Dosimetric Assessment of the Portable Device ICON 505M from Option Wireless Germany

According to the FCC requirements
FCC ID: NCMOGI1505

Product:

ICON 505M
Option Wireless Technology

Date: April 23, 2009

Summary

The device ICON 505M is a new USB Stick which provides the operating bands GSM850 (GPRS Class12), GSM900 (GPRS Class12), GSM1800 (GPRS Class12), GSM1900 (GPRS Class12), WCDMA FDD I+VIII. Combined with a microSD memory card the device can be used as a commercial memory stick.

The system concepts used are GPRS/EDGE GSM850, GPRS/EDGE GSM900, GPRS/EDGE PCN1800, GPRS/EDGE PCS1900, WCDMA FDD I and WDMA FDD VIII standards. The USB stick provides HSDPA (cat 9) and HSUPA (cat 6) in WCDMA.

The intention of the measurements is the evaluation of radiofrequency radiation exposure of the portable device in the operating bands GSM850 (GPRS Class12) and GSM1900 (GPRS Class12).

The ICON 505M USB stick was tested in all orientations: no.2 (antenna side), no.1 (opposite of antenna side), no.3 and no.4 (laterals) and no.5 (tip).

All SAR-measurements were performed with maximum distance of 5mm between device and phantom.

All bands were checked for maximum radiated power: GSM850 was tested with 2 TX-Slots (GPRS), while GSM1900 tests were performed on channel 512 with 4 TX-Slots (GPRS), on channel 661 with 3 TX-Slots (GPRS) and on channel 810 with 2 TX-Slots (GPRS).

The measurements were performed with the host devices FUJITSU SIEMENS LIFEBOOK S6410.
To allow 5mm-distance between USB-stick and SAR-phantom, orientation 1 was measured in the lower- and orientation 2 in the upper horizontal USB-slot of the Notebook. The vertical USB-slot was used in USB-stick orientation 3, 4 and 5.

The device is working in data transfer mode only (no speech mode), so the tests in GSM850 and GSM1900 are performed in GPRS- mode.

The measurements were made according to the Supplement C OET BULLETIN 65 Edition 97-01. Due to the fact the USB-stick is designed for use in laptops and notebooks, it is to be classified as a portable device (47 CFR §2.1093).

Pursuant to 47 CFR §2.908 the EUT has the state of a production unit.

The USB-stick was tested in the following configurations:

- **Module for use in portable exposure conditions that do not require SAR evaluation for simultaneous transmission**
- **GSM850 (GPRS powerclass 4), (EDGE powerclass E2)**
- **GSM1900 (GPRS powerclass 1), (EDGE powerclass E2)**
- **WCDMA FDD I and WCDMA FDD VIII (powerclass 3)**
- **Body worn**
- **Against the flat phantom**

Testreport and measurements performed by
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Measurements supervised
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1 Statement of Compliance

The portable device ICON 505M (FCC ID: NCMOGI1505) is in compliance with the FCC OET 65c, Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), for uncontrolled exposure. Pursuant to 47 CFR §2.908 the EUT has the state of a production unit.

2 Summary of the SAR Test Results

The measurements were made according to the Supplement C OET BULLETIN 65 Edition 97-01. Due to the fact the USB stick is designed for use in laptops and notebooks, it is to be classified as a portable device (47 CFR §2.1093).

The ICON 505M USB stick was tested in all orientations: orientation 2 (antenna side), orientation 1 (opposite of antenna side), orientation 3 and 4 (laterals) and orientation 5 (tip).

To ensure maximum radiated power, the tests were performed in PCS1900 channel 512 in GPRS/EDGE multislot class 12 , on channel 661 in GPRS/EDGE multislot class 11 and on channel 810 in GPRS/EDGE multislot class 10. In GSM850 all tests were performed in GPRS/EDGE multislot class 10.

Because of EDGE power class E2 is 3-5dB less than GSM850 powerclass 4 or GSM1900 powerclass 1, the SAR tests were performed in GMSK mode only.

2.1 Orientation 1

		≤ 5mm distance to phantom		Temperature	
Transmission Band	Channel	SAR_{1g} [W/kg]	Drift [dB]	Ambient temperature	Liquid temp. Liquid depth
GPRS / GSM850 (multislot cl. 10)	Ch 128	-	-	21.0°C	19.2°C 15.4cm
	Ch 190	0.222	-0.101		
	Ch 251	-	-		
GPRS / GSM1900 (multislot cl. 11)	Ch 512	-	-	20.5°C	18.8°C 15.0cm
	Ch 661	0.159	-0.169		
	Ch 810	-	-		

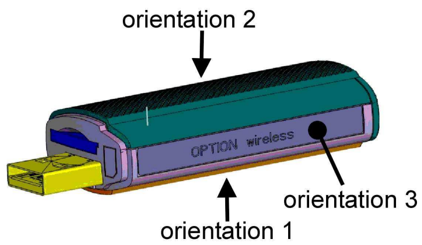


Fig. 2.1: Summary of the measurement result (orientation 1)

2.2 *Orientation 2*

		≤ 5mm distance to phantom		Temperature	
Transmission Band	Channel	SAR_{1g} [W/kg]	Drift [dB]	Ambient temperature	Liquid temp. Liquid depth
GPRS / GSM850 (multislot cl. 10)	Ch 128	-	-	21.0°C	19.2°C 15.4cm
	Ch 190	0.262	-0.0404		
	Ch 251	-	-		
GPRS / GSM1900 (multislot cl. 12)	Ch 512	0.982	-0.107	20.5°C	18.6°C 15.0cm
GPRS / GSM1900 (multislot cl. 11)	Ch 661	0.969	-0.0474	20.5°C	18.8°C 15.0cm
GPRS / GSM1900 (multislot cl. 10)	Ch 810	0.948	0.0626	20.5°C	18.8°C 15.0cm

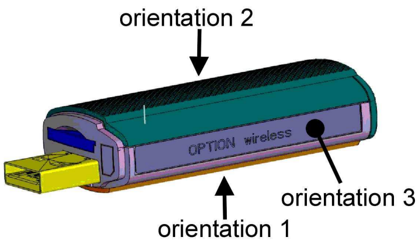


Fig. 2.2: Summary of the measurement result (orientation 2)

2.3 Orientation 3

		≤ 5mm distance to phantom		Temperature	
Transmission Band	Channel	SAR_{1g} [W/kg]	Drift [dB]	Ambient temperature	Liquid temp. Liquid depth
GPRS / GSM850 (multislot cl. 10)	Ch 128	-	-	21.0°C	19.2°C 15.4cm
	Ch 190	0.413	-0.0385		
	Ch 251	-	-		
GPRS / GSM1900 (multislot cl. 11)	Ch 512	-	-	20.5°C	18.8°C 15.0cm
	Ch 661	0.198	-0.0121		
	Ch 810	-	-		

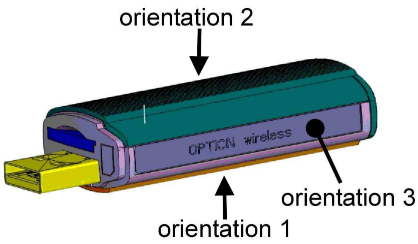


Fig. 2.3: Summary of the measurement result (orientation 3)

2.4 Orientation 4

		≤ 5mm distance to phantom		Temperature	
Transmission Band	Channel	SAR_{1g}[W/kg]	Drift [dB]	Ambient temperature	Liquid temp. Liquid depth
GPRS / GSM850 (multislot cl. 10)	Ch 128	-	-	21.0°C	19.2°C 15.4cm
	Ch 190	0.282	-0.0172		
	Ch 251	-	-		
GPRS / GSM1900 (multislot cl. 11)	Ch 512	-	-	20.5°C	18.8°C 15.0cm
	Ch 661	0.548	-0.0143		
	Ch 810	-	-		

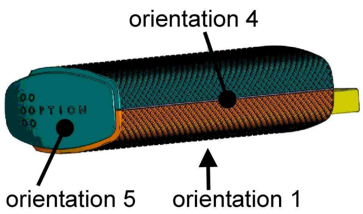


Fig. 2.4: Summary of the measurement result (orientation 4)

2.5 Orientation 5

		≤ 5mm distance to phantom		Temperature	
Transmission Band	Channel	SAR_{1g} [W/kg]	Drift [dB]	Ambient temperature	Liquid temp. Liquid depth
GPRS / GSM850 (multislot cl. 10)	Ch 128	–	–	21.0°C	19.2°C 15.4cm
	Ch 190	0.121	-0.111		
	Ch 251	–	–		
GPRS / GSM1900 (multislot cl. 11)	Ch 512	–	–	20.5°C	18.8°C 15.0cm
	Ch 661	0.305	-0.044		
	Ch 810	–	–		

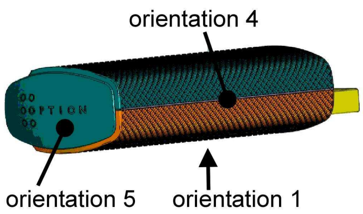


Fig. 2.5: Summary of the measurement result (orientation 5)

2.6 *Check Of Enhanced Energy Coupling*

According FCC document 447498 D01 Mobile Portable RF Exposure v03r02 it must be determined if additional SAR evaluation is required due to enhanced energy coupling at increased separation distances.

The measurement procedure is described in that document 447489 D01 in chapter 2)b)ii):

1) Test configuration with the highest 1-g SAR for each device configuration is chosen
2) Probe tip is positioned at the peak SAR location determined in item 2)b)ii at 3.4mm distance from the phantom (half probe tip diameter)
3) DASY4 system is switched to multimeter. The multimeter job measures the field with the probe standing still.
4) While probe location is fixed, the device is moved away from the phantom in 5mm increments from the initial position.
5) A single point SAR is measured for each of these device positions until the SAR is less than 50% of that measured at the initial position.

At GSM850 (GPRS) the maximum SAR was measured in device orientation 3, while at GSM1900 (GPRS) the maximum SAR was measured in device orientation 2.

Measurement results GSM850, ch190

Ambient temperature: 21.0°C
Liquid temperature: 19.2°C
Liquid depth: 15.4cm
Orientation 3
Distance to phantom: ≤5mm
GPRS/GSM850 (multislot cl. 10)

- Initial position:
  SAR (1g avg.): 0.413 W/kg – Drift: -0.0385dB
- Moving tip by 3.4mm away from phantom, changing DASY4 to "multimeter job":
  SAR (multimeter): 0.4 W/kg at initial device position
- Increment distance between device and phantom by 5mm:
  SAR (multimeter): 0.23 W/kg at 10mm position
- Increment distance between device and phantom by another 5mm:
  SAR (multimeter): 0.15 W/kg at 15mm position

Measurement results GSM1900, ch512

Ambient temperature: 20.5°C
Liquid temperature: 18.6°C
Liquid depth: 15.0cm
Orientation 2
Distance to phantom: ≤5mm
GPRS/GSM1900 (multislot cl. 12)

- Initial position:
  SAR (1g avg.): 0.982 W/kg – Drift: -0.107dB
- Moving tip by 3.4mm away from phantom, changing DASY4 to "multimeter job":
  SAR (multimeter): 0.88 W/kg at initial device position
- Increment distance between device and phantom by 5mm:
  SAR (multimeter): 0.43 W/kg at 10mm position

Conclusion: Moving the device away from the phantom results in consistently lower SAR. An enhanced energy coupling is not ascertainable.

3 Description of the EUT

3.1 General Description

The device ICON 505M is a new USB stick which provides the operating bands GSM850 (GPRS Class12), GSM900 (GPRS Class12), GSM1800 (GPRS Class12), GSM1900 (GPRS Class12), WCDMA FDD I+VIII.

Because the EUT does not have speech function but only data transfer function, the tests in GSM850 and GSM1900 are performed only in GMSK- and EDGE mode.

The dimensions of the EUT are: Length: 81.5mm # Width: 28.5mm # Height: 16.5mm

Fig. 3.1: Picture of the ICON 505M

3.2 EUT parameter

Product Type: ICON 505M
IMEI: 004401441240203
SNR: ZN1493B0DL

3.3 Operating Conditions

	GSM 850	GSM 1900
TX frequency range [MHz]	824.2-848.8	1850.2-1909.8
RX frequency range [MHz]	869.2-893.8	1930.2-1989.8
Modulation	GMSK (EDGE)	GMSK (EDGE)
Power level	PCL 5	PCL 0
Power class	4 (E2)	1 (E2)

3.4 Conducted Power

<u>GPRS/EDGE</u>

	power per slot [dBm]			averaged power over 8 slots [dBm]		
GMSK 850MHz	ch 128	ch 190	ch 251	ch 128	ch 190	ch 251
1TXslot	31.6	31.5	31.6	22.59	22.5	22.59
2TXslots	28.7	28.6	28.7	**22.64**	**22.54**	22.63
3TXslots	26.9	26.8	26.9	22.62	22.53	22.63
4TXslots	25.6	25.5	25.7	22.62	22.53	**22.64**

	power per slot [dBm]			averaged power over 8 slots [dBm]		
EDGE 850MHz	ch 128	ch 190	ch 251	ch 128	ch 190	ch 251
1TXslot	25.4	25.2	25.5	16.33	16.21	16.47
2TXslots	23.2	23.1	23.4	**17.22**	**17.1**	**17.36**
3TXslots	21.3	21.2	21.4	16.99	16.9	17.15
4TXslots	20.1	20.00	20.2	17.04	16.98	17.23

	power per slot [dBm]			averaged power over 8 slots [dBm]		
GMSK 1900MHz	ch 512	ch 661	ch 810	ch 512	ch 661	ch 810
1TXslot	28.4	28.4	28.3	19.41	19.34	19.28
2TXslots	25.6	25.5	25.9	19.57	19.45	**19.85**
3TXslots	24.2	24.1	24.1	19.96	**19.85**	19.84
4TXslots	23.0	22.9	22.8	**19.97**	19.84	19.83

	power per slot [dBm]			averaged power over 8 slots [dBm]		
EDGE 1900MHz	ch 512	ch 661	ch 810	ch 512	ch 661	ch 810
1TXslot	24.3	24.2	24.4	15.29	15.2	15.38
2TXslots	22.8	22.5	22.8	**16.81**	**16.45**	**16.77**
3TXslots	20.9	20.7	20.7	16.62	16.41	16.47
4TXslots	19.4	19.2	19.4	16.43	16.16	16.36

NOTES

1) Division Factors

To average the power, the division factor is as follows:
1TX-slot = 1 transmit time slot out of 8 time slots
=> conducted power divided by (8/1) => -9.03dB
2TX-slots = 2 transmit time slots out of 8 time slots
=> conducted power divided by (8/2) => -6.02dB
3TX-slots = 3 transmit time slots out of 8 time slots
=> conducted power divided by (8/3) => -4.26dB
4TX-slots = 4 transmit time slots out of 8 time slots
=> conducted power divided by (8/4) => -3.01dB

2) Averaged Power Numbers

The maximum averaged power numbers are marked in **bold**.

3) All power numbers in dBm.

3.5 Antenna

Find information concerning the antenna in the appendix to this SAR report:
2009042905 icon505m FCCsar antenna

4 Operational Conditions during the Tests

4.1 Test Orientations

SAR is evaluated using simulated tissue medium contained in a realistic human shaped phantom shell that allows a small diameter, miniature electric field probe to measure the electric field within the tissue regions exposed to the transmitter configured in normal operating positions.

According 447498 D01 Mobile Portable RF Exposure v03r01 2)b)i)(1) devices that can be connected to a host through a cable must be tested with the device positioned in all applicable orientations against the flat phantom (1). A separation distance ≤ 0.5cm is required for USB-dongle transmitters.

To achieve maximum distance to the border of the phantom, the antenna of the EUT is positioned at the cross of the flat section of the phantom (Fig. 4.2).

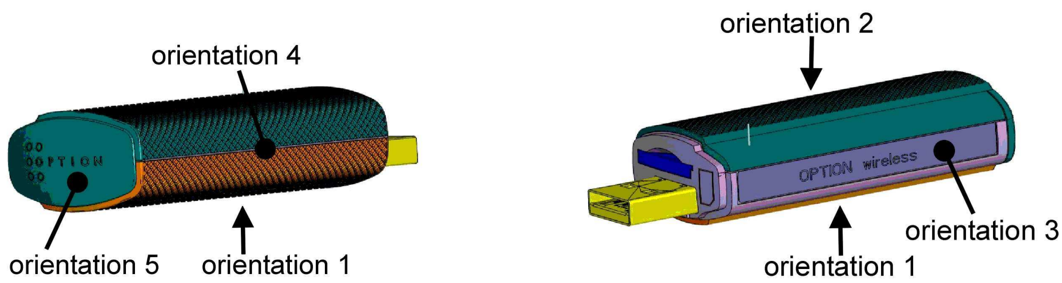


Fig. 4.1: EUT Orientations

4.2 Device Positioning

For body worn the flat section of the phantom is used.

Fig. 4.2: Center point of the phantom


Fig. 4.3: Orientation 1 (Distance DUT «» phantom ≤ 5mm)


Fig. 4.4: Orientation 2 (Distance DUT «» phantom ≤ 5mm)


Fig. 4.5: Orientation 3 (Distance DUT «» phantom ≤ 5mm)


Fig. 4.6: Orientation 4 (Distance DUT «» phantom ≤ 5mm)

Fig. 4.7: Orientation 5 (Distance DUT «» phantom ≤ 5mm)

4.3 Measurement Procedure

Each measurement is done pursuant to the following procedure:

- Connection to EUT is established via air interface with a base station controller.
- EUT is set to maximum output power by base station controller
- Measurement of an E-Field level at a certain reference point. This is the reference value to determine the power drift.
- Measurement of the SAR distribution with 10x10mm grid spacing at a remaining distance to the inner surface of the phantom. Because the sensor can not measure in direct contact with the surface, the values are extrapolated. Based on these values the maximum SAR of the area is calculated by interpolation scheme (combination of a least-square fitted function and a weighted average method). Any additional peak within 2dB of maximum SAR will be searched.
- A cube of 30x30x30mm is assessed around these points by measuring 5x5x5 points. The first two measurement points are within the required 10mm of the surface. Based on these dates the peak spatial-average SAR value is calculated.
- All used calculation routines are bases on the Quadratic Shepard's method (DASY4).
- Repetition of E-Field-measurement at the certain reference point to calculate the power drift.
- Measurement will be repeated in case of power drift is more than ±0.2dB.

4.4 *Configuration of Basestation Controller*

4.4.1 Determination of Maximum Radiated Power

In order to manage terminal heat dissipation resulting from transmission on multiple uplink timeslots, the ICON 505M reduces its maximum output power.

To ensure the EUT is transmitting the maximum radiated power during SAR tests, the conducted power was measured in all multislot classes and averaged (chapter 3.4).

For SAR testing the EUT was set to multislot class based on the maximum averaged conducted power.

4.4.2 Configuration Base Station Controller (BSC) For GSM850 (GMSK)

TCH	BCCH	BCCH-Level	Attenuation	Main Slot	Coding Scheme	Mode	Crest factor
190	162	-65.0	35.0	3	MCS1	EGPRS	4.16

Fig. 4.8: General configuration BSC, GSM850

Slot number	Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
Status	-	-	-	active	active	-	-	-
Gamma (uplink)				3	3			

Fig. 4.9: Slot configuration GSM850

4.4.3 Configuration Base Station Controller (BSC) For GSM1900 (GMSK)

TCH	BCCH	BCCH-Level	Attenuation	Main Slot	Coding Scheme	Mode	Crest factor
512	688	-65.0	40.0	3	MCS1	EGPRS	2.08

Fig. 4.10: General configuration BSC, GSM1900 (channel 512)

Slot number	Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
Status	-	-	-	active	active	active	active	-
Gamma (uplink)				3	3	3	3	

Fig. 4.11: Slot configuration GSM1900 (channel 512)

TCH	BCCH	BCCH-Level	Attenuation	Main Slot	Coding Scheme	Mode	Crest factor
661	688	-65.0	40.0	3	MCS1	EGPRS	2.77

Fig. 4.12: General configuration BSC, GSM1900 (channel 661)

Slot number	Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
Status	-	-	-	active	active	active	-	-
Gamma (uplink)				3	3	3		

Fig. 4.13: Slot configuration GSM1900 (channel 661)

TCH	BCCH	BCCH-Level	Attenuation	Main Slot	Coding Scheme	Mode	Crest factor
810	688	-65.0	40.0	3	MCS1	EGPRS	4.16

Fig. 4.14: General configuration BSC, GSM1900 (channel 810)

Slot number	Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7
Status	-	-	-	active	active	-	-	-
Gamma (uplink)				3	3	-		

Fig. 4.15: Slot configuration GSM1900 (channel 810)

4.5 Host Laptop

All tests were performed with the following Laptop:

Fujitsu Siemens
Lifebook S, S6410
Ser.No. YK9S026535

Fig. 4.16: picture of host device Laptop

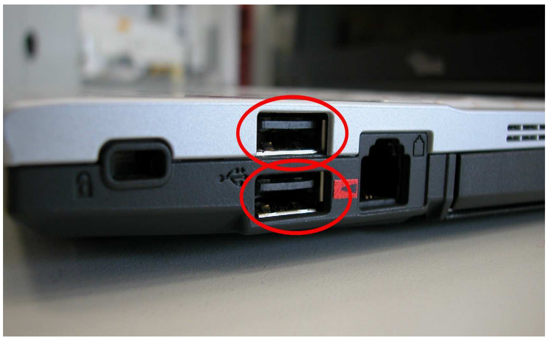


Fig. 4.17: Horizontal slot

Fig. 4.18: Vertical slot

5 FCC Informations

provided by Mr. Tim Harrington, Aug14, 2008

FCC is providing USB dongle transmitter manufacturers requesting considerations for products that are in their final stage ready to ship in early fall the opportunity to present relevant SAR test data and supporting info for us to examine if other possible alternatives may apply to issues relating to similar circumstances among these products. This is a collective consideration; we are not likely to consider the specific or individual requests or proposals from each individual manufacturer that have already been determined to be undesirable or unacceptable. These alternative considerations are not long term solutions and will require the certification to be submitted to the FCC for approval.

Manufacturers should consider the following to perform SAR compliance tests for their USB dongle modem transmitter(s). When the final test results for each product are ready, we can review and determine the type and extent of warning and/or labelling requirements according to the test distances and SAR levels to show compliance. While there is the possibility of considering warning instructions and pamphlets etc. to address SAR and distance issues for USB connection orientations that are found less often in typical laptop computers (mainly in one of the up-side-down horizontal configurations), higher SAR levels and larger separation distances in the other USB connection orientations may necessitate warnings on the device. We will need to review the final data to make this determination.

SAR compliance test considerations:
Test all USB orientations: Horizontal-up, Horizontal-down, Vertical-front, and Vertical-back a test distance of 5 mm or less, according to KDB 447498, should be considered for the orientations that can satisfy such requirements. The same test separation distance should be used for all frequency bands and modes in each USB orientation; that is, the frequency band with the highest SAR dictates the test distance in each orientation. Do not include any non-compliant data in the test report. The typical Horizontal-up USB connection, found in the majority of laptop computers, must be tested using an appropriate laptop computer. A laptop with either Vertical-front or Vertical-back USB connection should be used to test one of the vertical USB orientations. If laptop computers are not available for testing the Horizontal-down or remaining Vertical USB orientation, a short USB cable (12 inch or less) may be used for testing these other orientations. It should be ensured that the USB cable does not affect device output power and SAR. Since the warning and labelling requirements are dependent on the measured SAR levels and test distances, it would be desirable to test at the smallest distance that enable each USB orientation to comply (1.6 W/kg or 1.2 W/kg as appropriate) in all frequency bands and modes. When different distances are used to test the different orientations, the device design and antenna configuration with respect to their operating configurations and exposure conditions will also be considered to determine warning and labelling requirements. The FCC SAR test procedures for 3G devices, including power measurement requirements, should be used to perform the SAR evaluation.

6 SAR Measurement System

6.1 Description Of DASY Measurement Setup

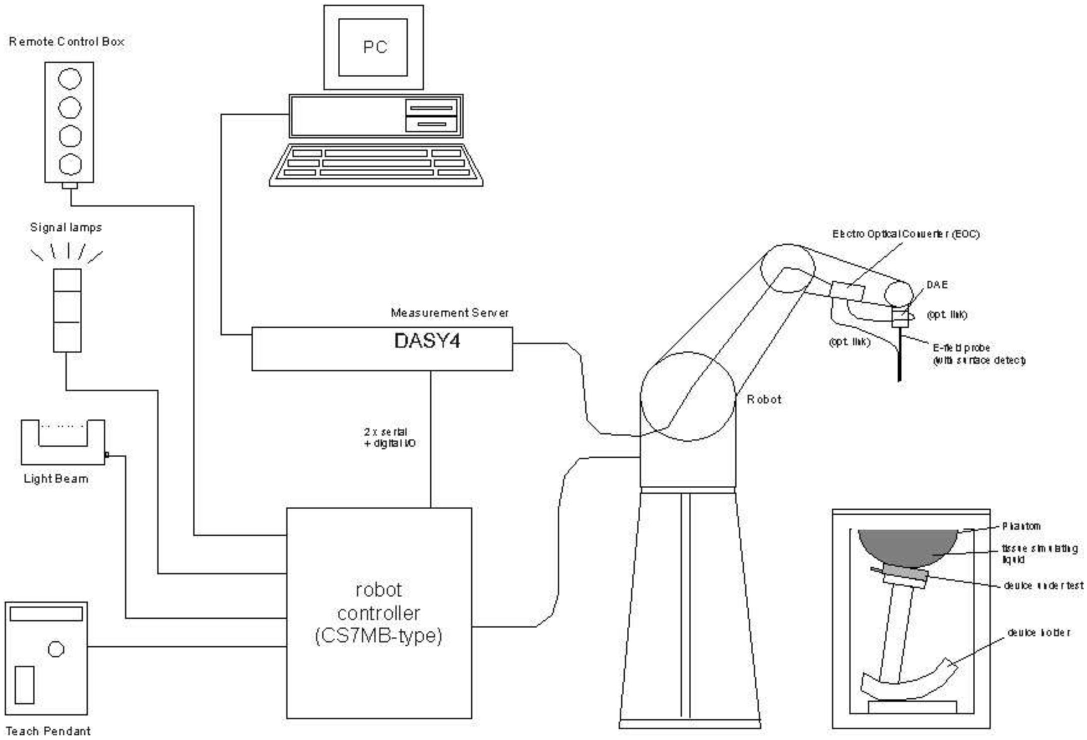


Fig. 6.1: Block diagram of DASY measurement set-up

Fig. 6.2: Picture of DASY measurement set-up with SAM Phantom

The main component of the SAR measurement set-up by SPEAG is the standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. A removable dosimetric probe allows measurements in all operating bands. The mechanical probe offset is completely compensated after aligning the probe in the light-beam. During this procedure, the system measures the actual probe offset. After passing alignment all further movements are adjusted to the actual tip position. This ensures an uncertainty of probe positioning of better than 0.1mm, even after changing probes. A data acquisition electronics (DAE) performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC. The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server. The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts. The DASY4 software allows a comfortable visualisation of the measurement results.

6.1.1 Description SAR Scan Method

Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.
Before starting the area scan a grid spacing of 10 mm x 10 mm is set. During the scan the distance of the probe to the phantom remains unchanged.

After finishing area scan, the field maxima within a range of 2 dB (specified by IEEE 1528-2003) will be ascertained.

Zoom Scan
Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

Spatial Peak Detection
The procedure for spatial peak SAR evaluation has been implemented according to the IEEE1529 standard and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY4 system allows evaluations that combine measured data and robot positions, such as:
· maximum search
· extrapolation
· boundary correction
· peak search for averaged SAR
During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

6.2 Description of the Phantom (Twin Sam)

The phantom table has a size of: 100cm x 50cm x 85cm (L x W x H) for use with a free standing robot. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used (e.g., for different liquids) A white cover is provided to top the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible.
On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

It has three measurement areas:

- Left hand
- Right hand
- Flat phantom

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, CENELEC 50361 and IEC 62209. 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.

Parameter of the phantom:

Shell Thickness:	2 ± 0.2 mm;
Centre ear point:	6 ± 0.2 mm
Filling Volume:	~ 25 litres
Length:	1000 mm
Width:	500 mm
Height:	adjustable feet

Fig. 6.3: SAM Twin Phantom

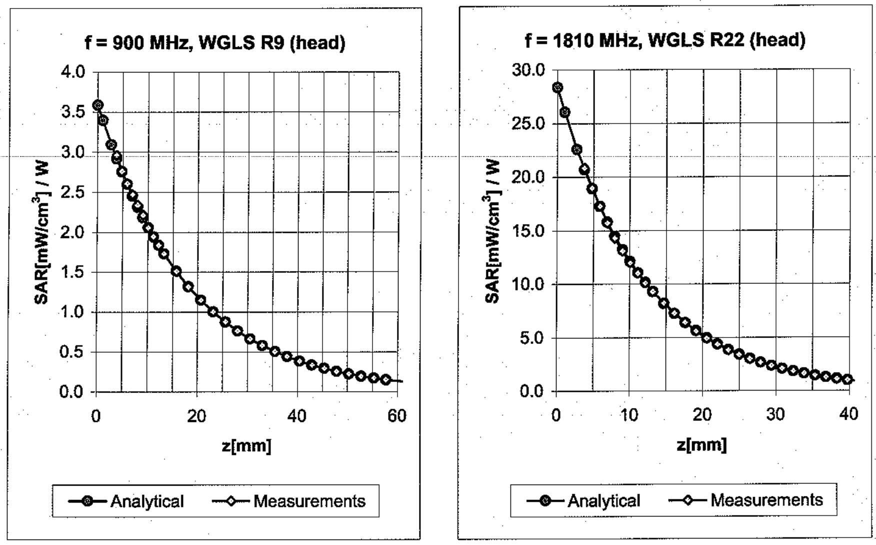
6.3 E-Field Probe (ET3DV6)

- Construction:
  Symmetrical design with triangular core
  Built-in optical fibre for surface detection system (ET3DV6 only)
  Built-in shielding against static charges
  PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
- Calibration
  Basic Broad Band Calibration in air
  Conversion Factors (CF) for HSL 900 and HSL 1810
  Additional CF for other liquids and frequencies upon request
- Frequency
  10 MHz to 2.3 GHz
  Linearity: ± 0.2 dB (30 MHz to 2.3 GHz)
- Directivity
  ± 0.2 dB in HSL (rotation around probe axis)
  ± 0.4 dB in HSL (rotation normal to probe axis)
- Dynamic Range
  5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
- Optical Surface Detection
  ± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces (ET3DV6 only)
- Dimensions
  Overall length: 330 mm (Tip: 16 mm)
  Tip diameter: 6.8 mm (Body: 12 mm)
  Distance from probe tip to dipole centre: 2.7 mm

- Application
  General dosimetric measurements up to 2.3 GHz
  Compliance tests of mobile phones
  Fast automatic scanning in arbitrary phantoms

ET3DV6 SN:1723 **November 10, 2008**

Conversion Factor Assessment



f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty	
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	0.29	3.60	6.00	± 11.0% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.26	3.89	5.82	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.99	1.79	5.12	± 11.0% (k=2)
1900	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.99	1.77	5.05	± 11.0% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.45	2.73	5.91	± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.48	2.64	5.72	± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.99	1.83	4.59	± 11.0% (k=2)
1900	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.99	1.75	4.40	± 11.0% (k=2)

[C] **The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.**

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Fig. 6.4: Conversion factor assessment Dipole ET3DV6

6.4 Probe Positioning

The probe positioning procedures affect the tolerance of the separation distance between the probe tip and the phantom surface as:

$$SAR_{tolerance}[\%] = 100 \times \frac{d_{ph}}{\delta/2}$$

where dph is the maximum deviation of the distance between the probe tip and the phantom surface. The optical surface detection has a precision of better than 0.2 mm, resulting in an SARtolerance[%] of <2.9% (rectangular distribution). Since the mechanical detection provides better accuracy, 2.9% is a worst-case figure for DASY4 system.

6.5 Reference Dipols

Technical Data

- Symmetrical dipole with λ/4 balun
- Enables measurement of feedpoint impedance with NWA
- Matched for use near flat phantoms filled with tissue simulating solutions
- Return Loss > 20 dB at specified validation position
- Max. Power: 100W@f<1GHz, 40W@f>1GHz

- Used dipols at Option Wireless Germany:

Type	Dipole length	Overall height
D835V2	161.0 mm	340.0 mm
D900V2	148.5 mm	340.0 mm
D1800V2	72.5 mm	300.0 mm
D1900V2	67.7 mm	300.0 mm

Calibration data are listed in the appendix to this document:
2009042904 icon505m FCCsar caldata

6.6 Recipes SAR-Liquids for Body

Liquid type	M 900-B		M 1950-A	
Ingredient	weight (g)	weight (%)	weight (g)	weight (%)
Water	633.91	50.75	697.94	69.79
DGBE	-	-	300.03	30.00
Sugar	602.12	48.21		
Salt	11.76	0.94	2.03	0.20
Preventol	1.20	0.10		
Total amount	1249.00	100.00	1000.00	100.00
Goal dielectric parameters				
Frequency [MHz]	835	900	1950	2000
Relative Permittivity	55.2	55.0	53.3	53.3
Conductivity [S/m]	0.97	1.05	1.52	1.52

Fig. 6.5: Recipes SAR-liquids for body [DASY4 System Handbook]

6.7 Tissue Dielectric Parameters for Body

Target frequency		ε_r	σ(S/m)
835 MHz	Target value with tolerances	55.2 ± 2.76	0.97 ± 0.10
	Measured value	53.81	0.99
900 MHz	Target value with tolerances	55.0 ± 2.75	1.05 ± 0.10
	Measured value	54.1	1.01
1800 MHz -2000 MHz	Target value with tolerances	53.3 ± 2.66	1.52 ± 0.15
	Measured value	53.95	1.58

Fig. 6.6: Dielectric parameters for body [OET65c Edition 97-01]

The dielectric parameters are measured with the Hewlett Packard Network Analyzer in combination with the Probe Kid 85070D.

6.8 Liquid Depth of the Phantom

The liquid depth in the phantom should be in a range of 15 cm ± 0.5 cm.

7 Setup for the System Check

The verification of the system (liquid included) is done by using the reference dipoles. The measurement set-up (Fig. 7.4) is based on IEC1528-2003. By setting output power at power meter 1 (PM1) to 250 mW, the listed levels in figure 7.1 indicate what may be expected. Because the probe of the power meter (PM1) is limited to 100mW, an attenuator (Att1) of 10 dB is used. The matching of the dipole is checked by using a directional coupler with power meter PM2 + PM3 to ensure that the backward power is at least 20 dB lower than the forward power.

Frequency Signal Generator	Level Generator [dBm]	Forward Power PM2 [dBm]	Backward Power PM3 [dBm]	Feeding point reference dipole PM1 [dBm]	Liquid Temperature	Liquid depth
835 MHz	-11.36	-14.4	-37.8	14.0	19.2 °C	15.4 cm
1900 MHz	-9.66	-13.5	-37.9	14.0	18.6 °C	15.0 cm
1900 MHz	-9.64	-13.5	-38.1	14.0	18.8 °C	15.0 cm

Fig. 7.1: Power performance measurement set-up

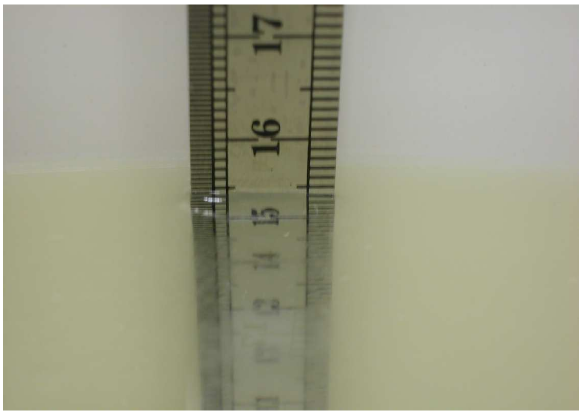

Fig. 7.2: Liquid depth 850/900MHz

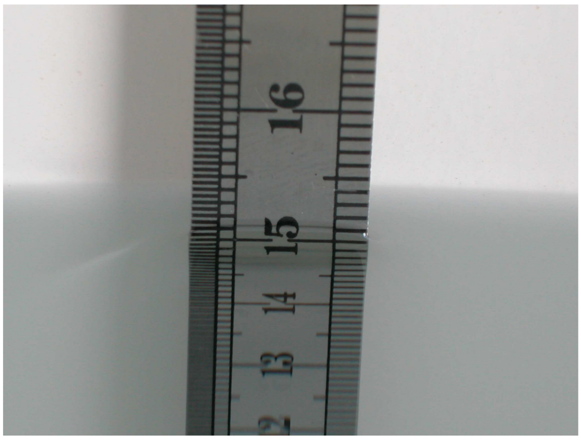

Fig. 7.3: Liquid depth 1900MHz

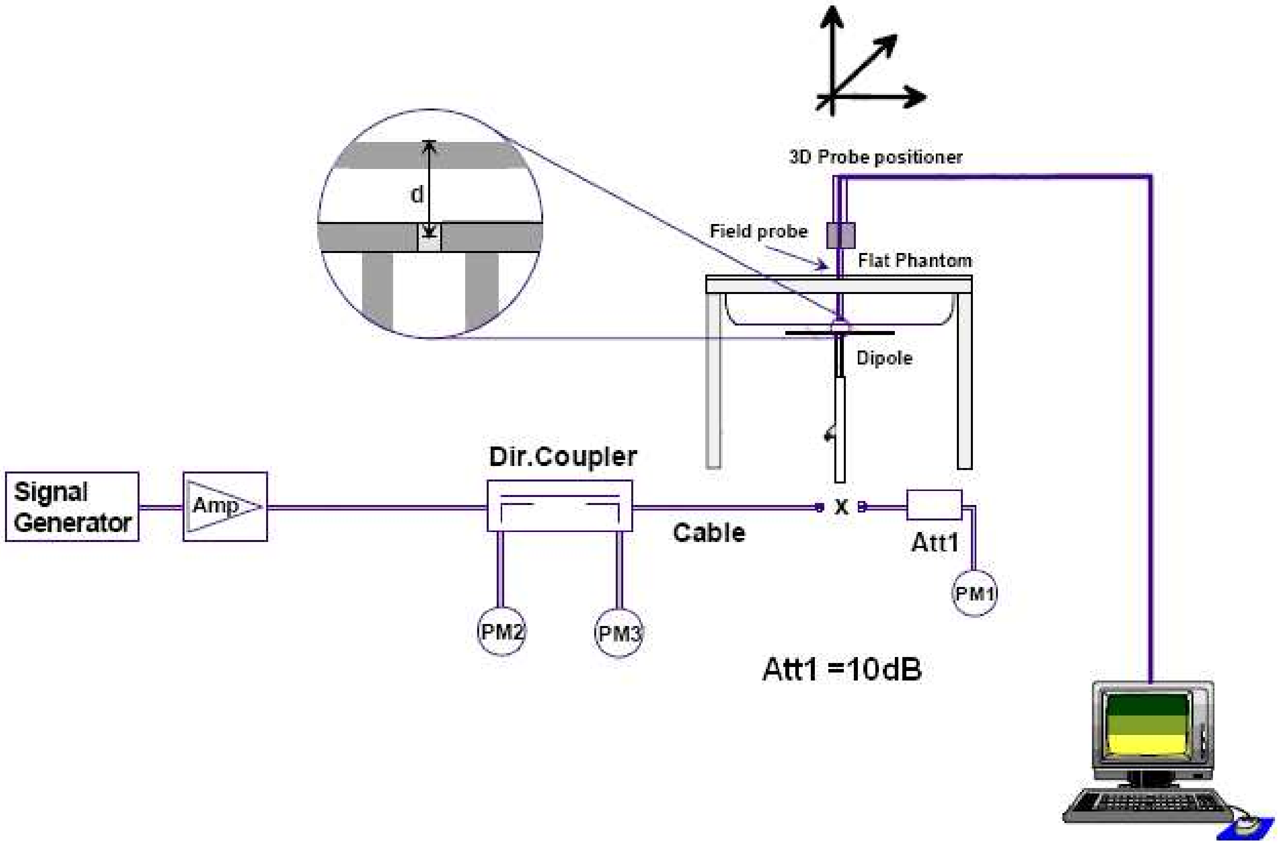

Fig. 7.4: Simplified measurement set-up for system check

Frequency	$SAR_{1g\ avg}$ [W/kg]			Dipole Type	Cal. Date
	Lower limit	Upper limit	Measured value		
835 MHz	2.2	2.7	2.48	D835V2	11/2008
1900 MHz	9.27	11.33	11.0	D1900V2	11/2008
1900 MHz	9.27	11.33	10.9	D1900V2	11/2008

Fig. 7.5: Target values for Dipole calibration (Body worn)

For the reference dipoles the frequencies the spacing distances d is given by:

a) d = 15 mm ± 0.2 mm for 300 MHz ≤ f ≤ 1000MHz
b) d = 10 mm ± 0.2 mm for 1000 MHz < f ≤ 3000MHz
c) d = 10 mm ± 0.2 mm for 3000 MHz < f ≤ 6000MHz

7.1 Systemvalidation

Refer to appendix to the report:
All system validation files are listed in the document:
2009042903 icon505m FCCsar systemvalidation

7.2 Equipment for Setup Validation

Measurement Equipment for system performance check				
Measurement device	**Type**	**Serial Number**	**Last calibration**	**Next calibration**
Schmid & Partner Dipole 835 MHz	D835V2	470	11/2008	11/2009
Schmid & Partner Dipole 900	D900V2	167	11/2008	11/2009
Schmid & Partner Dipole 1800 MHz	D1800V2	2d051	11/2008	11/2009
Schmid & Partner Dipole 1900 MHz	D1900V2	5d021	11/2008	11/2009
Power Meter Rohde&Schwarz	NRVS	833302/042	11/2008	11/2009
Power Sensor Rohde&Schwarz	NRV-Z51	839800/036	11/2008	11/2009
Power Meter Hewlett Packard	437B	3125U23483	N/A	N/A
Power Sensor Hewlett Packard	8482A	3318A29530	N/A	N/A
Power Meter Hewlett Packard	437B	3125U23477	N/A	N/A
Power Sensor Hewlett Packard	8482A	3318A29512	N/A	N/A
Directional Coupler Amplifier Research	DC7144M1	305854	N/A	N/A
Linear Power Amplifier MILMEGA		1002534	N/A	N/A
Digital Signal Generator Hewlett Packard	ESG-D2000A	US36260115	N/A	N/A
Network Analyzer Hewlett Packard	8753D	3410J02063	04/2008	04/2009
Dielectric Probe Kid Agilent	85070D	US01440138	N/A	N/A

Fig.7.9: Used equipment to validate the measurement set-up

7.3 Equipment for SAR Measurement

Measurement Equipment for system performance check				
Measurement device	Type	Serial Number	Last calibration	Next calibration
Computer Compac		6S29-KN82-H1LS	N/A	N/A
DASY4 Software	Version 4.7	N/A	N/A	N/A
Semcad	Version 1.8	N/A	N/A	N/A
Robot Stäubli Unimation	EOC5	232	N/A	N/A
Schmid & Partner DAE4	SD 000 D04 BA	523	11/2008	11/2009
Light Beam calibration unit	LB; Version 2	332	N/A	N/A
Coupling Antenna KATHREIN	VPol Indoor 800/2000	D624575853	N/A	N/A
E-field probe	ET3DV6	1723	11/2008	11/2009
Twin Phantom, SAM Right	QD 000 P40 CA	TP-1241	N/A	N/A
Twin Phantom, SAM Left	QD 000 P40 CA	TP-1237	N/A	N/A
BSC Rohde & Schwarz	CMU200	105314	N/A	N/A
Precision Thermometer	Flüssigkeitsglas-thermometer	1650	02/2008	12/2023

Fig.7.10: General equipment of the measurement set-up

8 Tolerances and Uncertainty

8.1 DASY4 Uncertainty Budget

DASY4 Uncertainty Budget According to IEEE 1528								
Error Description	Uncertainty value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std. Unc. 1g	Std. Unc. 10g	υ_i
Measurement System								
Probe Calibration	±5.9%	N	1	1	1	±5.9%	±5.9%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Conditions	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	√3	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	√3	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±10.8%	±10.6%	330
Expanded uncertainty (95% confidence interval), k = 2						**21.6%**	**21.2 %**	

Fig. 8.1 DASY 4 uncertainty budget according to IEEE 1528

Abbreviations: N ≡ Normal Distribution, R ≡ Rectangular Distribution

Worst-Case uncertainty budget for DASY4 assessed according to IEEE 1528. The budget is valid for the frequency range 300MHz – 3GHz and represents a worst-case analysis.

8.2 System Validation Uncertainty Budget

Uncertainty Budget for system validation, According to IEEE 1528								
Error Description	Uncertainty value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std. Unc. 1g	Std. Unc. 10g	υ_i
Measurement System								
Probe Calibration	±5.9%	N	1	1	1	±5.9%	±5.9%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.0%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±0.0%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Conditions	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Dipole								
Dipole axis to liquid distance	±2.0%	R	√3	1	1	±1.2%	±1.2%	∞
Input power and SAR drift measurement	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	√3	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	√3	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±9.3%	±9.1%	∞
Expanded uncertainty (95% confidence interval), k = 2						**18.6%**	**18.2 %**	

Fig. 8.2: Uncertainty budget for system validation according to IEEE 1528

Worst-Case uncertainty budget for DASY4 assessed according to IEEE 1528. The budget is valid for the frequency range 300MHz - 3GHz and represents a worst-case analysis.

Abbreviations: N ≡ Normal Distribution, R ≡ Rectangular Distribution

9 Declaration Of Conformity Of DASY4 System

Schmid & Partner Engineering AG **s p e a g**

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info@speag.com, http://www.speag.com

Certificate of conformity

Item	Dosimetric Assessment System DASY4
Type No	SD 000 401A, SD 000 402A
Software Version No	4.7
Manufacturer / Origin	Schmid & Partner Engineering AG Zeughausstrasse 43, CH-8004 Zürich, Switzerland

References

[1] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003

[2] EN 50361:2001, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)", July 2001

[3] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005

[4] IEC 62209 – 2, Draft Version 0.9, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures
Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", December 2004

[5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01

[6] ANSI-C63.19-2007, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", June 2007

Conformity

We certify that this **system is designed to be fully compliant** with the standards [1 – 6] for RF emission tests of wireless devices.

Uncertainty

The uncertainty of the measurements with this system was evaluated according to the above standards and is documented in the applicable chapters of the DASY4 system handbook.
The uncertainty values represent current state of methodology and are subject to changes. They are applicable to all laboratories using DASY4 provided the following requirements are met (responsibility of the system end user):

1) the system is used by an experienced engineer who follows the manual and the guidelines taught during the training provided by SPEAG,
2) the probe and validation dipoles have been calibrated for the relevant frequency bands and media within the requested period,
3) the DAE has been calibrated within the requested period,
4) the "minimum distance" between probe sensor and inner phantom shell and the radiation source is selected properly,
5) the system performance check has been successful,
6) the operational mode of the DUT is CW, CDMA, FDMA or TDMA (GSM, DCS, PCS, IS136, PDC) and the measurement/integration time per point is ≥ 500 ms,
7) the dielectric parameters of the liquid are conformant with the standard requirement,
8) the DUT has been positioned as described in the manual.
9) the uncertainty values from the calibration certificates, and the laboratory and measurement equipment dependent uncertainties, are updated by end user accordingly.

Date 15.8.2007 **Signature / Stamp**

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10 SAR Distribution Plots

Refer to appendix to the report:
All SAR-plots are listed in the document:
2009042902 icon505m FCCsar plots

11 References / Abbreviations

11.1 References

- FCC OET 65c Federal Communications Commission: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), FCC,
- 447498 D01 Mobile Portable RF Exposure v03r01: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies, 05/12/2008
- IEEE Std 1528™-2003 IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices:
- FCC- TCB Training on SAR Review Pt 22/24, Evaluation compliance/SAR Review of Part 22 Subpart H and Part 24 Wireless Handsets for Equipment Approval , Supplement C-01-01, 12-13 May 2003
- DASY4 Manual, Schmid & Partner Engineering AG, DASY4 Manual, February 2004

11.2 Used Abbreviations

BSC .... Base station controller
DAE .... Data Acquisition Electronics
DASY .... Dosimetric Assessment System
EOC .... Electro-optical converter
EUT .... Equipment under test
GPRS .... General Packet Radio Service
N/A .... Non-applicable
PCL .... Power Control Level
SAM .... Specific Anthropomorphic Mannequin
SAR .... Specific Absorption Rate
UL .... Uplink
UMTS .... Universal Mobile Telecommunications System