SAR TEST REPORT

Test item	:	FM transceiver
Model No.	:	**XU-100A**
Order No.	:	DEMC1205-00566
Date of receipt	:	2012-05-08
Test duration	:	2012-05-24 ~ 2012-06-04
Date of issue	:	2012-06-05
Use of report	:	FCC Original Grant

Applicant : **YEONWHA M TECH CO.,LTD**
#141, 201 Haan-3dong, Gwangmyeong-si, Gyeonggi-do,

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Kyunggi-Do, 449-080, Korea

Test specification	:	§2.1093, FCC/OET Bulletin 65 Supplement C[July 2001]
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

Tested by:	Witnessed by:	Reviewed by:
Engineer N.K.Lim	Engineer S.K. Ryu	Technical Director Harvey Sung

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1. INTROCUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU)absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1.1)

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho\, dv}\right)$$

Figure 1.1
SAR Mathematical Equation

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

Where:
σ = conductivity of the tissue-simulant material (S/m)
ρ = mass density of the tissue-simulant material (kg/m3)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

2. DESCRIPTION OF DEVICE

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

General Information

Equipment type	FM transceiver
FCC ID:	VSOXU-100A
Equipment model name	XU-100A
Equipment add model name	XU-100P
Equipment serial no.	Identical prototype
Mode(s) of Operation	FM Transmitter
TX Frequency Range	440~470MHz(FM Transmitter)
RX Frequency Range	440~470MHz(FM Transmitter)
Max. SAR Measurement	**3.960** mW/g Face Held SAR(Measured) / **4.095** mW/g Face Held SAR(Scaled) **4.100** mW/g Body-Worn SAR / **4.229** mW/g Body-Worn SAR
FCC Equipment Class	TNF - Licensed Non-Broadcast Transmitter Held to Face
Date(s) of Tests	2012-05-24 ~ 2012-06-04
Antenna Type	External Type Antenna

3. DESCRIPTION OF TEST EQUIPMENT

3.1 SAR MEASUREMENT SETUP

Measurements are perfor med using the DASY4 automated dosi metric assessment system. The DASY4 is made by Schmid & P artner Engineering AG (SPEAG) in Z urich, Switzerland and consi sts of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The ro bot is a si x-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 3.1).

A cell controller system contains the power supply, robot controller teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Micron Pentium IV 500 MHz computer with Windows NT system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot i s connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the si gnal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is conne cted to the El ectro-optical coupler (EOC). The EOC p erforms the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

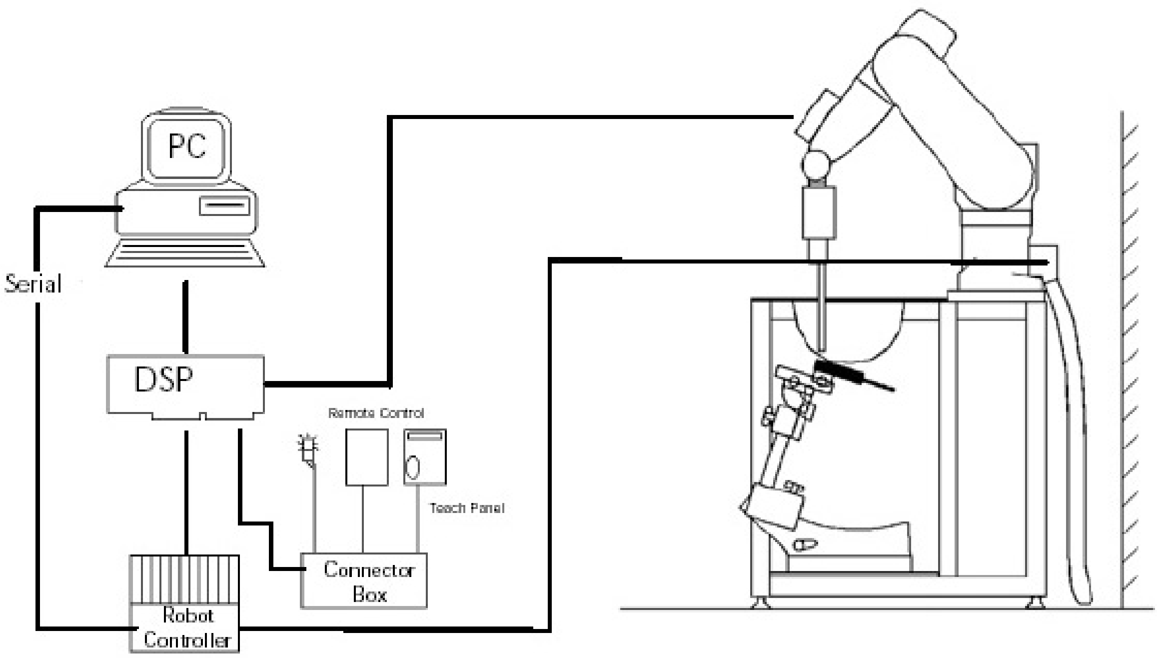


Figure 3.1 SAR Measurement System Setup

The DAE3 consi sts of a highly sensi tive electrometer-grade preamplifier with auto-zeroin g, a channel and gain-switching multiplexer, a fast 16 bit AD-converte r and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an o ptical uplink fo r commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail.

3.2 EX3DV4Probe Specification

Calibration: In air from 10 MHz to 6.0 GHz
In brain and muscle simulating tissue at Frequencies of
450 MHz, 750 MHz, 835 MHz, 1750 MHz, 1900 MHz, 2300 MHz, 2450 MHz
2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5600 MHz, 5800 MHz

Frequency: 10 MHz to 6 GHz

Linearity: ±0.2dB (30 MHz to 6 GHz)

Dynamic: 10 mW/kg to 100 W/kg

Range: Linearity: ±0.2dB

Dimensions: Overall length: 330 mm

Tip length: 20 mm

Body diameter: 12 mm

Tip diameter: 2.5 mm

Distance from probe tip to sensor center: 1 mm

Application: SAR Dosimetry Testing
Compliance tests of mobile phones

DAE System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration (see Fig. 3.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi fiber line ending at the front of the probe tip (see Fig. 3.3). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

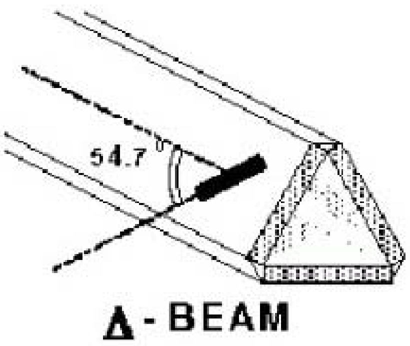


Figure 3.2 Triangular Probe Configurations

Figure 3.3 Probe Thick-Film Technique

3.3 Probe Calibration Process

3.3.1 E-Probe Calibration

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and th e conversion factor (ConvF) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test c hamber. This is pe rformed in a TEM cell for frequencies below 1 G Hz, and in a wave guide above 1GHz for free space. For the free space calibration, the probe is placed in the v olumetric center of the cavity at the p roper orientation with th e field. The probe is then rotated 360 degrees.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat ph antom filled with the ap propriate simulated brain tissue. The measured free space E-field in the medium, correlates to t emperature rise in a di electric medium. For temperature correlation calibration a RF transparent the rmist or based temperature probe is used in conjunction with the E-field probe.

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

$$\text{SAR} = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

SAR is proportional to$\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

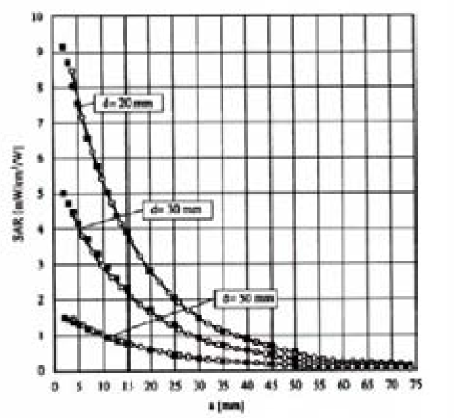


Figure 3.4E-Field and Temperature Measurements at 900MHz

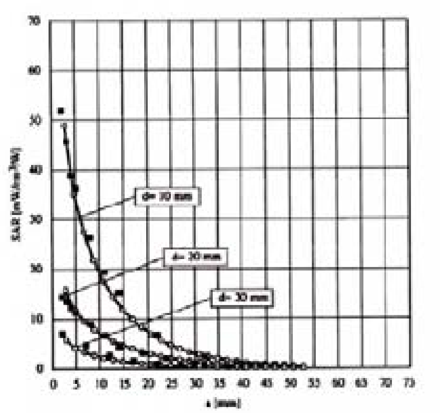


Figure 3.5 E-Field and Temperature Measurements at 1800MHz

3.4 Data Extrapolation

The DASY4 software aut omatically executes the following procedures to calculat e the field units from the microvol t readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation ele ctronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with P_{pwe} = equivalent power density of a plane wave in W/cm^2
E_{tot} = total electric field strength in V/m

3.5 SAM PHANTOM

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid.
Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 3.6)

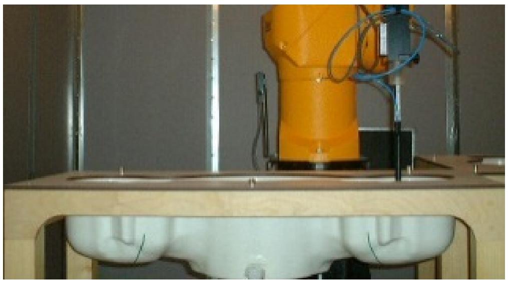


Figure 3.6 SAM Twin Phantom

3.6 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0 the Mounting Device (see Fig. 3.7), enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head and flat phantom).

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Figure 3.7 Mounting Device

3.7 Brain & Muscle Simulation Mixture Characterization

Figure 3.8 SimulatedTissue

The brain and muscle mixtures consist of a viscous gel using hy drox-ethyl cellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obta in proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Harts grove.

Table3.1 Composition of the Tissue Equivalent Matter

MIXTURE%	FREQUENCY(Brain) 450MHz
Water	38.56
Sugar	56.32
Salt	3.95
Preventol	0.10
Cellulose	1.07
Dielectric Parameters Target Value	f=450MHz ε=43.5 σ=0.87

MIXTURE%	FREQUENCY(Body)450MHz
Water	51.16
Sugar	46.78
Salt	1.49
Preventol	0.10
Cellulose	0.47
Dielectric Parameters Target Value	f=450MHz ε=56.7 σ=0.94

Salt: 99 % Pure Sodium Chloride Sugar: 98 % Pure Sucrose

Water: De-ionized, 16M resistivity HEC: Hydroxyethyl Cellulose

DGBE: 99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl]

3.8 SAR TEST EQUIPMENT

Table 3.2 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date (dd/mm/yy)	Next.Cal.Date (dd/mm/yy)	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SCHMID	RX90BL	N/A	N/A	F02/5Q85A1/A/01
☒	Robot Controller	SCHMID	CS7MB	N/A	N/A	F02/5Q85A1/C/01
☒	Joystick	SCHMID	N/A	N/A	N/A	D221340031
☒	Intel Core i5-2500 3.31 GHz Windows XP Professional	N/A	N/A	N/A	N/A	N/A
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	321
☒	Mounting Device	SCHMID	Holder	N/A	N/A	N/A
☒	Sam Phantom	SCHMID	TP1223	N/A	N/A	N/A
☒	Sam Phantom	SCHMID	TP1224	N/A	N/A	N/A
☒	Head/Body Equivalent Matter(450MHz)	N/A	N/A	2012-01-01	2013-01-01	N/A
☐	Head/Body Equivalent Matter(835MHz)	N/A	N/A	2012-01-01	2013-01-01	N/A
☐	Head/Body Equivalent Matter(1800MHz)	N/A	N/A	2012-01-01	2013-01-01	N/A
☐	Head/Body Equivalent Matter(1900MHz)	N/A	N/A	2012-01-01	2013-01-01	N/A
☐	Head/Body Equivalent Matter(2450MHz)	N/A	N/A	2012-01-01	2013-01-01	N/A
☒	Data Acquisition Electronics	SCHMID	DAE3V1	2012-01-20	2013-01-20	519
☒	Dosimetric E-Field Probe	SCHMID	EX3DV4	2012-01-27	2013-01-27	3643
☐	Dummy Probe	N/A	N/A	N/A	N/A	N/A
☒	450MHz System Validation Dipole	SCHMID	D450V2	2011-08-22	2013-08-22	1015
☐	835MHz System Validation Dipole	SCHMID	D835V2	2012-03-14	2014-03-14	464
☐	1800MHz System Validation Dipole	SCHMID	D1800V2	2010-07-16	2012-07-16	2d047
☐	1900MHz System Validation Dipole	SCHMID	D1900V2	2012-03-16	2014-03-16	5d029
☐	2450MHz System Validation Dipole	SCHMID	D2450V2	2012-03-15	2014-03-15	726
☐	2600MHz System Validation Dipole	SCHMID	D2600V2	2010-05-27	2012-05-27	1016
☐	3500MHz System Validation Dipole	SCHMID	D3500V2	2010-05-27	2012-05-27	1018
☒	Network Analyzer	Agilent	E5071C	2011-11-25	2012-11-25	MY46106970
☒	Signal Generator	HP	ESG-3000A	2011-07-01	2012-07-01	US37230529
☐	Amplifier	EMPOWER	BBS3Q7ELU	2011-09-30	2012-09-30	1020
☐	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	2011-11-07	2012-11-07	1005
☒	RF Power Amplifier	OPHIRRF	5069F	2011-07-01	2012-07-01	1006
☒	Power Meter	HP	EPM-442A	2012-03-05	2013-03-05	GB37170267
☒	Power Sensor	HP	8481A	2012-03-05	2013-03-05	3318A96566
☒	Power Sensor	HP	8481A	2012-02-27	2013-02-27	3318A96030
☒	Dual Directional Coupler	Agilent	778D-012	2012-01-09	2013-01-09	50228
☐	Directional Coupler	HP	773D	2011-07-01	2012-07-01	2389A00640
☒	Low Pass Filter 1.5GHz	Micro LAB	LA-15N	2012-01-09	2013-01-09	N/A
☐	Low Pass Filter 3.0GHz	Micro LAB	LA-30N	2011-09-30	2012-09-30	N/A
☒	Attenuators(3dB)	Agilent	8491B	2011-07-02	2012-07-02	MY39260700
☒	Attenuators(10dB)	WEINSCHEL	23-10-34	2012-01-09	2013-01-09	BP4387
☐	Step Attenuator	HP	8494A	2011-09-30	2012-09-30	3308A33341
☒	Dielectric Probe kit	Agilent	85070D	N/A	N/A	US01440118
☒	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	2012-03-05	2013-03-05	GB43461134

NOTE: The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Validation measurement is performed by Digital EMC before each test. The brain simulating material is calibrated by Digital EMC using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

4. TEST SYSTEM SPECIFICATIONS

Automated Test System Specifications

Positioner

Robot: Stäubli Unimation Corp. Robot Model: RX60L
Repeatability: 0.02 mm
No. of axis: 6

Figure 4.1 DASY4 Test System

Data Acquisition Electronic (DAE) System
Cell Controller

Processor: Intel Core i5-2500
Clock Speed: 3.31 GHz
Operating System: Windows XP Professional
Data Card: DASY4 PC-Board

Data Converter

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

PC Interface Card

Function: 24 bit (64 MHz) DSP for real time processing
Link to DAE 3
16 bit A/D converter for surface detection system
serial link to robot
direct emergency stop output for robot

E-Field Probes

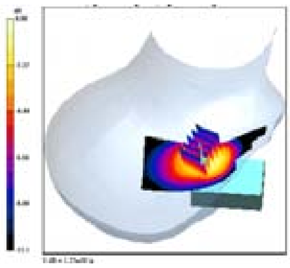
Model: EX3DV4 S/N: 3643
Construction: Triangular core fiber optic detection system
Frequency: 10 MHz to 6 GHz
Linearity: ±0.2dB (30MHz to 6GHz)

Phantom

Phantom: SAM Twin Phantom (V4.0)
Shell Material: Vivac Composite
Thickness: 2.0 ± 0.2 mm

5. SAR MEASUREMENT PROCEDURE

The evaluation was performed using the following procedure:



Sample SAR Area Scan

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and use d as a reference value.

2. The SAR distribution at the expose d side of the head wa s measured at a distan ce of 3.9mm from the Inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15 mm x 15 mm.

3. Based on the area scan data, the area of the maximum abs orption was determined by sp line interpolation. Around this point, a volume of 32 mm x 32 mm x 30 mm (fine re solution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see Sample SAR Area Scan):

    a. The data at the surface was extrapolated, since the center of the dipoles is 2.5 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolatio n was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

    b. The maximum interpolated value wa s searched with a straig ht-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interp olation algorithm. The 3D-spline is composed of three one-dimensional sp lines with the “Not a knot” condition (in x, y, and z directions). The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10x 10) were interpolated to calculate the average.

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

4. The SAR reference value, at the same location as procedure #1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.

Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for hand set SAR asse ssment testing is a lo w-loss dielectric shell, with shap e and dime nsions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Fig. 5.1). The perimeter side walls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

Figure 5.1 Sam Twin Phantom shell

6. DESCRIPTION OF TEST POSITION

6.1 HEAD POSITION

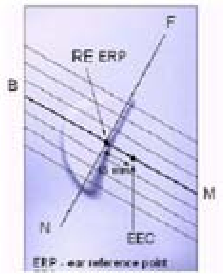


Figure 6.2 Close-up side view of ERPs

Figure 6.1 shows the front, back and side views of the SAM Twin Phantom. The point"M" is the reference point for the center of the mouth, "LE" is the left ear reference point(ERP), and "RE" is the right ERP. The ERPs are 15mm posterior to the entrance to the Ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 6.5. The plane Passing, through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck- Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 6.2). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate hand set positioning.

Figure 6.1 Front, back and side view SAM Twin Phantom

Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Fig. 6.3). The "test device reference point" was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at it's top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

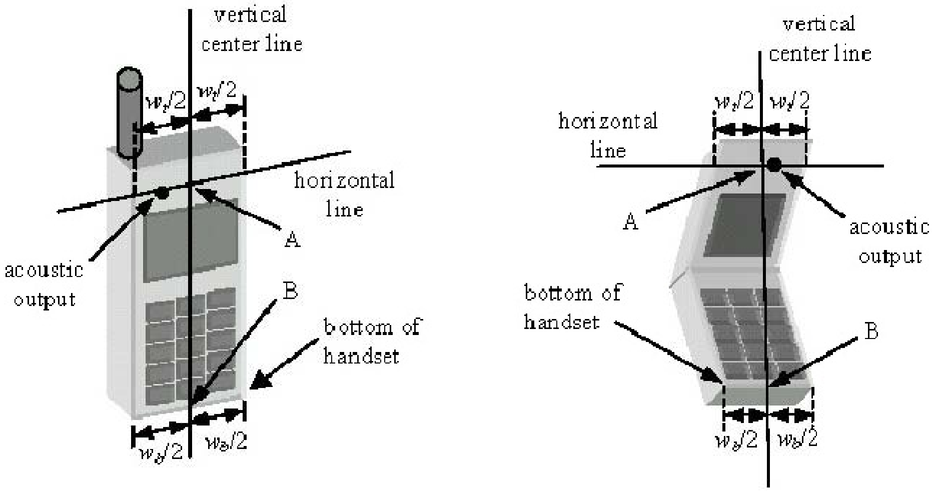


Figure 6.3 Handset Vertical Center & Horizontal Line Reference Points

6.2 Positioning for Cheek/Touch

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6.4), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

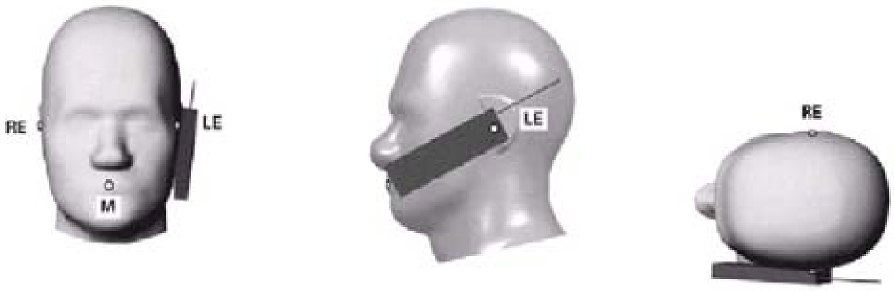


Figure 6.4Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.

3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).

4. The phone was hen rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.

5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). (See Figure 6.5)

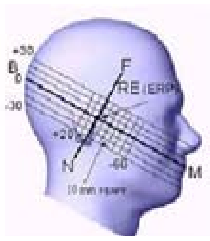


Figure 6.5Side view w/relevant markings

6.3 Positioning for Ear / 15 ° Tilt

With the test device aligned in the “Cheek/Touch Position”:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.

2. The phone was then rotated around the horizontal line by 15 degree.

3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 6.6).

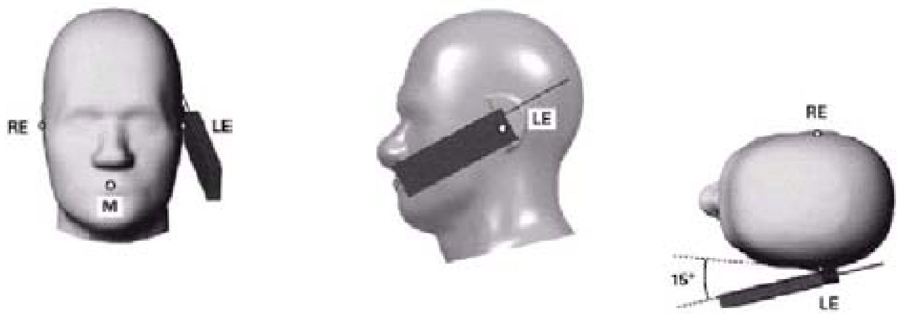


Figure 6.6 Front, Side and Top View of Ear/15°Position

6.4 Body Holster /Belt Clip Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6.8). A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are supplied with the device, the device is tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component(i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Figure 6.8 Body Belt Clip & Holster Configurations

Body-worn accessories may not always be supplied or available as options for some.

Devices intended to be authorized for body-worn use. In this case, a test configuration where a separation distances between the back of the device and the flat phantom is used. All test position spacing is documented.

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom.

For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory (ies), including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing. In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

7. IEEE P1528 –MEASUREMENT UNCERTAINTIES

450 MHz Head

Error Description	Uncertaint value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.7	Normal	1	1	± 6.7 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.543 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.144 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.501 %	∞
RF Ambient Conditions	± 3.0	Rectangular	√3	1	± 1.732 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.231 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.674 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.577 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.887 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.309 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 4.8	Normal	1	0.64	± 4.8 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.7	Normal	1	0.6	± 4.7 %	∞
CombinedStandard Uncertainty					**± 12.6 %**	330
Expanded Uncertainty (k=2)					**± 25.2 %**	

The above measurement uncertainties are according to IEEE P1528 (2003)

450 MHz Body

Error Description	Uncertaint value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 6.7	Normal	1	1	± 6.7 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.543 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.144 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.501 %	∞
RF Ambient Conditions	± 3.0	Rectangular	√3	1	± 1.732 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.231 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.674 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.577 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.887 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.309 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 3.9	Normal	1	0.64	± 3.9 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 4.3	Normal	1	0.6	± 4.3 %	∞
CombinedStandard Uncertainty					**± 12.4 %**	330
Expanded Uncertainty (k=2)					**± 24.9 %**	

The above measurement uncertainties are according to IEEE P1528 (2003)

8. ANSI / IEEE C95.1-2005 RF EXPOSURE LIMITS

Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 8.1.SAR Human Exposure Specified in ANSI/IEEE C95.1-2005

	HUMAN EXPOSURE LIMITS	
	General Public Exposure (W/kg) or (mW/g)	Occupational Exposure (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.0

NOTES:

* The Spatial Peak value of the SAR averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole-body.

*** The Spatial Peak value of the SAR averaged over any 10 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e.as a result of employment or occupation).

9. SYSTEM VERIFICATION

9.1 Tissue Verification

MEASURED TISSUE PARAMETERS									
Freq. [MHz]	Date(s)	Liquid	Ambient Temp.[°C]	Liquid Temp.[°C]	Parameters	Target Value	Measured Value	Deviation [%]	Limit [%]
450	Jun. 04, 2012	Head	22.2	22.5	εr	43.50	43.00	-1.15	± 5
					σ	0.870	0.879	1.03	± 5
450	May. 24, 2012	Body	22.3	22.5	εr	56.70	55.80	-1.59	± 5
					σ	0.940	0.958	1.91	± 5

9.2 Test System Validation

Prior to assessment, the system is verified to the ± 10 % of the specifications at 450 MHz by using the system validation kit(s). (Graphic Plots Attached)

SYSTEM DIPOLE VALIDATION TARGET & MEASURED										
Freq. [MHz]	System Validation Kit	Date(s)	Liquid	Ambient Temp.[°C]	Liquid Temp.[°C]	Input Power (mW)	1 W Target SAR_{1g} (W/kg)	Measured SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	Deviation [%]
450	D-450V2 S/N: 1015	Jun. 04, 2012	Head	22.2	22.5	398	4.97	1.840	4.62	-6.98
450	D-450V2 S/N: 1015	May. 24, 2012	Body	22.3	22.5	398	4.73	1.920	4.82	1.99

Note: Validation was measured with input power 398 mW and normalized to 1 W.

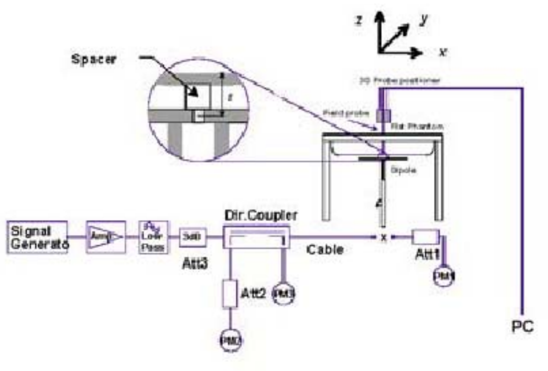


Figure 9.1 Dipole Validation Test Setup

10. Push-to-talk (PTT) devices

a) RF exposure is evaluated with a duty factor of 50 % when the actual operating duty factor is ≤ 50 %. Devices supporting higher duty factors shall be evaluated at the maximum duty factor; for example, devices supporting operator-assisted PSTN calls. Contact the FCC Laboratory when unable to test a device at the required duty factor due to hardware limitations or other reasons.

b) Portable PTT devices

i. The power thresholds and operating conditions in Table 1 are used to determine SAR test requirements for PTT radios required to comply with the general population exposure limit. When the occupational exposure limit applies, these power thresholds are increased by a factor of five (5) to determine the test requirements. SAR is required for PTT devices with maximum output power greater than these thresholds. SAR evaluation is also required for separation distances smaller than those in Table 1. Contact the FCC Laboratory to determine if SAR evaluation is necessary for other frequencies or when the SAR is very low.

Table 1 - SAR Evaluation Power Thresholds for PTT devices, f ≤ 0.5 GHz Exposure Conditions	mW
Held to face ≥ 2.5 cm	250
Body-worn ≥ 1.5 cm	200
Body-worn ≥ 1.0 cm	150
Notes: 1. The time-averaged output power, corresponding to the required PTT duty factor, is compared with these thresholds. 2. The closest distance between the user and the device or its antenna is used to determine the power thresholds.	

ii. Additional SAR evaluation with a SA M phantom is required for PTT devices with held-to-ear operating mode.30 Contact the FCC Laboratory for device operating and test configurations.

11. SAR TEST SUMMARY AND POWER TABLE

See Measurement Result Data Pages

Procedures Used To Establish Test Signal

The EUT was placed into simulated call mode (FM Transmitter) using manufacturers test codes. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR. When test modes are not available or inappropriate for testing a EUT, the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

Device Test Conditions

The EUT is battery operated. Each SAR measurement was taken with a fully charged battery.
In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a conducted power deviation of more than 5% occurred, the test was repeated.

Max. Power Output Table for XU-100A

Band	Frequency		Test Result	
	MHz	Channel	W	dBm
FM Transmitter	440	1	1.995	33.00
	455	2	1.986	32.98
	470	3	1.972	32.95

12. SAR TEST DATA RESULTS

12.1 Measurement Results

Mode: FM Transmitter, Face Held							
FREQUENCY		Begin Power (dBm)	Drift Power (dB)	Test Position	Antenna Position	SAR Results (W/kg) Duty Cycle	
MHz	Ch					100 %	50 %
440	1	33.00	-0.166	25 mm [Front]	External	2.360	1.180
455	**2**	**32.98**	**0.146**	**25 mm [Front]**	**External**	**3.960**	**1.980**
470	3	32.95	0.049	25 mm [Front]	External	2.090	1.045
ANSI / IEEE C95.1 2005 – SAFETY LIMIT **Spatial Peak** **Controlled Exposure/ Occupational Exposure**						**Head** **8.0 W/kg (mW/g)** averaged over 1 gram	
Mode: FM Transmitter, Body-Worn, With Belt Clip							
FREQUENCY		Begin Power (dBm)	Drift Power (dB)	Test Position	Antenna Position	SAR Results (W/kg) Duty Cycle	
MHz	Ch					100 %	50 %
440	1	33.00	-0.070	0 mm [Rear]	External	2.790	1.395
455	**2**	**32.98**	**-0.135**	**0 mm [Rear]**	**External**	**4.100**	**2.050**
470	3	32.95	-0.101	0 mm [Rear]	External	2.660	1.330
ANSI / IEEE C95.1 2005 – SAFETY LIMIT **Spatial Peak** **Controlled Exposure/ Occupational Exposure**						**Body** **8.0 W/kg (mW/g)** averaged over 1 gram	

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Test Signal Call Mode ▣Continuous Tx On □Manu. Test Codes □Base Station Simulator
6. Tissue parameters and temperatures are listed on the SAR plots.
7. Liquid tissue depth is 15.0cm.±0.1
8. Justification for reduced test configurations: per FCC/OET Supplement C (July, 2001), if the SAR measured at the middle channel for each test configuration (Left, right, cheek/touch, tilt/ear, extended and retracted) is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).

12.2 Measurement Results are scaled for the power drift

Mode: FM Transmitter, Face Held							
FREQUENCY		Drift Power (dB)	+Drift Power 10^(dB/10)	Test Position	Antenna Position	Scaled SAR(W/kg) (Include + Drift Power) Duty Cycle	
MHz	Ch					100 %	50 %
440	1	-0.166	1.039	25 mm [Front]	External	2.452	1.226
455	2	0.146	1.034	25 mm [Front]	External	4.095	2.048
470	3	0.049	1.011	25 mm [Front]	External	2.114	1.057
ANSI / IEEE C95.1 2005 – SAFETY LIMIT Spatial Peak Controlled Exposure/ Occupational Exposure						Head 8.0 W/kg (mW/g) averaged over 1 gram	

Mode: FM Transmitter, Body-Worn, With Belt Clip							
FREQUENCY		Drift Power (dB)	+Drift Power 10^(dB/10)	Test Position	Antenna Position	SAR(W/kg) (Include + Drift Power) Duty Cycle	
MHz	Ch					100 %	50 %
440	1	-0.070	1.016	0 mm [Rear]	External	2.835	1.418
455	2	-0.135	1.032	0 mm [Rear]	External	4.229	2.115
470	3	-0.101	1.024	0 mm [Rear]	External	2.723	1.361
ANSI / IEEE C95.1 2005 – SAFETY LIMIT Spatial Peak Controlled Exposure/ Occupational Exposure						Body 8.0 W/kg (mW/g) averaged over 1 gram	

13. CONCLUSION

Measurement Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under the worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s)tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role impossible biological effect are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease).

Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

14. REFERENCES

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Attachment 1. – Dipole Validation Plots

DIGITAL EMC CO., LTD

DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1015

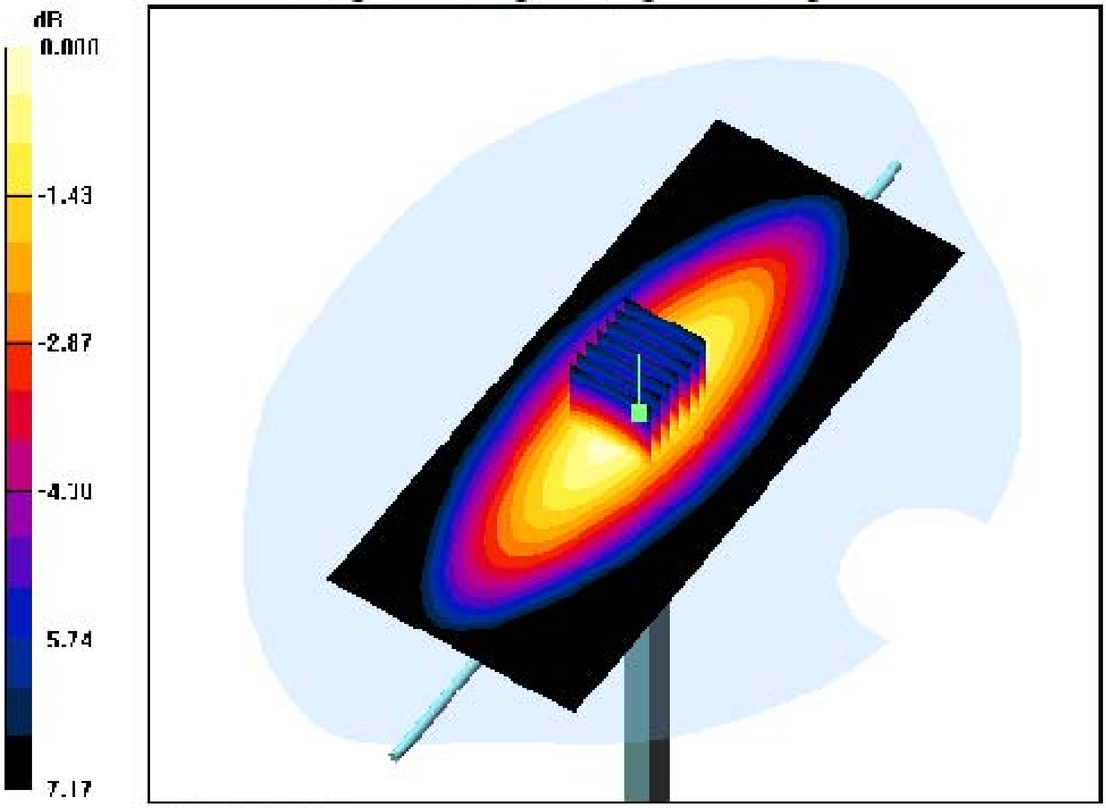
Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 450 MHz; σ = 0.879 mho/m; ε_r = 43; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(9.78, 9.78, 9.78); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM with 835MHz; Type: SAM; Serial: TP-1223
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-06-04; Ambient Temp: 22.2; Tissue Temp:22.5

Dipole Validation

Area Scan (61x141x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Power Drift = 0.010 dB
Peak SAR (extrapolated) = 2.55 W/kg
SAR(1 g) = 1.84 mW/g; SAR(10 g) = 1.32 mW/g



0 dB = 1.95mW/g

DIGITAL EMC CO., LTD

DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1015

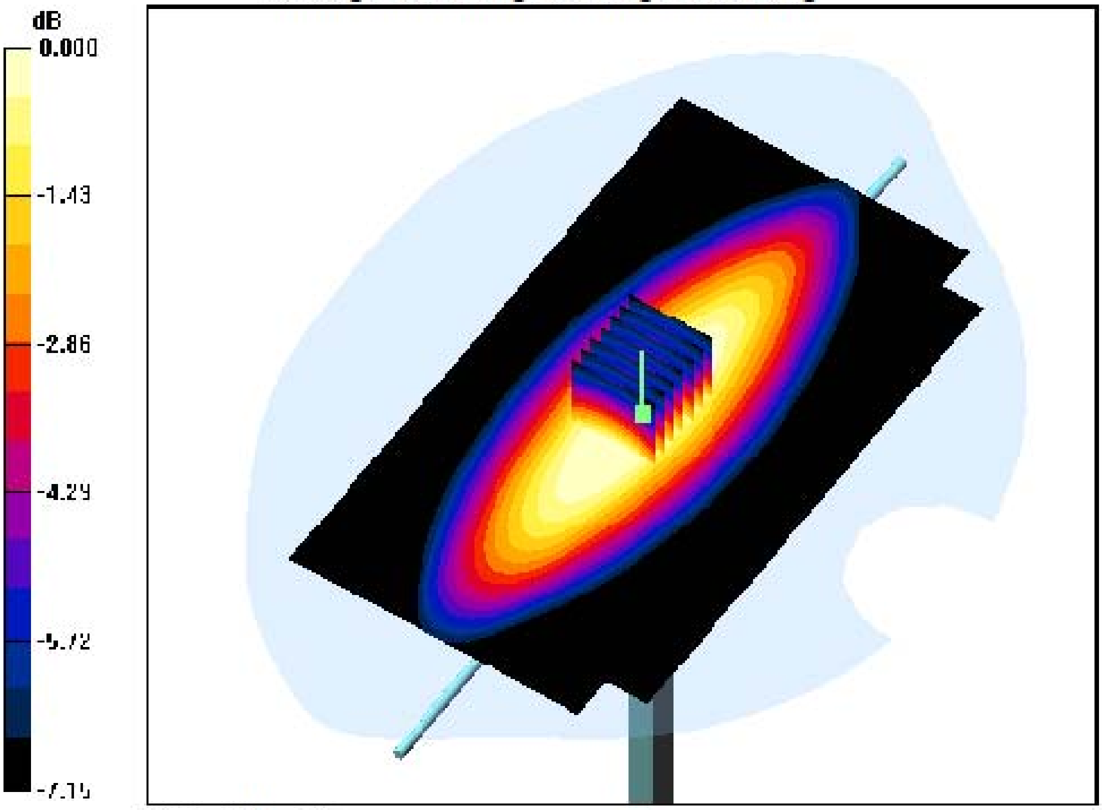
Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 450 MHz; $\sigma = 0.958$ mho/m; $\varepsilon_r = 55.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(10.32, 10.32, 10.32); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-05-24; Ambient Temp: 22.3; Tissue Temp:22.5

Dipole Validation

Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Power Drift = 0.012 dB
Peak SAR (extrapolated) = 2.68 W/kg
SAR(1 g) = 1.92 mW/g; SAR(10 g) = 1.38 mW/g



0 dB = 2.04mW/g

Attachment 2. – SAR Test Plots

DIGITAL EMC CO., LTD

DUT: XU-100A; Type: FM Transmitter

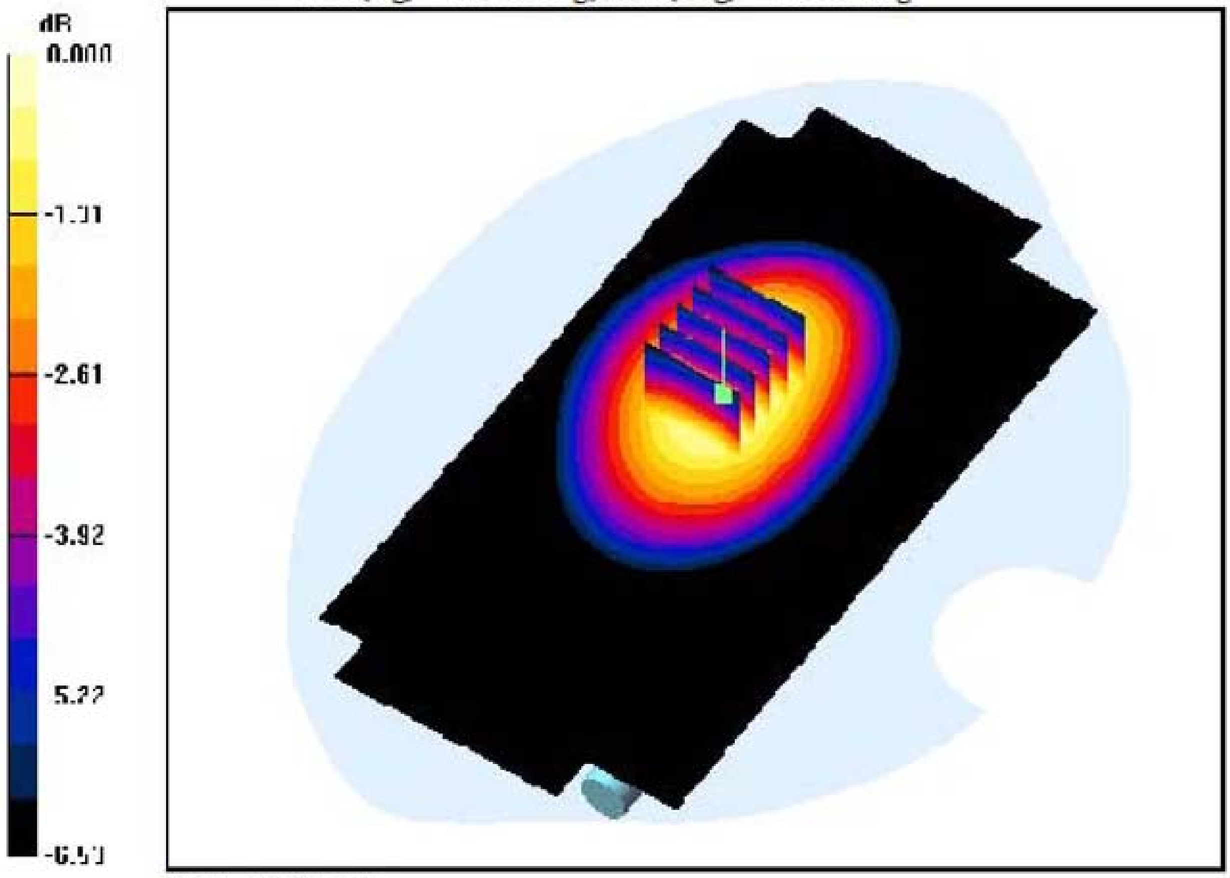
Communication System: PTT; Frequency: 440 MHz;Duty Cycle: 1:1
Medium parameters used: f = 440 MHz; σ = 0.877 mho/m; ε_r = 42.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(9.78, 9.78, 9.78); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM with 835MHz; Type: SAM; Serial: TP-1223
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-06-04; Ambient Temp: 22.2; Tissue Temp:22.5

2.5 cm space from Body, Front, FM Transmitter, Ch. 1(440 MHz), Ant External

Area Scan (81x161x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Power Drift = -0.166 dB
Peak SAR (extrapolated) = 3.05 W/kg
SAR(1 g) = 2.36 mW/g; SAR(10 g) = 1.83 mW/g



0 dB = 2.67mW/g

DIGITAL EMC CO., LTD

DUT: XU-100A; Type: FM Transmitter

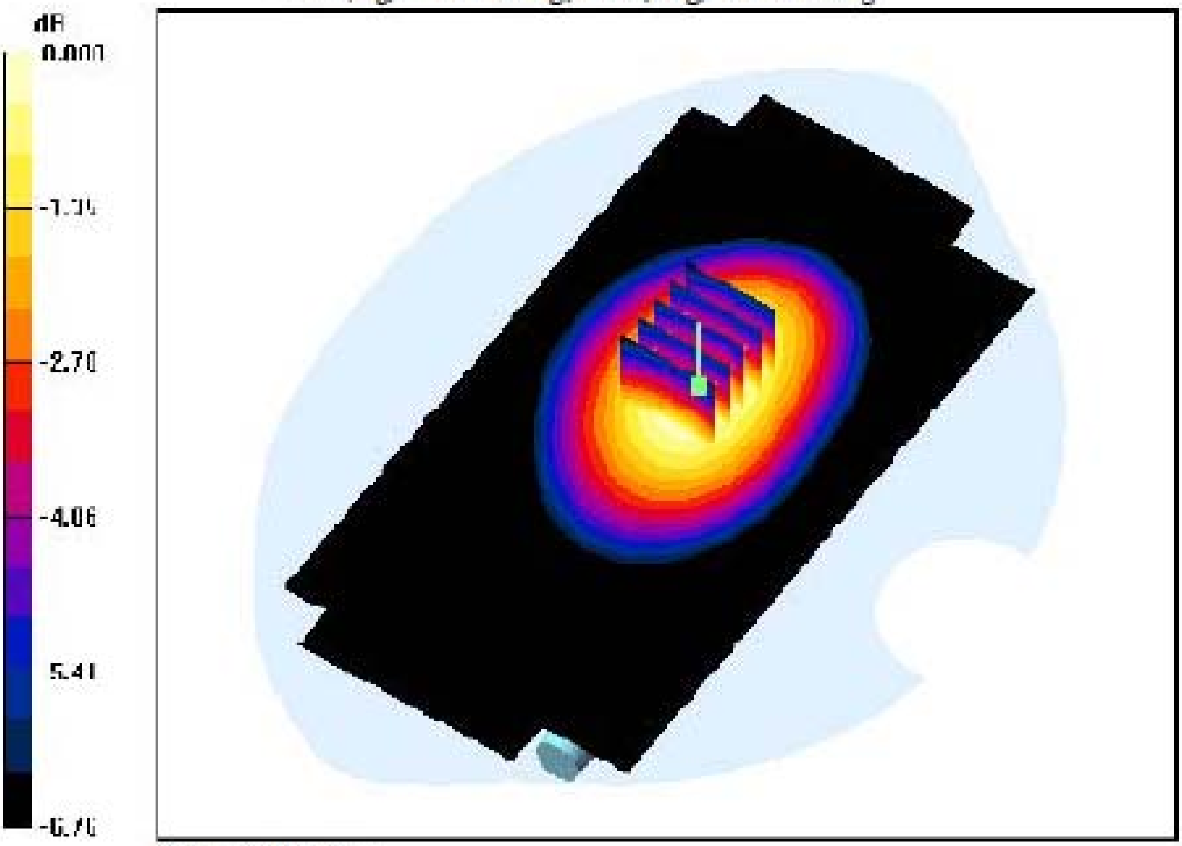
Communication System: PTT; Frequency: 455 MHz;Duty Cycle: 1:1
Medium parameters used: f = 455 MHz; σ = 0.882 mho/m; ε_r = 43; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(9.78, 9.78, 9.78); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM with 835MHz; Type: SAM; Serial: TP-1223
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-06-04; Ambient Temp: 22.2; Tissue Temp:22.5

2.5 cm space from Body, Front, FM Transmitter, Ch. 2(455 MHz), Ant External

Area Scan (81x161x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Power Drift = 0.146 dB
Peak SAR (extrapolated) = 5.15 W/kg
SAR(1 g) = 3.96 mW/g; SAR(10 g) = 3.05 mW/g



0 dB = 4.48mW/g

DIGITAL EMC CO., LTD

DUT: XU-100A; Type: FM Transmitter

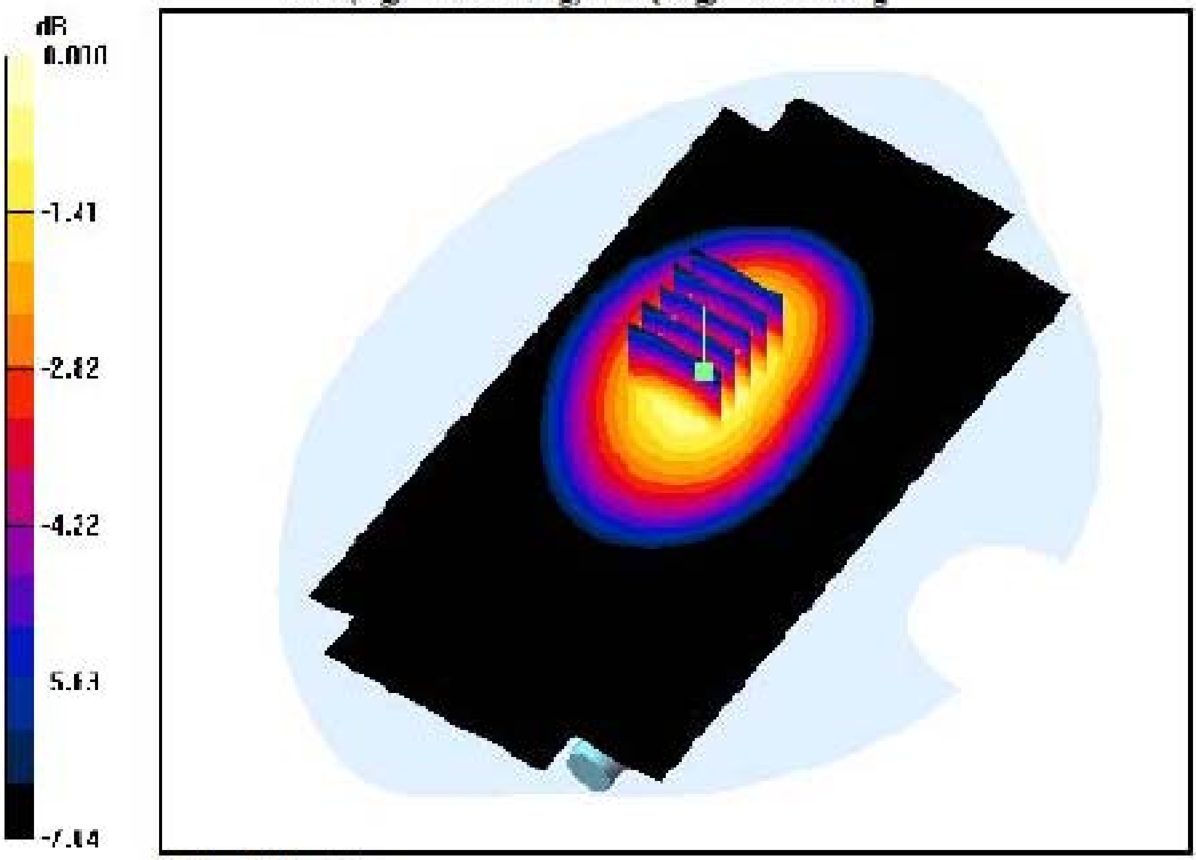
Communication System: PTT; Frequency: 470 MHz;Duty Cycle: 1:1
Medium parameters used: f = 470 MHz; σ = 0.893 mho/m; ε_r = 43.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(9.78, 9.78, 9.78); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM with 835MHz; Type: SAM; Serial: TP-1223
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-06-04; Ambient Temp: 22.2; Tissue Temp:22.5

2.5 cm space from Body, Front, FM Transmitter, Ch. 3(470 MHz), Ant External

Area Scan (81x161x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Power Drift = 0.049 dB
Peak SAR (extrapolated) = 2.73 W/kg
SAR(1 g) = 2.09 mW/g; SAR(10 g) = 1.59 mW/g



0 dB = 2.38mW/g

DIGITAL EMC CO., LTD

DUT: XU-100A; Type: FM Transmitter

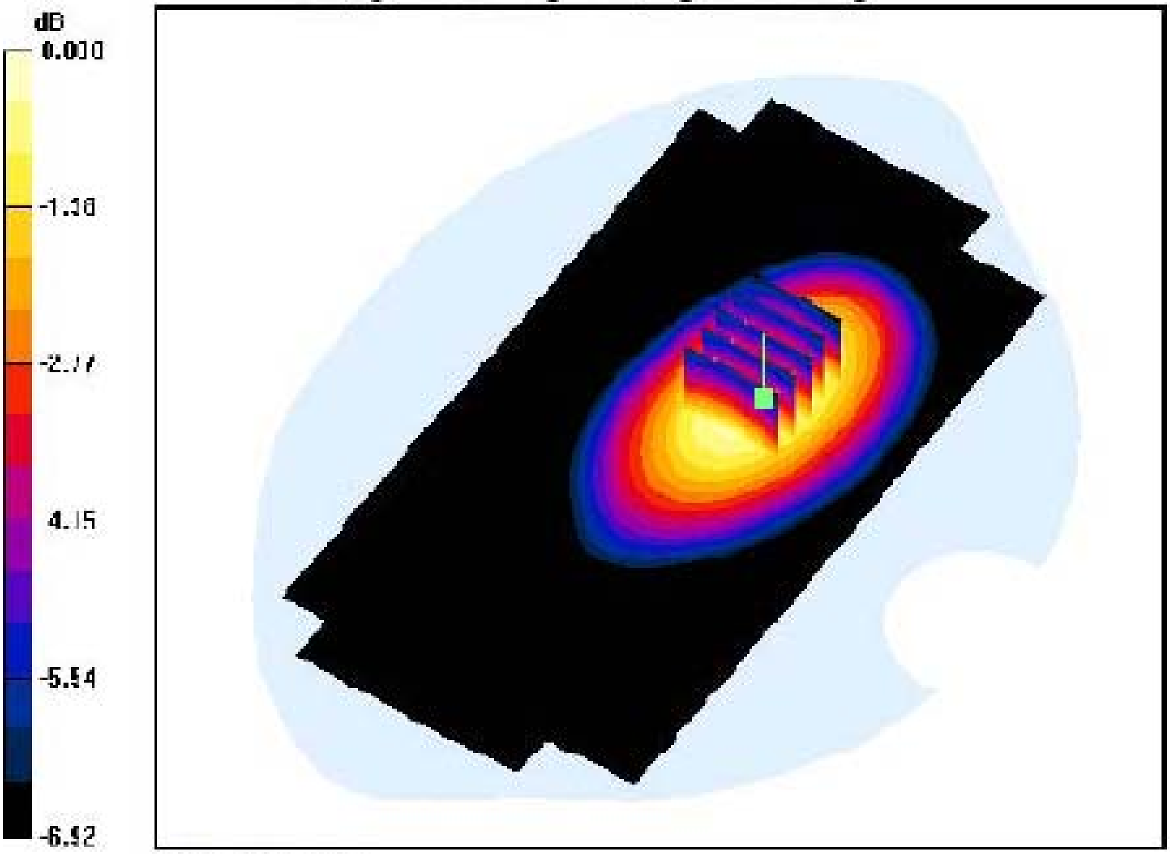
Communication System: PTT; Frequency: 440 MHz;Duty Cycle: 1:1
Medium parameters used: f = 440 MHz; σ = 0.938 mho/m; ε_r = 55.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(10.32, 10.32, 10.32); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-05-24; Ambient Temp: 22.3; Tissue Temp:22.5

Touch from Body, Rear +Belt Clip, FM Transmitter, Ch. 1(440 MHz), Ant External

Area Scan (81x161x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Power Drift = -0.070 dB
Peak SAR (extrapolated) = 3.64 W/kg
SAR(1 g) = 2.79 mW/g; SAR(10 g) = 2.13 mW/g



0 dB = 3.16mW/g

DIGITAL EMC CO., LTD

DUT: XU-100A; Type: FM Transmitter

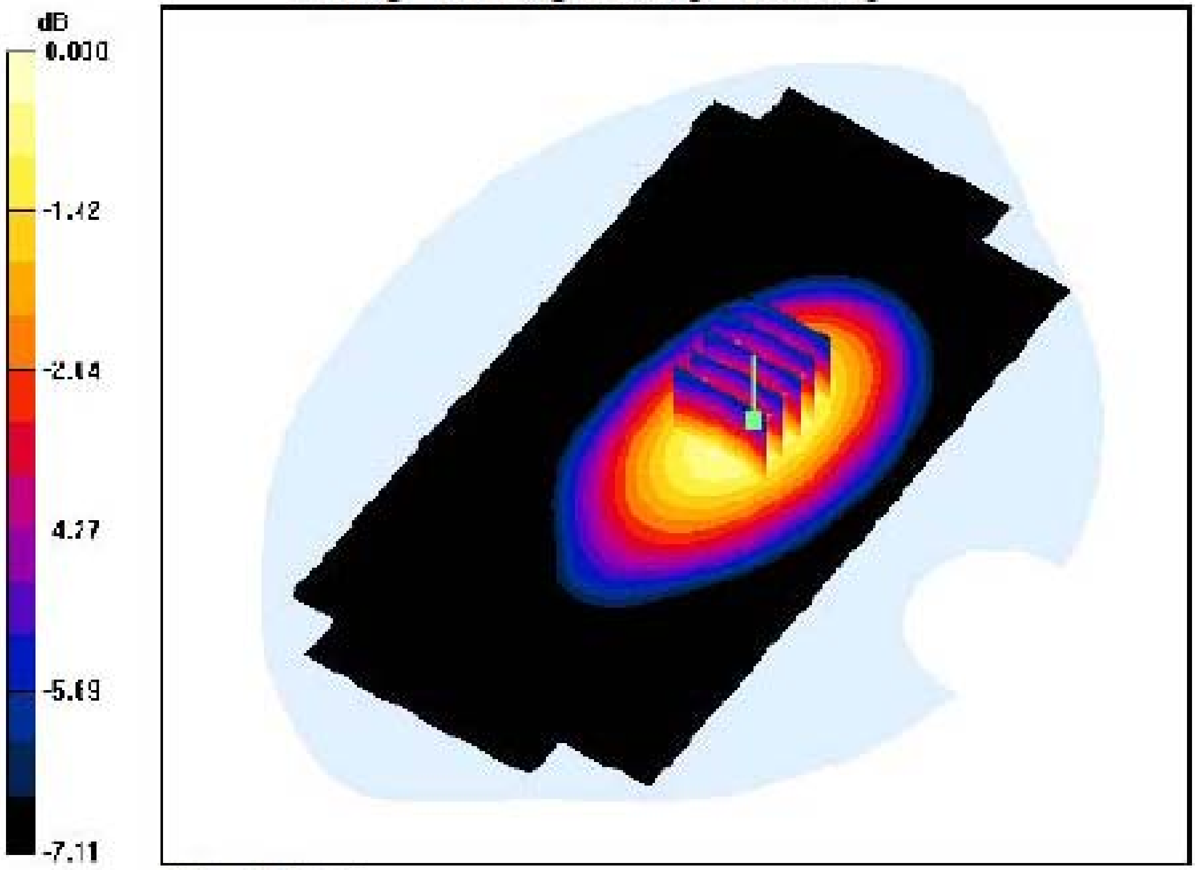
Communication System: PTT; Frequency: 455 MHz;Duty Cycle: 1:1
Medium parameters used: f = 455 MHz; σ = 0.961 mho/m; ε_r = 56; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(10.32, 10.32, 10.32); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-05-24; Ambient Temp: 22.3; Tissue Temp:22.5

Touch from Body, Rear +Belt Clip, FM Transmitter, Ch. 2(455 MHz), Ant External

Area Scan (81x161x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Power Drift = -0.135 dB
Peak SAR (extrapolated) = 5.38 W/kg
SAR(1 g) = 4.1 mW/g; SAR(10 g) = 3.13 mW/g



0 dB = 4.67mW/g

DIGITAL EMC CO., LTD

DUT: XU-100A; Type: FM Transmitter

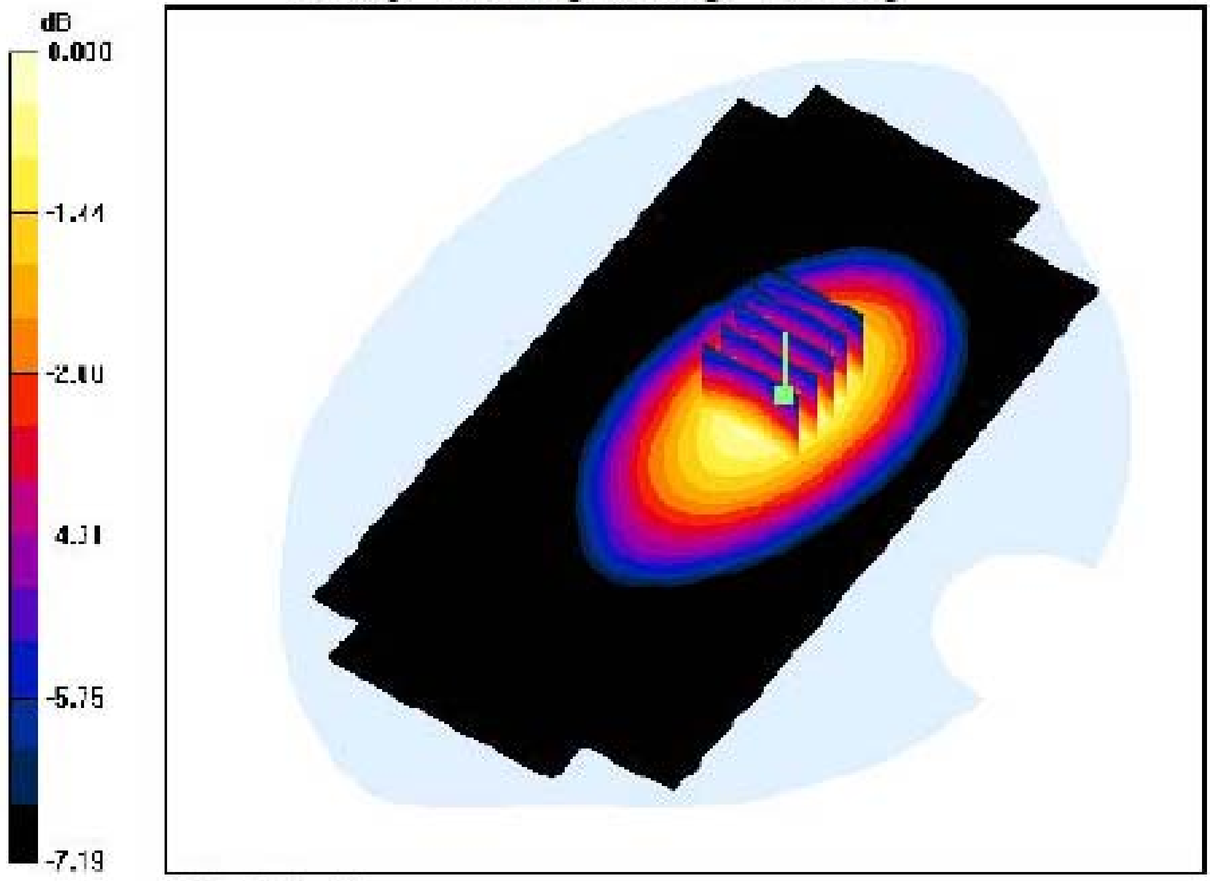
Communication System: PTT; Frequency: 470 MHz;Duty Cycle: 1:1
Medium parameters used: f = 470 MHz; σ = 0.974 mho/m; ε_r = 56.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(10.32, 10.32, 10.32); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-05-24; Ambient Temp: 22.3; Tissue Temp:22.5

Touch from Body, Rear +Belt Clip, FM Transmitter, Ch. 3(470 MHz), Ant External

Area Scan (81x161x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Power Drift = -0.101 dB
Peak SAR (extrapolated) = 3.49 W/kg
SAR(1 g) = 2.66 mW/g; SAR(10 g) = 2.02 mW/g



0 dB = 3.02mW/g

DIGITAL EMC CO., LTD

DUT: XU-100A; Type: FM Transmitter

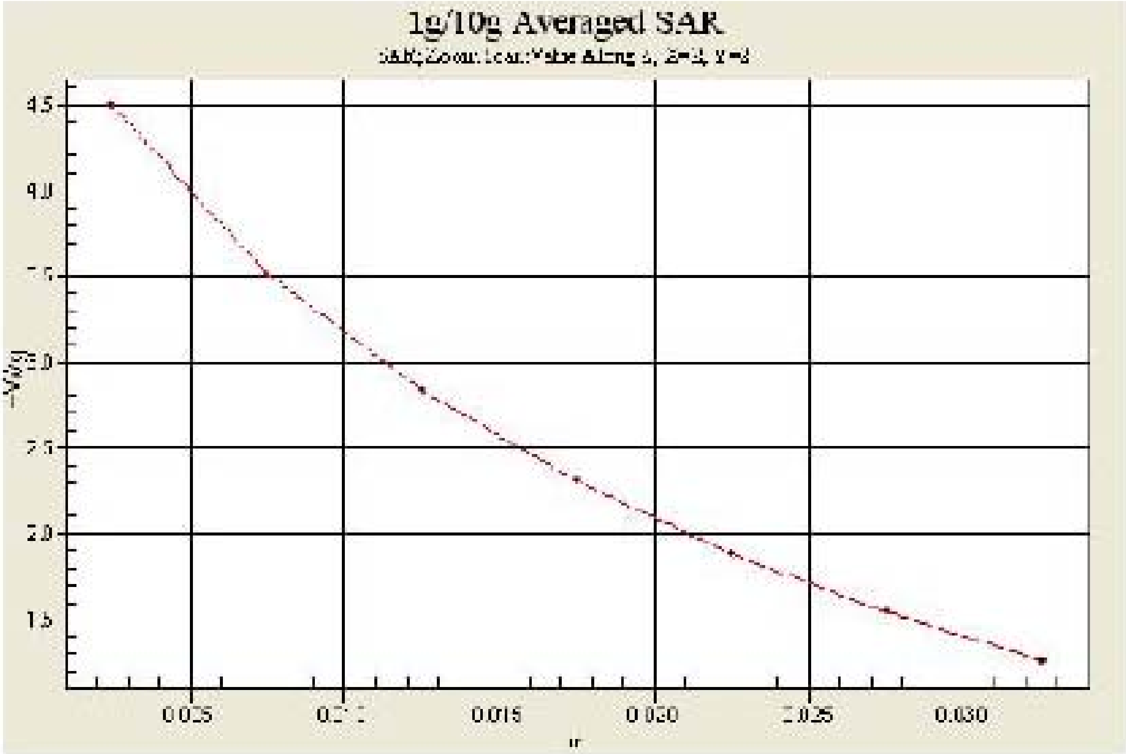
Communication System: PTT; Frequency: 455 MHz;Duty Cycle: 1:1
Medium parameters used: f = 455 MHz; σ = 0.882 mho/m; ε_r = 43; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(9.78, 9.78, 9.78); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM with 835MHz; Type: SAM; Serial: TP-1223
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-06-04; Ambient Temp: 22.2; Tissue Temp:22.5

2.5 cm space from Body, Front, FM Transmitter, Ch. 2(455 MHz), Ant External

Area Scan (81x161x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Power Drift = 0.146 dB
Peak SAR (extrapolated) = 5.15 W/kg
SAR(1 g) = 3.96 mW/g; SAR(10 g) = 3.05 mW/g



DIGITAL EMC CO., LTD

DUT: XU-100A; Type: FM Transmitter

Communication System: PTT; Frequency: 455 MHz;Duty Cycle: 1:1
Medium parameters used: f = 455 MHz; σ = 0.961 mho/m; ε_r = 56; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
Probe: EX3DV4 - SN3643; ConvF(10.32, 10.32, 10.32); Calibrated: 2012-01-27; Electronics: DAE3 Sn519
Phantom: SAM 1800/1900 MHz; Type: SAM; Serial: TP-1224
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Test Date: 2012-05-24; Ambient Temp: 22.3; Tissue Temp:22.5

Touch from Body, Rear +Belt Clip, FM Transmitter, Ch. 2(455 MHz), Ant External

Area Scan (81x161x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Power Drift = -0.135 dB
Peak SAR (extrapolated) = 5.38 W/kg
SAR(1 g) = 4.1 mW/g; SAR(10 g) = 3.13 mW/g

Attachment 3. – Probe Calibration Data

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Digital EMC (Dymstec)**

Certificate No: **EX3-3643_Jan12**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3643
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	January 27, 2012

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: January 27, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: EX3-3643_Jan12 Page 1 of 11

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3643

Manufactured: January 8, 2008
Calibrated: January 27, 2012

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3643

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.40	0.42	0.45	± 10.1 %
DCP (mV)[B]	95.9	96.7	93.7	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	95.7	±1.9 %
			Y	0.00	0.00	1.00	102.9	
			Z	0.00	0.00	1.00	106.4	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3643

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	43.5	0.87	9.78	9.78	9.78	0.11	1.00	± 13.4 %
750	41.9	0.89	9.33	9.33	9.33	0.36	0.87	± 12.0 %
835	41.5	0.90	8.94	8.94	8.94	0.37	0.83	± 12.0 %
1750	40.1	1.37	8.25	8.25	8.25	0.42	0.83	± 12.0 %
1900	40.0	1.40	7.97	7.97	7.97	0.50	0.73	± 12.0 %
2450	39.2	1.80	7.12	7.12	7.12	0.41	0.80	± 12.0 %
5200	36.0	4.66	4.94	4.94	4.94	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.69	4.69	4.69	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.11	4.11	4.11	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.16	4.16	4.16	0.50	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3643

Calibration Parameter Determined in Body Tissue Simulating Media

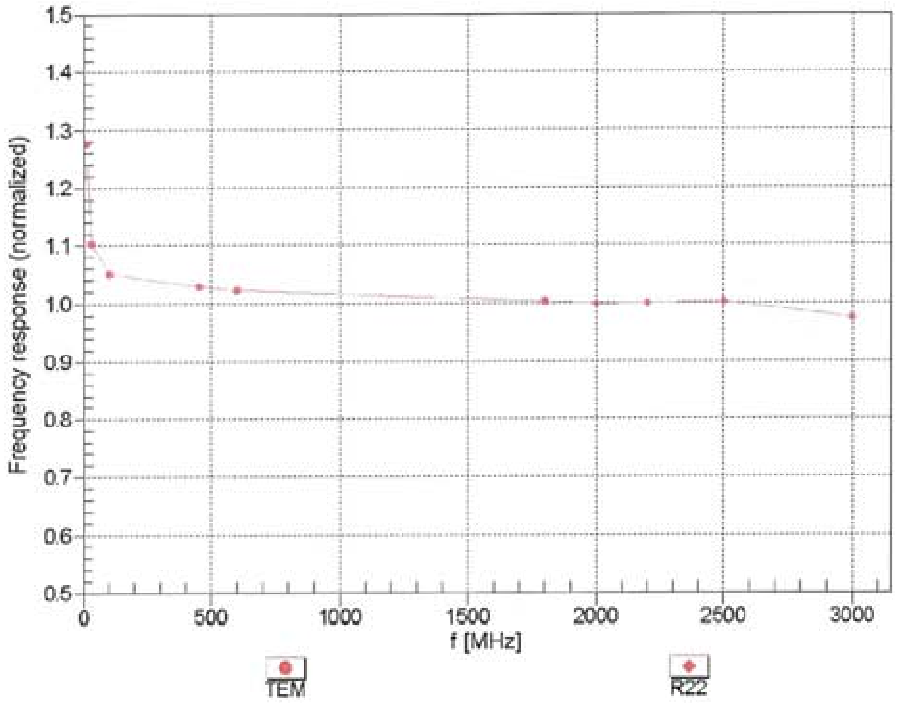
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	56.7	0.94	10.32	10.32	10.32	0.04	1.00	± 13.4 %
750	55.5	0.96	9.23	9.23	9.23	0.31	0.94	± 12.0 %
835	55.2	0.97	9.12	9.12	9.12	0.32	0.96	± 12.0 %
1750	53.4	1.49	7.75	7.75	7.75	0.69	0.67	± 12.0 %
1900	53.3	1.52	7.34	7.34	7.34	0.63	0.66	± 12.0 %
2300	52.9	1.81	7.08	7.08	7.08	0.80	0.55	± 12.0 %
2450	52.7	1.95	6.95	6.95	6.95	0.75	0.57	± 12.0 %
2600	52.5	2.16	6.71	6.71	6.71	0.80	0.50	± 12.0 %
3500	51.3	3.31	6.17	6.17	6.17	0.34	1.22	± 13.1 %
5200	49.0	5.30	4.23	4.23	4.23	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.05	4.05	4.05	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.61	3.61	3.61	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.80	3.80	3.80	0.60	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

EX3DV4– SN:3643 January 27, 2012

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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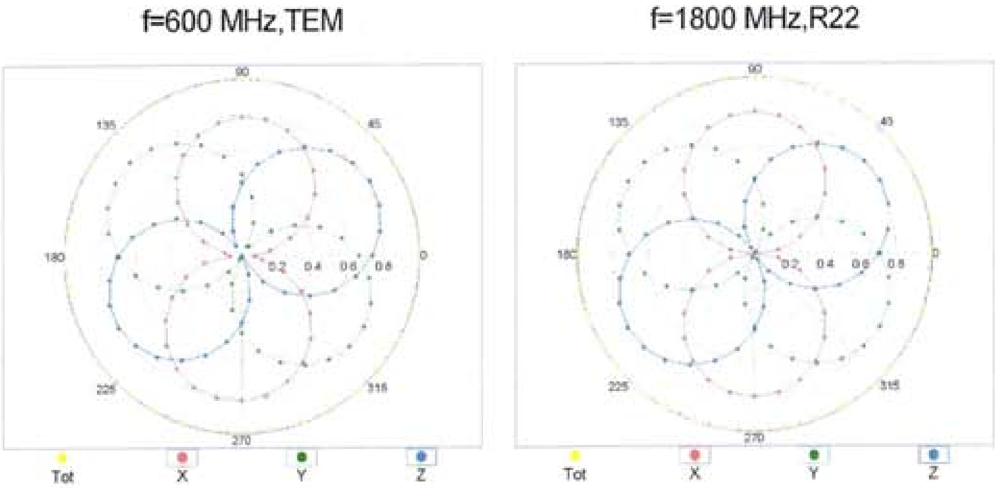
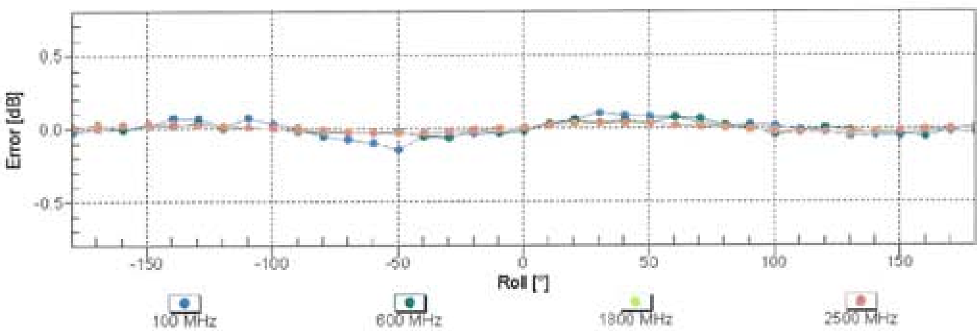
EX3DV4– SN:3643 January 27, 2012

Receiving Pattern (ϕ), ϑ = 0°





Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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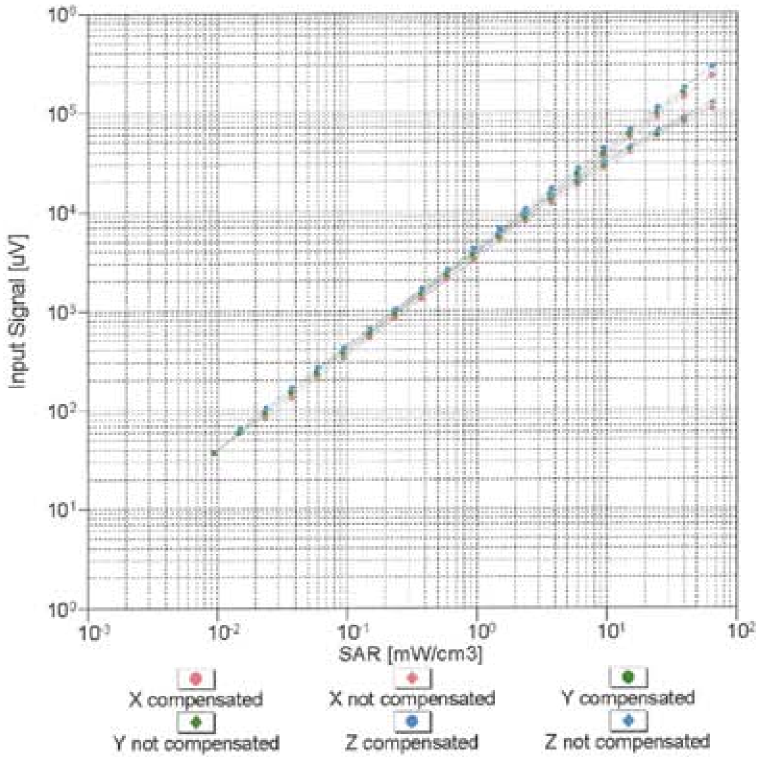
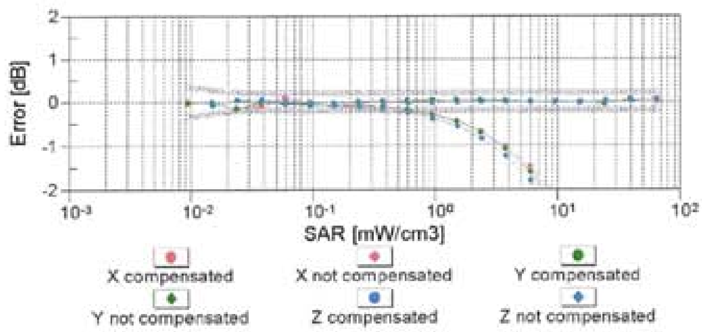
EX3DV4– SN:3643 January 27, 2012

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)





Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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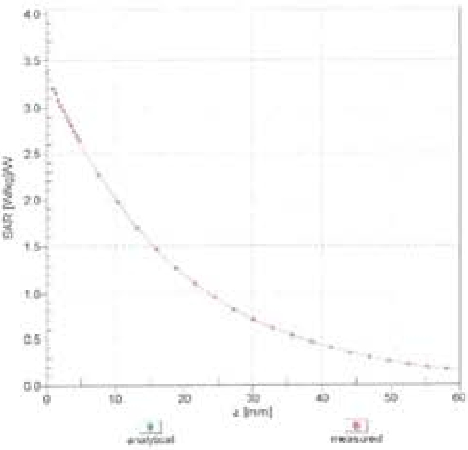
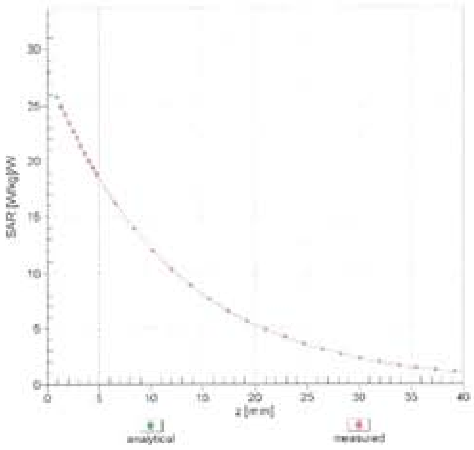
Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

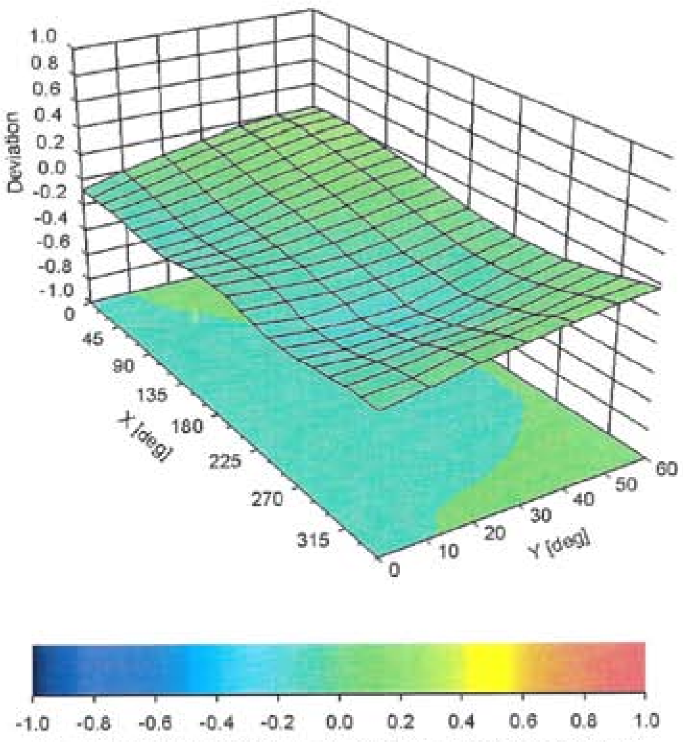


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3643

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Attachment 4. – Dipole Calibration Data

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client SGS (Dymstec)

Certificate No: D450V2-1015_Aug11/2

CALIBRATION CERTIFICATE (Replacement of No:D450V2-1015_Aug11)

Object	D450V2 - SN: 1015
Calibration procedure(s)	QA CAL-15.v6 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	August 22, 2011

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.3 / 06327	29-Mar-11 (No. 217-01168)	Apr-12
Reference Probe ET3DV6	SN: 1507	30-Apr-10 (No. ET3-1507_Apr10)	Apr-11
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 26, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Flat Phantom V4.4	Shell thickness: 6 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	44.5 ± 6 %	0.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	398 mW input power	1.95 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**4.97 mW /g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	398 mW input power	1.30 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**3.30 mW /g ± 17.6 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.5 ± 6 %	0.94 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	398 mW input power	1.89 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**4.73 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	398 mW input power	1.26 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**3.16 mW / g ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 Ω - 9.1 jΩ
Return Loss	- 20.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.1 Ω - 10.1 jΩ
Return Loss	- 20.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.356 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	May 30, 2003

DASY5 Validation Report for Head TSL

Date: 22.08.2011

Test Laboratory: SPEAG

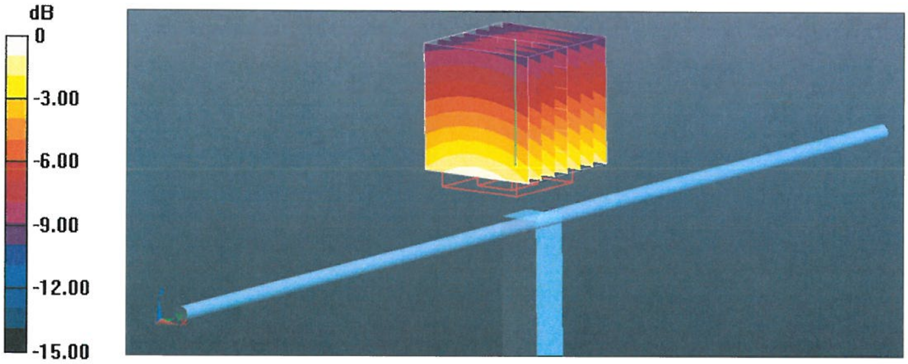
DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN: 1015

Communication System: CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.86 mho/m; εr = 44.5; ρ = 1000 kg/m3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.59, 6.59, 6.59); Calibrated: 29.04.2011;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 03.05.2011
- Phantom: Flat Phantom 4.4 ; Type: Flat Phantom 4.4; Serial: 1002
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Head Tissue/d=15mm, Pin=398mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 48.990 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 2.97 W/kg
SAR(1 g) = 1.95 W/kg; SAR(10 g) = 1.3 W/kg
Maximum value of SAR (measured) = 2.09 W/kg



0 dB = 2.09 W/kg = 3.20 dBW/kg

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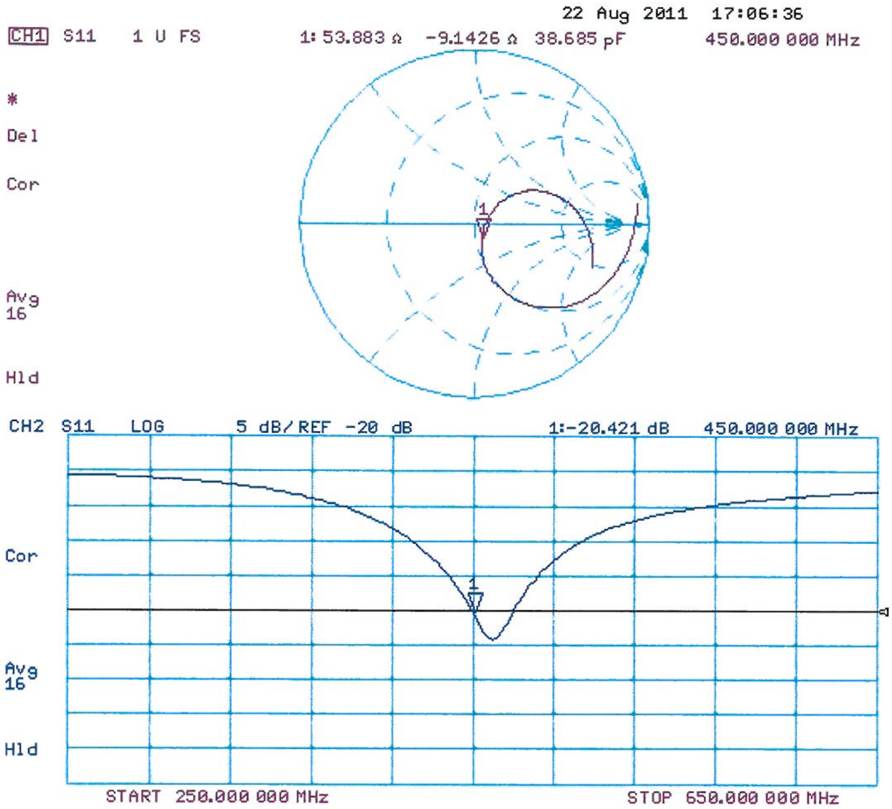
Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 22.08.2011

Test Laboratory: SPEAG

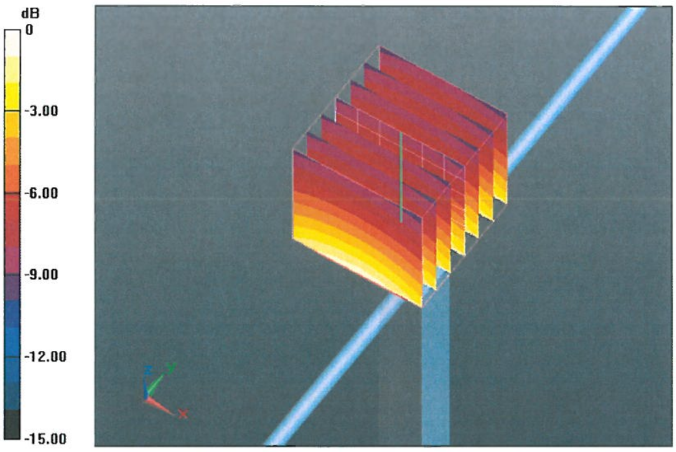
DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN: 1015

Communication System: CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; $\sigma = 0.94$ mho/m; $\varepsilon_r = 55.5$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

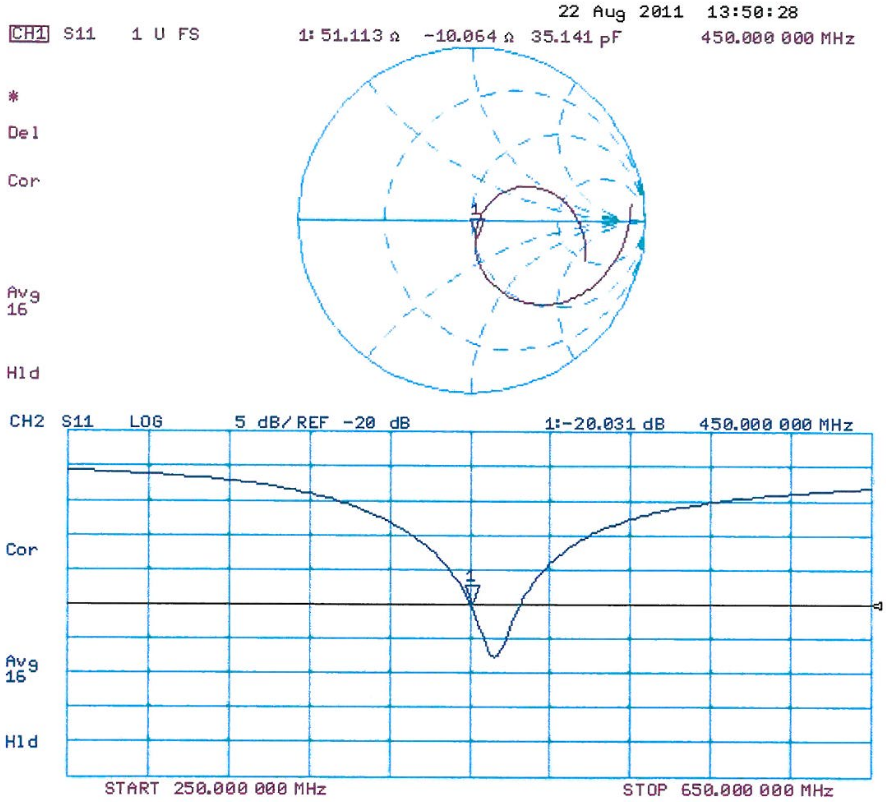
- Probe: ET3DV6 - SN1507; ConvF(7.05, 7.05, 7.05); Calibrated: 29.04.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 03.05.2011
- Phantom: Flat Phantom 4.4 ; Type: Flat Phantom 4.4; Serial: 1002
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Body Tissue/d=15mm, Pin=398mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 46.322 V/m; Power Drift = -0.0035 dB
Peak SAR (extrapolated) = 2.964 W/kg
SAR(1 g) = 1.89 mW/g; SAR(10 g) = 1.26 mW/g
Maximum value of SAR (measured) = 2.026 mW/g



0 dB = 2.030mW/g

Impedance Measurement Plot for Body TSL



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