

## Appendix 5. System Performance Check

Prior to the assessment, the system was verified in the flat region of the phantom, 900 MHz, 1900 MHz and 2450 MHz dipoles were 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 2450MHz dipoles.

The applicable verification normalised to 1 Watt.

### System Check 850/900 Head

Date: 20/11/2012

Validation Dipole and Serial Number: D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	24.0 °C	22.5 °C	$\epsilon_r$	41.50	39.86	-3.94	5.00
				$\sigma$	0.97	0.97	0.27	5.00
				1g SAR	10.50	10.64	1.33	5.00
				10g SAR	6.74	6.92	2.67	5.00

### Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	$\epsilon_r$	40.5
			$\sigma$	0.91
190	Middle	836.6	$\epsilon_r$	40.3
			$\sigma$	0.91
251	High	848.8	$\epsilon_r$	40.2
			$\sigma$	0.92

Date: 23/11/2012

Validation Dipole and Serial Number: D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	24.0 °C	23.0 °C	$\epsilon_r$	41.50	40.45	-2.53	5.00
				$\sigma$	0.97	0.94	-3.35	5.00
				1g SAR	10.50	10.68	1.71	5.00
				10g SAR	6.74	6.96	3.26	5.00

### Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
4132	Low	826.4	$\epsilon_r$	41.0
			$\sigma$	0.87
4183	Middle	836.6	$\epsilon_r$	40.9
			$\sigma$	0.87
4233	High	846.6	$\epsilon_r$	40.8
			$\sigma$	0.88

**System Check 850/900 Body**

Date: 21/11/2012

Validation Dipole and Serial Number: D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	24.0°C	23.5°C	$\epsilon_r$	55.00	53.72	-2.32	5.00
				$\sigma$	1.05	1.01	-3.76	5.00
				1g SAR	10.80	11.12	2.96	5.00
				10g SAR	6.96	7.28	4.60	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	$\epsilon_r$	54.2
			$\sigma$	0.95
190	Middle	836.6	$\epsilon_r$	54.1
			$\sigma$	0.95
251	High	848.8	$\epsilon_r$	53.9
			$\sigma$	0.95

Date: 22/11/2012

Validation Dipole and Serial Number: D900V2; SN: 035 D900V2; SN: 035

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	24.0°C	23.5°C	$\epsilon_r$	55.00	53.72	-2.32	5.00
				$\sigma$	1.05	1.01	-3.76	5.00
				1g SAR	10.80	10.88	0.74	5.00
				10g SAR	6.96	7.12	2.30	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
4132	Low	826.4	$\epsilon_r$	54.2
			$\sigma$	0.95
4183	Middle	836.6	$\epsilon_r$	54.1
			$\sigma$	0.95
4233	High	846.6	$\epsilon_r$	54.0
			$\sigma$	0.95

**System Check 1900 Head**

Date: 23/11/2012

Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	24.0°C	23.3°C	$\epsilon_r$	40.00	41.43	3.56	5.00
				$\sigma$	1.40	1.43	2.23	5.00
				1g SAR	40.30	40.00	-0.74	5.00
				10g SAR	21.00	20.76	-1.14	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
512	Low	1850.2	$\epsilon_r$	41.3
			$\sigma$	1.39
661	Middle	1880.0	$\epsilon_r$	41.4
			$\sigma$	1.42
810	High	1909.8	$\epsilon_r$	41.4
			$\sigma$	1.44

Date: 26/11/2012

Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	24.0°C	24.0°C	$\epsilon_r$	40.00	41.73	4.33	5.00
				$\sigma$	1.40	1.43	2.43	5.00
				1g SAR	40.30	42.00	4.22	5.00
				10g SAR	21.00	21.76	3.62	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
512	Low	1850.2	$\epsilon_r$	41.8
			$\sigma$	1.39
661	Middle	1880.0	$\epsilon_r$	41.8
			$\sigma$	1.42
810	High	1909.8	$\epsilon_r$	41.7
			$\sigma$	1.45

**System Check 1900 Body**

Date: 26/11/2012

Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	24.0 °C	24.0 °C	$\epsilon_r$	53.30	52.14	-2.17	5.00
				$\sigma$	1.52	1.58	3.73	5.00
				1g SAR	40.70	39.12	-3.88	5.00
				10g SAR	21.60	20.88	-3.33	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
512	Low	1850.2	$\epsilon_r$	52.4
			$\sigma$	1.51
661	Middle	1880.0	$\epsilon_r$	52.2
			$\sigma$	1.55
810	High	1909.8	$\epsilon_r$	52.2
			$\sigma$	1.59

Date: 27/11/2012

Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	24.0 °C	24.0 °C	$\epsilon_r$	53.30	52.14	-2.17	5.00
				$\sigma$	1.52	1.58	3.73	5.00
				1g SAR	40.70	40.40	-0.74	5.00
				10g SAR	21.60	21.44	-0.74	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
512	Low	1850.2	$\epsilon_r$	52.4
			$\sigma$	1.51
661	Middle	1880.0	$\epsilon_r$	52.2
			$\sigma$	1.55
810	High	1909.8	$\epsilon_r$	52.2
			$\sigma$	1.59

**System Check 2450 Head**

Date: 28/11/2012

Validation Dipole and Serial Number: D2450V2; SN: 725

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	2450	24.0 °C	22.4 °C	$\epsilon_r$	39.20	38.36	-2.15	5.00
				$\sigma$	1.80	1.87	4.12	5.00
				1g SAR	52.90	52.00	-1.70	5.00
				10g SAR	24.70	24.12	-2.35	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412	$\epsilon_r$	38.5
			$\sigma$	1.83
6	Middle	2437	$\epsilon_r$	38.4
			$\sigma$	1.86
11	High	2463	$\epsilon_r$	38.3
			$\sigma$	1.89

**System Check 2450 Body**

Date: 27/11/2012

Validation Dipole and Serial Number: D2450V2; SN: 725

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	24.0 °C	24.0 °C	$\epsilon_r$	52.70	50.55	-4.08	5.00
				$\sigma$	1.95	2.01	2.99	5.00
				1g SAR	51.90	50.00	-3.66	5.00
				10g SAR	24.10	23.12	-4.07	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412	$\epsilon_r$	40.80
			$\sigma$	1.80
6	Middle	2437	$\epsilon_r$	40.70
			$\sigma$	183.00
11	High	2463	$\epsilon_r$	40.70
			$\sigma$	1.86

Date: 28/11/2012

Validation Dipole and Serial Number: D2450V2; SN: 725

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	24.0 °C	24.0 °C	$\epsilon_r$	52.70	50.55	-4.08	5.00
				$\sigma$	1.95	2.01	2.99	5.00
				1g SAR	51.90	52.40	0.96	5.00
				10g SAR	24.10	24.40	1.24	5.00

**Dielectrics for Frequencies Tested**

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412	$\epsilon_r$	40.80
			$\sigma$	1.80
6	Middle	2437	$\epsilon_r$	40.70
			$\sigma$	183.00
11	High	2463	$\epsilon_r$	40.70
			$\sigma$	1.86

## Appendix 6. Simulated Tissues

The body mixture consists of water, Polysorbate 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 coPower Back offised 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 mulitplexer, 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:431
<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 nit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.

<b>DASY4 SAR System Specifications (Continued)</b>	
<b>E-Field Probe</b>	
<b>Model:</b>	ET3DV6
<b>Serial No:</b>	1587
<b>Construction:</b>	Triangular core
<b>Frequency:</b>	10 MHz to 2.55GHz
<b>Linearity:</b>	±0.2 dB (30 MHz to 2.55GHz)
<b>Probe Length (mm):</b>	337
<b>Probe Diameter (mm):</b>	10
<b>Tip Length (mm):</b>	10
<b>Tip Diameter (mm):</b>	6.8
<b>Sensor X Offset (mm):</b>	2.7
<b>Sensor Y Offset (mm):</b>	2.7
<b>Sensor Z Offset (mm):</b>	2.7
<b>Phantom</b>	
<b>Phantom:</b>	SAM Phantom
<b>Shell Material:</b>	Fibreglass
<b>Thickness:</b>	2.0 ±0.1 mm