

## Appendix 5. Validation of System

Prior to the assessment, the system was verified in the flat region of the phantom. A 900MHz, 1900MHz and a 2450MHz dipole was used. A forward power of 250 mW was applied to the dipole and the system was verified to a tolerance of  $\pm 5\%$  for the 900MHz, 1900MHz and a 245MHz dipole.

The applicable verifications were normalised to 1 Watt:

**Date: 04/05/2011**

**Validation Dipole and Serial Number: D900V2; SN: 124**

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	23.0 °C	22.1 °C	$\epsilon_r$	41.50	41.18	-0.77	5.00
				$\sigma$	0.97	0.93	-4.20	5.00
				1g SAR	11.00	11.28	2.55	5.00
				10g SAR	7.01	7.28	3.85	5.00

**Date: 05/05/2011**

**Validation Dipole and Serial Number: D900V2; SN: 185**

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	23.0 °C	22.2 °C	$\epsilon_r$	55.00	53.47	-2.79	5.00
				$\sigma$	1.05	1.07	1.72	5.00
				1g SAR	11.00	11.00	0.00	5.00
				10g SAR	7.16	7.12	-0.56	5.00

**Date: 06/05/2011**

**Validation Dipole and Serial Number: D900V2; SN: 185**

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	23.0 °C	21.8 °C	$\epsilon_r$	41.50	41.75	0.60	5.00
				$\sigma$	0.97	0.93	-4.12	5.00
				1g SAR	11.00	10.60	-3.64	5.00
				10g SAR	7.06	6.88	-2.55	5.00

**Date: 07/05/2011**

**Validation Dipole and Serial Number: D900V2; SN: 185**

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	23.0 °C	22.2 °C	$\epsilon_r$	55.00	53.96	-1.89	5.00
				$\sigma$	1.05	1.08	2.60	5.00
				1g SAR	11.00	11.40	3.64	5.00
				10g SAR	7.16	7.16	0.00	5.00

Date: 08/05/2011

Validation Dipole and Serial Number: D900V2; SN: 185

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	23.0 °C	22.2 °C	$\epsilon_r$	55.00	53.96	-1.89	5.00
				$\sigma$	1.05	1.08	2.60	5.00
				1g SAR	11.00	10.80	-1.82	5.00
				10g SAR	7.16	6.88	-3.91	5.00

Date: 09/05/2011

Validation Dipole and Serial Number: D900V2; SN: 185

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	23.0 °C	22.2 °C	$\epsilon_r$	55.00	53.22	-3.24	5.00
				$\sigma$	1.05	1.07	2.02	5.00
				1g SAR	11.00	11.08	0.73	5.00
				10g SAR	7.16	7.16	0.00	5.00

**Note:**

The version of DASY system used by RFI for SAR measurements is v4.7.

The SAR probe for the DASY v4.4 and higher has a validity of +/- 100 MHz from the spot frequency at which the system is calibrated.

The SAR probe was calibrated at 750 MHz (covering 650 MHz to 850 MHz) and 900 MHz (covering 800 MHz to 1000 MHz) for the Head tissue with both the 750 MHz and 900 MHz calibration parameters imported on the same data file of the DASY4 system.

For GSM850 (head SAR test) the DASY4 v4.7 system uses the conversion factor for 750 MHz calibration as this covers the frequency range of 650 MHz to 850 MHz. The SAR system uses the 900 MHz conversion factor which is valid from 800 MHz to 1000 MHz for the system validation performed at 900 MHz.

The 900 MHz validation is applicable for the 850 band as this is within 50 MHz of the of the centre frequency.

Date: 28/04/2011

Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	23.0 °C	23.0 °C	$\epsilon_r$	40.00	40.19	0.46	5.00
				$\sigma$	1.40	1.37	-1.98	5.00
				1g SAR	40.30	40.80	1.24	5.00
				10g SAR	21.00	20.88	-0.57	5.00

Date: 29/04/2011

Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	23.0 °C	22.0 °C	$\epsilon_r$	53.30	52.29	-1.89	5.00
				$\sigma$	1.52	1.51	-0.47	5.00
				1g SAR	40.70	40.40	-0.74	5.00
				10g SAR	21.60	20.72	-4.07	5.00

Date: 03/05/2011

Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	22.0 °C	22.8 °C	$\epsilon_r$	53.30	52.79	-0.95	5.00
				$\sigma$	1.52	1.56	2.71	5.00
				1g SAR	40.70	41.60	2.21	5.00
				10g SAR	21.60	21.68	0.37	5.00

Date: 08/05/2011

Validation Dipole and Serial Number: D2450V2; SN: 725

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	2450	23.0 °C	23.2 °C	$\epsilon_r$	39.20	38.43	-1.97	5.00
				$\sigma$	1.80	1.82	1.29	5.00
				1g SAR	52.90	55.20	4.35	5.00
				10g SAR	24.70	25.12	1.70	5.00

Date: 09/05/2011

Validation Dipole and Serial Number: D2450V2; SN: 725

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	23.0 °C	23.0 °C	$\epsilon_r$	52.70	52.03	-1.26	5.00
				$\sigma$	1.95	1.98	1.60	5.00
				1g SAR	51.90	54.00	4.05	5.00
				10g SAR	24.10	24.80	2.90	5.00

## Appendix 6. Simulated Tissues

The body mixture consists of de-ionised water, Polysorbate 20 and salt. Visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

ingredient	Frequency
	835/850/900 MHz Head
De-Ionized Water	52.87
Polysorbate 20 (Tween 20)	46.10
Salt	1.03

Ingredient	Frequency
	835/850/900 MHz Body
De-Ionized Water	71.30
Polysorbate 20 (Tween 20)	28.00
Salt	0.70

Ingredient	Frequency
	1800/1900 MHz Head
De-Ionized Water	55.40
Polysorbate 20 (Tween 20)	44.22
Salt	0.38

Ingredient	Frequency
	1800/1900 MHz Body
De-Ionized Water	71.50
Polysorbate 20 (Tween 20)	28.00
Salt	0.50

Ingredient	Frequency
	2450 MHz Head
De-Ionized Water	55.75
Polysorbate 20 (Tween 20)	45.25

Ingredient	Frequency
	2450 MHz Body
De-Ionized Water	71.70
Polysorbate 20 (Tween 20)	28.00
Salt	0.30

## Appendix 7. DASY4 System Details

### A.7.1. DASY4 SAR Measurement System

RFI Global Services Ltd, SAR measurement facility utilises the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY4 system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, and the SAM phantom containing brain or muscle 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). A cell controller system contains the power supply, robot controller; teach pendant (Joystick), and remote control. This is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. The data acquisition electronics (DAE) performs signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection etc. The DAE 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. The DAE3 utilises 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.

**A.7.2. DASY4 SAR System Specifications**

<b>Robot System</b>	
<b>Positioner:</b>	Stäubli Unimation Corp. Robot Model: RX90L
<b>Repeatability:</b>	0.025 mm
<b>No. of Axis:</b>	6
<b>Serial Number:</b>	F00/SD89A1/A/01
<b>Reach:</b>	1185 mm
<b>Payload:</b>	3.5 kg
<b>Control Unit:</b>	CS7
<b>Programming Language:</b>	V+
<b>Data Acquisition Electronic (DAE) System</b>	
<b>Serial Number:</b>	DAE3 SN:450
<b>PC Controller</b>	
<b>PC:</b>	Dell Precision 340
<b>Operating System:</b>	Windows 2000
<b>Data Card:</b>	DASY4 Measurement Server
<b>Serial Number:</b>	1080
<b>Data Converter</b>	
<b>Features:</b>	Signal Amplifier, multiplexer, A/D converted and control logic.
<b>Software:</b>	DASY4 Software
<b>Connecting Lines:</b>	Optical downlink for data and status info. Optical uplink for commands and clock.
<b>PC Interface Card</b>	
<b>Function:</b>	24 bit (64 MHz) DSP for real time processing Link to DAE3 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.

**DASY4 SAR System Specifications (Continued)****E-Field Probe**

<b>Model:</b>	EX3DV3
<b>Serial No:</b>	3508
<b>Construction:</b>	Triangular core
<b>Frequency:</b>	10 MHz to >6 GHz
<b>Linearity:</b>	$\pm 0.2$ dB (30 MHz to 6 GHz)
<b>Probe Length (mm):</b>	330
<b>Probe Diameter (mm):</b>	12
<b>Tip Length (mm):</b>	20
<b>Tip Diameter (mm):</b>	2.5
<b>Sensor X Offset (mm):</b>	1
<b>Sensor Y Offset (mm):</b>	1
<b>Sensor Z Offset (mm):</b>	1
<b>Phantom</b>	
<b>Phantom:</b>	SAM Phantom
<b>Shell Material:</b>	Fibreglass
<b>Thickness:</b>	$2.0 \pm 0.1$ mm