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TEST REPORT

Report number : Z101C-14091

Issue date : October 15, 2014

The device, as described herewith, was tested pursuant to applicable test procedure and complies with the requirements of;

FCC 47CFR §2. 1093

The test results are traceable to the international or national standards.

Applicant	:	KYOCERA Corporation
Equipment under test (EUT)	:	Mobile Phone
Model number	:	KYY09
FCC ID	:	JOYKYY09

Date of test	:	September 18, 22, 24, 25, 2014
Test place	:	TÜV SÜD Zacta Ltd. Yonezawa Testing Center 4149-7 Hachimanpara 5-chome Yonezawa-shi Yamagata 992-1128 Japan Phone: +81-238-28-2880 Fax: +81-238-28-2888
Test results	:	Complied

The results in this report are applicable only to the equipment tested.
This report shall not be re-produced except in full without the written approval of TÜV SÜD Zacta Ltd.
This test report must not be used by client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Tested by : Chiaki Kanno

Chiaki Kanno

Authorized by :

Eiji Akiba
Deputy General Manager of EMC Technical Department

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Table of contents

Zacta

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1. Summary of Test

1.1 Purpose of test

It is the original test in order to verify conformance to standards listed in section 1.2.

1.2 Standards

FCC 47CFR §2. 1093

1.2.1 Guidance applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G and Hotspot)
- FCC KDB Publication 447498 D01 v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 648474 D03-D04

1.2.2 Deviation from standards

None

1.3 Modification to the EUT by laboratory

None

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2. Equipment Under Test

2.1 General description of equipment

EUT is the Mobile Phone.

2.2 EUT information

Applicant	:	KYOCERA Corporation Yokohama Office 2-1-1 Kagahara, Tsuzuki-ku Yokohama-shi, Kanagawa, Japan Phone: +81-45-943-6253 Fax: +81-45-943-6314
Equipment under test	:	Mobile Phone
Trade name	:	Kyocera
Model number	:	KYY09
Serial number	:	N/A
EUT condition	:	Identical prototype
Power ratings	:	Battery: DC 3.7V
Size	:	(W) 49 × (D) 16.8 × (H) 112 mm
Environment	:	Indoor and Outdoor use
Terminal limitation	:	-20˚C to 60˚C
RF Specification		
Equipment type	:	Transceiver
Mode(s) of operation	:	CDMA Cellular, PCS 1900
Antenna type	:	Internal antenna
Antenna gain	:	0dBi
Frequency of operation	:	Up Link 824.70 – 848.31 MHz (CDMA Cellular) 1850.2 – 1909.8 MHz (PCS Band) Down Link 869.70 – 893.31 MHz (CDMA Cellular) 1930.2 – 1989.8 MHz (PCS Band)

2.3 Variation of the family model(s)

None

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2.4 Description of test modes

The EUT had been tested under operating condition.
There are three channels have been tested as following:

Band	Channel	Test mode
CDMA Cellular	1013, 384, 777	Voice/Data
PCS 1900	512, 661, 810	Voice/ Data

The worst case data was reported.

2.5 Test Results

Equipment Class	Band	Measured Conducted Power [dBm]	Reported SAR 1g SAR [W/kg]		
			Head	Body-worn	Hotspot
PCE	PCS 1900	29.49	0.216	0.247	0.377
	Cell. CDMA	23.83	0.606	0.475	0.475
DSS/DTS	Bluetooth	6.73	N/A	N/A	N/A
Simultaneous SAR per KDB 690783 D01v01r03			N/A	0.360	N/A

2.6 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications.
SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05r02.

Band & Mode		Modulated Average [dBm]
Cell. CDMA	Maximum	24.0
	Nominal	23.5

Band & Mode		Voice [dBm]	Burst Average GMSK [dBm]	
		1TX Slot	1TX Slot	2TX Slot
GSM/GPRS 1900	Maximum	30.0	30.0	28.5
	Nominal	29.5	29.5	28.0

Band & Mode		Modulated Average [dBm]
Bluetooth 1 Mbps	Maximum	6.8
	Nominal	5.3
Bluetooth 2 Mbps	Maximum	4.5
	Nominal	3.0
Bluetooth 3 Mbps	Maximum	3.5
	Nominal	2.0

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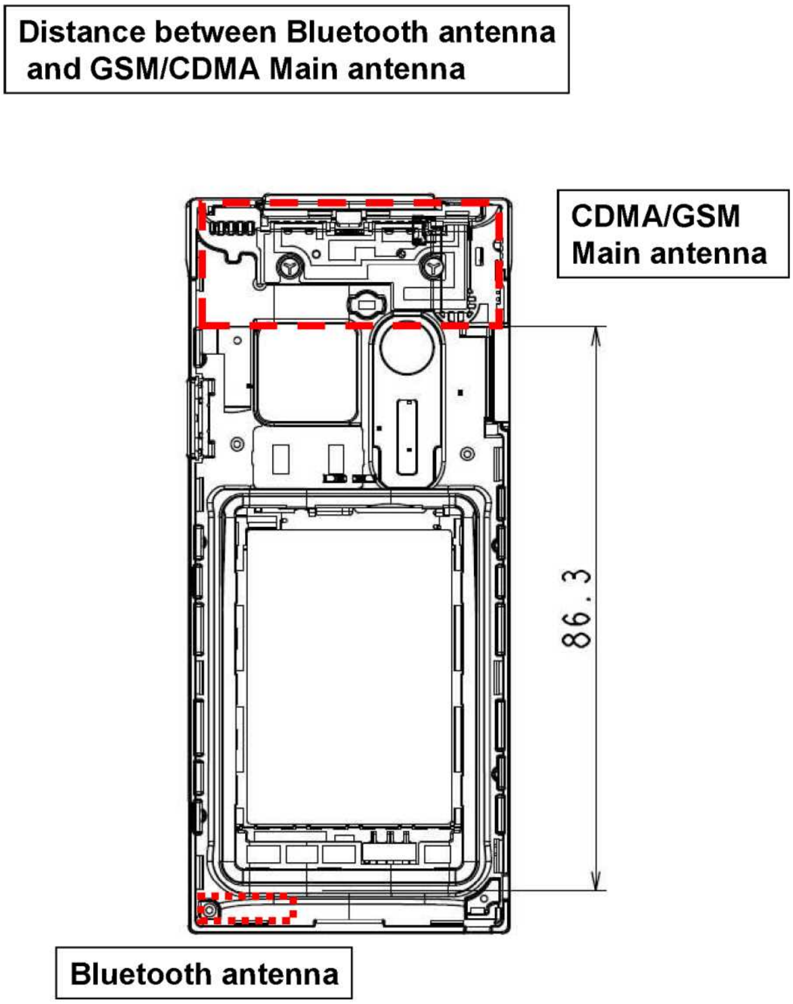
2.7 DUT Antenna Locations & SAR Test Configurations

DUT Antenna Locations (Rear side view):



Note: Specific antenna dimensions and separation distances are shown in the antenna distance document.

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2.8 SAR Test Exclusions Applied

(A) BT

Per FCC KDB 447498 D01v05r02, the SAR exclusion threshold for distances < 50 mm is defined by the following equation:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 3.0$$

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth SAR was not required; [(6/10)* $\sqrt{2.480}$] = 1.0 < 3.0.

Per KDB Publication 447498 D01v05r02, the maximum power of the channel was rounded to the nearest mW before calculation.

WLAN is not supported for this device.

(B) Licensed Transmitter(s)

GSM/GPRS DTM is not supported for US bands.
Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS Data.

CDMA 1xAdvanced technology and EVDO are not supported for this device.

2.9 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

2.10 Device Serial Numbers

Band & Mode	Head Serial Number		Body-Worn Serial Number		Hotspot Serial Number	
CDMA Cellular PCS 1900	FCC #1	FCC #1	FCC #1	FCC #1	FCC #1	FCC #1

3. Introduction

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.
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.

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

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

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

Where:
σ= conductivity of the tissue - simulating material (S/m)
ρ= mass density of the tissue-simulating 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.

4. Description of test equipment

4.1 SAR Measurement Setup

Measurements are performed using the DASY5 automated dosimetric assessment system. The DASY5 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 4.1).

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 Intel Core i7-3770 3,40 GHz desktop computer with Windows NT system and SAR Measurement Software DASY5, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

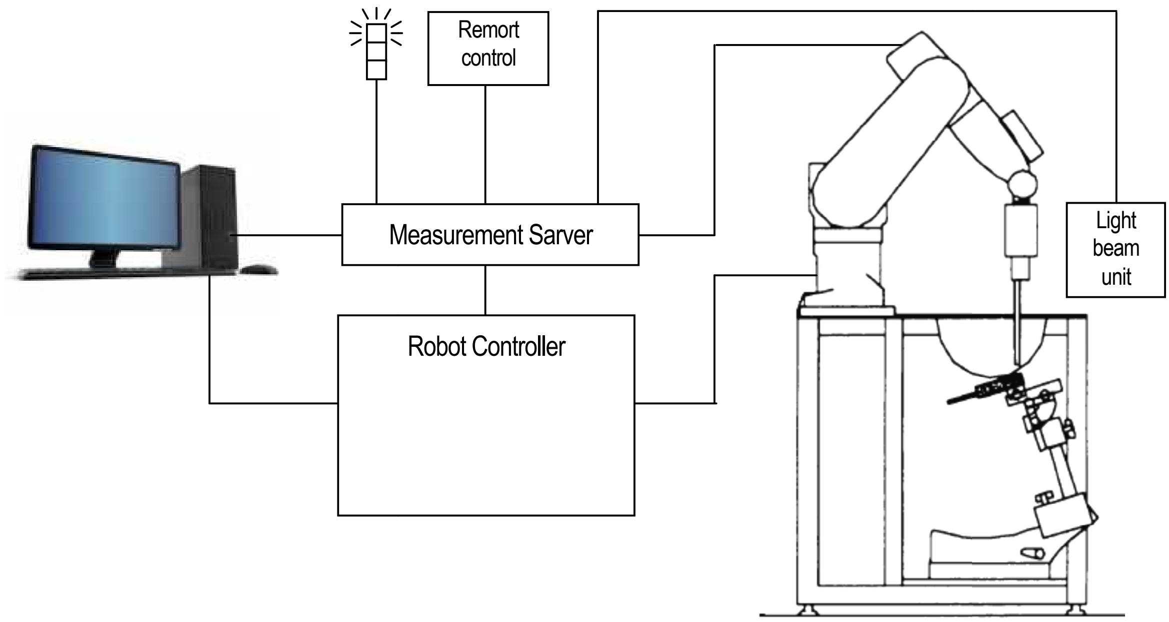

Figure 4.1 SAR Measurement system setup

The DAE consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter 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 optical uplink for 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.

4.2 Probe measurement 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. 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 DASY5 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.

DAE System

Probe specifications

Calibration	In air from 10 MHz to 6 GHz In brain and muscle simulating tissue at Frequencies of 750MHz, 835MHz, 900MHz, 1750MHz, 1900MHz, 2000MHz 2300MHz, 2450MHz, 2600MHz, 3500MHz, 5200MHz, 5300MHz, 5500MHz, 5600MHz, 5800MHz
Frequency	10 MHz to 6 GHz
Linearity	± 0.2 dB(30 MHz to 6 GHz)
Dynamic	10 µW/g to > 100 mW/g
Range linearity	± 0.2 dB
Dimensions Overall length	337 mm(Tip: 20 mm)
Tip diameter	2.5 mm(Body: 12 mm)

Typical distance from probe tip to dipole centers: 1 mm

Application	Dosimetry testing Compliance tests of mobile phones

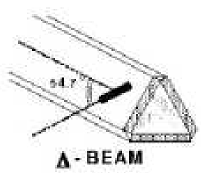

Figure 4.2 Triangular Probe Configurations

Figure 4.3 Probe Thick-Film Technique

4.3 Probe calibration process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in with accuracy better than +/-10%. The spherical isotropy was evaluated with the procedure described in and found to be better than +/-0.25dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium, correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent the remits or based temperature probe is used in conjunction with the E-field probe.

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

Where:

Δt = exposure time (30 seconds),

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

ΔT = temperature increase due to RF exposure.

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

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;

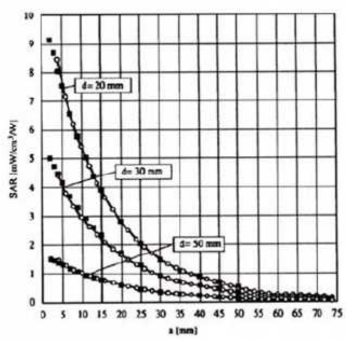

Figure 4.4 E-Field and Temperature Measurements at 900MHz

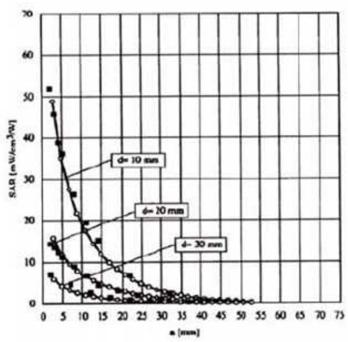

Figure 4.5 E-Field and Temperature Measurements at 1800MHz

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Data Extrapolation

The DASY software automatically executes the following procedures to calculate the field units from the microvolt 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 electronics. 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 = linearized voltage of channel i (uV) (i = x,y,z)
U_i = measured voltage of channel i (uV) (i = x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point of channel i (uV) (Probe parameter, i = x,y,z)

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

$$\text{E} - \text{fieldprobes}: \quad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = linearized voltage 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 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 (Hermitian 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.

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

with ***SAR*** = local specific absorption rate in mW/g
Etot = 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 mW/cm^2
E_{tot} = total electric field strength in V/m

4.4 SAM Twin Phantom

The SAM Twin Phantom V5.0 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. 4.6)

Figure 4.6 SAM Twin phantom

SAM Twin Phantom Specification

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. 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 evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0, but has reinforced top structure.
Shell Thickness	2 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet

Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions 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. 4.7). 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 4.7 Sam Twin Phantom shell

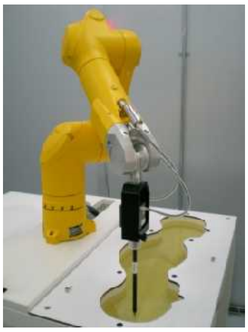
4.5 Device Holder for Transmitters

In combination with the Twin SAM Phantom V5.0 or ELI5, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications.
The device holder can be locked for positioning at different phantom sections (left head, right head, flat).

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 4.8 Mounting Device

4.6 Brain & Muscle Simulating Mixture Characterization



Simulated Tissue

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution. (see Table 4.1)
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 obtain 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.

Table 4.1 Composition of the Equivalent Matter

Ingredients [% by weight]	Frequency [MHz]									
	750		835		1900		2450		5200 - 5800	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	42.10	50.00	40.19	50.75	55.24	70.23	71.88	73.40	65.52	80.00
Salt(NaCl)	1.500	0.800	1.480	0.940	0.310	0.290	0.160	0.060	-	-
Sugar	56.00	48.80	57.90	48.21	-	-	-	-	-	-
HEC	0.200	0.200	0.250	-	-	-	-	-	-	-
Bactericide	0.200	0.200	0.180	0.100	-	-	-	-	-	-
Triton X-100	-	-	-	-	-	-	19.97	-	17.24	-
DGBE	-	-	-	-	48.45	29.48	7.990	26.54	-	-
Diethylenglycol monohexylether	-	-	-	-	-	-	-	-	17.24	-
Polysorbate (Tween) 80	-	-	-	-	-	-	-	-	-	20.00
Target for Dielectric Constant	**41.9**	**55.5**	**41.5**	**55.2**	**40.0**	**53.3**	**39.2**	**52.7**	**-**	**-**
Target for Conductivity (S/m)	**0.89**	**0.96**	**0.90**	**0.97**	**1.40**	**1.52**	**1.80**	**1.95**	**-**	**-**

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]

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4.7 SAR Test equipment

Table 4.2 Test Equipment Calibration

USE	Equipment	Company	Model No.	Serial No.	Cal. Due	Cal. Date
X	SAR Test Room No.3	TOKIN	N/A	N/A	N/A	N/A
X	Robot Arm	speag	TX60L	F13/5SC6C1/A/01	N/A	N/A
X	Robot Controller	speag	CS8c	F13/5SC6C1/A/01	N/A	N/A
X	Probe Alignment Unit LB	speag	N/A	N/A	N/A	N/A
X	Mounting Device	speag	SD000H01KA	N/A	N/A	N/A
	Laptop Holder	speag	SMLH1001CD	N/A	N/A	N/A
X	SAM Twin Phantom	speag	QD000P40CD	1799	N/A	N/A
	SAM Flat Phantom	speag	QDOVA001BB	1230	N/A	N/A
X	Data Acquisition Electronics	speag	DAE4	1409	Nov. 30, 2014	Nov. 22, 2013
X	Dosimetric E-Field Probe	speag	EX3DV4	3957	Dec. 31, 2014	Dec. 3, 2013
	750MHz SAR Dipole	speag	D750V3	1100	Dec. 31, 2014	Dec. 4, 2013
	835MHz SAR Dipole	speag	D835V2	4d163	Dec. 31, 2014	Dec. 4, 2013
X	900MHz SAR Dipole	speag	D900V2	1d161	Dec. 31, 2014	Dec. 4, 2013
	1450MHz SAR Dipole	speag	D1450V2	1048	Dec. 31, 2014	Dec. 3, 2013
	1750MHz SAR Dipole	speag	D1750V2	1106	Dec. 31, 2014	Dec. 4, 2013
X	1900MHz SAR Dipole	speag	D1900V2	5d183	Dec. 31, 2014	Dec. 2, 2013
	1950MHz SAR Dipole	speag	D1950V3	1150	Dec. 31, 2014	Dec. 2, 2013
	2450MHz SAR Dipole	speag	D2450V2	925	Dec. 31, 2014	Dec. 3, 2013
	2600MHz SAR Dipole	speag	D2600V2	1072	Dec. 31, 2014	Dec. 3, 2013
	5000MHz SAR Dipole	speag	D5GHzV2	1166	Dec. 31, 2014	Dec. 3, 2013
X	Dielectric Assessment Kit	speag	DAK-3.5	1141	Nov. 30, 2014	Nov. 26, 2013
X	Network Analyzer	Agilent	8720ES	US39172791	Nov. 30, 2014	Nov. 8, 2013
X	Signal generator	ROHDE	SMB100A	177525	Feb. 28, 2015	Feb. 19, 2014
X	Power Amplifier	R&K	CGA020M602-2633R	B40240	Mar. 31, 2015	Mar. 7, 2014
X	Power meter	ROHDE	NRP2	103269	Dec. 31, 2014	Dec. 19, 2013
X	Power sensor	ROHDE	NRP-Z81	102459	Dec. 31, 2014	Dec. 19, 2013
X	Power sensor	ROHDE	NRP-Z81	102467	Dec. 31, 2014	Dec. 19, 2013
X	Directional Coupler	Narda	4226-20	09886	Feb. 28, 2015	Feb. 14, 2014
X	Attenuator(3dB)	AEROFLEX	26A-03	081217-07	Nov. 30, 2014	Nov. 5, 2013
X	Attenuator(10dB)	SUHNER	6810.19A	10005430	Nov. 30, 2014	Nov. 5, 2013
	Attenuator(20dB)	SUHNER	6810.19A	10002840	Oct. 31, 2014	Oct. 14, 2013
X	Microwave cable(1m)	SUHNER	SUCOFLEX104	199120/4	Nov. 30, 2014	Nov. 12, 2013
X	Microwave cable(1.5m)	SUHNER	SUCOFLEX104	199121/4	Oct. 31, 2014	Oct. 7, 2013
X	Wideband Radio Frequency Tester	ROHDE	CMW500	126079	Aug. 31, 2015	Aug. 28, 2014
X	PC	HP	HP Compaq Elite 8300	CZC3234D1P	N/A	N/A
X	Software	speag	DAK	Ver 1.10.321.11	N/A	N/A
X	Software	speag	DASY5	Ver 52.8.7.1137	N/A	N/A

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

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5. Test system specifications

Automated TEST SYSTEM SPECIFICATIONS:

Positioner

Robot	Stäubli Unimation Corp. Robot Model: TX60L
Repeatability	0.02mm
No. of axis	6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor	Intel Core i7-3770
Clock Speed	3.40 GHz
Operating System	Windows 7 Professional
Data Card	DASY5 PC-Board

Data Converter

Features	Signal, multiplexer, A/D converter. & control logic
Software	DASY5
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 4 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: 3957
Construction	Triangular core fiber optic detection system
Frequency	10 MHz to 6 GHz
Linearity	± 0.2 dB (30 MHz to 6 GHz)

Phantom

Phantom	SAM Twin Phantom (V5.0)
Shell Material	Composite
Thickness	2.0 ± 0.2 mm

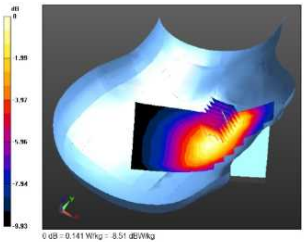
Figure 5.1 DASY5 Test System

6. SAR Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell.
   The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664D01v01.

2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.



Sample SAR Area Scan

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table6.1).
   On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

b. After the maximum interpolated values were calculated between the points in the cube,the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot"condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

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 step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Table 6.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01

Frequency	Maximum Area Scan Resolution[mm] $(\Delta x_{area}, \Delta y_{area})$	Maximum Zoom Scan Resolution[mm] $(\Delta x_{zoom}, \Delta y_{zoom})$	Maximum Zoom Scan Spatial Resolution[mm] $\Delta z_{zoom}(n)$	Minimum Zoom Scan Volume[mm](x,y,z)
≦2GHz	≦15	≦8	≦5	≧30
2-3GHz	≦12	≦5	≦5	≧30
3-4GHz	≦12	≦5	≦4	≧28
4-5GHz	≦10	≦4	≦3	≧25
5-6GHz	≦10	≦4	≦2	≧22

7. Definition of reference points

7.1 EAR Reference Point

Figure 7.1 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 Earcanal (EEC) along the B- M line (Back-Mouth), as shown in Figure 7.1. 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 7.2).
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 handset positioning.

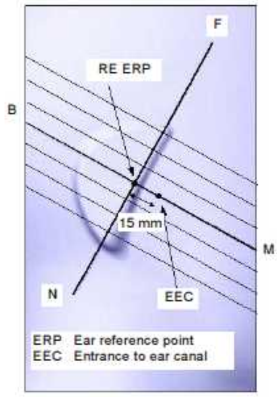


Figure 7.1 Close-up side view of ERPs

7.2 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. 7.3). 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 outersurface of the both the left and right head phantoms on the ear reference point.

Figure 7.2 Front, back and side view of SAM Twin Phantom

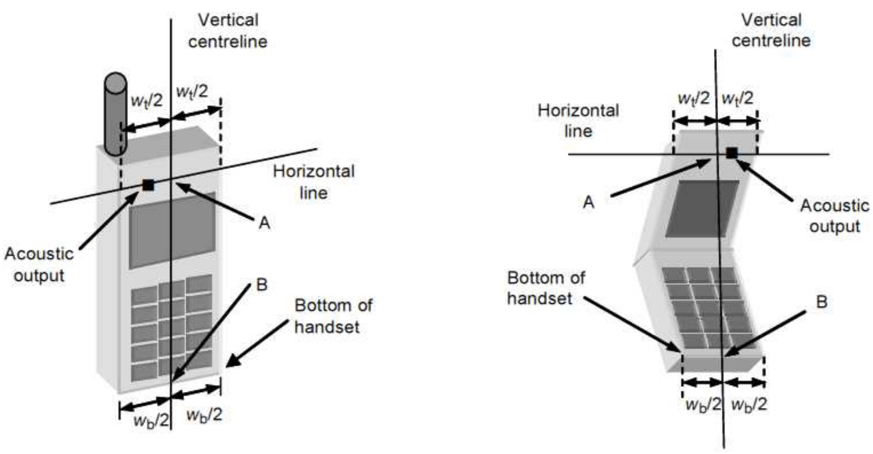


Figure 7.3 Handset Vertical Center & Horizontal Line Reference Points

7.3 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters:relative permittivity ε =3 and loss tangent δ = 0.02.

7.4 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 Fig. 7.4), 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.

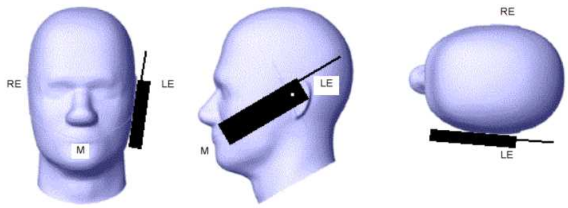


Figure 7.4 Front, Side and Top View of Cheek/Touch Position

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 Fig. 7.5)

7.5 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 7.6).

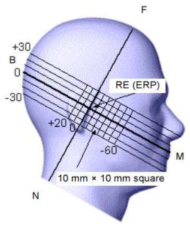


Figure 7.5 Side view/relevant markings

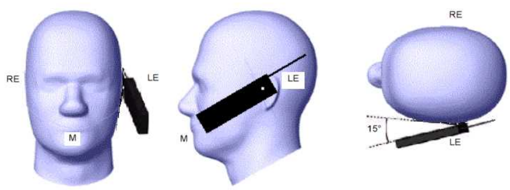


Figure 7.6 Front, Side and Top View of Ear/15° Position

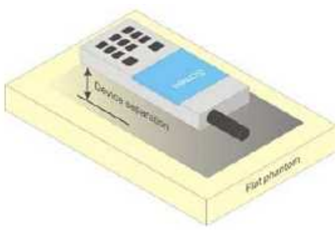


Figure 7.7 Sample Body-Worn Diagram

7.6 Body-Worn Accessory 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 Fig. 7.7). Per FCC KDB Publication 648474 D04_v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05r02 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

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 tested with the device with each accessory. 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.

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 with a separation distance betweenthe back of the device and the flat phantom is used. Test position spacing was 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 in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

7.7 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user’s body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v05r02 should be applied to determine SAR test requirements.
Per KDB Publication 447498 D01v05r02, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require
extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

7.8 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v01 where SAR test considerations for handsets(L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05r02 publication procedures.
The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

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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 employmentrelated; 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, which 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 *1 (Brain)	1.60	8.00
SPATIAL AVERAGE SAR *2 (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *3 (Hands / Feet / Ankle / Wrist)	4.00	20.0

*1. 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.
*2. The Spatial Average value of the SAR averaged over the whole-body.
*3. 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. FCC Measurement Procedures

Power measurements were performed using a base station simulator under digital average power.

9.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05r02, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. The highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r02.

9.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v02r02 “SAR Measurement Procedures for 3G Devices” v02, October 2007.
The device was placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4].
Devices under test were evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device was tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviated by more than 5%, the SAR test and drift measurements were repeated.

9.2.1 SAR measurement conditions for CDMA2000

The following procedures were performed according to FCC KDB publication 941225 D01 “SAR measurement Procedures for Devices” c02, October 2007.

Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended “SAR Measurement Procedures for 3G Devices” v02, October 2007. Maximum output power is verified on the High, Middle and Low channels according to procedures in section 4.4.5.2 of 3GPP2 C.S001/TIA-98-E. SO55 tests were measured with power control bits in the “All Up” condition.

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 11-1 parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH0 and demodulation of RC 3, 4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH0 data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 11-2 was applied.

Parameters for Max. Power for RC1

Parameter	Units	Value
I_{or}	dBm/1.23 MHz	-104
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

Table 11-1

Parameters for Max. power for RC3

Parameter	Units	Value
I_{or}	dBm/1.23 MHz	-86
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

Table 11-2

5. FCHs were configured at full rate for maximum SAR with “All Up” power control bits.

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CDMA 2000 1x Advanced

This device additionally supports 1x Advanced. Conducted powers were measured using SO75 with RC8 on the uplink and RC11 on the downlink per Oct 2012 TCB Workshop notes. Smart blanking was disabled for all measurements. The EUT was configured with forward power control Mode 000 and reverse power control at 400 bps. Conducted powers were measured on an Agilent 8960 Series 10 Wireless Communications Test Set, Model E5515C using the CDMA2000 1x Advanced applications, Option E1962B-410.

Based on the maximum output power measured for 1x Advanced, SAR is required for 1x advanced when if the maximum output for 1x Advanced is more than 0.25 dB higher than the maximum measured for 1x. Also, if the measured SAR in any 1x mode exposure conditions (head, body etc.) is larger than 1.2 W/kg, the highest of those configurations above 1.2 W/kg for each exposure condition in 1x Advanced has to be repeated. All measured SAR in 1x mode higher than 1.5 W/kg must be repeated for 1x Advanced.

Head SAR measurements

SAR for head exposure configurations is measured in RC3 with the DUT configured to transmit at full rate using Loopback Service Option SO55. SAR for RC1 is not required when the maximum average output of each channel is less than 1/4 dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1 using the exposure configuration that results in the highest SAR for that channel in RC3.

Body SAR measurements

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channel (FCH + SCHn) is not required when the maximum average output of each RF channel is less than 1/4 dB higher than that measured with FCH only. Otherwise, SAR is measured on the maximum output channel (FCH + SCHn) with FCH at full rate and SCH0 enabled at 9600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only. When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts. Body SAR was measured using TDSO / SO32 with power control bits in the “All Up”.

Body SAR in RC1 is not required when the maximum average output of each channel is less than 1/4 dB higher than that measured in RC3. Otherwise, SAR is measured on the maximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that result in the highest SAR for that channel in RC3.

10. RF Conducted Power

10.1 GSM Conducted Powers

Band	Channel	Maximum Burst-Averaged Output Power [dBm]		
		Voice	GPRS/EDGE(GMSK)Data	
		GSM CS 1slot	GPRS 1 TX Slot	GPRS 2 TX Slot
PCS1900	512	29.36	29.16	27.76
	661	29.49	29.31	27.83
	810	29.48	29.11	27.83
Band	**Channel**	**Calculated Maximum Frame-Averaged Output Power [dBm]**		
		Voice	**GPRS/EDGE(GMSK)Data**	
		GSM CS 1slot	**GPRS 1 TX Slot**	**GPRS 2 TX Slot**
PCS1900	512	20.33	20.13	21.74
	661	20.46	20.28	21.81
	810	20.45	20.08	21.81

Table 10.1 The power was measured by E5515C

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
2. The bolded GPRS modes were selected according to the highest frame-averaged output power table according to KDB 941225 D03v01.
3. GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.

GSM Class: B
GPRS Multislot class: 12 (max 4 TX Uplink slots)
EDGE multislot class: N/A (Rx Only)
DTM Multislot Class: N/A

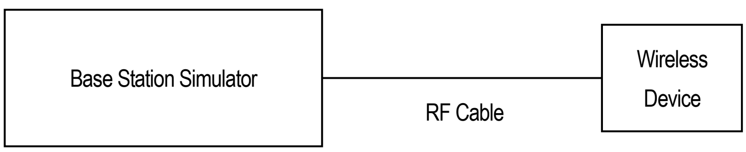

Figure 10.1 Power Measurement Setup

10.2 CDMA Conducted Powers

Band	Channel	Loopback				Data	
		Frequency	SO55 [dBm]	SO55 [dBm]	SO75 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]
	F-RC	MHz	RC1	RC3	RC8	FCH+SCH	FCH
Cellular	1013	824.70	23.81	23.83	N/A(Note2)	23.79	23.80
	384	836.52	23.78	23.83	N/A(Note2)	23.79	23.81
	777	848.31	23.80	23.83	N/A(Note2)	23.79	23.80

Table 10.2 The power was measured by E5515C

Note1: RC1 is only applicable for IS-95 Compatibility.

Note2: This device does not support 1xAdvanced (SO5) and EVDO.

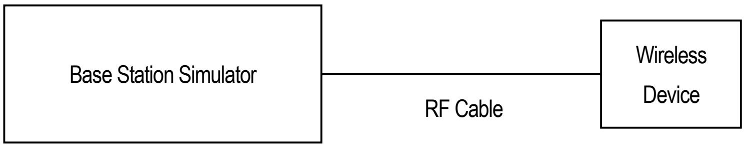

Figure 10.2 Power Measurement Setup

10.3 Bluetooth Conducted Powers

Channel	Frequency	Output Power (1 Mbps)	Output Power (2 Mbps)	Output Power (3 Mbps)
	(MHz)	(dBm)		
Low	2402	5.20	2.83	1.84
Mid	**2441**	**6.73**	4.35	3.32
High	2480	6.35	3.92	2.90

Table 10.3 Bluetooth Average RF Power

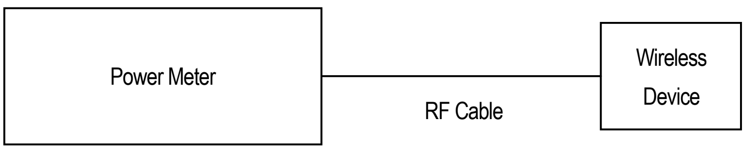

Figure 10.3 Power Measurement Setup

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11. System Verification

11.1 Tissue verification

MEASURED TISSUE PARAMETERS										
Date(s)	Tissue Type	Ambient Temp. [℃]	Liquid Temp. [℃]	Measured Frequency [MHz]	Target Dielectric constant, ε_r	Target Conductivity, σ[S/m]	Measured Dielectric constant, ε_r	Measured Conductivity, σ[S/m]	ε_r Deviation [%]	σ Deviation [%]
Sep. 18, 2014	835 Head	22.0	23.0	824.70	41.601	0.910	40.87	0.897	-1.76	-1.44
				835.00	41.523	0.910	40.72	0.906	-1.93	-0.47
				836.52	41.511	0.910	40.76	0.909	-1.81	-0.13
				848.31	41.500	0.919	40.63	0.919	-2.10	-0.03
Sep. 22, 2014	835 Body	22.1	21.8	824.70	55.201	0.980	53.22	0.973	-3.59	-0.74
				835.00	55.200	0.980	53.13	0.982	-3.75	0.18
				836.52	55.200	0.980	53.17	0.986	-3.68	0.64
				848.31	55.200	0.989	53.02	0.995	-3.95	0.59
Sep. 24, 2014	1900 Head	23.3	23.0	1850.2	40.000	1.400	39.71	1.364	-0.72	-2.57
				1880.0	40.000	1.400	39.61	1.388	-0.98	-0.86
				1900.0	40.000	1.400	39.52	1.407	-1.20	0.50
				1909.8	40.000	1.400	39.43	1.418	-1.43	1.29
Sep. 25, 2014	1900 Body	23.2	22.9	1850.2	53.300	1.520	52.02	1.489	-2.40	-2.04
				1880.0	53.300	1.520	51.87	1.523	-2.68	0.20
				1900.0	53.300	1.520	51.76	1.540	-2.89	1.32
				1909.8	53.300	1.520	51.73	1.551	-2.95	2.04

Tissue Verification Note:

Note: The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per IEEE 1528 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the sample which was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured.
4) The complex relative permittivity, for example from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon'_r\,\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi'\,\frac{\exp\left[-j\omega(\propto_0\varepsilon'_r\,\varepsilon_0)^{1/2}r\right]}{r}\,d\phi' d\rho' d\rho$$

Where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2=\rho^2+\rho'^2-2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j=\sqrt{-1}$.

11.2 Test system verification

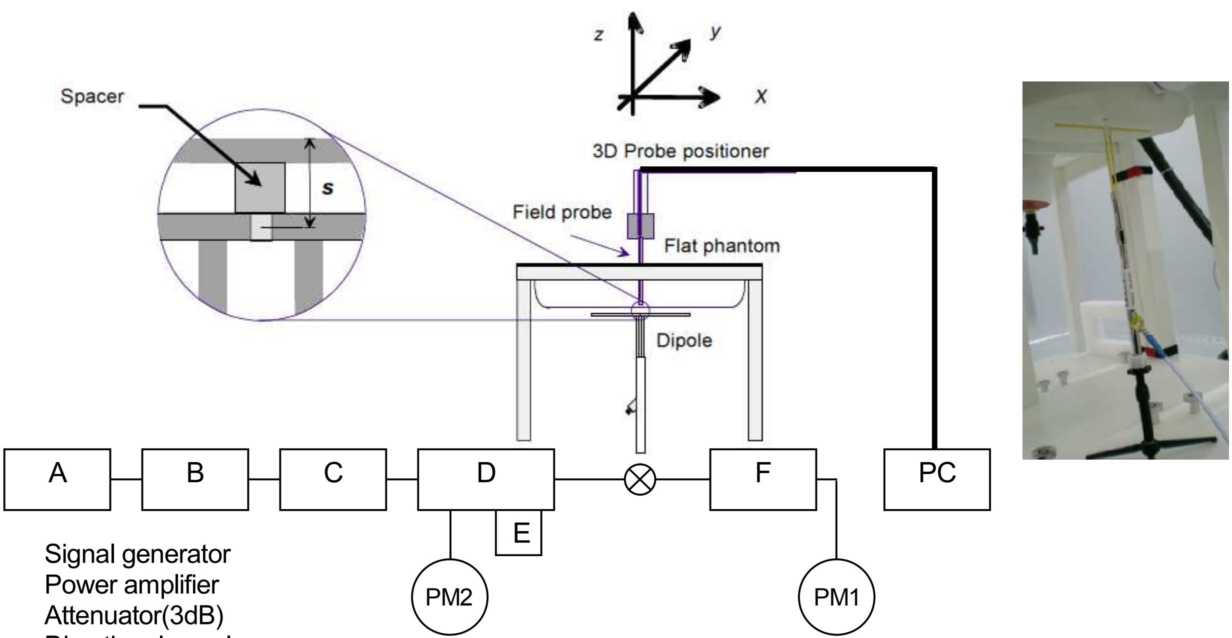
Prior to assessment, the system is verified to the ± 10% of the specifications at 835 MHz, 1900 MHz by using the SAR Dipole kit(s). (Graphic Plots Attached)

SYSTEM DIPOLE VERIFICATION TARGET & MEASURED											
Freq. [MHz]	SAR Dipole Kits	Date(s)	Liquid	Ambient Temp.[°C]	Liquid Temp.[°C]	Probe S/N	Input Power [mW]	1W Targeted SAR 1g [W/kg]	Measured SAR 1g [W/kg]	1W Normalized SAR 1g [W/kg]	Deviation [%]
835	D835V2, S/N: 4d163	Sep. 18, 2014	Head	22.0	23.0	3957	250	9.45	2.49	9.96	5.40
835	D835V2, S/N: 4d163	Sep. 22, 2014	Body	22.1	21.8	3957	250	9.43	2.51	10.04	6.47
1900	D1900V2, S/N: 5d183	Sep. 24, 2014	Head	23.3	23.0	3957	250	40.5	9.58	38.32	-5.38
1900	D1900V2, S/N: 5d183	Sep. 25, 2014	Body	23.2	22.9	3957	250	40.6	9.65	38.60	-4.93

Note1 : System Validation was measured with input 250 mW and normalized to 1W.

Note2 : To confirm the proper SAR liquid depth, the z-axis plots from the system verifications were included since the system verifications were performed using the same liquid, probe and DAE as the SAR tests in the same time period.

Note3: Full system validation status and results can be found in Attachment 3.



A: Signal generator
B: Power amplifier
C: Attenuator(3dB)
D: Directional coupler
E: Terminator(50Ω)
F: Attenuator(10dB)
PM1: Power sensor A
PM2: Power sensor B

Figure10.1 Dipole Verification Test Setup

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12. SAR Test Results

12.1 Head SAR Results

Table 12.1 CDMA Head SAR

MEASUREMENT RESULTS											
Frequency		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	1g SAR [W/kg]	Scaling Factor	1g Scaled SAR [W/kg]
MHz	Ch										
836.52	384	Cell. CDMA	RC3/SO55	24.0	23.83	-0.01	Left Touch	FCC #1	0.583	1.040	**0.606**
836.52	384	Cell. CDMA	RC3/SO55	24.0	23.83	-0.13	Right Touch	FCC #1	0.531	1.040	0.552
836.52	384	Cell. CDMA	RC3/SO55	24.0	23.83	-0.19	Left Tilt	FCC #1	0.274	1.040	0.285
836.52	384	Cell. CDMA	RC3/SO55	24.0	23.83	0.14	Right Tilt	FCC #1	0.29	1.040	0.302
ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure							Head 1.6 W/kg(mW/g) averaged over 1 gram				

Table 12.2 PCS 1900 Head SAR

MEASUREMENT RESULTS												
Frequency		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	# of Time slots	1g SAR [W/kg]	Scaling Factor	1g Scaled SAR [W/kg]
MHz	Ch											
1880.0	661	PCS1900	PCS	30.0	29.49	-0.08	Left Touch	FCC #1	1	0.192	1.125	**0.216**
1880.0	661	PCS1900	PCS	30.0	29.49	-0.17	Right Touch	FCC #1	1	0.185	1.125	0.208
1880.0	661	PCS1900	PCS	30.0	29.49	0.19	Left Tilt	FCC #1	1	0.149	1.125	0.168
1880.0	661	PCS1900	PCS	30.0	29.49	-0.14	Right Tilt	FCC #1	1	0.177	1.125	0.199
ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure							Head 1.6 W/kg(mW/g) averaged over 1 gram					

12.2 Standalone Body-Worn SAR Results

Table 12.3 CDMA/PCS Body-Worn SAR

MEASUREMENT RESULTS												
Frequency		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time slots	1g SAR [W/kg]	Scaling Factor	1g Scaled SAR [W/kg]
MHz	Ch											
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.13	15mm [Front]	FCC #1	N/A	0.314	1.045	0.328
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.02	15mm [Rear]	FCC #1	N/A	0.455	1.045	**0.475**
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	-0.19	15mm [Right side]	FCC #1	N/A	0.224	1.045	0.234
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.10	15mm [Left side]	FCC #1	N/A	0.24	1.045	0.251
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.20	15mm [Top side]	FCC #1	N/A	0.025	1.045	0.026
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.20	15mm [Bottom side]	FCC #1	N/A	0.00858	1.045	0.009
1880.0	661	PCS1900	PCS	30.0	29.49	-0.20	15mm [Front]	FCC #1	1	0.22	1.125	**0.247**
1880.0	661	PCS1900	PCS	30.0	29.49	-0.08	15mm [Rear]	FCC #1	1	0.205	1.125	0.231
1880.0	661	PCS1900	PCS	30.0	29.49	0.11	15mm [Right side]	FCC #1	1	0.064	1.125	0.072
1880.0	661	PCS1900	PCS	30.0	29.49	0.04	15mm [Left side]	FCC #1	1	0.122	1.125	0.137
1880.0	661	PCS1900	PCS	30.0	29.49	0.14	15mm [Top side]	FCC #1	1	0.020	1.125	0.023
1880.0	661	PCS1900	PCS	30.0	29.49	0.05	15mm [Bottom side]	FCC #1	1	0.059	1.125	0.066
ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure							Head 1.6 W/kg(mW/g) averaged over 1 gram					

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12.3 Standalone Body SAR Results

Table 12.4 CDMA/PCS Body SAR

MEASUREMENT RESULTS												
Frequency		Mode/ Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Spacing [Side]	Device Serial Number	# of Time slots	1g SAR [W/kg]	Scaling Factor	1g Scaled SAR [W/kg]
MHz	Ch											
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.13	15mm [Front]	FCC #1	N/A	0.314	1.045	0.328
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.02	15mm [Rear]	FCC #1	N/A	0.455	1.045	**0.475**
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	-0.19	15mm [Right side]	FCC #1	N/A	0.224	1.045	0.234
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.10	15mm [Left side]	FCC #1	N/A	0.24	1.045	0.251
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.20	15mm [Top side]	FCC #1	N/A	0.025	1.045	0.026
836.52	384	Cell. CDMA	TDSO/SO32	24.0	23.81	0.20	15mm [Bottom side]	FCC #1	N/A	0.00858	1.045	0.009
1880.0	661	PCS1900	GPRS	28.5	27.83	-0.02	15mm [Front]	FCC #1	2	0.323	1.167	**0.377**
1880.0	661	PCS1900	GPRS	30.0	29.31	-0.02	15mm [Rear]	FCC #1	1	0.2	1.172	0.234
1880.0	661	PCS1900	GPRS	28.5	27.83	-0.19	15mm [Rear]	FCC #1	2	0.303	1.167	0.354
1880.0	661	PCS1900	GPRS	28.5	27.83	0.05	15mm [Right side]	FCC #1	2	0.092	1.167	0.107
1880.0	661	PCS1900	GPRS	28.5	27.83	-0.07	15mm [Left side]	FCC #1	2	0.178	1.167	0.208
1880.0	661	PCS1900	GPRS	28.5	27.83	0.05	15mm [Top side]	FCC #1	2	0.089	1.167	0.104
1880.0	661	PCS1900	GPRS	28.5	27.83	0.01	15mm [Bottom side]	FCC #1	2	0.084	1.167	0.098
ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure							Head 1.6 W/kg(mW/g) averaged over 1 gram					

12.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC/OET Bulletin 65, Supplement C [June 2001] and FCC KDB Publication447498 D01v05r02.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05r02.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 15 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01r01, SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was ≤ 1.2 W/kg, no additional SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01v01r01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 14 for variability analysis.
9. This device does not support Hotspot and VOIP operation.

GSM Notes:

1. This device supports GSM VOIP in the head and body-worn configurations, therefore GPRS was additionally evaluated for head and body-worn compliance.
2. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
3. Per FCC KDB Publication 447498 D01v05r02, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

CDMA Notes:

1. Head SAR for CDMA2000 mode was tested under RC3/SO55 per FCC KDB Publication 941225 D01v02.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers, per FCC KDB Publication 941225 D01v02.
3. Per FCC KDB Publication 447498 D01v05r02, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

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13. FCC Multi-TX and Antenna SAR Considerations

13.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05r02 are applicable to handsets with built-in unlicensed transmitters such as Bluetooth devices which may simultaneously transmit with the licensed transmitter.

13.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05r02 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05r02 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\text{Max. Tune up Power}_{(\text{mW})}}{\text{Min. Test Separation Distance}_{(\text{mm})}} \times \frac{\sqrt{f_{(\text{GHz})}}}{7.5}$$

Table 13.1 Estimated SAR

Mode	Frequency	Maximum Allowed Power		Separation Distance (Body)	Estimated SAR (Body)
	MHz	[dBm]	[mW]	[mm]	[W/kg]
Bluetooth	2441	6.8	5	15	0.069

Note : Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05r02, the maximum power of the channel was rounded to the nearest mW before calculation.

13.3 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v05r02, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 13.1 and are color-coded to indicate communication modes which share the same path.
Modes which share the same transmission path cannot transmit simultaneously with one another.

Path 1

GSM/GPRS, CDMA

Path 2

Bluetooth

Figure 13.1 Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05r02 3) procedures.

Table 13.2 Simultaneous Transmission Scenarios

Ref.	Simultaneous Transmission Configurations	Head	Body-Worn Accessory	Body
1	Cell. CDMA + Bluetooth	N/A	Yes	N/A
2	PCS 1900 Voice + Bluetooth	N/A	Yes	N/A

Notes:

1. CDMA, GPRS is not supported Hotspot.
2. PCS and CDMA cannot transmit simultaneously since they share the same chip.
3. This device not supports VoIP.
4. WLAN is not supported this device.

13.4 Body-Worn Simultaneous Transmission Analysis

Table 13.3 **Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 15 mm)**

Configuration	Mode	2G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Front Side	Cell. CDMA	0.328	0.069	0.397
Rear Side	Cell. CDMA	0.475	0.069	0.544
Front Side	PCS 1900	0.247	0.069	0.316
Rear Side	PCS 1900	0.231	0.069	0.300

Note : Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

13.5 Simultaneous Transmission Conclusion

The abode numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05r02.

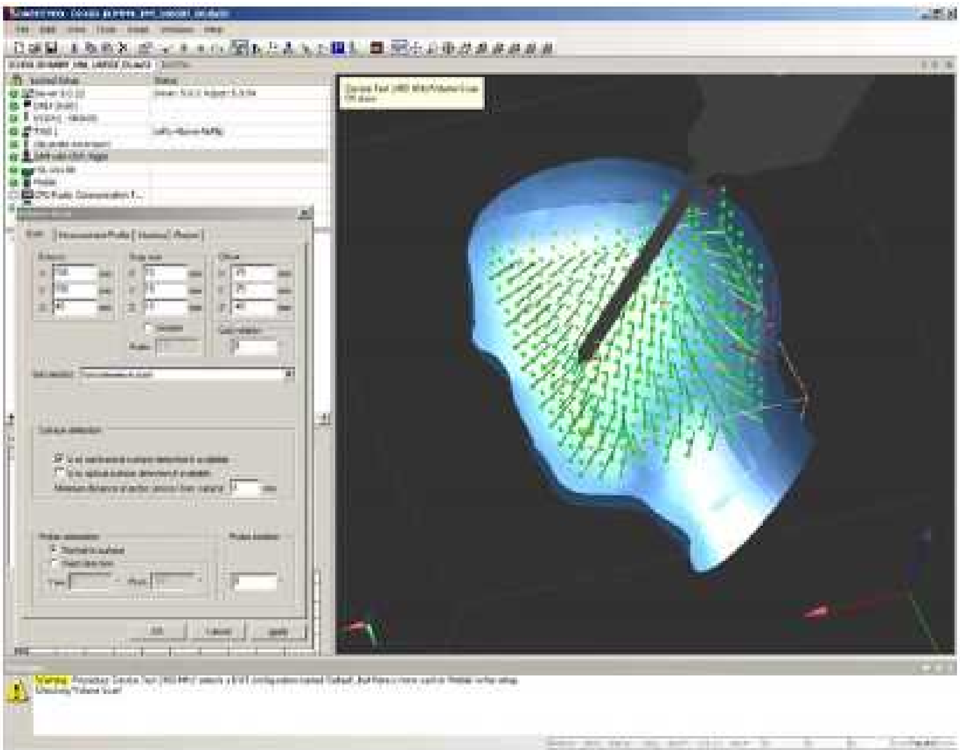
Description of Volume Scan:

In order to determine the EM field distribution in a three-dimensional spatial extension, volume scans are required. In free space, these assessments can help to gain more information on the performance of the DUT(e.g., to determine the degree of symmetry of the filed radiated from a horn antenna).

For dosimetric application, it is necessary to assess the peak spatial SAR value averaged over a volume. For this purpose, fine resolution volume scans need to be performed at the peak SAR location(s) determined during the Area Scan. In DASY5 software these scans are called Zoom Scan jobs. The default Zoom Scan measures 7 x 7 x 7 points with a step size of 5 mm. Faster evaluations can be achieved with a reduced number of measurement points. For example, a Zoom Scan with a grid step size in x- and y-directions of 7.5 mm (5 x 5 x 7cube configuration) reduces the measurement time to almost half with only 1-2% difference in SAR reading compared to the fine-resolution 7 x 7 x 7 scan.

For SAR evaluations with larger spatial extensions (e.g., within a complete phantom head section)a Volume Scan job should be used.

The Volume Scan job is compatible with DASY5 SAR, PRO and NEO system levels. Volume Scans are used to assess peak SAR and averaged SAR measurement in largely extended 3-dimensional volumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location With an Administrator access mode, the grid can be optionally graded in Z-direction, whereby the smallest grid step and the grading ratio can be defined. Chosen grading ratio is automatically adjusted so that the desired extent in Z-direction is fully covered.



Under the Report page, the quantity to be evaluated for an instant report may be selected. This quantity can be: field magnitude, SAR, interpolated SAR or averaged SAR.

SAR Assessment:

Alternative 1

- Evaluation Method
  - Maximum summed SAR Value
- Description
  - Easiest and most conservative method to determine the upper limit of multi-band SAR
- Example
  - F1's SAR Value is 0.9
  - F2's SAR Value is 1.3
  - Multi-band SAR Value is 0.9 + 1.3 = 2.2

Alternative 2

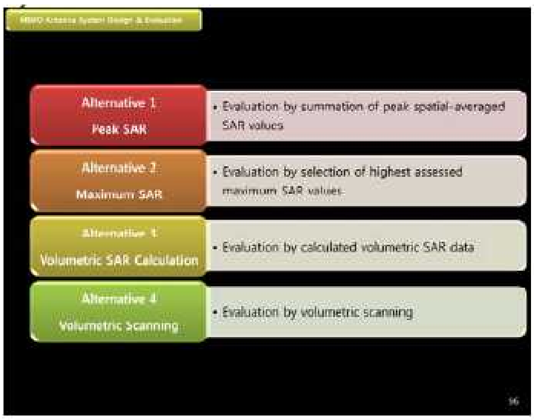
- Evaluation Method
  - Selection of highest assessed maximum SAR Value
- Description
  - Accurate estimate of the multi-band SAR
- Example
  - F1's SAR Value is 0.9
  - F2's SAR Value is 1.3
  - Multi-band SAR Value is 1.3

Alternative 3

- Evaluation Method
  - Combining existing Area and Zoom Scan results by Post-Processor
- Description
  - Rapid way of obtaining the multi-band SAR. It is always applicable.
- Example
  - F1's SAR Value is 0.9
  - F2's SAR Value is 1.3
  - Combining results by Post-Processor

Alternative 4

- Evaluation Method
  - Combining existing Area and Zoom Scan results by Post-Processor
- Description
  - The most accurate way of assessing the multi-band SAR and always
- Example
  - F1's SAR Value is 0.9
  - F2's SAR Value is 1.3
  - Combining results by Post-Processor



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14. SAR Measurement Variability

14.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.
These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1. When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.

2. A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

3. A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

4. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg.

14.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664D01v01r01, the standard measurement uncertainty analysis per IEEE 1528-2003 was not required.

15. IEEE P1528 - Measurement uncertainties

Expanded uncertainties stated are calculated with a coverage Factor k=2.
Please note that these results are not taken into account when determining compliance or non-compliance with test result.

835MHz Head

Error Description	Uncertainty Value ± %	Probability distribution	Divisor	ci (1g)	Standard uncertainty ±%,(1g)	vi or veff
Measurement System						
Probe Calibration	± 6.0	N	1	1	± 6.0	∞
Axial Isotropy	± 4.7	R	$\sqrt{3}$	0.7	± 1.9	∞
Hemispherical Isotropy	± 9.6	R	$\sqrt{3}$	0.7	± 3.9	∞
Boundary Effect	± 1.0	R	$\sqrt{3}$	1	± 0.6	∞
Linearity	± 4.7	R	$\sqrt{3}$	1	± 2.7	∞
System Detection Limits	± 1.0	R	$\sqrt{3}$	1	± 0.6	∞
Readout Electronics	± 0.3	N	1	1	± 0.3	∞
Response Time	± 0.8	R	$\sqrt{3}$	1	± 0.5	∞
Integration Time	± 2.6	R	$\sqrt{3}$	1	± 1.5	∞
RF Ambient Noise	± 3.0	R	$\sqrt{3}$	1	± 1.7	∞
RF Ambient Reflections	± 3.0	R	$\sqrt{3}$	1	± 1.7	∞
Probe Positioner	± 0.4	R	$\sqrt{3}$	1	± 0.2	∞
Probe Positioning	± 2.9	R	$\sqrt{3}$	1	± 1.7	∞
Max. SAR Eval.	± 1.0	R	$\sqrt{3}$	1	± 0.6	∞
Test sample related						
Device Positioning	± 2.9	N	1	1	± 2.9	145
Device Holder	± 3.6	N	1	1	± 3.6	5
Power Drift	± 5.0	R	$\sqrt{3}$	1	± 2.9	∞
Phantom and set-up						
Phantom Uncertainty	± 4.0	R	$\sqrt{3}$	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	R	$\sqrt{3}$	0.64	± 1.8	∞
Liquid conductivity (meas.)	± 2.1	R	1	0.64	± 1.3	∞
Liquid permittivity (target)	± 5.0	R	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (meas.)	± 1.4	R	1	0.6	± 0.8	∞
Combined Std. Uncertainty					± 11.2	387
Expanded uncertainty (95% confidence interval)					**± 22.4**	

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

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835MHz Body

Error Description	Uncertainty Value ± %	Probability distribution	Divisor	ci (1g)	Standard uncertainty ±%,(1g)	vi or veff
Measurement System						
Probe Calibration	± 6.0	N	1	1	± 6.0	∞
Axial Isotropy	± 4.7	R	√3	0.7	± 1.9	∞
Hemispherical Isotropy	± 9.6	R	√3	0.7	± 3.9	∞
Boundary Effect	± 1.0	R	√3	1	± 0.6	∞
Linearity	± 4.7	R	√3	1	± 2.7	∞
System Detection Limits	± 1.0	R	√3	1	± 0.6	∞
Readout Electronics	± 0.3	N	1	1	± 0.3	∞
Response Time	± 0.8	R	√3	1	± 0.5	∞
Integration Time	± 2.6	R	√3	1	± 1.5	∞
RF Ambient Noise	± 3.0	R	√3	1	± 1.7	∞
RF Ambient Reflections	± 3.0	R	√3	1	± 1.7	∞
Probe Positioner	± 0.4	R	√3	1	± 0.2	∞
Probe Positioning	± 2.9	R	√3	1	± 1.7	∞
Max. SAR Eval.	± 1.0	R	√3	1	± 0.6	∞
Test sample related						
Device Positioning	± 2.9	N	1	1	± 2.9	145
Device Holder	± 3.6	N	1	1	± 3.6	5
Power Drift	± 5.0	R	√3	1	± 2.9	∞
Phantom and set-up						
Phantom Uncertainty	± 4.0	R	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	R	√3	0.64	± 1.8	∞
Liquid conductivity (meas.)	± 4.0	R	1	0.64	± 2.6	∞
Liquid permittivity (target)	± 5.0	R	√3	0.6	± 1.7	∞
Liquid permittivity (meas.)	± 0.7	R	1	0.6	± 0.4	∞
Combined Std. Uncertainty					± 12.1	387
Expanded uncertainty (95% confidence interval)					**± 24.2**	

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

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1900MHz Head

Error Description	Uncertainty Value ± %	Probability distribution	Divisor	ci (1g)	Standard uncertainty ±%,(1g)	vi or veff
Measurement System						
Probe Calibration	± 6.0	N	1	1	± 6.0	∞
Axial Isotropy	± 4.7	R	√3	0.7	± 1.9	∞
Hemispherical Isotropy	± 9.6	R	√3	0.7	± 3.9	∞
Boundary Effect	± 1.0	R	√3	1	± 0.6	∞
Linearity	± 4.7	R	√3	1	± 2.7	∞
System Detection Limits	± 1.0	R	√3	1	± 0.6	∞
Readout Electronics	± 0.3	N	1	1	± 0.3	∞
Response Time	± 0.8	R	√3	1	± 0.5	∞
Integration Time	± 2.6	R	√3	1	± 1.5	∞
RF Ambient Noise	± 3.0	R	√3	1	± 1.7	∞
RF Ambient Reflections	± 3.0	R	√3	1	± 1.7	∞
Probe Positioner	± 0.4	R	√3	1	± 0.2	∞
Probe Positioning	± 2.9	R	√3	1	± 1.7	∞
Max. SAR Eval.	± 1.0	R	√3	1	± 0.6	∞
Test sample related						
Device Positioning	± 2.9	N	1	1	± 2.9	145
Device Holder	± 3.6	N	1	1	± 3.6	5
Power Drift	± 5.0	R	√3	1	± 2.9	∞
Phantom and set-up						
Phantom Uncertainty	± 4.0	R	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	R	√3	0.64	± 1.8	∞
Liquid conductivity (meas.)	± 1.4	R	1	0.64	± 0.9	∞
Liquid permittivity (target)	± 5.0	R	√3	0.6	± 1.7	∞
Liquid permittivity (meas.)	± 2.6	R	1	0.6	± 1.6	∞
Combined Std. Uncertainty					± 11.6	387
Expanded uncertainty (95% confidence interval)					**± 23.2**	

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

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1900MHz Body

Error Description	Uncertainty Value ± %	Probability distribution	Divisor	ci (1g)	Standard uncertainty ±%,(1g)	vi or veff
Measurement System						
Probe Calibration	± 6.0	N	1	1	± 6.0	∞
Axial Isotropy	± 4.7	R	√3	0.7	± 1.9	∞
Hemispherical Isotropy	± 9.6	R	√3	0.7	± 3.9	∞
Boundary Effect	± 1.0	R	√3	1	± 0.6	∞
Linearity	± 4.7	R	√3	1	± 2.7	∞
System Detection Limits	± 1.0	R	√3	1	± 0.6	∞
Readout Electronics	± 0.3	N	1	1	± 0.3	∞
Response Time	± 0.8	R	√3	1	± 0.5	∞
Integration Time	± 2.6	R	√3	1	± 1.5	∞
RF Ambient Noise	± 3.0	R	√3	1	± 1.7	∞
RF Ambient Reflections	± 3.0	R	√3	1	± 1.7	∞
Probe Positioner	± 0.4	R	√3	1	± 0.2	∞
Probe Positioning	± 2.9	R	√3	1	± 1.7	∞
Max. SAR Eval.	± 1.0	R	√3	1	± 0.6	∞
Test sample related						
Device Positioning	± 2.9	N	1	1	± 2.9	145
Device Holder	± 3.6	N	1	1	± 3.6	5
Power Drift	± 5.0	R	√3	1	± 2.9	∞
Phantom and set-up						
Phantom Uncertainty	± 4.0	R	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	R	√3	0.64	± 1.8	∞
Liquid conductivity (meas.)	± 3.0	R	1	0.64	± 1.9	∞
Liquid permittivity (target)	± 5.0	R	√3	0.6	± 1.7	∞
Liquid permittivity (meas.)	± 2.0	R	1	0.6	± 1.2	∞
Combined Std. Uncertainty					± 12.2	387
Expanded uncertainty (95% confidence interval)					**± 24.4**	

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

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16. 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.

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Attachment 1. Probe 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 **TÜV SüD Zacta (PTT)**

Certificate No: EX3-3957_Dec13/2

CALIBRATION CERTIFICATE (Replacement of No: EX3-3957_Dec13)

Object	EX3DV4 - SN:3957
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	December 3, 2013

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	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: December 12, 2013

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

S Schweizerischer Kalibrierdienst
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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, D	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., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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 ϑ = 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; Dx,y,z; VRx,y,z: A, B, C, D* 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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3957

Manufactured: August 6, 2013
Calibrated: December 3, 2013

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

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:3957

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.46	0.45	0.48	± 10.1 %
DCP (mV)[B]	100.1	101.5	101.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	154.3	±3.3 %
		Y	0.0	0.0	1.0		151.6	
		Z	0.0	0.0	1.0		159.1	

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:3957

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 [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	10.35	10.35	10.35	0.42	0.85	± 12.0 %
835	41.5	0.90	10.02	10.02	10.02	0.30	1.03	± 12.0 %
900	41.5	0.97	9.82	9.82	9.82	0.37	0.95	± 12.0 %
1450	40.5	1.20	9.22	9.22	9.22	0.50	0.78	± 12.0 %
1750	40.1	1.37	8.58	8.58	8.58	0.46	0.75	± 12.0 %
1900	40.0	1.40	8.35	8.35	8.35	0.80	0.58	± 12.0 %
1950	40.0	1.40	8.02	8.02	8.02	0.62	0.64	± 12.0 %
2450	39.2	1.80	7.49	7.49	7.49	0.39	0.79	± 12.0 %
2600	39.0	1.96	7.21	7.21	7.21	0.36	0.84	± 12.0 %
5200	36.0	4.66	4.94	4.94	4.94	0.50	1.80	± 13.1 %
5300	35.9	4.76	5.03	5.03	5.03	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.81	4.81	4.81	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.52	4.52	4.52	0.39	1.80	± 13.1 %
5800	35.3	5.27	4.68	4.68	4.68	0.37	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY/EASY - Parameters of Probe: EX3DV4 - SN:3957

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 [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	9.91	9.91	9.91	0.61	0.72	± 12.0 %
835	55.2	0.97	9.78	9.78	9.78	0.53	0.75	± 12.0 %
900	55.0	1.05	9.62	9.62	9.62	0.42	0.86	± 12.0 %
1450	54.0	1.30	8.64	8.64	8.64	0.47	0.74	± 12.0 %
1750	53.4	1.49	8.33	8.33	8.33	0.71	0.68	± 12.0 %
1900	53.3	1.52	7.91	7.91	7.91	0.58	0.67	± 12.0 %
1950	53.3	1.52	8.09	8.09	8.09	0.28	1.11	± 12.0 %
2450	52.7	1.95	7.33	7.33	7.33	0.80	0.55	± 12.0 %
2600	52.5	2.16	7.20	7.20	7.20	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.48	4.48	4.48	0.37	1.90	± 13.1 %
5300	48.9	5.42	4.27	4.27	4.27	0.38	1.90	± 13.1 %
5500	48.6	5.65	4.00	4.00	4.00	0.42	1.90	± 13.1 %
5600	48.5	5.77	4.05	4.05	4.05	0.29	1.90	± 13.1 %
5800	48.2	6.00	4.07	4.07	4.07	0.45	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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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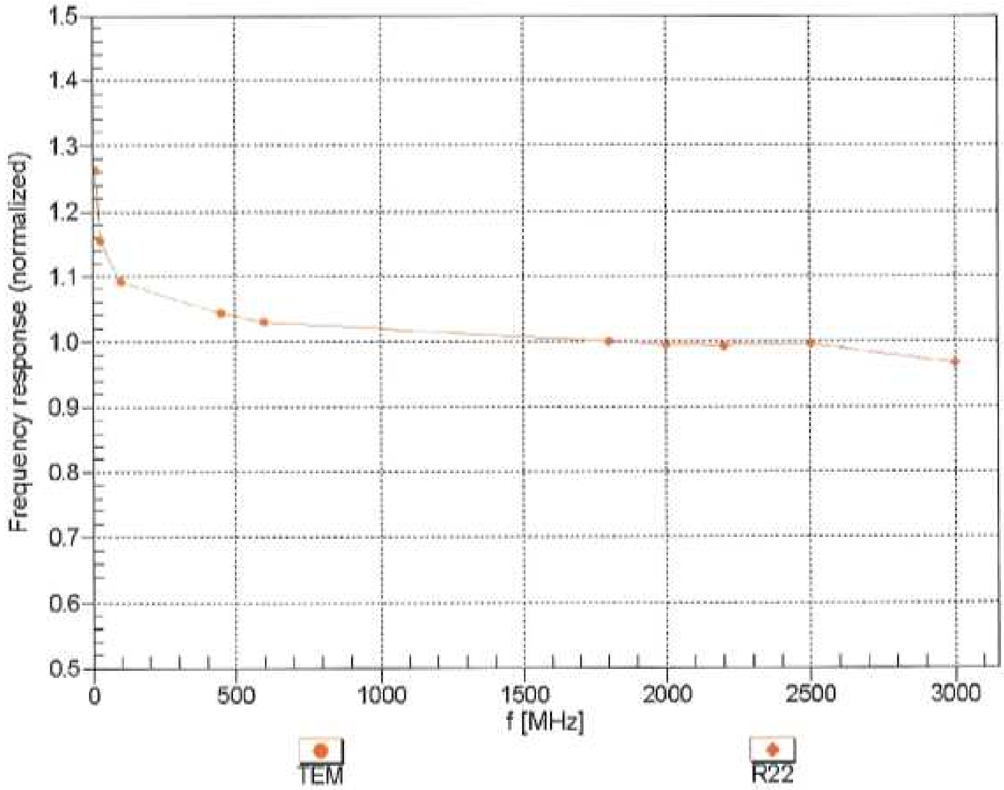
EX3DV4– SN:3957 December 3, 2013

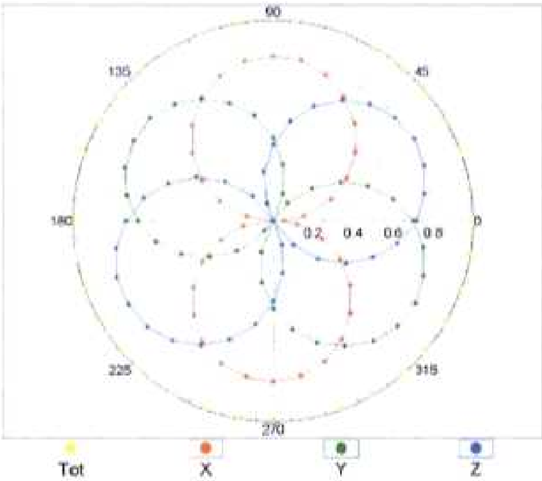
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



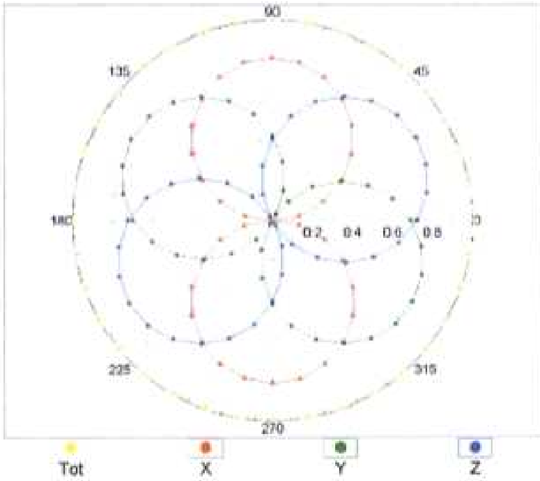
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

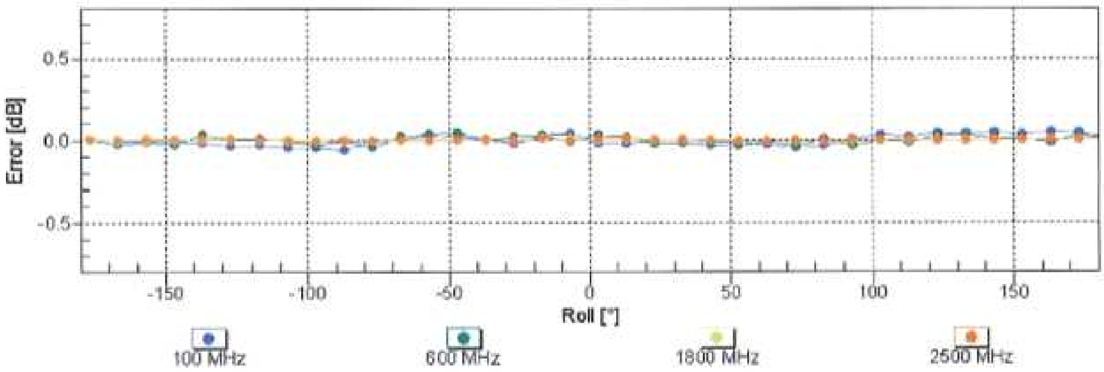
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



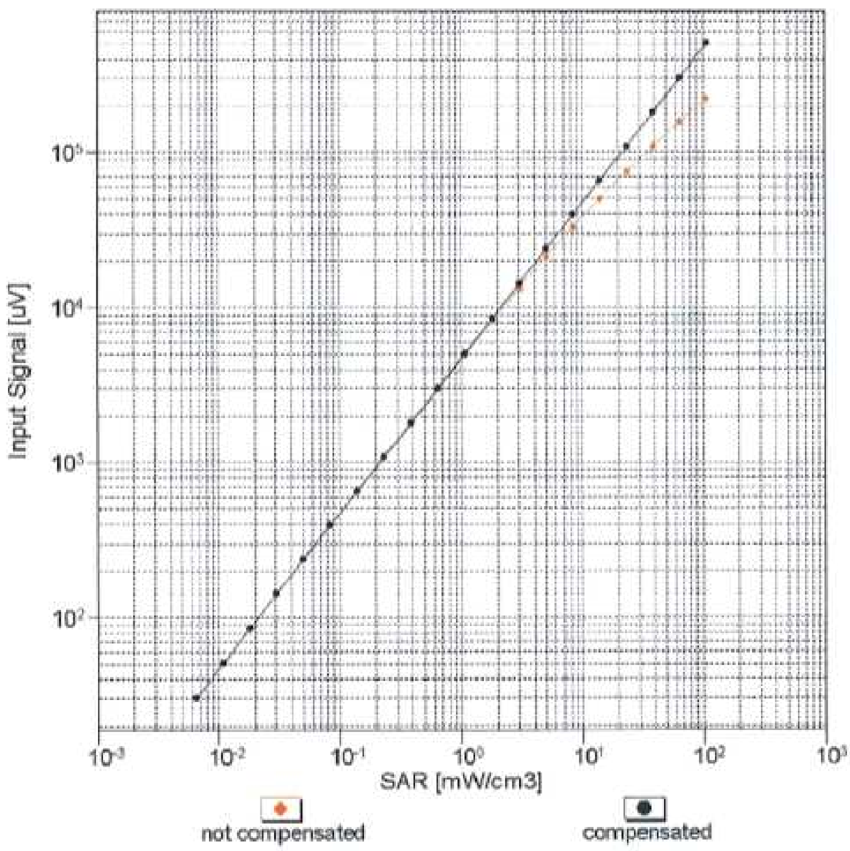
f=1800 MHz,R22

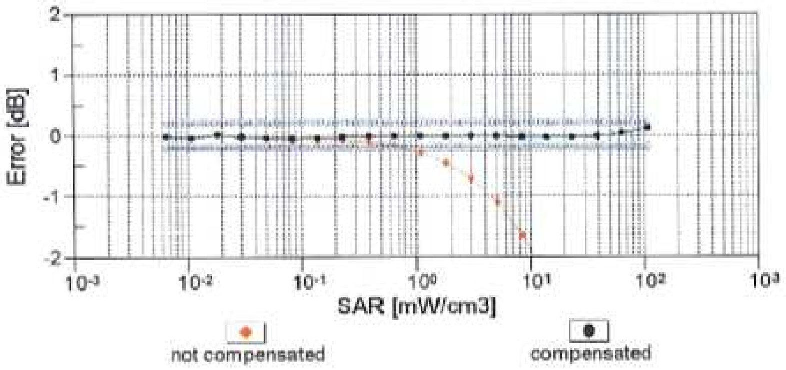




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

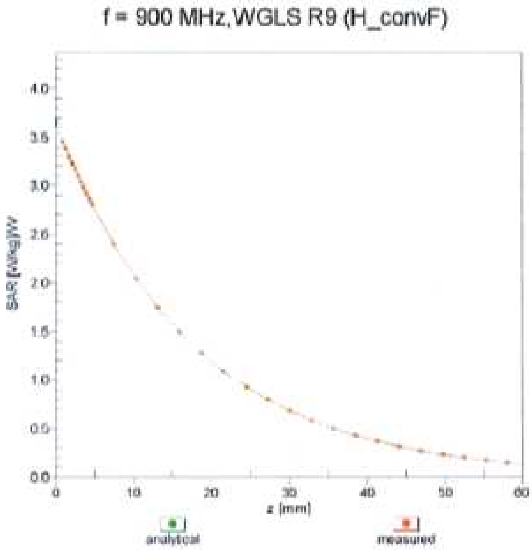
Dynamic Range f(SAR$_{head}$)
(TEM cell , f = 900 MHz)

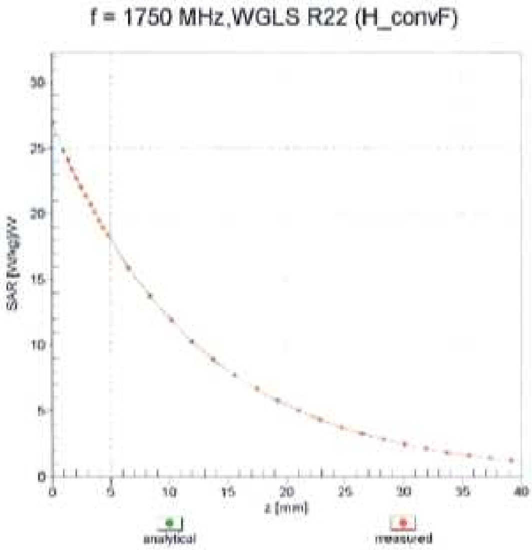




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

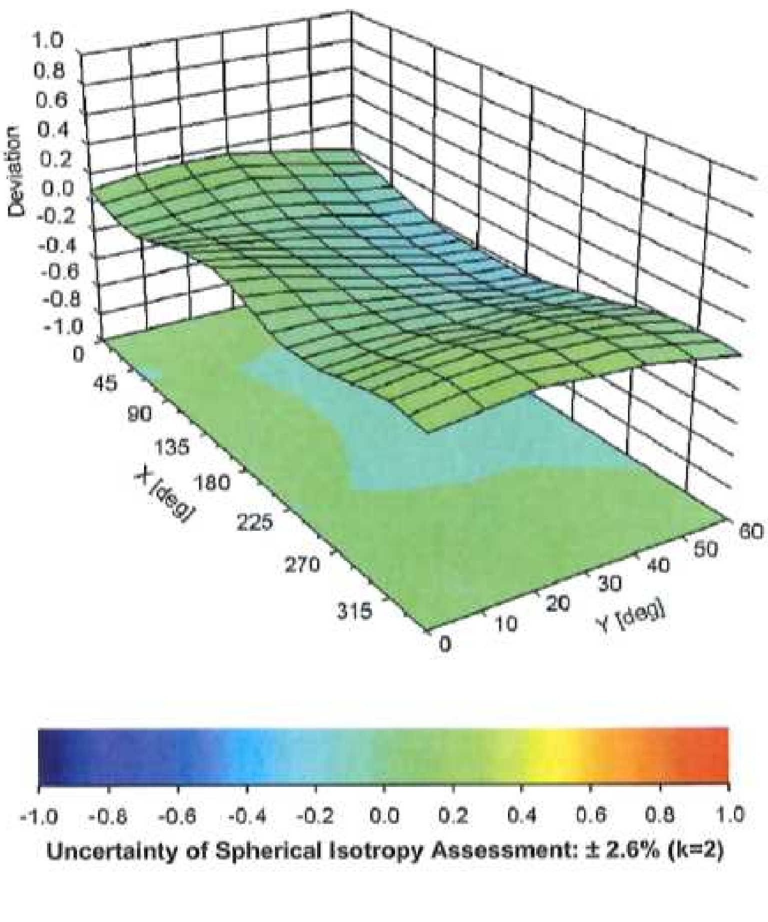
Conversion Factor Assessment





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:3957

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-16.9
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

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Attachment 2. Dipole calibration data

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

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

Client **TÜV SüD Zacta (PTT)**

Certificate No: **D835V2-4d163_Dec13**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d163
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	December 04, 2013

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 EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: December 4, 2013

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

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S 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
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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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.

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%.

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 6 %	0.94 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	250 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.45 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.14 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.7 ± 6 %	1.01 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	250 mW input power	2.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.43 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.17 W/kg ± 16.5 % (k=2)**

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.7 Ω - 2.5 jΩ
Return Loss	- 28.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.1 Ω - 4.4 jΩ
Return Loss	- 25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.436 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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	December 28, 2012

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DASY5 Validation Report for Head TSL

Date: 04.12.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d163

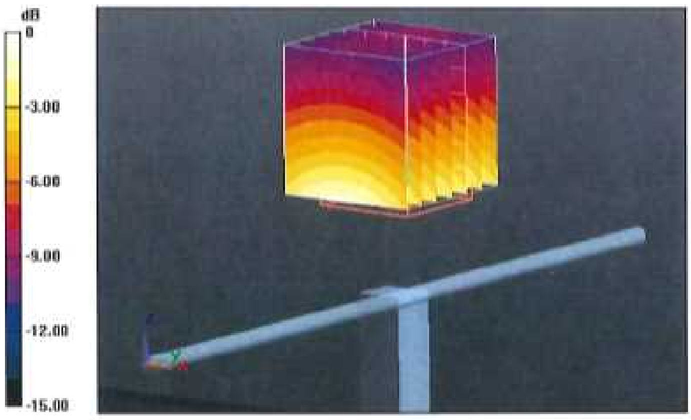
Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.700 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.76 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.58 W/kg
Maximum value of SAR (measured) = 2.87 W/kg



0 dB = 2.87 W/kg = 4.58 dBW/kg

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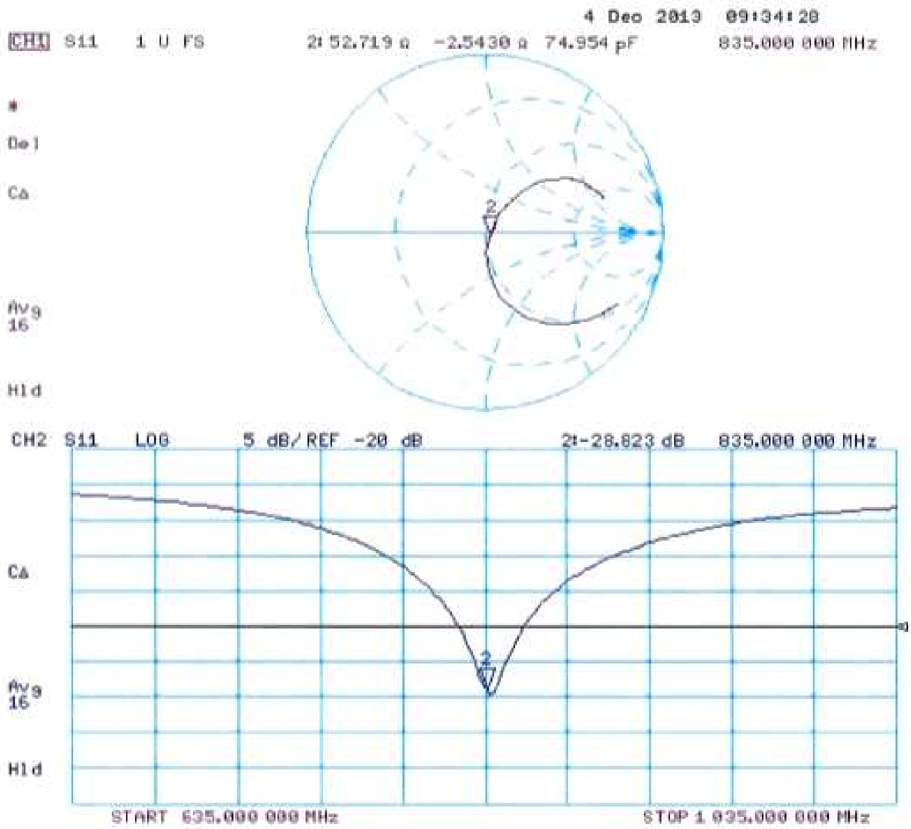
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 02.12.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d163

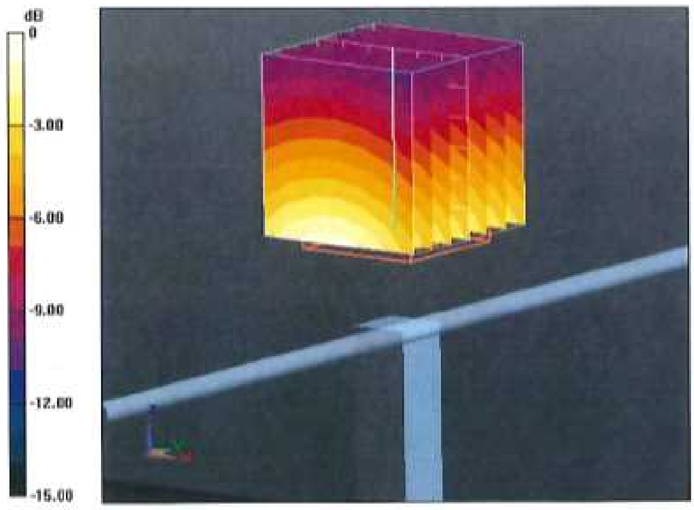
Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma = 1.007$ S/m; $\varepsilon_r = 54.7$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.673 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.58 W/kg
SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.58 W/kg
Maximum value of SAR (measured) = 2.81 W/kg



0 dB = 2.81 W/kg = 4.49 dBW/kg

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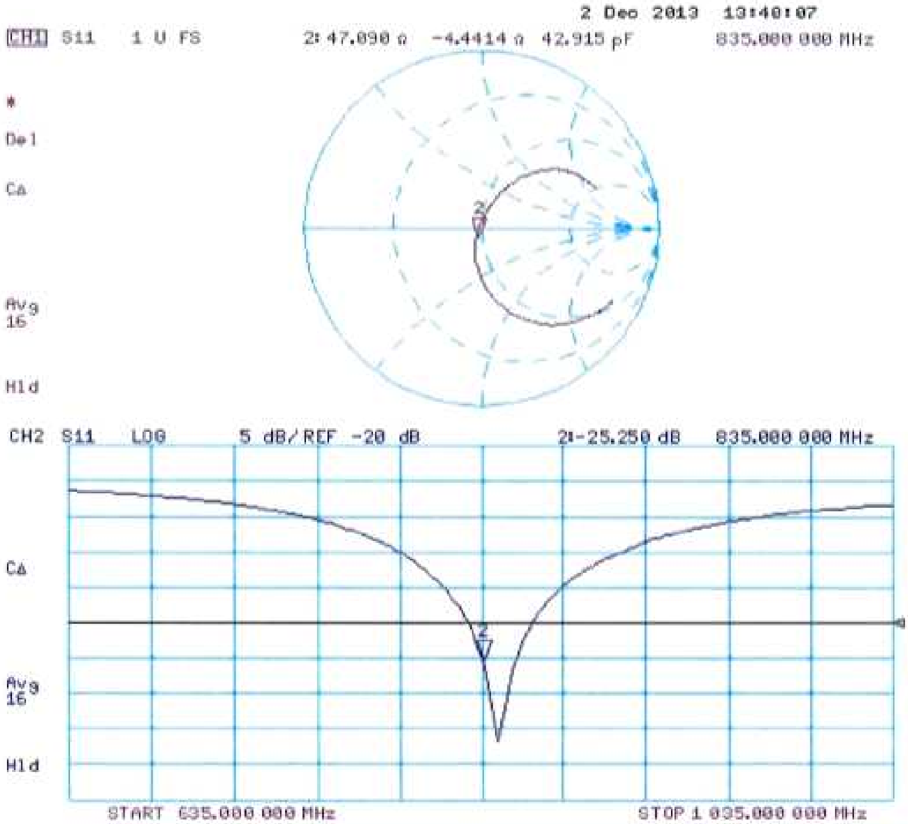
Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **TÜV SüD Zacta (PTT)**

Certificate No: D1900V2-5d183_Dec13

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d183
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	December 02, 2013

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 EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: December 2, 2013

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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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
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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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.

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%.

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.39 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	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.4 ± 6 %	1.51 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	250 mW input power	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.35 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 16.5 % (k=2)**

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.0 Ω + 6.0 jΩ
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.7 Ω + 6.3 jΩ
Return Loss	- 23.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.208 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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	August 23, 2013

Zacta

DASY5 Validation Report for Head TSL

Date: 02.12.2013

Test Laboratory: SPEAG, Zurich, Switzerland

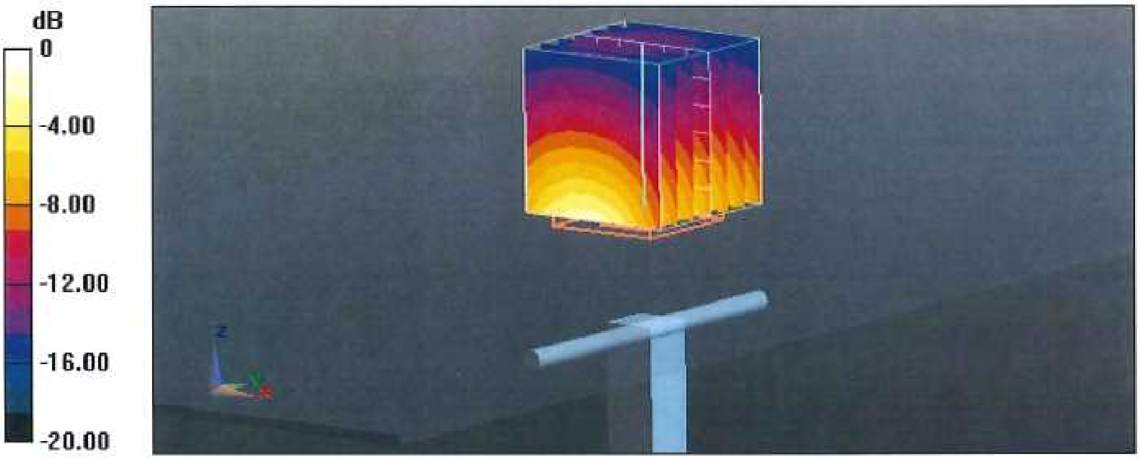
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d183

Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma = 1.39$ S/m; $\varepsilon_r = 39.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.554 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 18.5 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.29 W/kg
Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

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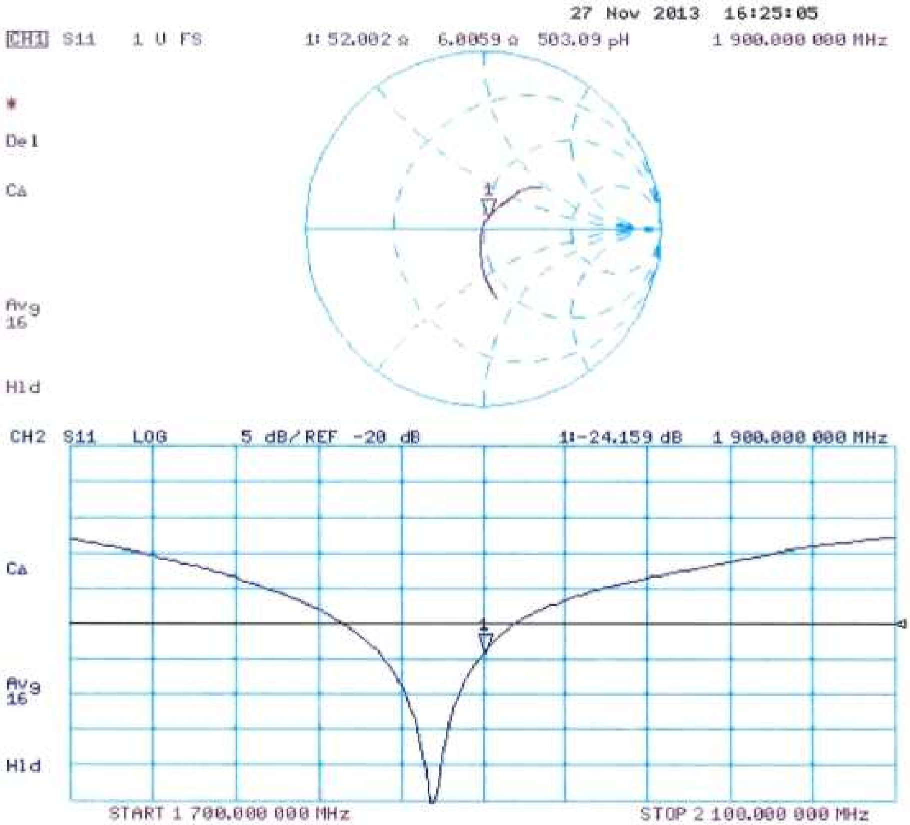
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 02.12.2013

Test Laboratory: SPEAG, Zurich, Switzerland

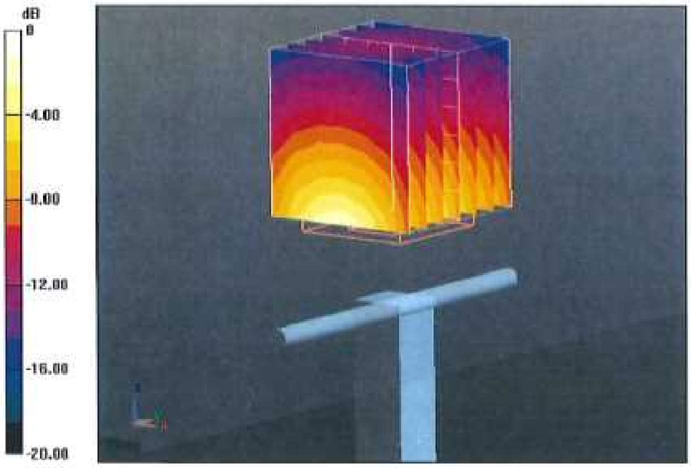
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d183

Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma = 1.51$ S/m; $\varepsilon_r = 53.4$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.554 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 17.2 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.35 W/kg
Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

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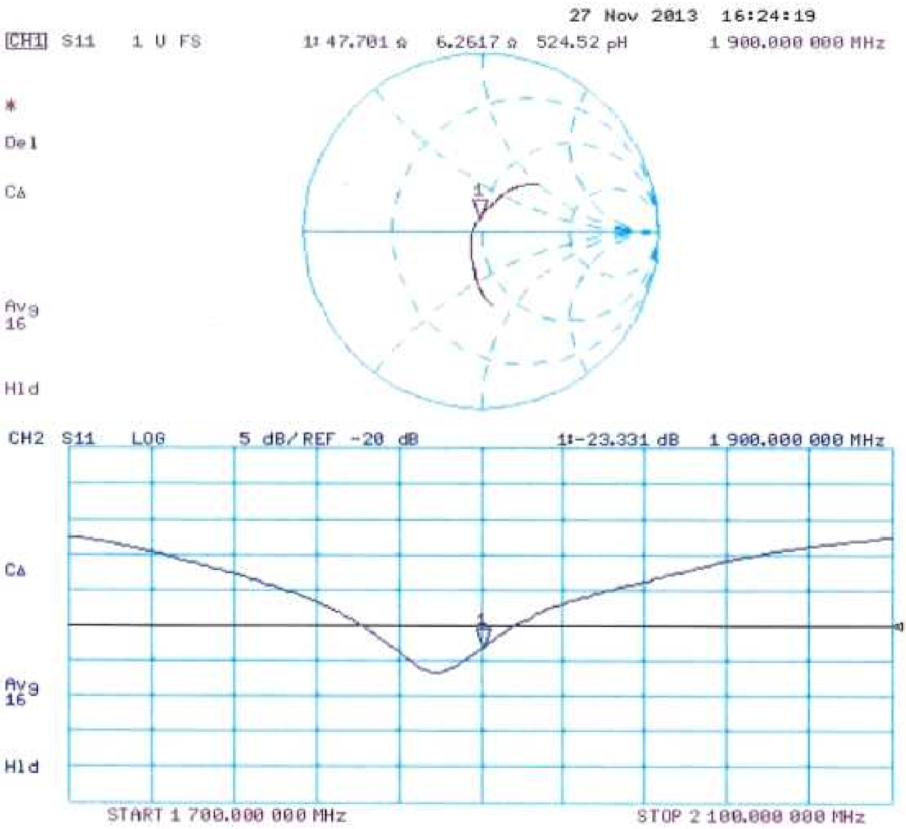
Impedance Measurement Plot for Body TSL



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Attachment 3. SAR system validation

SAR System Validation

Per FCC KDB 865664 D02v01r01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01v01r01.

Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table Attachment 3.1 SAR System Validation Summary

SAR System	Freq. [MHz]	Data	Probe Type	Probe CAL. Point		PERM. (εr)	COND. (σ)	CW Validation			MOD. Validation		
								Sensi-tivity	Probe Linearity	Probe Isotropy	MOD. Type	Duty Factor	PAR
E	835	2014-04-15	3957	835	Head	40.093	0.898	PASS	PASS	PASS	GMSK	PASS	N/A
E	1900	2014-04-12	3957	1900	Head	38.868	1.454	PASS	PASS	PASS	GMSK	PASS	N/A
E	2450	2014-04-10	3957	2450	Head	37.810	1.867	PASS	PASS	PASS	OFDM	N/A	PASS
E	835	2014-04-15	3957	835	Body	55.031	1.011	PASS	PASS	PASS	GMSK	PASS	N/A
E	1900	2014-04-13	3957	1900	Body	52.572	1.524	PASS	PASS	PASS	GMSK	PASS	N/A
E	2450	2014-04-11	3957	2450	Body	50.702	1.972	PASS	PASS	PASS	OFDM	N/A	PASS