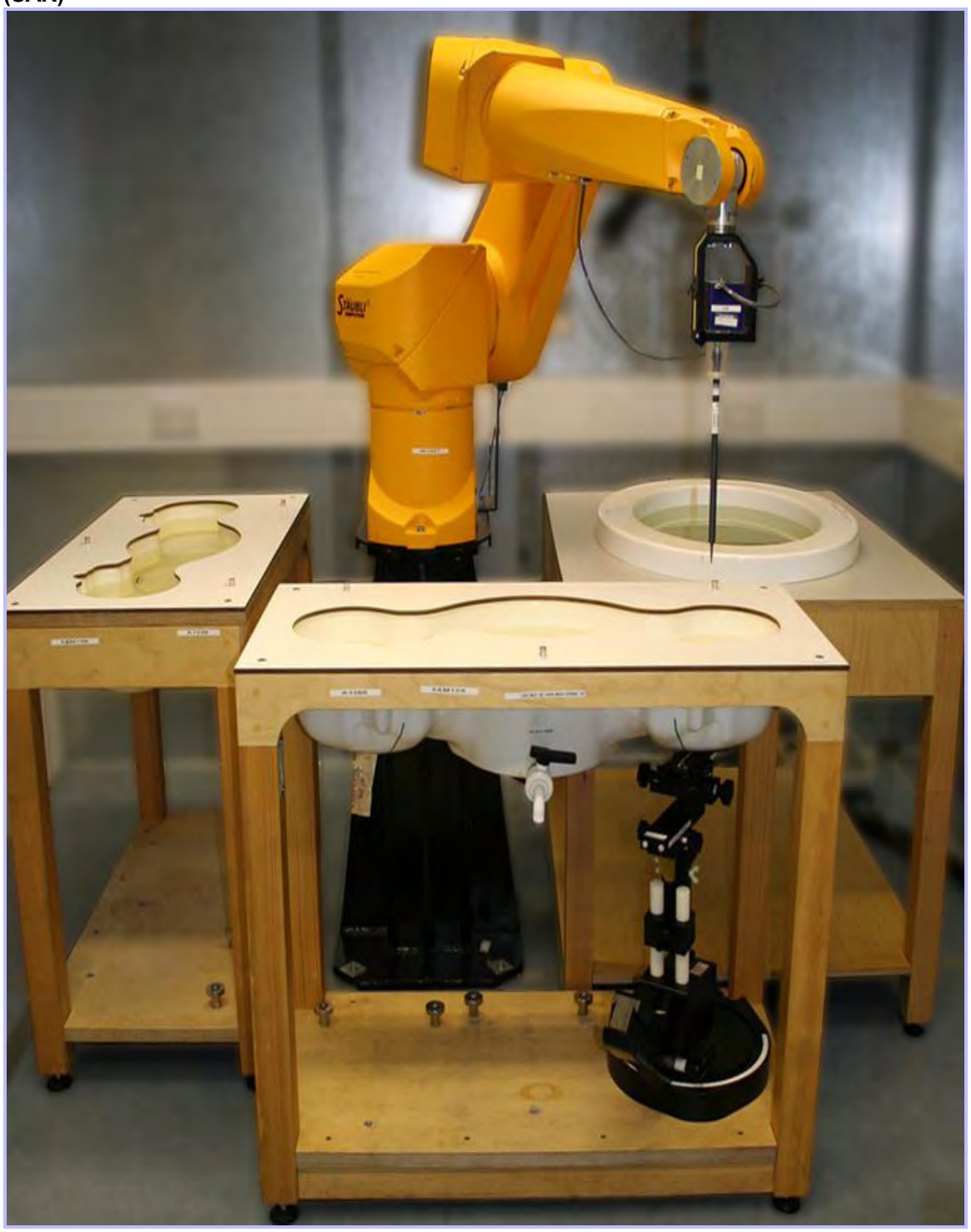
Appendix 4. Photographs

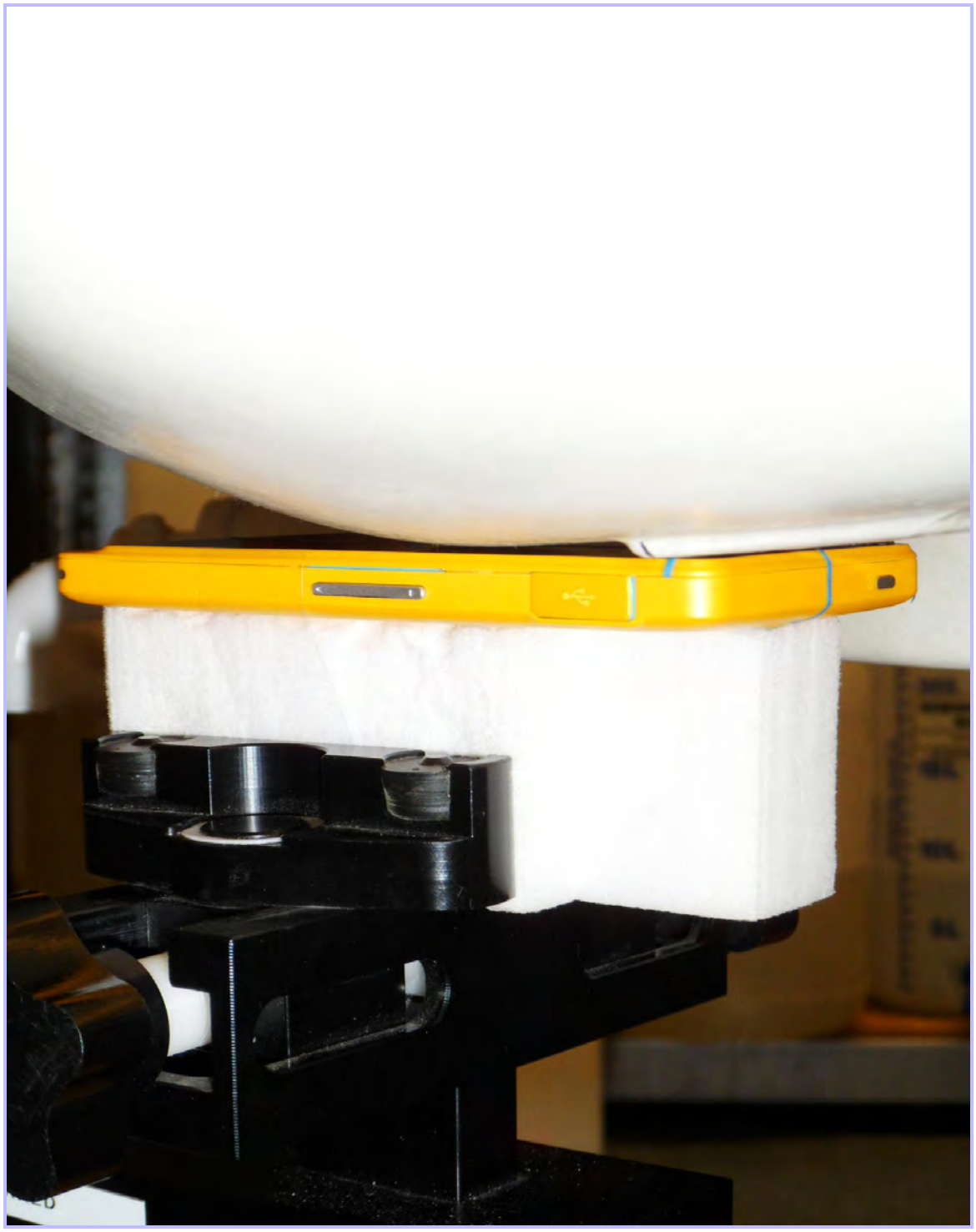
This appendix contains the following photographs:

Photo Reference Number	Title
PHT/87693JD01/001	Test configuration for the measurement of Specific Absorption Rate (SAR)
PHT/87693JD01/002	Touch Left
PHT/87693JD01/003	Tilt Left
PHT/87693JD01/004	Touch Right
PHT/87693JD01/005	Tilt Right
PHT/87693JD01/006	Front of EUT Facing Phantom at 10mm separation
PHT/87693JD01/007	Front of EUT Facing Phantom at 15mm separation
PHT/87693JD01/008	Back of EUT Facing Phantom at 10mm separation
PHT/87693JD01/009	Back of EUT Facing Phantom at 15mm separation
PHT/87693JD01/010	Left Hand Side of EUT Facing Phantom
PHT/87693JD01/011	Right Hand Side of EUT Facing Phantom
PHT/87693JD01/012	Top of EUT Facing Phantom
PHT/87693JD01/013	Bottom of EUT Facing Phantom
PHT/87693JD01/014	General Set up of EUT with PHF
PHT/87693JD01/015	Front View of EUT
PHT/87693JD01/016	Back View of EUT
PHT/87693JD01/017	Left Hand Side View of EUT
PHT/87693JD01/018	Right Hand Side View of EUT
PHT/87693JD01/019	Top View of EUT
PHT/87693JD01/020	Bottom View of EUT
PHT/87693JD01/021	Internal View of WWAN Head Sample
PHT/87693JD01/022	Internal View of WWAN Body Sample
PHT/87693JD01/023	Internal View of WWAN Back Cover
PHT/87693JD01/024	Internal View of WLAN Head Sample
PHT/87693JD01/025	Internal View of WLAN Body Sample
PHT/87693JD01/026	Internal View of WLAN Back Cover
PHT/87693JD01/027	900 MHz Head Fluid Level
PHT/87693JD01/028	900 MHz Body Fluid Level
PHT/87693JD01/029	1900 MHz Head Fluid Level
PHT/87693JD01/030	1900 MHz Body Fluid Level
PHT/87693JD01/031	2450 MHz Head Fluid Level
PHT/87693JD01/032	2450 MHz Body Fluid Level

PHT/87693JD01/001: Test configuration for the measurement of Specific Absorption Rate (SAR)



PHT/87693JD01/002: Touch Left



PHT/87693JD01/003: Tilt Left

PHT/87693JD01/004: Touch Right

PHT/87693JD01/005: Tilt Right

PHT/87693JD01/006: Front of EUT Facing Phantom at 10mm separation

PHT/87693JD01/007: Front of EUT Facing Phantom at 15mm separation

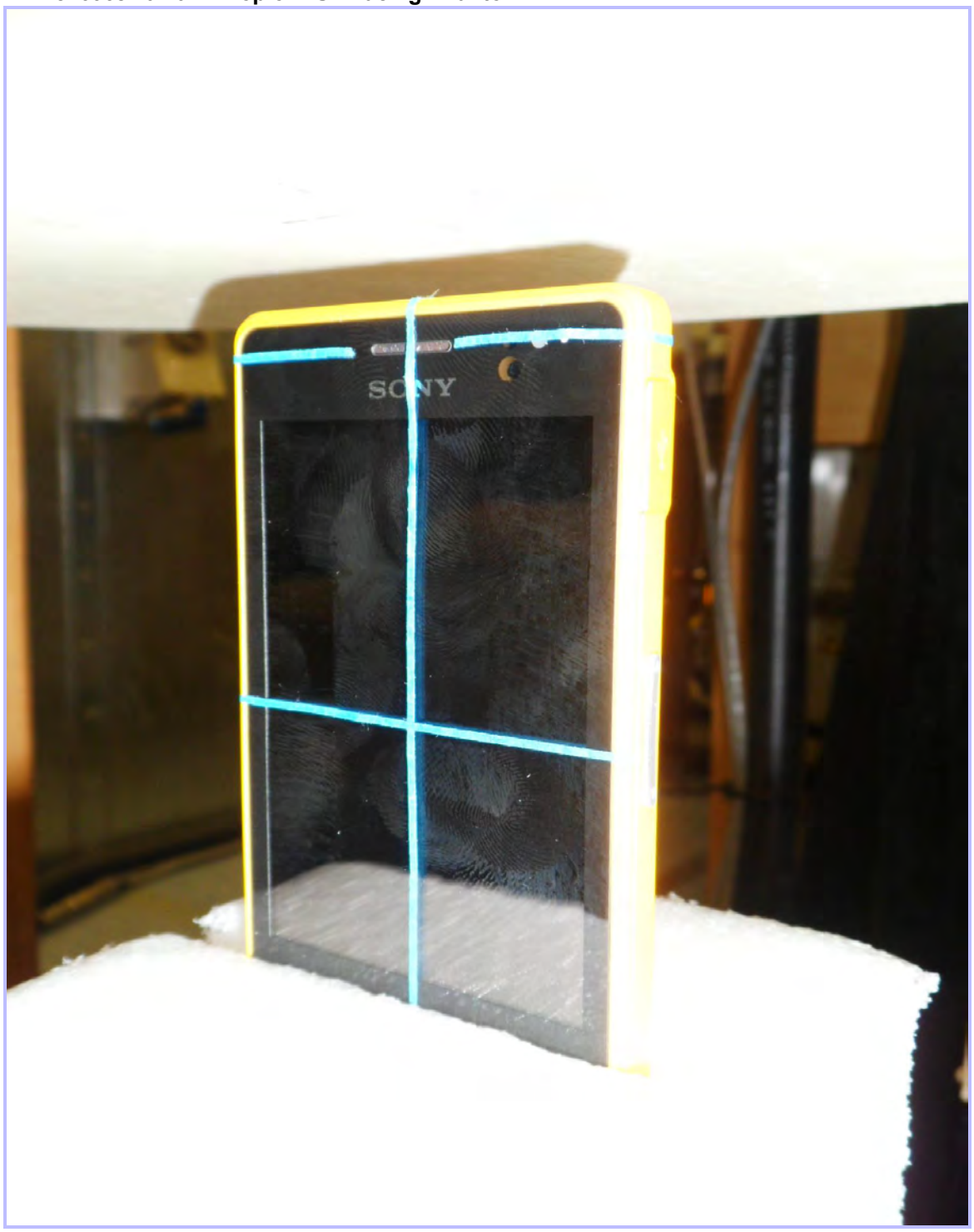
PHT/87693JD01/008: Back of EUT Facing Phantom at 10mm separation

PHT/87693JD01/009: Back of EUT Facing Phantom at 15mm separation

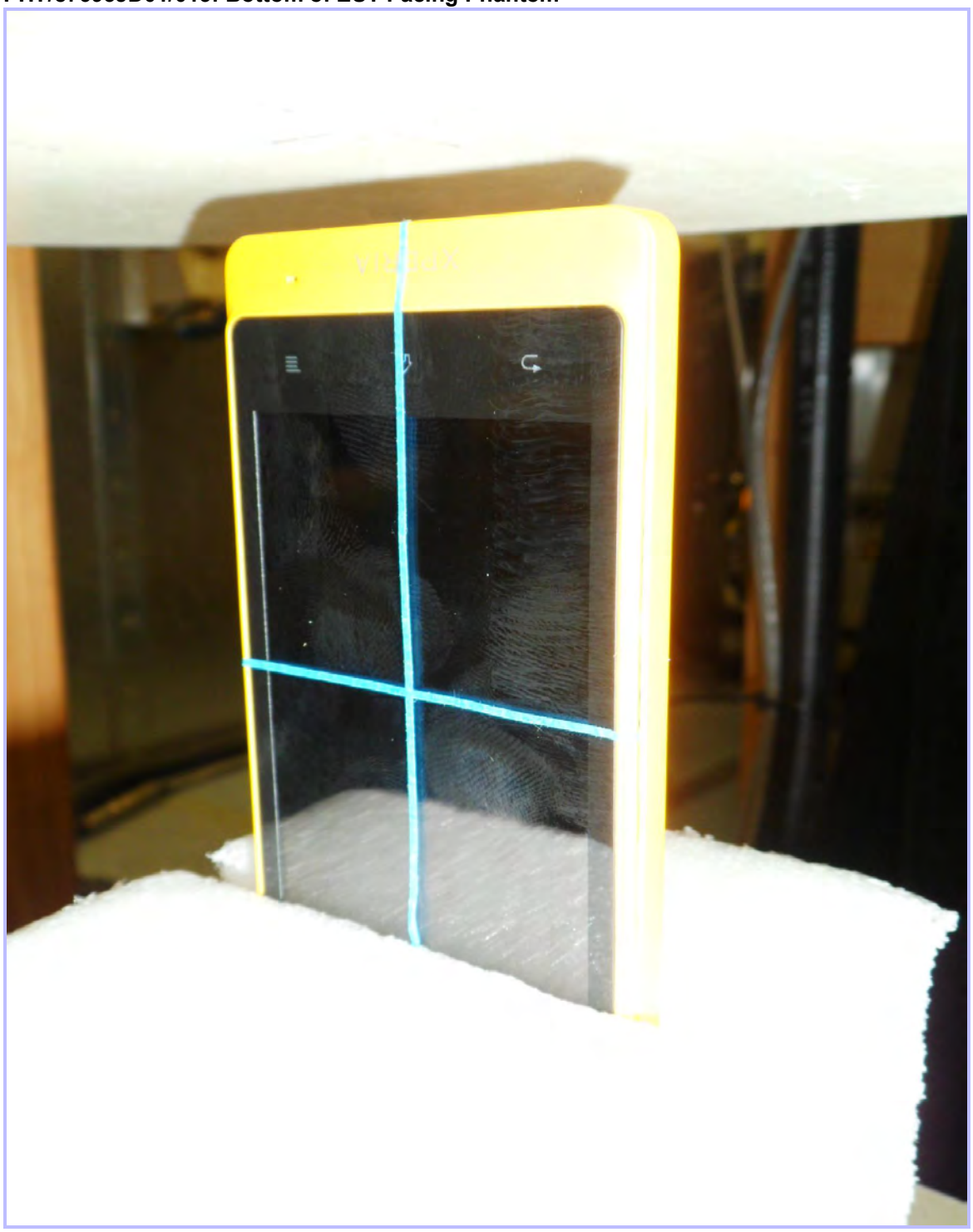
PHT/87693JD01/010: Left Hand Side of EUT Facing Phantom

PHT/87693JD01/011: Right Hand Side of EUT Facing Phantom

PHT/87693JD01/012: Top of EUT Facing Phantom



PHT/87693JD01/013: Bottom of EUT Facing Phantom



PHT/87693JD01/014: General Set up of EUT with PHF

PHT/87693JD01/015: Front View of EUT

PHT/87693JD01/016: Back View of EUT

PHT/87693JD01/017: Left Hand Side View of EUT

PHT/87693JD01/018: Right Hand Side View of EUT

PHT/87693JD01/019: Top View of EUT

PHT/87693JD01/020: Bottom View of EUT

PHT/87693JD01/021: Internal View of WWAN Head Sample

PHT/87693JD01/022: Internal View of WWAN Body Sample

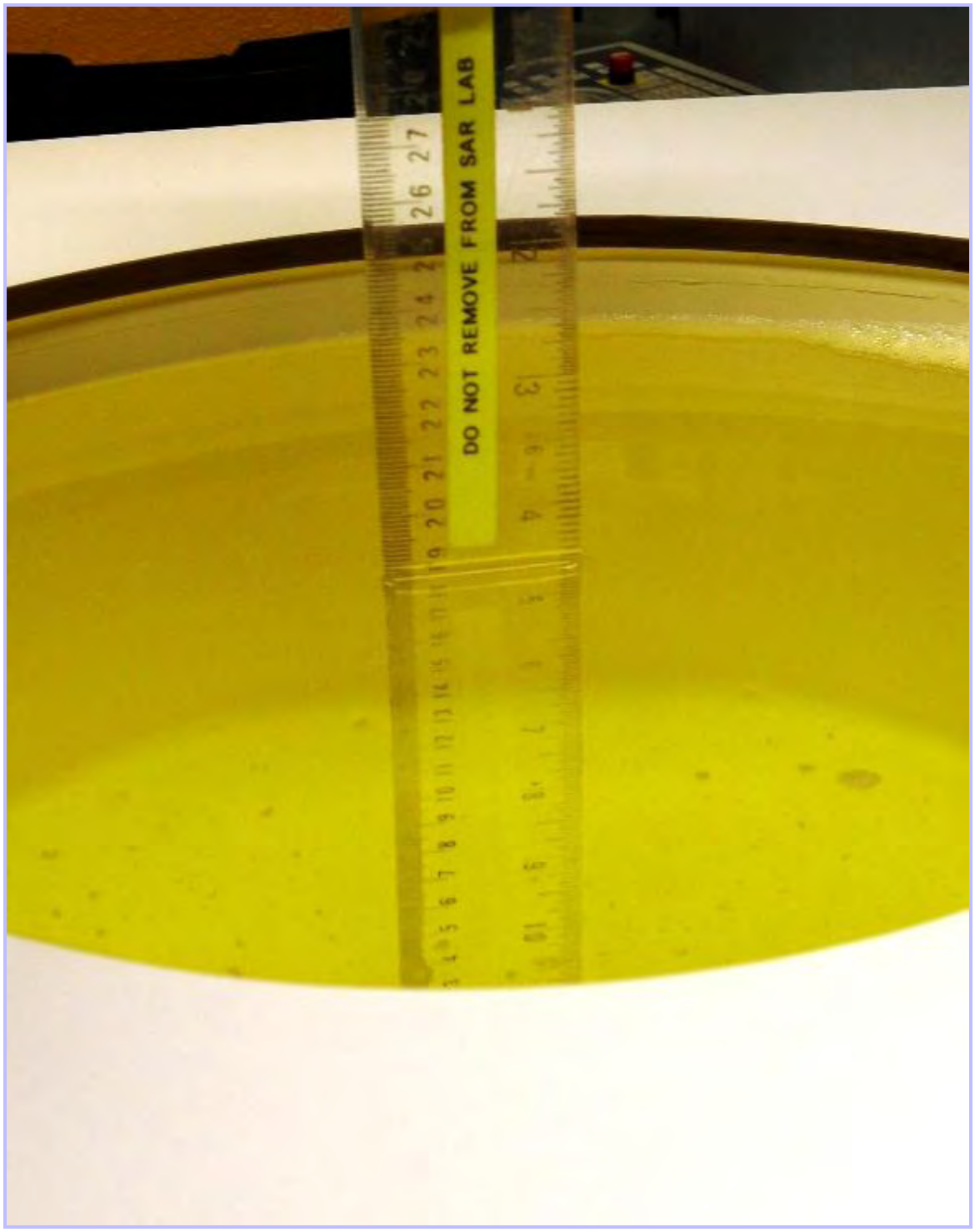
PHT/87693JD01/023: Internal View of WWAN Back Cover

PHT/87693JD01/024: Internal View of WLAN Head Sample

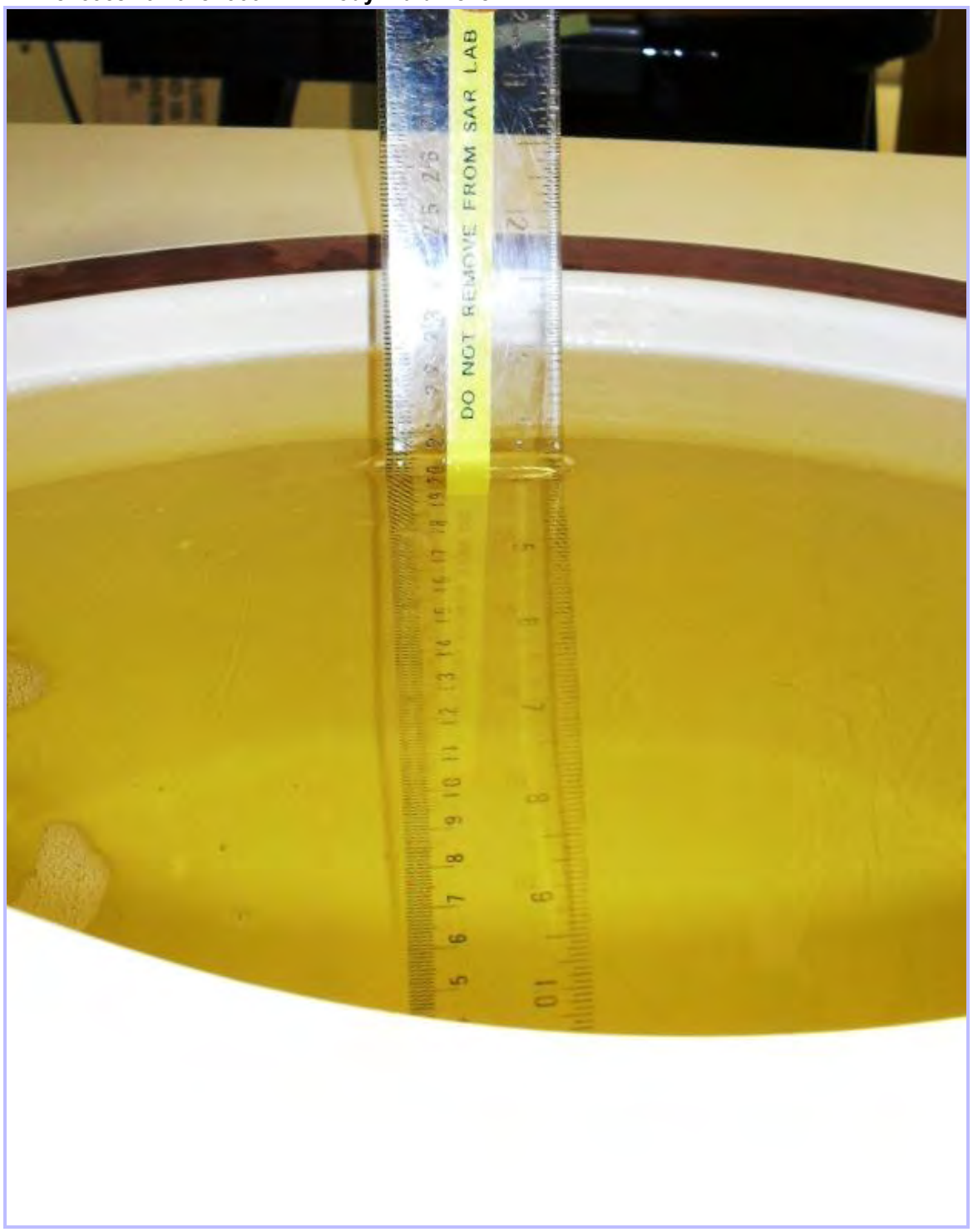
PHT/87693JD01/025: Internal View of WLAN Body Sample

PHT/87693JD01/026: Internal View of WLAN Back Cover

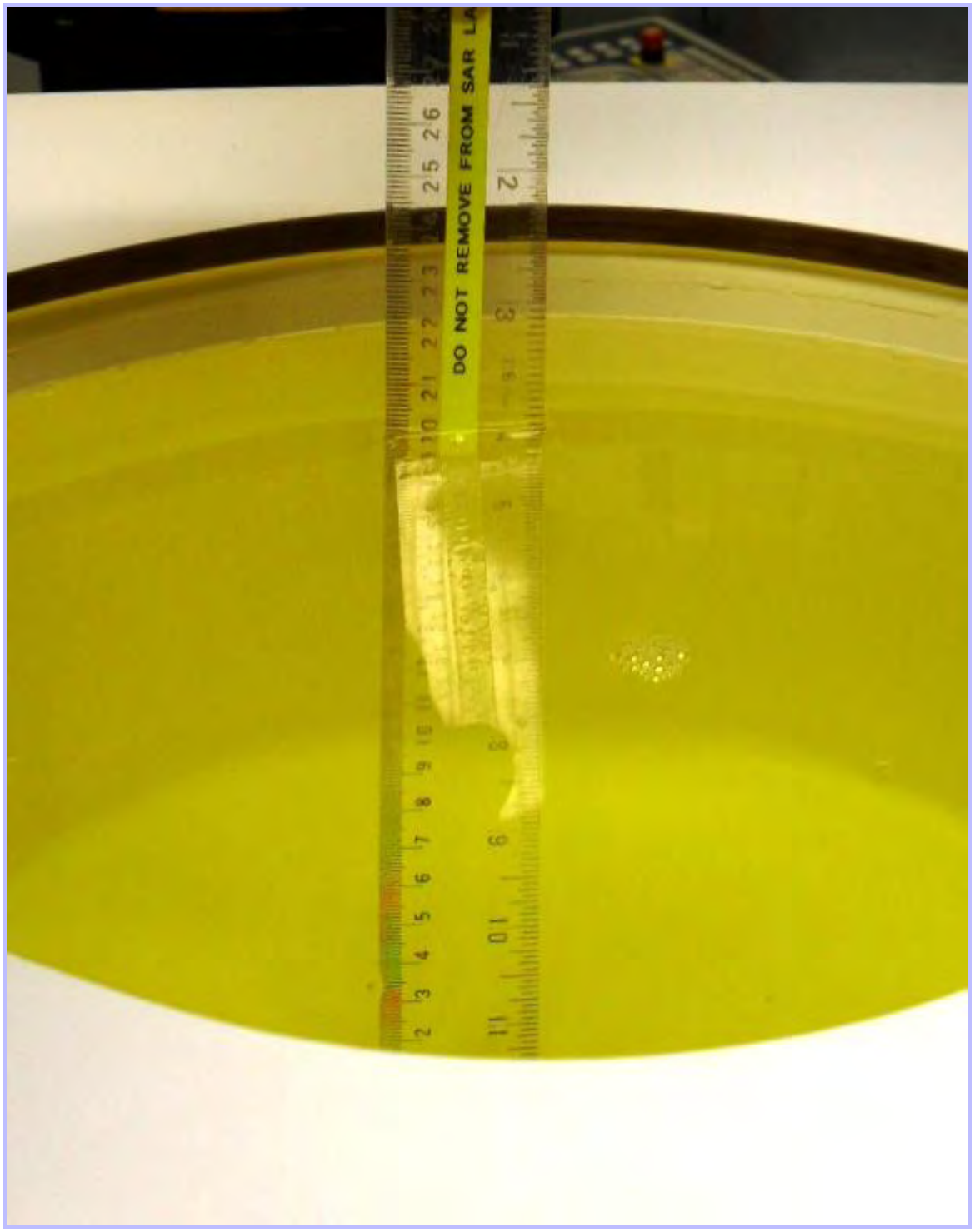
PHT/87693JD01/027: 900 MHz Head Fluid Level



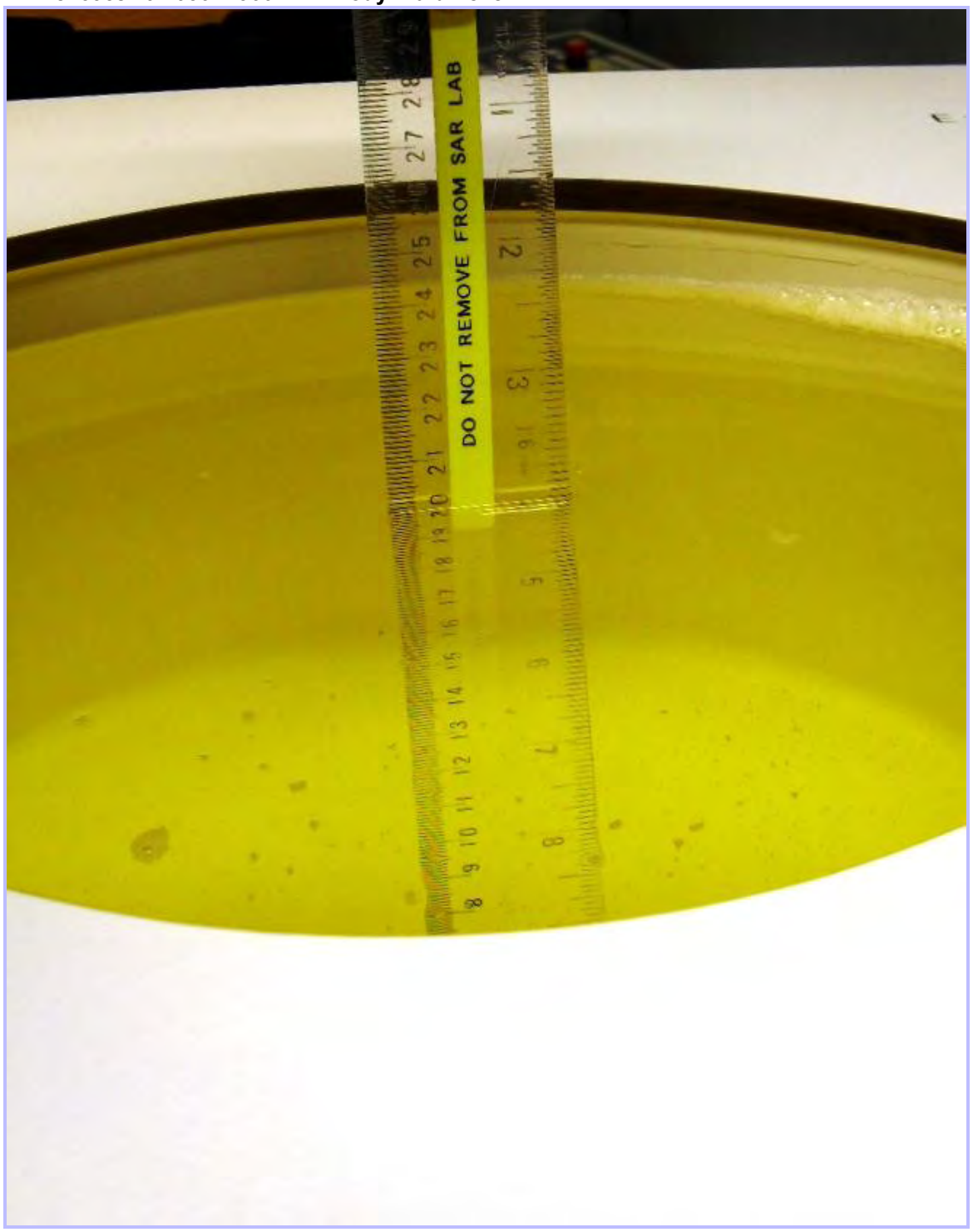
PHT/87693JD01/028: 900 MHz Body Fluid Level



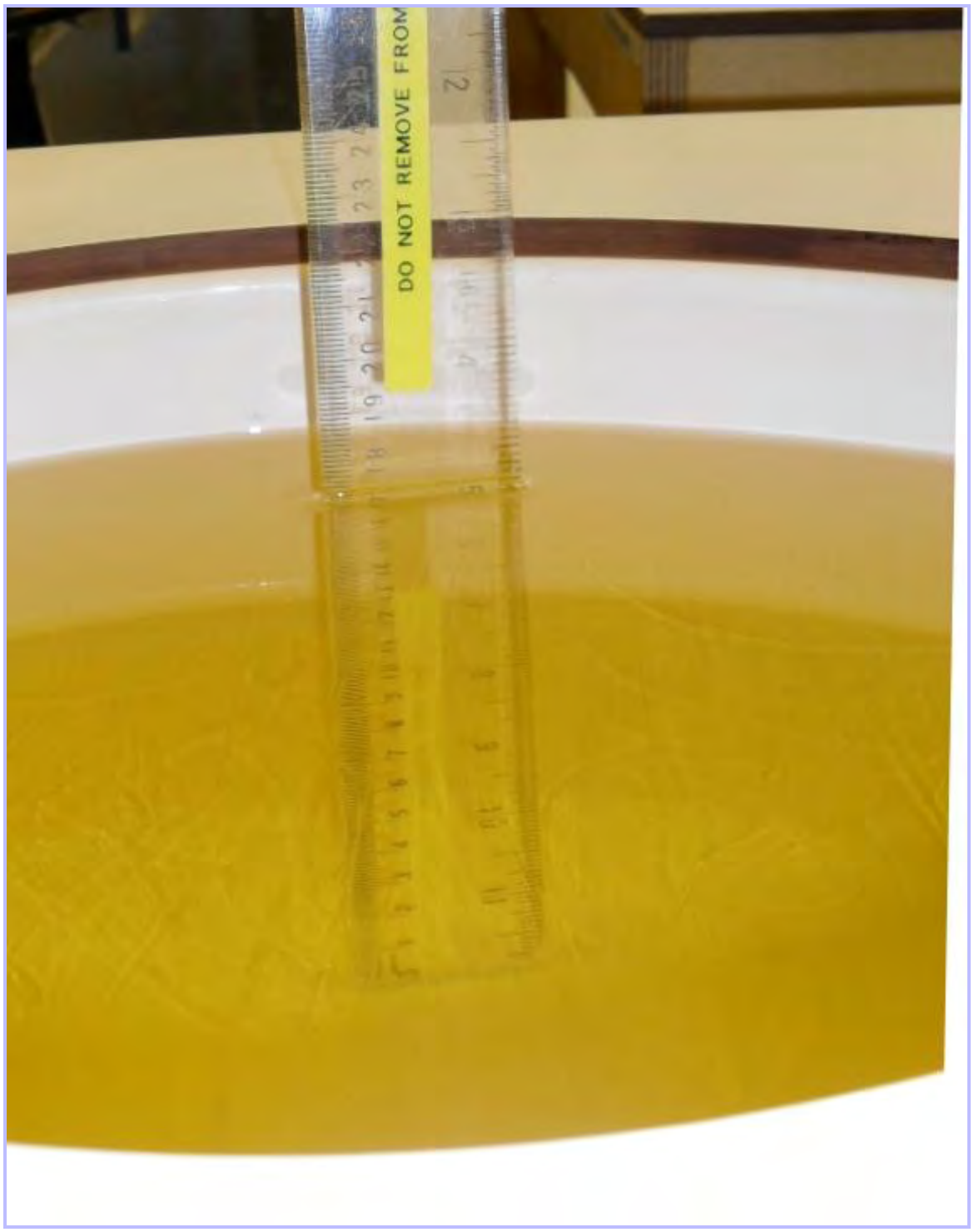
PHT/87693JD01/029: 1900 MHz Head Fluid Level



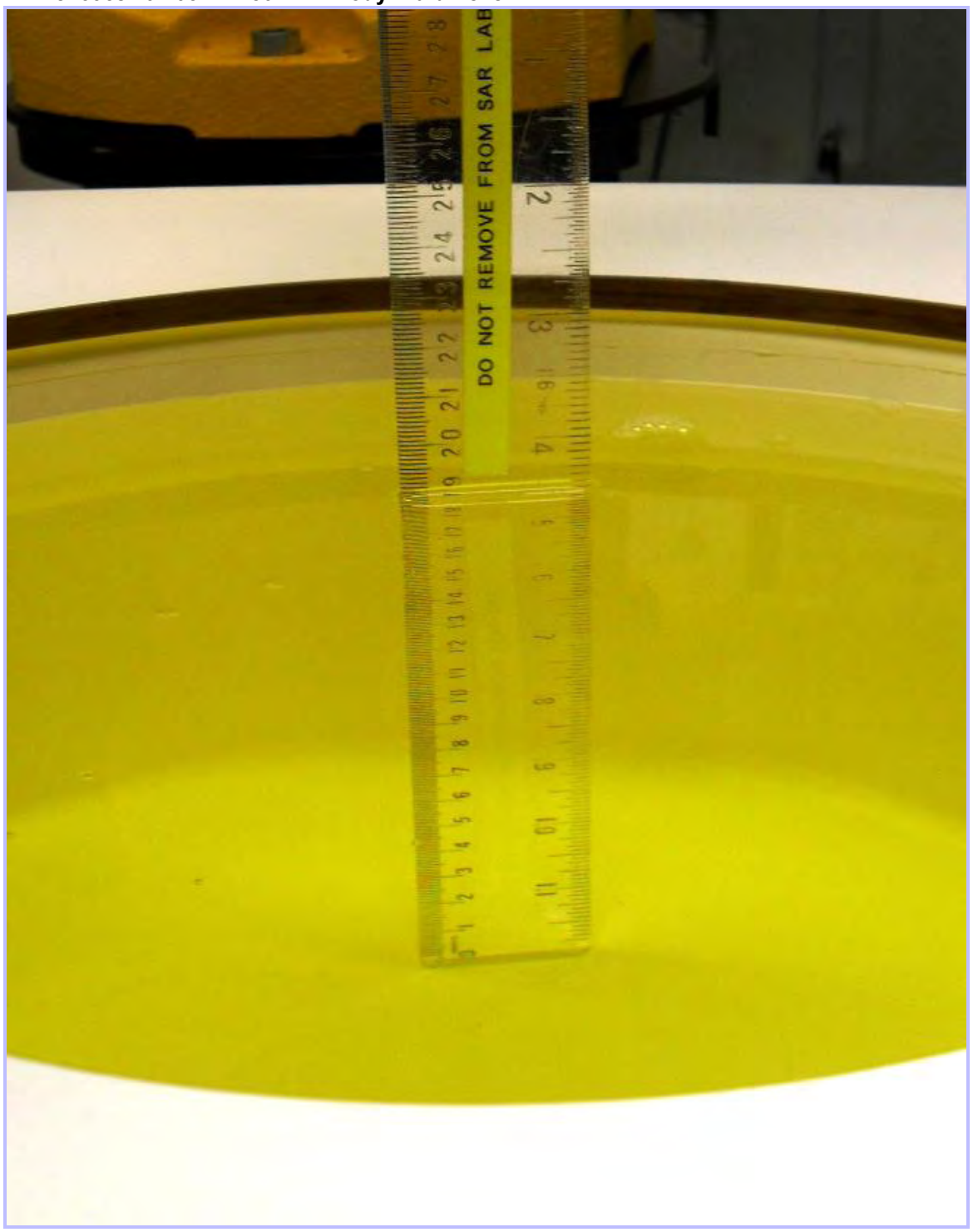
PHT/87693JD01/030: 1900 MHz Body Fluid Level



PHT/87693JD01/031: 2450 MHz Head Fluid Level



PHT/87693JD01/032: 2450 MHz Body Fluid Level



Appendix 5. System 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 ±5% for the 900 MHz, 1900 MHz and 2450 MHz dipoles.

The applicable verification normalised to 1 Watt.

System Check 850/900 Head

Date: 26/05/2012
Validation Dipole and Serial Number: D900V2; SN: 124

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	24.0 ºC	22.8 ºC	ε_r	41.50	42.50	2.42	5.00
				σ	0.97	0.94	-2.83	5.00
				1g SAR	11.00	10.72	-2.55	5.00
				10g SAR	7.01	6.96	-0.71	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	ε_r	42.90
			σ	0.89
190	Middle	836.6	ε_r	42.80
			σ	0.90
251	High	848.8	ε_r	42.80
			σ	0.91

Date: 28/05/2012
Validation Dipole and Serial Number: D900V2; SN: 124

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	24.0 ºC	24.0 ºC	ε_r	41.50	43.15	3.97	5.00
				σ	0.97	0.94	-3.19	5.00
				1g SAR	11.00	10.80	-1.82	5.00
				10g SAR	7.01	7.00	-0.14	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	ε_r	43.60
			σ	0.89
190	Middle	836.6	ε_r	43.50
			σ	0.90
251	High	848.8	ε_r	43.50
			σ	0.90

System Check (Continued) 850/900 Body

Date: 28/05/2012
Validation Dipole and Serial Number: D900V2; SN: 124

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	24.0 ºC	23.1 ºC	ε_r	55.00	55.11	0.20	5.00
				σ	1.05	1.03	-2.20	5.00
				1g SAR	11.10	10.68	-3.78	5.00
				10g SAR	7.14	6.92	-3.08	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	ε_r	55.40
			σ	0.98
190	Middle	836.6	ε_r	55.40
			σ	0.99
251	High	848.8	ε_r	55.30
			σ	1.00

Date: 29/05/2012
Validation Dipole and Serial Number: D900V2; SN: 124

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	24.0 ºC	23.1 ºC	ε_r	55.00	55.11	0.20	5.00
				σ	1.05	1.03	-2.20	5.00
				1g SAR	11.10	10.60	-4.50	5.00
				10g SAR	7.14	6.88	-3.64	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
128	Low	824.2	ε_r	55.40
			σ	0.98
190	Middle	836.6	ε_r	55.40
			σ	0.99
251	High	848.8	ε_r	55.30
			σ	1.00

System Check (Continued) 850/900 Body

Date: 30/05/2012
Validation Dipole and Serial Number: D900V2; SN: 124

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	900	24.0 ºC	22.5 ºC	ε_r	55.00	55.51	0.92	5.00
				σ	1.05	1.01	-3.60	5.00
				1g SAR	11.10	11.08	-0.18	5.00
				10g SAR	7.14	7.24	1.40	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
9262	Low	1852.4	ε_r	38.80
			σ	1.39
9400	Middle	1880.0	ε_r	38.70
			σ	1.42
9538	High	1907.6	ε_r	38.60
			σ	1.45

System Check (Continued) 1900 Head

Date: 28/05/2012
Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	23.0 ºC	21.6 ºC	ε_r	40.00	38.59	-3.52	5.00
				σ	1.40	1.45	3.23	5.00
				1g SAR	40.30	38.88	-3.52	5.00
				10g SAR	21.00	20.20	-3.81	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
512	Low	1850.2	ε_r	38.80
			σ	1.40
661	Middle	1880.0	ε_r	38.70
			σ	1.43
810	High	1909.8	ε_r	38.60
			σ	1.46

Date: 29/05/2012
Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	23.0 ºC	22.1 ºC	ε_r	40.00	38.65	-3.38	5.00
				σ	1.40	1.44	2.75	5.00
				1g SAR	40.30	42.00	4.22	5.00
				10g SAR	21.00	22.00	4.76	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
9262	Low	1852.4	ε_r	38.80
			σ	1.39
9400	Middle	1880.0	ε_r	38.70
			σ	1.42
9538	High	1907.6	ε_r	38.60
			σ	1.45

System Check (Continued) 1900 Body

Date: 30/05/2012
Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	23.0 ºC	22.7 ºC	ε_r	53.3	52.83	-0.88	5.00
				σ	1.52	1.54	1.21	5.00
				1g SAR	40.70	40.40	-0.74	5.00
				10g SAR	21.60	21.68	0.37	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
512	Low	1850.2	ε_r	53.00
			σ	1.49
661	Middle	1880.0	ε_r	52.90
			σ	1.52
810	High	1909.8	ε_r	52.80
			σ	1.55

Date: 31/05/2012
Validation Dipole and Serial Number: D1900V2; SN: 540

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1900	23.0 ºC	22.7 ºC	ε_r	53.3	52.53	-0.88	5.00
				σ	1.52	1.54	1.21	5.00
				1g SAR	40.70	41.60	2.21	5.00
				10g SAR	21.60	22.40	3.70	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
9262	Low	1852.4	ε_r	52.90
			σ	1.49
9400	Middle	1880.0	ε_r	52.90
			σ	1.52
9538	High	1907.6	ε_r	52.80
			σ	1.55

System Check (Continued) 2450 Head

Date: 01/06/2012
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 ºC	22.3 ºC	ε_r	39.20	38.33	-2.22	5.00
				σ	1.80	1.83	1.74	5.00
				1g SAR	52.90	52.00	-1.70	5.00
				10g SAR	24.70	23.88	-3.32	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412.0	ε_r	38.50
			σ	1.79
6	Middle	2437.0	ε_r	38.40
			σ	1.82
11	High	2462.0	ε_r	38.30
			σ	1.85

Date: 02/06/2012
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 ºC	22.3 ºC	ε_r	39.20	38.33	-2.22	5.00
				σ	1.80	1.83	1.74	5.00
				1g SAR	52.90	54.00	2.08	5.00
				10g SAR	24.70	24.96	1.05	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412.0	ε_r	38.50
			σ	1.79
6	Middle	2437.0	ε_r	38.40
			σ	1.82
11	High	2462.0	ε_r	38.30
			σ	1.85

System Check (Continued) 2450 Body

Date: 01/06/2012
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 ºC	23.0 ºC	ε_r	52.70	50.68	-3.83	5.00
				σ	1.95	2.02	3.73	5.00
				1g SAR	51.90	53.60	3.28	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	2412.0	ε_r	50.80
			σ	1.98
6	Middle	2437.0	ε_r	50.70
			σ	2.01
11	High	2462.0	ε_r	50.70
			σ	2.04

Date: 02/06/2012
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 ºC	23.0 ºC	ε_r	52.70	51.06	-3.12	5.00
				σ	1.95	2.02	3.54	5.00
				1g SAR	51.90	52.40	0.96	5.00
				10g SAR	24.10	24.00	-0.41	5.00

Dielectrics for Frequencies Tested

Channel Number	Channel Description	Frequency (MHz)	Parameters	
1	Low	2412.0	ε_r	51.30
			σ	1.98
6	Middle	2437.0	ε_r	51.10
			σ	2.01
11	High	2462.0	ε_r	51.00
			σ	2.04

Appendix 6. Simulated Tissues

The body mixture consists of 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 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

Robot System	
Positioner:	Stäubli Unimation Corp. Robot Model: RX90L
Repeatability:	0.025 mm
No. of Axis:	6
Serial Number:	F00/SD89A1/A/01
Reach:	1185 mm
Payload:	3.5 kg
Control Unit:	CS7
Programming Language:	V+
Data Acquisition Electronic (DAE) System	
Serial Number:	DAE3 SN:394
Serial Number:	DAE3 SN:432
PC Controller	
PC:	Dell Precision 340
Operating System:	Windows 2000
Data Card:	DASY4 Measurement Server
Serial Number:	1080
Data Converter	
Features:	Signal Amplifier, multiplexer, A/D converted and control logic.
Software:	DASY4 Software
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 DAE3 16 nit 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	
Model:	EX3DV4
Serial No:	3814
Construction:	Triangular core
Frequency:	10 MHz to >6 GHz
Linearity:	±0.2 dB (30 MHz to 6 GHz)
Probe Length (mm):	330
Probe Diameter (mm):	12
Tip Length (mm):	20
Tip Diameter (mm):	2.5
Sensor X Offset (mm):	1
Sensor Y Offset (mm):	1
Sensor Z Offset (mm):	1
E-Field Probe	
Model:	ET3DV6
Serial No:	1587
Construction:	Triangular core
Frequency:	735 MHz to 2.55GHz
Linearity:	±0.2 dB (735 MHz to 2.55GHz)
Probe Length (mm):	337
Probe Diameter (mm):	10
Tip Length (mm):	10
Tip Diameter (mm):	6.8
Sensor X Offset (mm):	2.7
Sensor Y Offset (mm):	2.7
Sensor Z Offset (mm):	2.7
Phantom	
Phantom:	SAM Phantom
Shell Material:	Fibreglass
Thickness:	2.0 ±0.1 mm