [mW/g] ± 0.01 dB, SAR (10g): 0.761 [mW/g] ± 0.06 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, FM ch991, Conducted Power = 25.9dBm.DA3
Operator: DWS

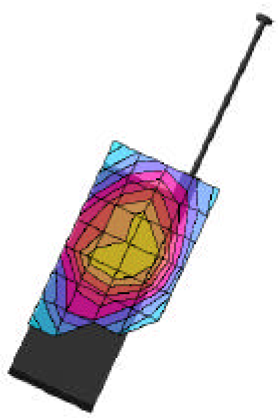
KWC-2255, #0873, FM Ch799, conducted power=25.9dBm

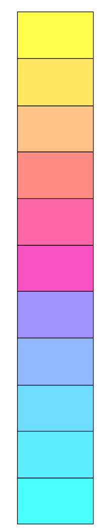
SAR (1g): 1.06 [mW/g] ± 0.00 dB, SAR (10g): 0.758 [mW/g] ± 0.01 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, FM ch991, Conducted Power = 25.9dBm.DA3
Operator: DWS



KWC-2255, #0873, FM Ch383, conducted power=25.9dBm

SAR (1g): 0.972 [mW/g] ± 0.02 dB, SAR (10g): 0.721 [mW/g] ± 0.01 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, FM ch383, Conducted Power = 25.9dBm.DA3
Operator: DWS





KWC-2255, #0873, FM Ch383, conducted power=25.9dBm

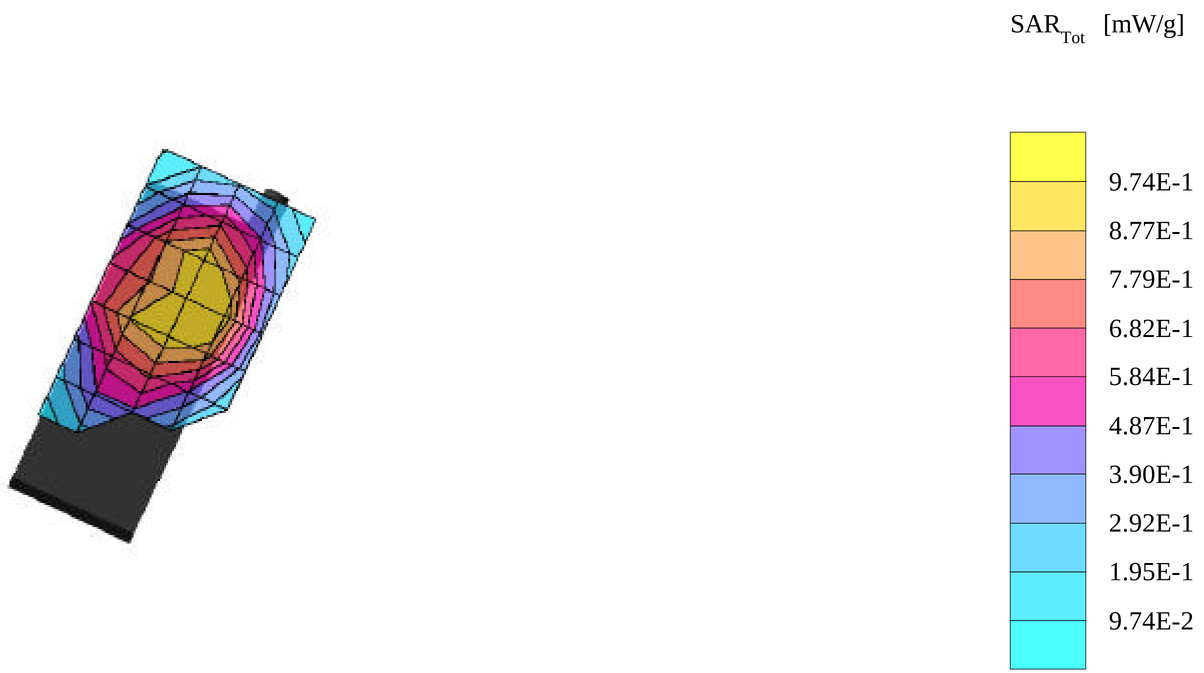
SAR (1g): 1.11 [mW/g] ± 0.09 dB, SAR (10g): 0.788 [mW/g] ± 0.12 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ϵ_r = 42.3 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, FM ch383, Conducted Power = 25.9dBm.DA3
Operator: DWS

KWC-2255, #0873, FM Ch799, conducted power=25.9dBm

SAR (1g): 1.05 [mW/g] ± 0.04 dB, SAR (10g): 0.756 [mW/g] ± 0.10 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, FM ch799, Conducted Power = 25.9dBm.DA3
Operator: DWS

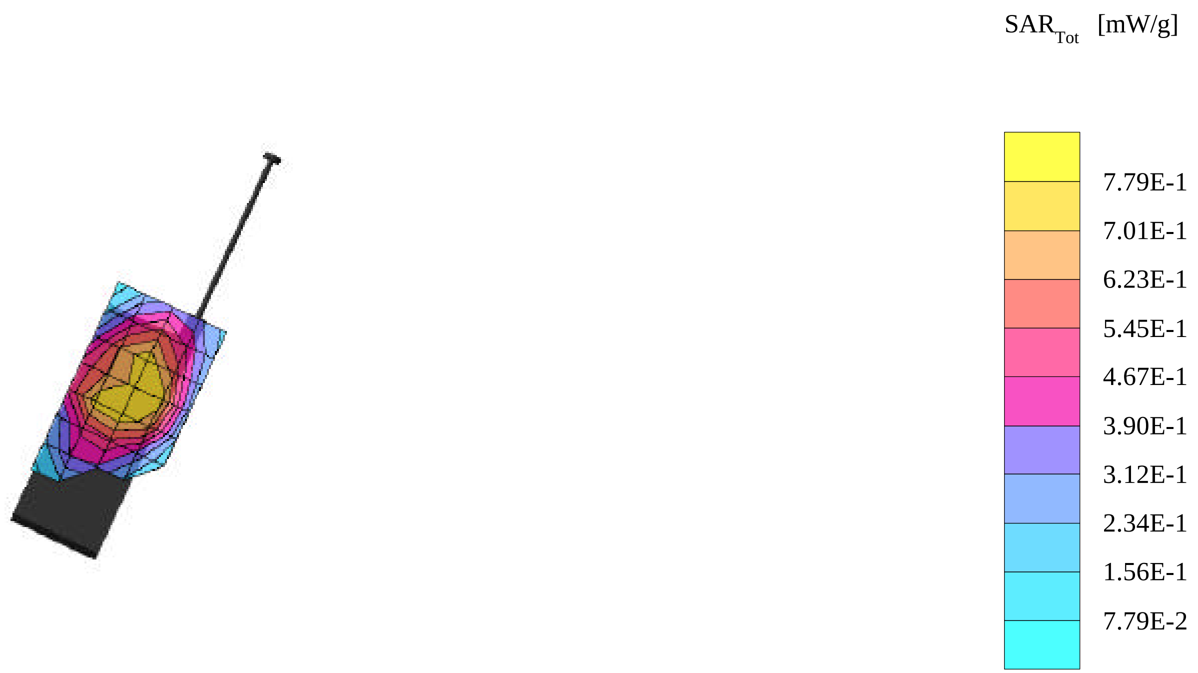
KWC-2255, #0873, FM Ch799, conducted power=25.9dBm

SAR (1g): 1.04 [mW/g] ± 0.02 dB, SAR (10g): 0.726 [mW/g] ± 0.07 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, FM ch799, Conducted Power = 25.9dBm.DA3
Operator: DWS



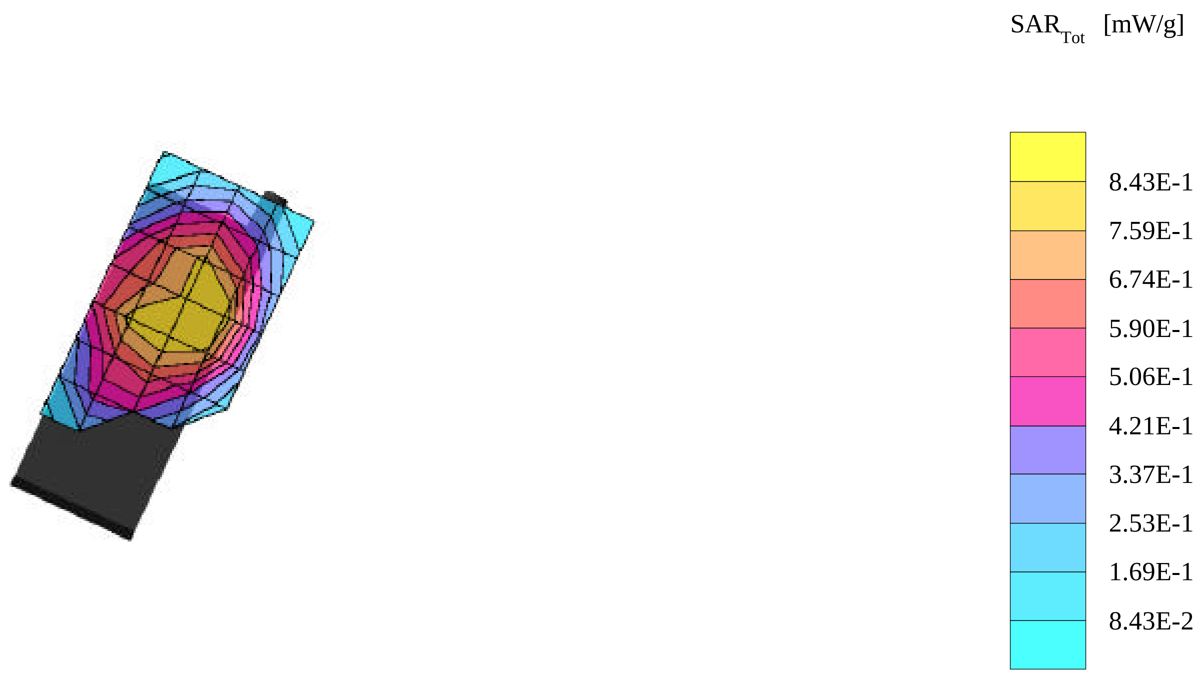
KWC-2255, #0873, CDMA Ch383, conducted power=24.9dBm

SAR (1g): 0.787 [mW/g] ± 0.08 dB, SAR (10g): 0.576 [mW/g] ± 0.02 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, CDMA ch383, Conducted Power = 24.9dBm.DA3
Operator: DWS



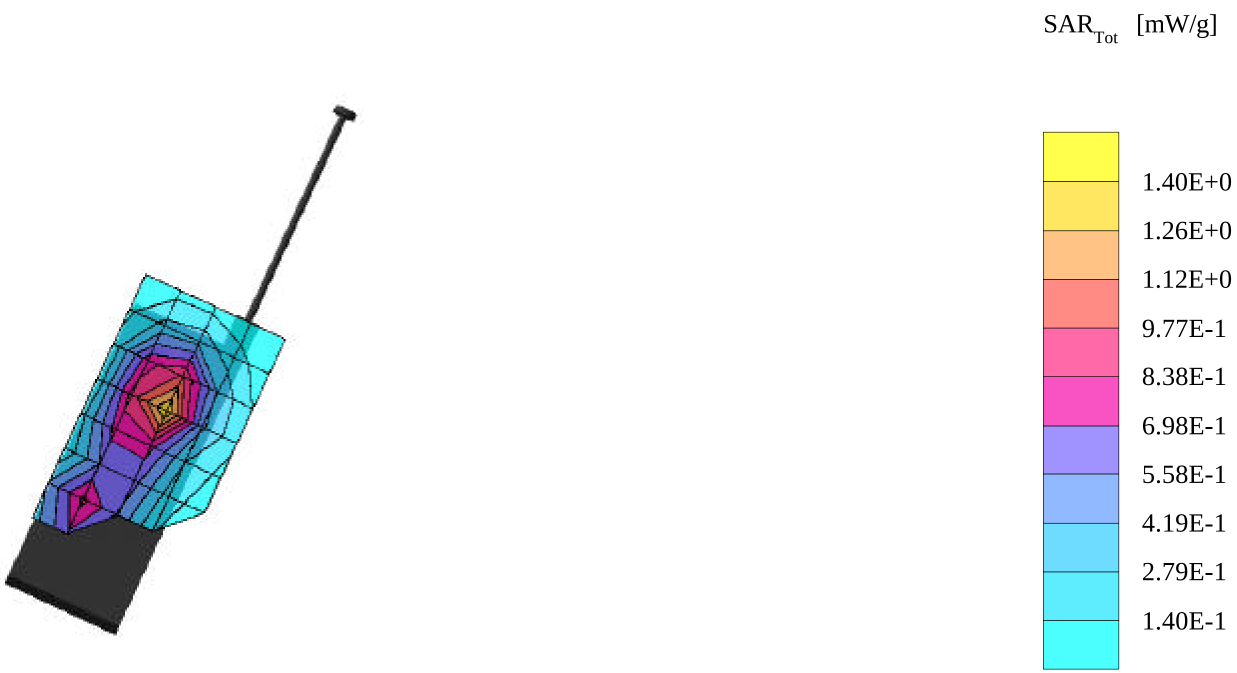
KWC-2255, #0873, CDMA Ch383, conducted power=24.9dBm

SAR (1g): 0.887 [mW/g] ± 0.04 dB, SAR (10g): 0.627 [mW/g] ± 0.06 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.70,5.70,5.70)
Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 42.3 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, CDMA ch383, Conducted Power = 24.9dBm.DA3
Operator: DWS



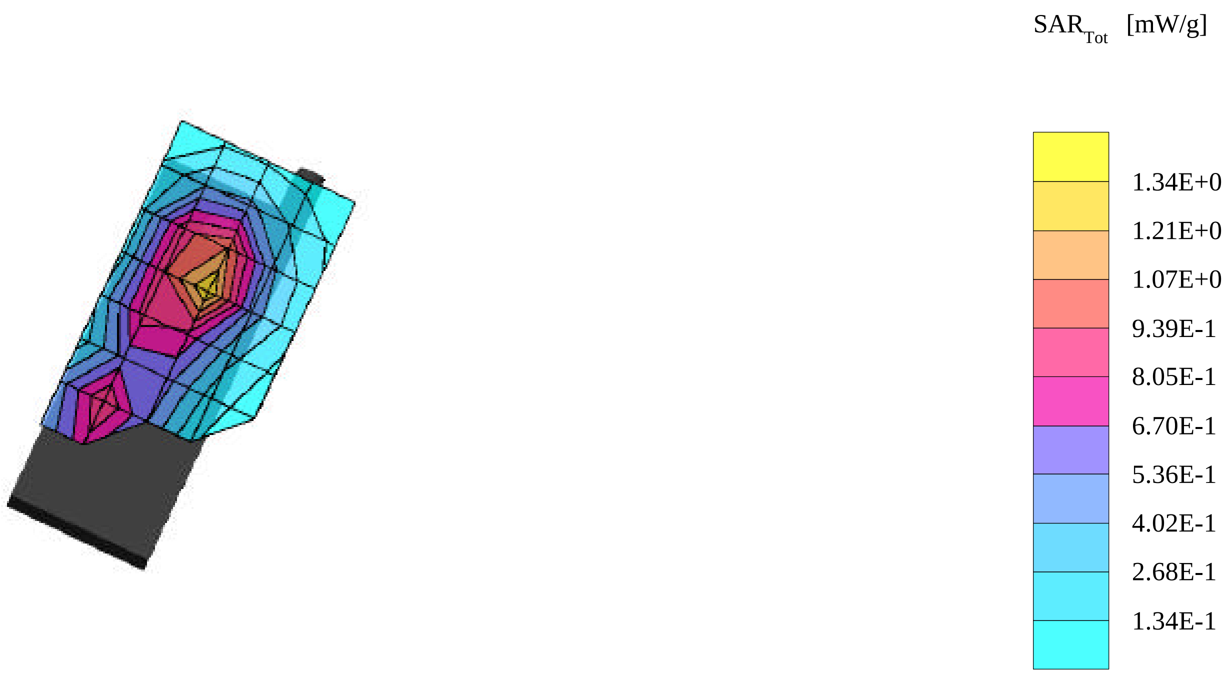
KWC-2255, #0873, PCS Ch25, conducted power=23.2dBm

SAR (1g): 1.45 [mW/g] ± 0.01 dB, SAR (10g): 0.769 [mW/g] ± 0.04 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 41.4 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, PCS ch25, Conducted Power = 23.2dBm, 07-05-01.DA3
Operator: DWS

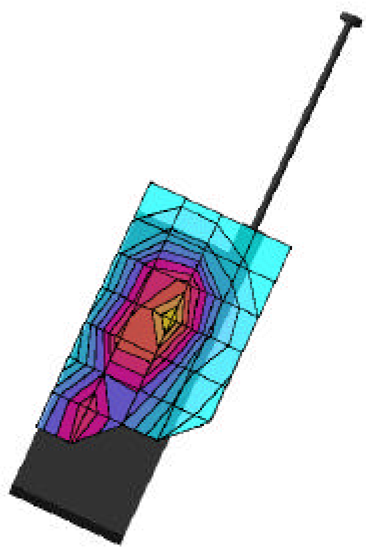


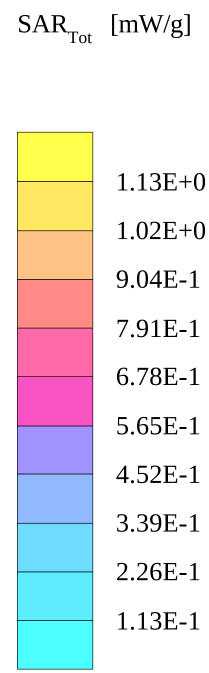
KWC-2255, #0873, PCS Ch25, conducted power=23.2dBm

SAR (1g): 1.45 [mW/g] ± 0.07 dB, SAR (10g): 0.787 [mW/g] ± 0.02 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 41.4 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, PCS ch25, Conducted Power = 23.2dBm, 07-05-01.DA3
Operator: DWS



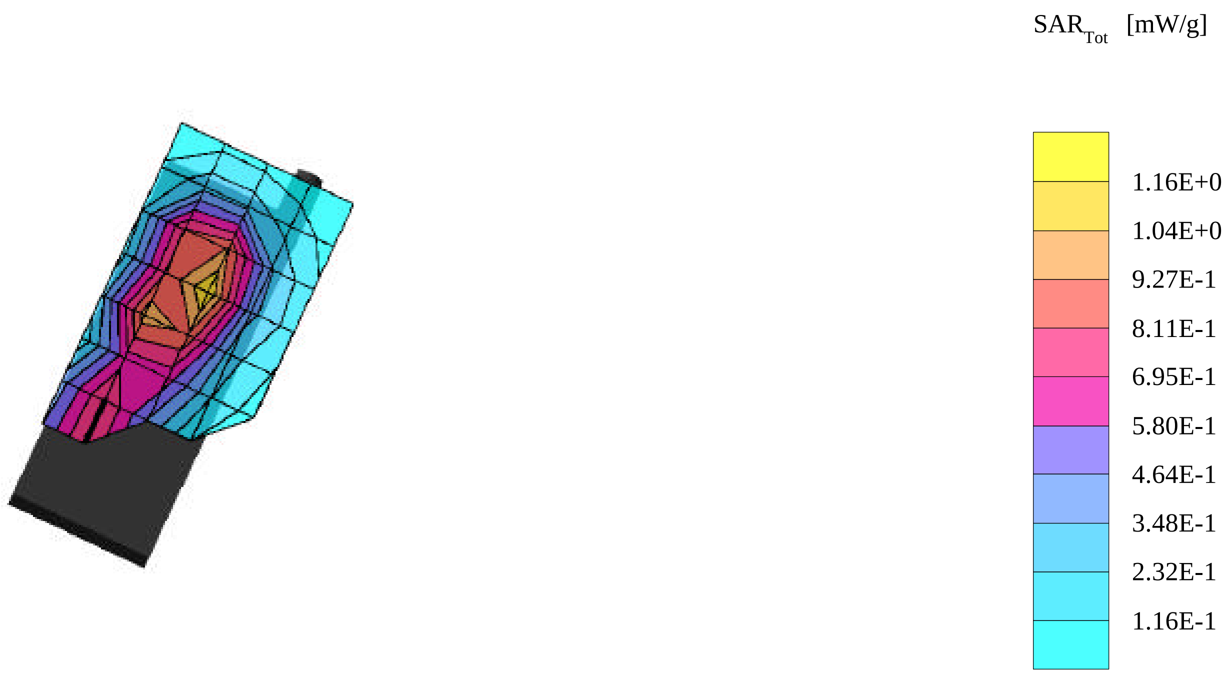
KWC-2255, #0873, PCS Ch600, conducted power=23.2dBm
SAR (1g): 1.34 [mW/g] ± 0.03 dB, SAR (10g): 0.687 [mW/g] ± 0.05 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 41.4 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, PCS ch600, Conducted Power = 23.2dBm, 07-05-01.DA3
Operator: DWS





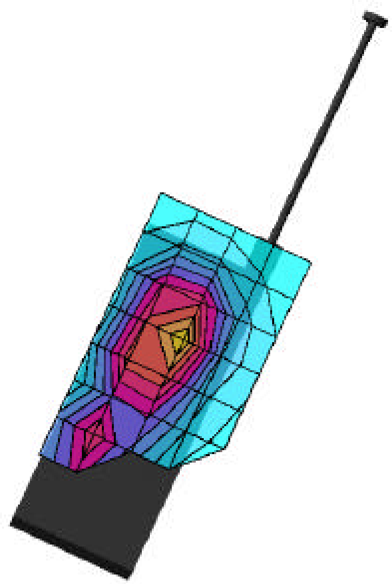
KWC-2255, #0873, PCS Ch600, conducted power=23.2dBm

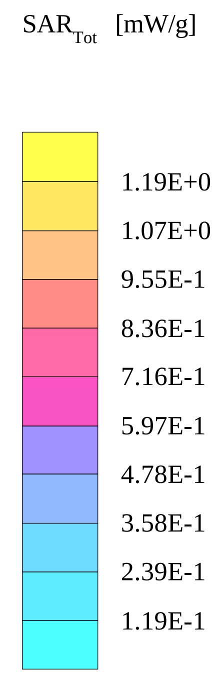
SAR (1g): 1.37 [mW/g] ± 0.02 dB, SAR (10g): 0.709 [mW/g] ± 0.04 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 41.4 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, PCS ch600, Conducted Power = 23.2dBm, 07-05-01.DA3
Operator: DWS



KWC-2255, #0873, PCS Ch1175, conducted power=23.2dBm

SAR (1g): 1.45 [mW/g] ± 0.03 dB, SAR (10g): 0.743 [mW/g] ± 0.01 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 41.4 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, PCS ch1175, Conducted Power = 23.2dBm, 07-05-01.DA3
Operator: DWS





KWC-2255, #0873, PCS Ch1175, conducted power=23.2dBm

SAR (1g): 1.47 [mW/g] ± 0.12 dB, SAR (10g): 0.760 [mW/g] ± 0.05 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Left Hand Section
Probe: ET3DV5 - SN1353; ConvF(5.00,5.00,5.00)
Brain 1800 MHz: σ = 1.67 [mho/m] ε_r = 41.4 ρ = 1.00 [g/cm³]
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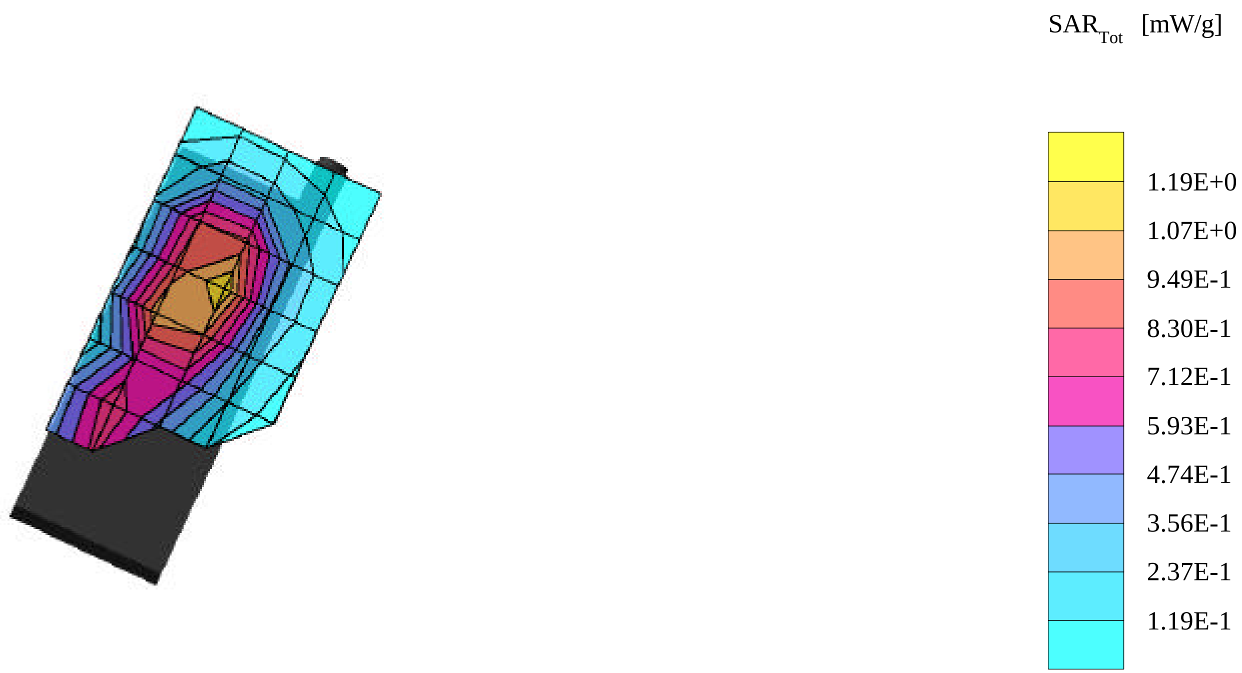
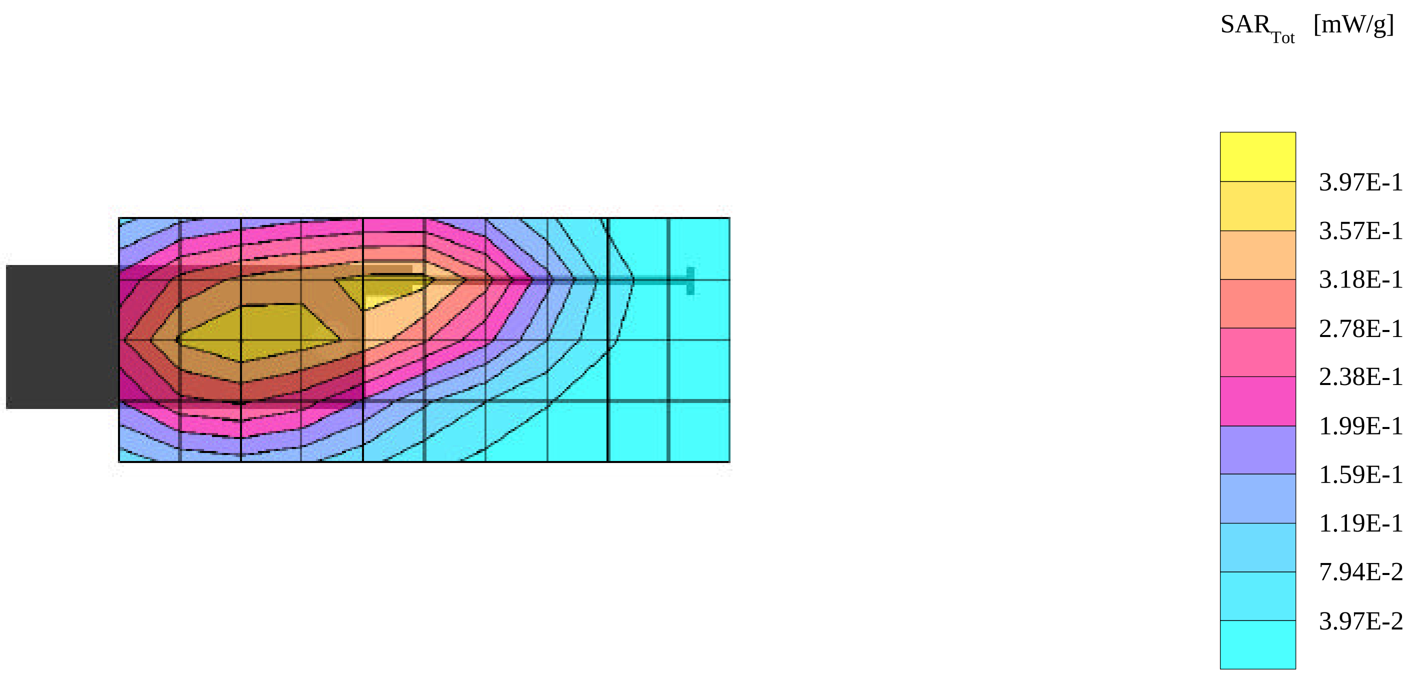
Operator: DWS



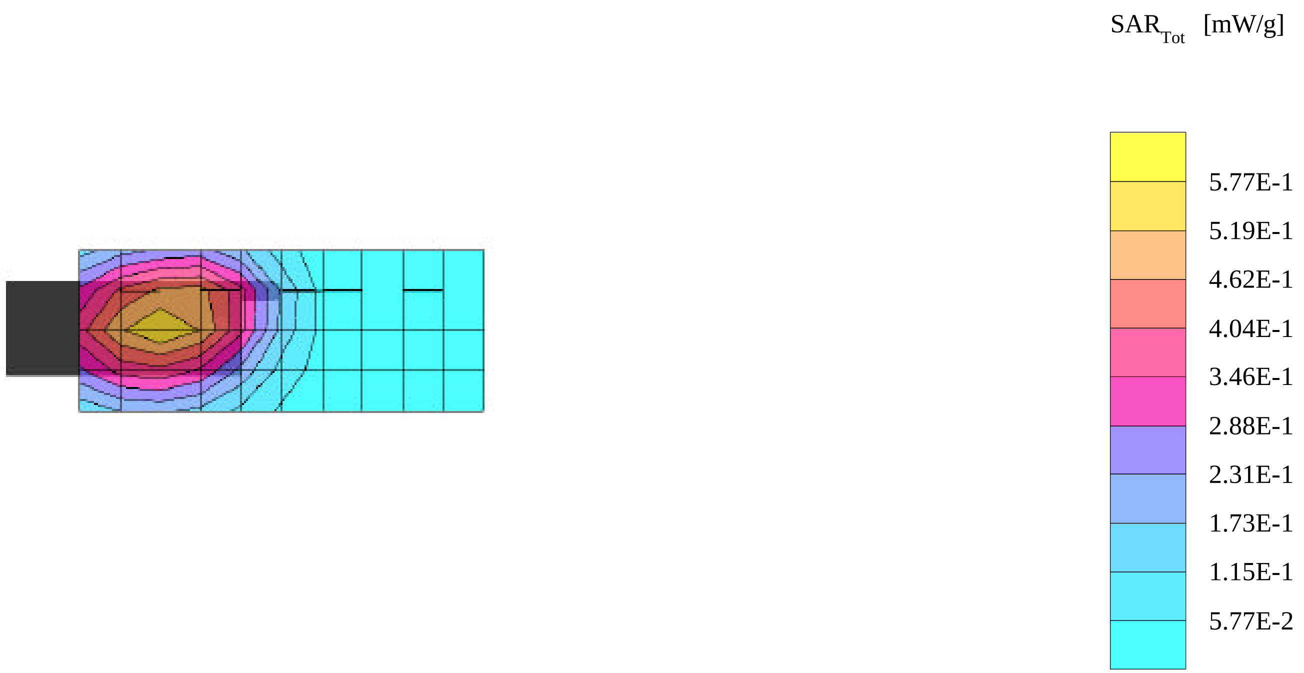
KWC-2255, #0873, FM Ch991, tested at waist level, Conducted Power = 25.9dBm, 22.5mm space

SAR (1g): 0.386 [mW/g] ± 0.01 dB, SAR (10g): 0.291 [mW/g] ± 0.01 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.36,5.36,5.36)
Muscle 900 MHz: σ = 0.93 [mho/m] ε_r = 56.3 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, FM ch991, Conducted Power = 25.9dBm, Muscle without bc.DA3
Operator: DWS



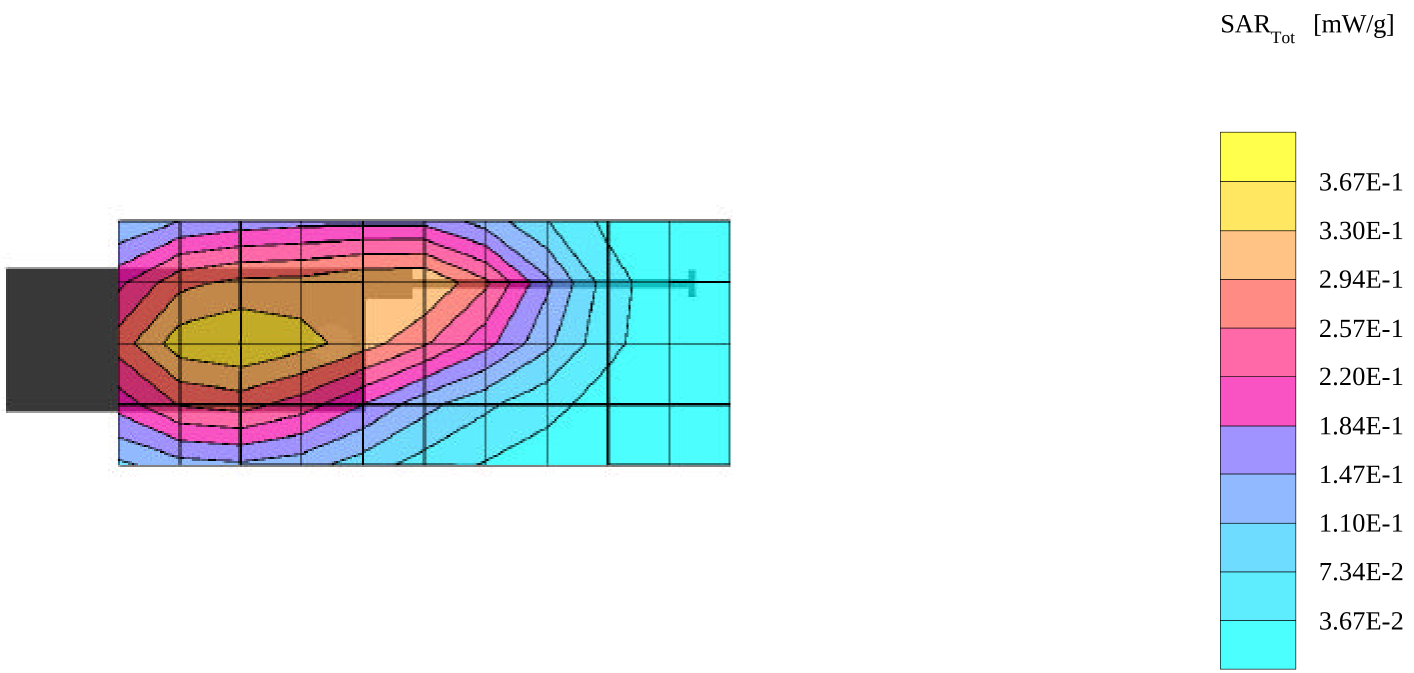
KWC-2255, #0873, FM Ch991, tested at waist level, Conducted Power = 25.9dBm, 22.5mm space

SAR (1g): 0.562 [mW/g] ± 0.06 dB, SAR (10g): 0.422 [mW/g] ± 0.05 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.36,5.36,5.36)
Muscle 900 MHz: σ = 0.93 [mho/m] ε_r = 56.3 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, FM ch991, Conducted Power = 25.9dBm, Muscle without bc.DA3
Operator: DWS



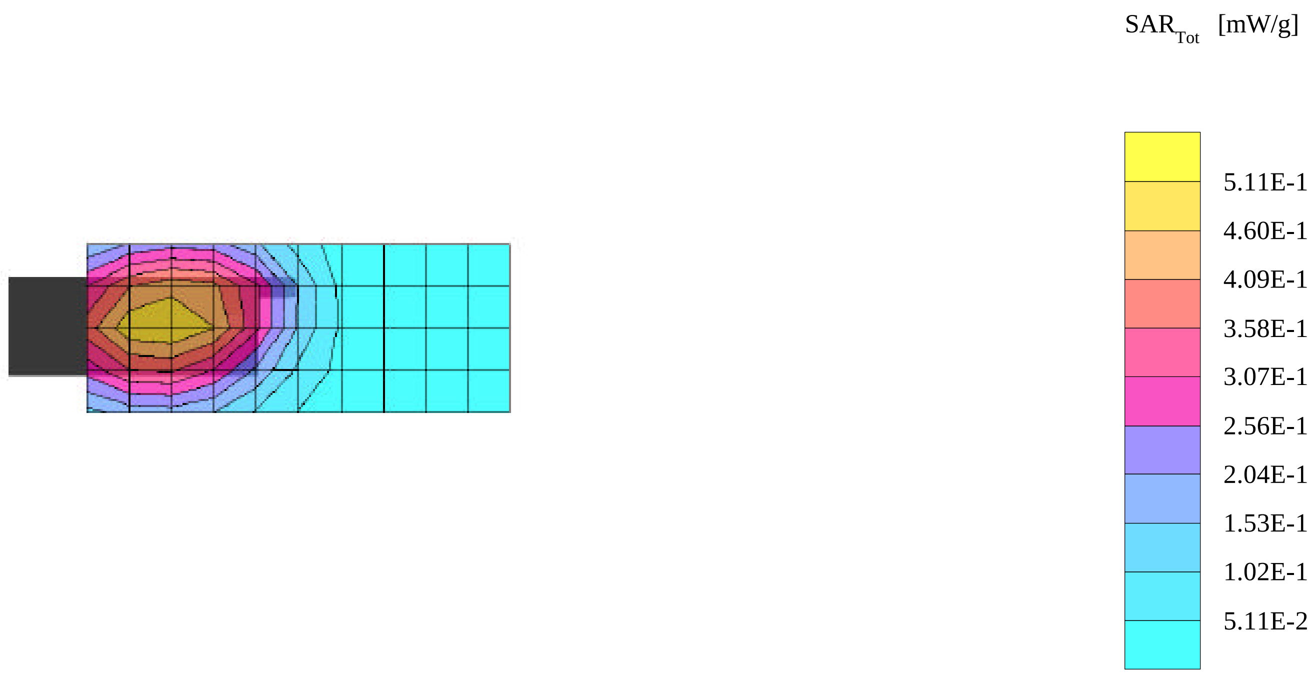
KWC-2255, #0873, FM Ch383, tested at waist level, Conducted Power = 25.9dBm, 22.5mm space

SAR (1g): 0.374 [mW/g] ± 0.01 dB, SAR (10g): 0.283 [mW/g] ± 0.01 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.36,5.36,5.36)
Muscle 900 MHz: σ = 0.93 [mho/m] ε_r = 56.3 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, FM ch383, Conducted Power = 25.9dBm, Muscle without bc.DA3
Operator: DWS



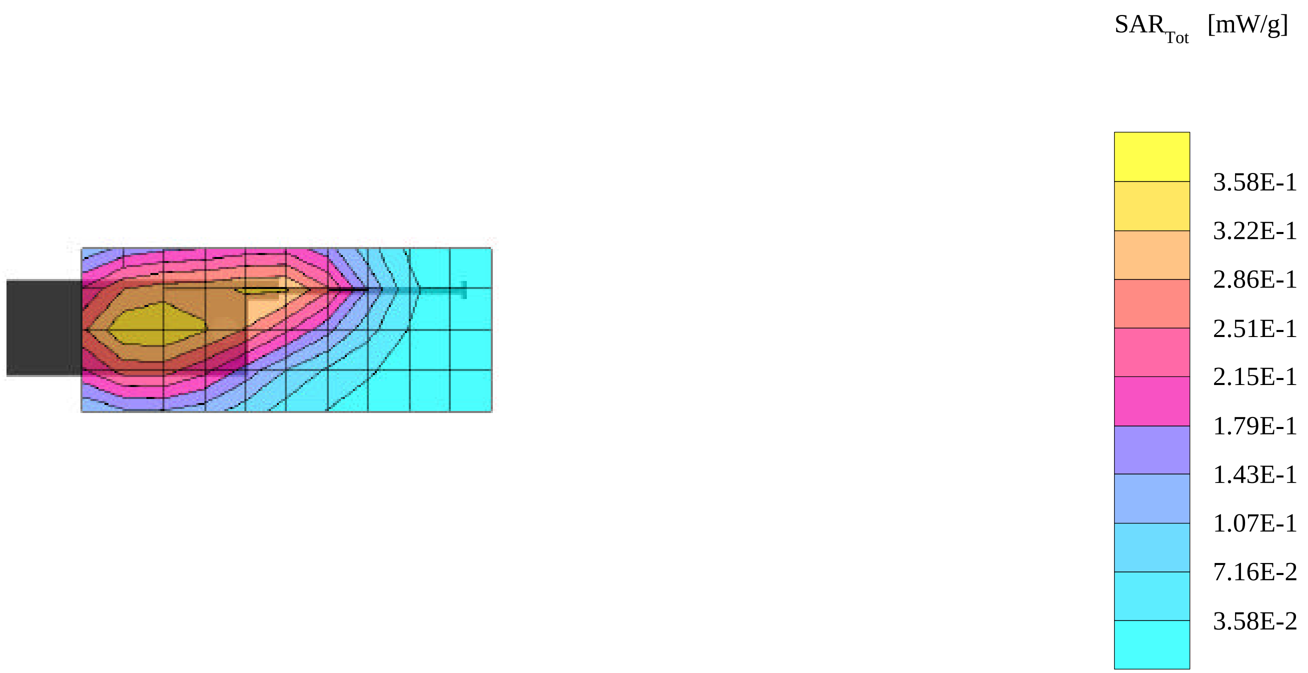
KWC-2255, #0873, FM Ch383, tested at waist level, Conducted Power = 25.9dBm, 22.5mm space

SAR (1g): 0.521 [mW/g] ± 0.06 dB, SAR (10g): 0.393 [mW/g] ± 0.05 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.36,5.36,5.36)
Muscle 900 MHz: σ = 0.93 [mho/m] ε_r = 56.3 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, FM ch383, Conducted Power = 25.9dBm, Muscle without bc.DA3
Operator: DWS



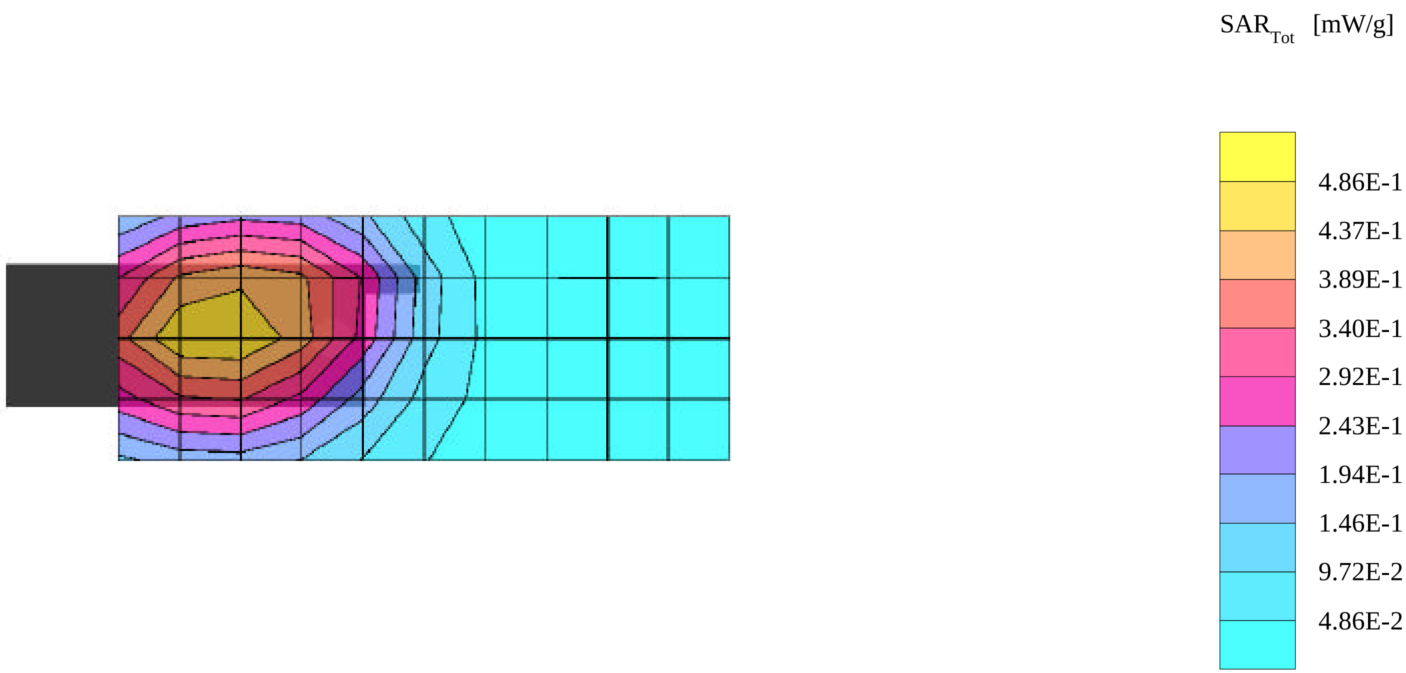
KWC-2255, #0873, FM Ch799, tested at waist level, Conducted Power = 25.9dBm, 22.5mm space

SAR (1g): 0.359 [mW/g] ± 0.07 dB, SAR (10g): 0.271 [mW/g] ± 0.07 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.36,5.36,5.36)
Muscle 900 MHz: σ = 0.93 [mho/m] ε_r = 56.3 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, FM ch799, Conducted Power = 25.9dBm, Muscle without bc.DA3
Operator: DWS



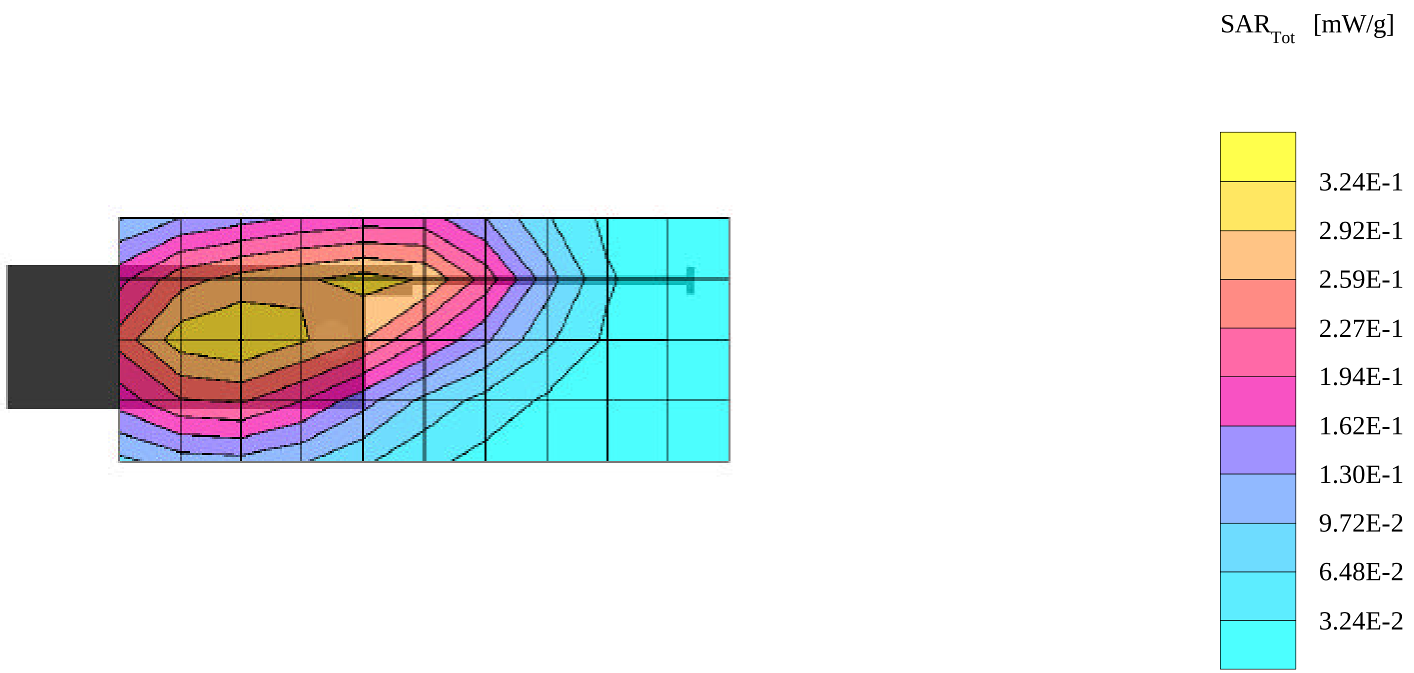
KWC-2255, #0873, FM Ch799, tested at waist level, Conducted Power = 25.9dBm, 22.5mm space

SAR (1g): 0.478 [mW/g] ± 0.00 dB, SAR (10g): 0.359 [mW/g] ± 0.01 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.36,5.36,5.36)
Muscle 900 MHz: σ = 0.93 [mho/m] ε_r = 56.3 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, FM ch799, Conducted Power = 25.9dBm, Muscle without bc.DA3
Operator: DWS



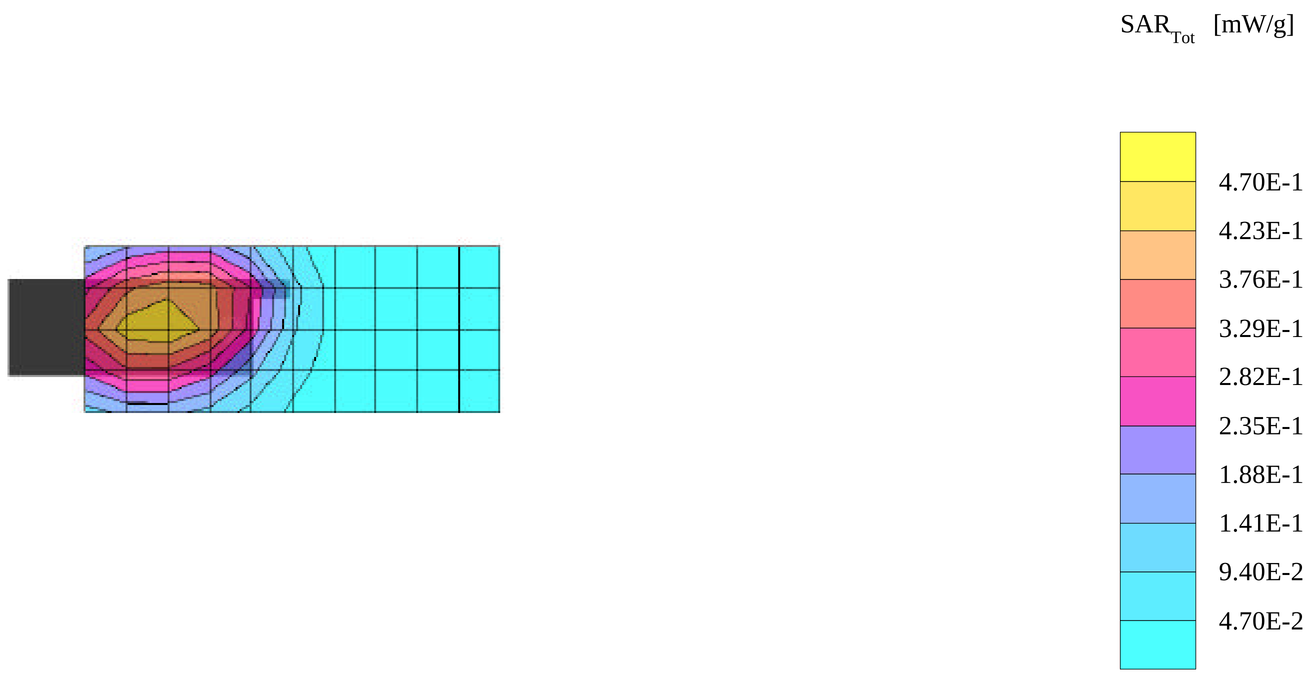
KWC-2255, #0873, CDMA Ch1013, tested at waist level, Conducted Power = 24.9dBm, 22.5mm space

SAR (1g): 0.322 [mW/g] ± 0.01 dB, SAR (10g): 0.244 [mW/g] ± 0.01 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.36,5.36,5.36)
Muscle 900 MHz: σ = 0.93 [mho/m] ε_r = 56.3 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, CDMA ch1013, Conducted Power = 24.9dBm, Muscle without bc.DA3
Operator: DWS



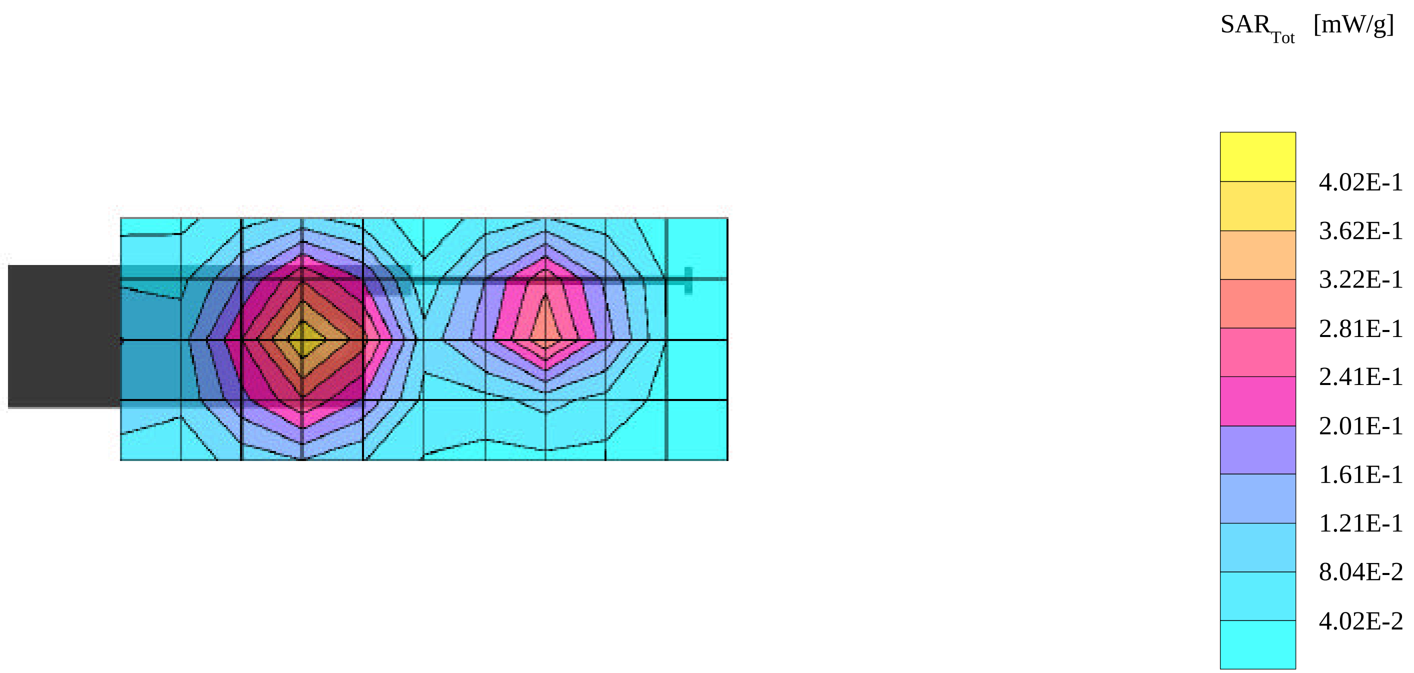
KWC-2255, #0873, CDMA Ch1013, tested at waist level, Conducted Power = 24.9dBm, 22.5mm space

SAR (1g): 0.471 [mW/g] ± 0.00 dB, SAR (10g): 0.353 [mW/g] ± 0.01 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(5.36,5.36,5.36)
Muscle 900 MHz: σ = 0.93 [mho/m] ε_r = 56.3 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, CDMA ch1013, Conducted Power = 24.9dBm, Muscle without bc.DA3
Operator: DWS



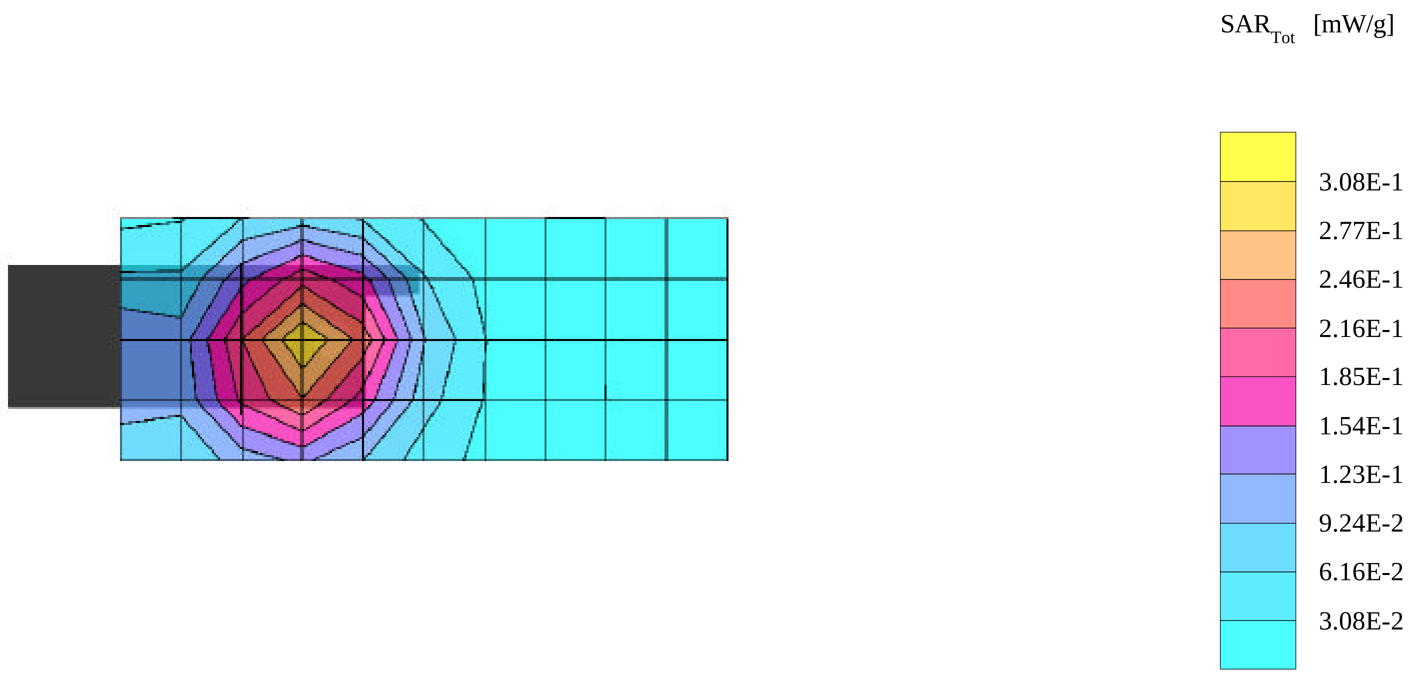
KWC-2255, #0873, PCS Ch25, tested at waist level, Conducted Power = 23.2dBm, 22.5mm space

SAR (1g): 0.400 [mW/g] ± 0.07 dB, SAR (10g): 0.250 [mW/g] ± 0.06 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(4.50,4.50,4.50)
Muscle 1800 MHz: σ = 1.54 [mho/m] ε_r = 55.0 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, PCS ch25, Conducted Power = 23.2dBm, Muscle without bc.DA3
Operator: DWS



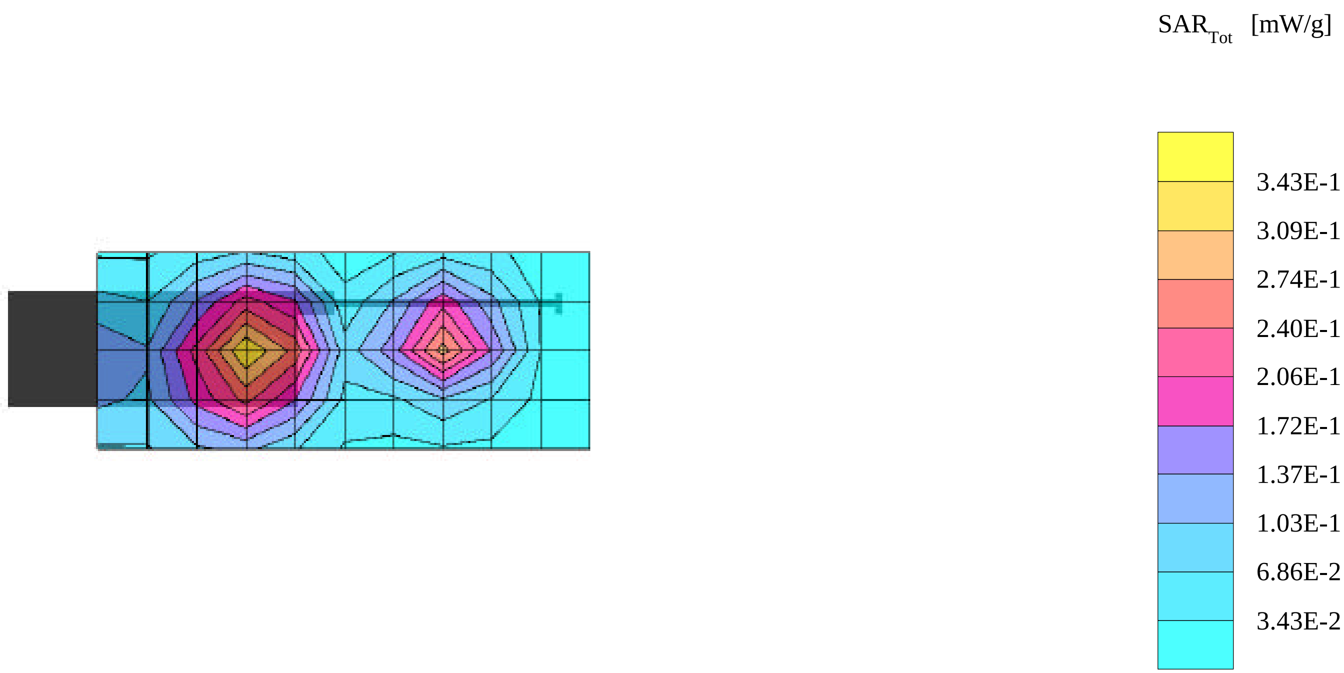
KWC-2255, #0873, PCS Ch25, tested at waist level, Conducted Power = 23.2dBm, 22.5mm space

SAR (1g): 0.297 [mW/g] ± 0.00 dB, SAR (10g): 0.191 [mW/g] ± 0.00 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(4.50,4.50,4.50)
Muscle 1800 MHz: σ = 1.54 [mho/m] ε_r = 55.0 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, PCS ch25, Conducted Power = 23.2dBm, Muscle without bc.DA3
Operator: DWS



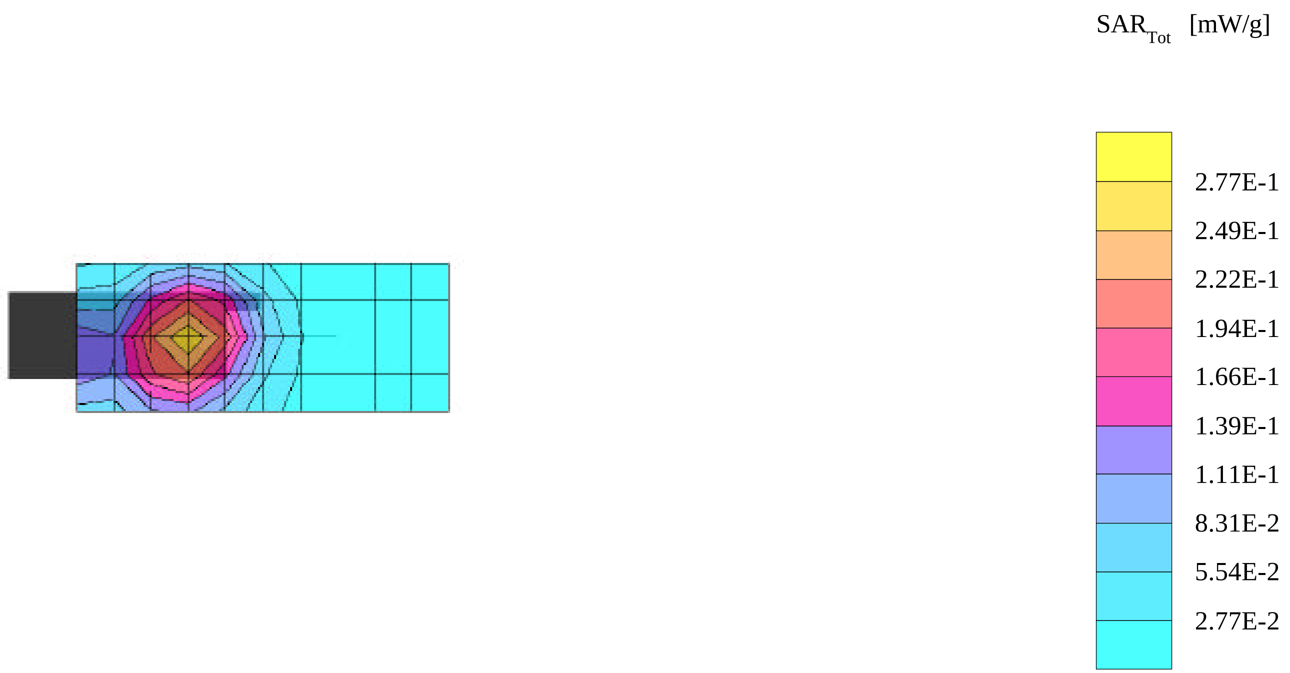
KWC-2255, #0873, PCS Ch600, tested at waist level, Conducted Power = 23.2dBm, 22.5mm space

SAR (1g): 0.334 [mW/g] ± 0.05 dB, SAR (10g): 0.210 [mW/g] ± 0.07 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(4.50,4.50,4.50)
Muscle 1800 MHz: σ = 1.54 [mho/m] ε_r = 55.0 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, PCS ch600, Conducted Power = 23.2dBm, Muscle without bc.DA3
Operator: DWS



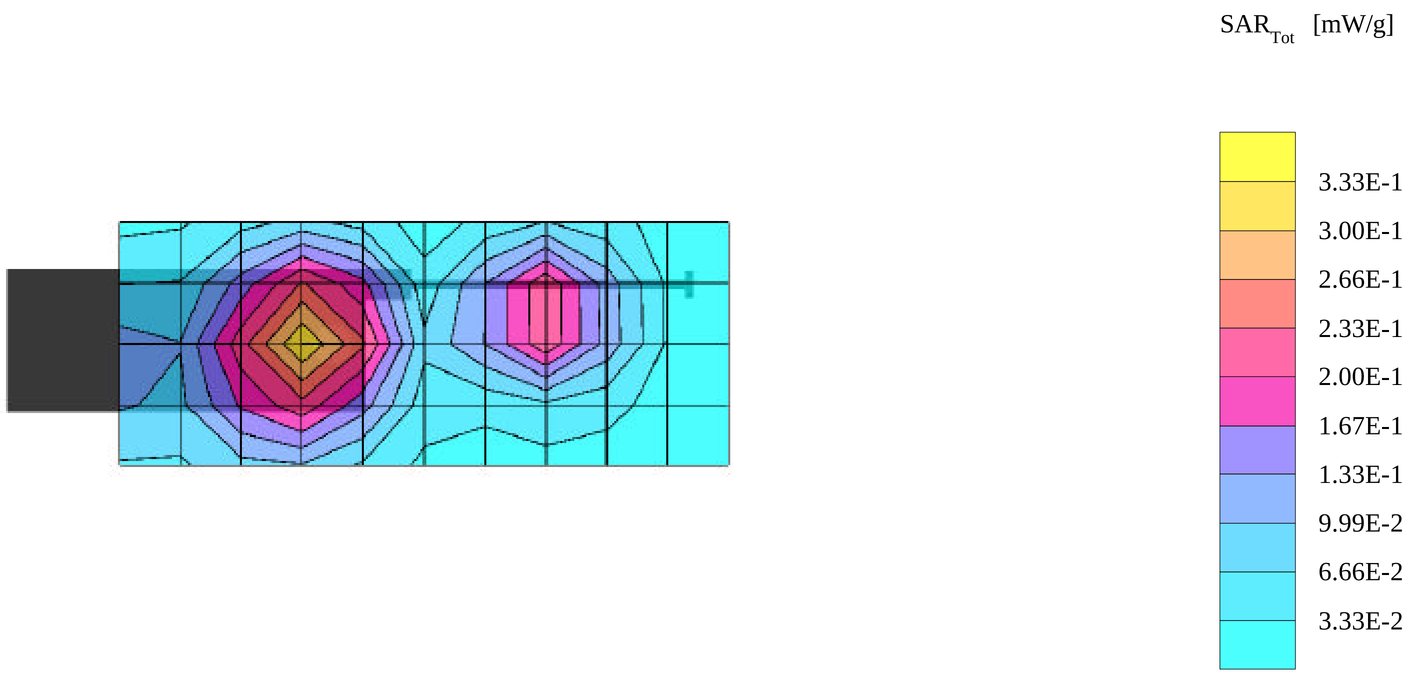
KWC-2255, #0873, PCS Ch600, tested at waist level, Conducted Power = 23.2dBm, 22.5mm space

SAR (1g): 0.292 [mW/g] ± 0.40 dB, SAR (10g): 0.184 [mW/g] ± 0.35 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(4.50,4.50,4.50)
Muscle 1800 MHz: σ = 1.54 [mho/m] ε_r = 55.0 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, PCS ch600, Conducted Power = 23.2dBm, Muscle without bc.DA3
Operator: DWS



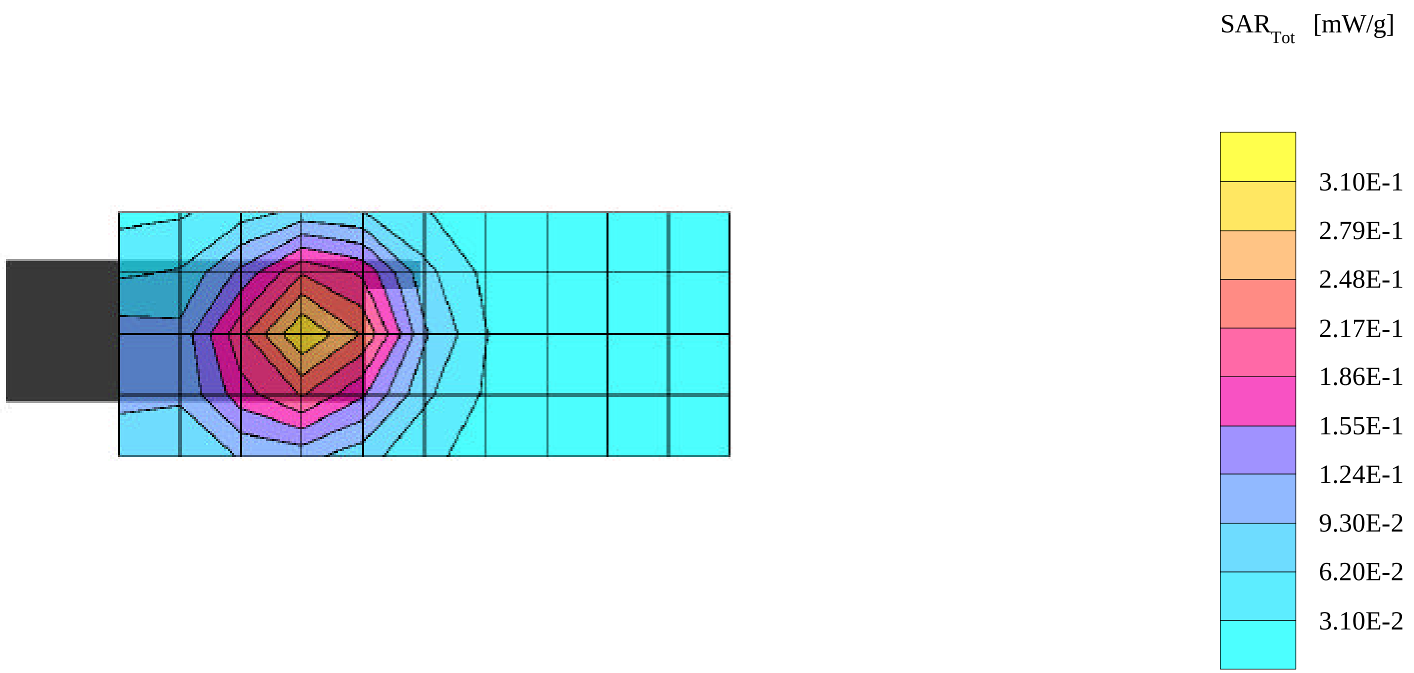
KWC-2255, #0873, PCS Ch1175, tested at waist level, Conducted Power = 23.2dBm, 22.5mm space

SAR (1g): 0.335 [mW/g] ± 0.10 dB, SAR (10g): 0.208 [mW/g] ± 0.08 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(4.50,4.50,4.50)
Muscle 1800 MHz: σ = 1.54 [mho/m] ε_r = 55.0 ρ = 1.00 [g/cm^3]
File Name: KWC-2255, #0873, PCS ch1175, Conducted Power = 23.2dBm, Muscle without bc.DA3
Operator: DWS



KWC-2255, #0873, PCS Ch1175, tested at waist level, Conducted Power = 23.2dBm, 22.5mm space

SAR (1g): 0.308 [mW/g] ± 0.00 dB, SAR (10g): 0.192 [mW/g] ± 0.02 dB
Cubes (2) (Worst-case extrapolation)
Generic Twin Phantom; Flat Section
Probe: ET3DV5 - SN1353; ConvF(4.50,4.50,4.50)
Muscle 1800 MHz: σ = 1.54 [mho/m] ε_r = 55.0 ρ = 1.00 [g/cm³]
File Name: KWC-2255, #0873, PCS ch1175, Conducted Power = 23.2dBm, Muscle without bc.DA3
Operator: DWS



12 PHOTOS

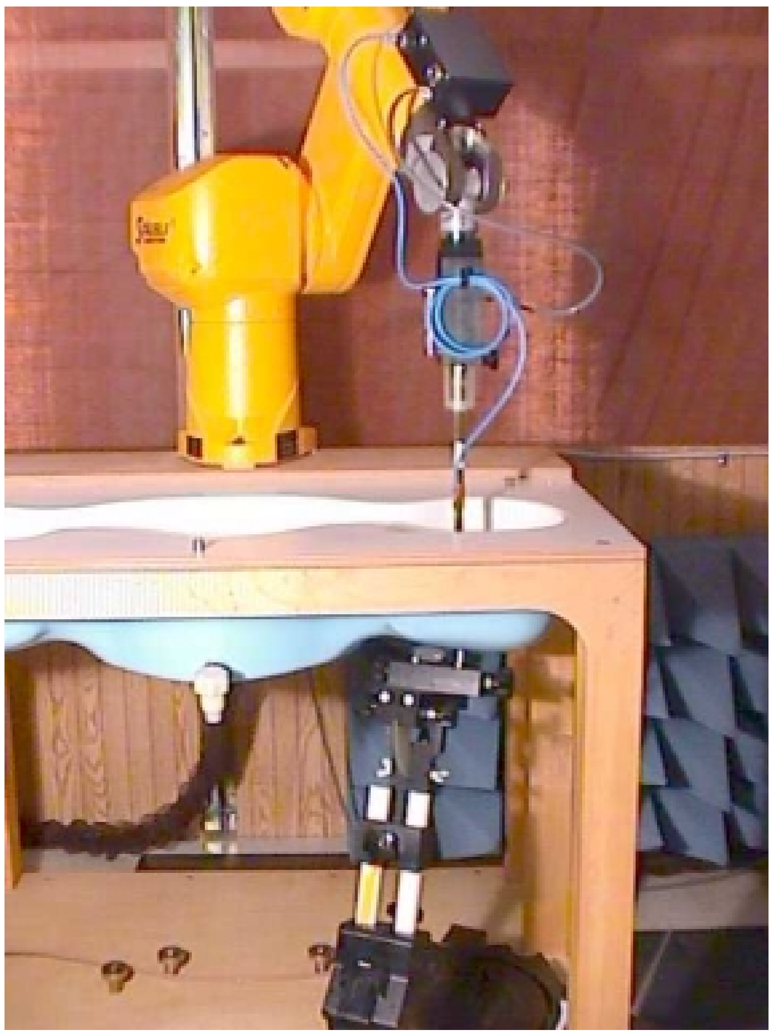
KWC-2255

SAR Tester

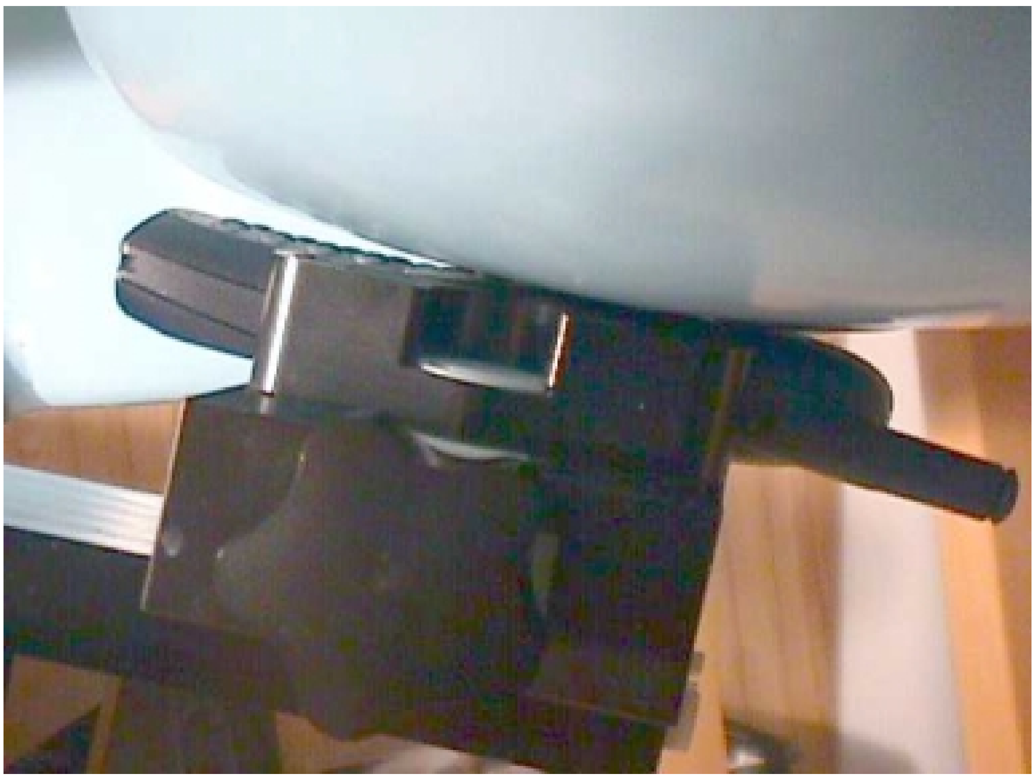
SAR Probe

Left Head SAR Test

(a)



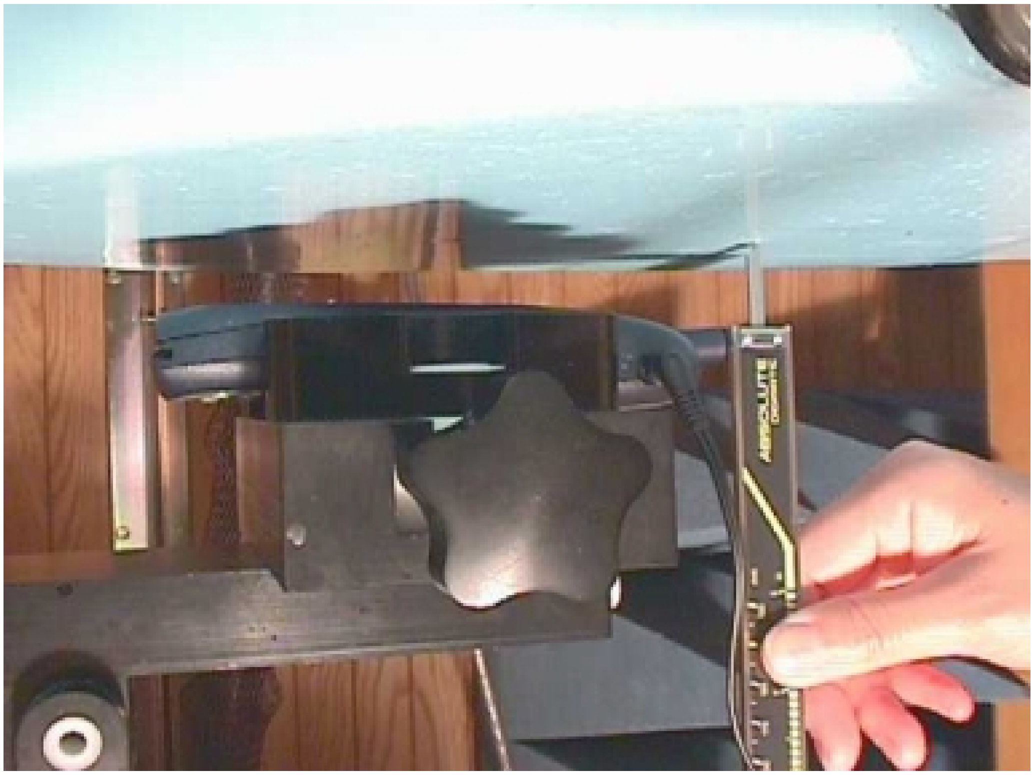
(b)



Body-Worn SAR Test

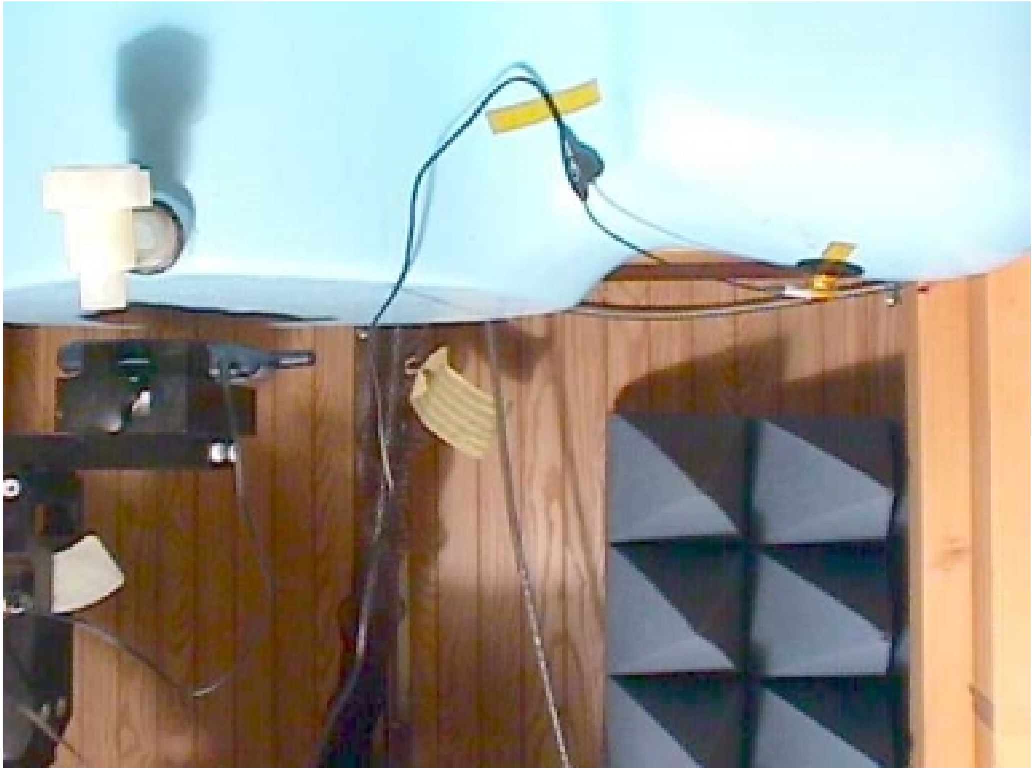
(a)

(b)



(c)

(d)



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

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