

# DASY4 Validation Report for Head TSL

Date/Time: 17.01.2007 12:35:59

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN725**

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U10 BB;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.79$  mho/m;  $\epsilon_r = 38$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025 (HF); ConvF(4.5, 4.5, 4.5); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn907; Calibrated: 20.07.2006
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Pin = 250 mW; d = 10 mm 2/Zoom Scan (7x7x7)/Cube 0:**

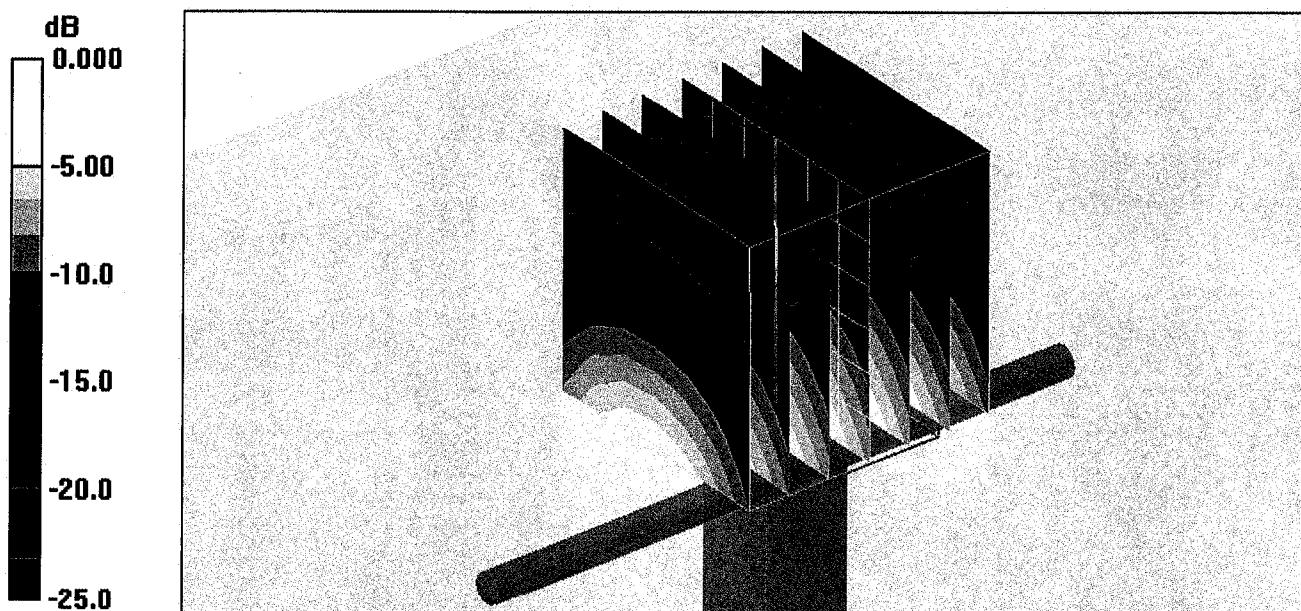
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.0 V/m; Power Drift = 0.021 dB

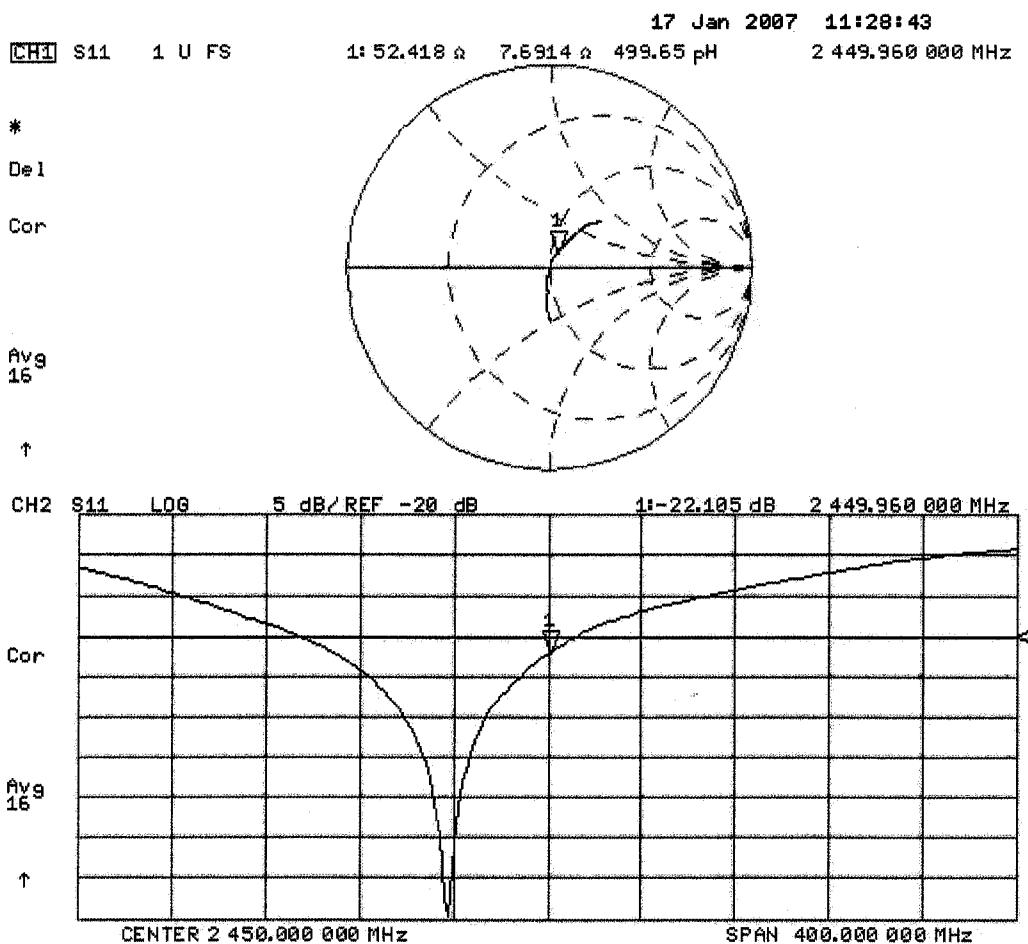
Peak SAR (extrapolated) = 28.9 W/kg

**SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.26 mW/g**

Maximum value of SAR (measured) = 15.1 mW/g



## Impedance Measurement Plot for Head TSL



# DASY4 Validation Report for Body TSL

Date/Time: 17.01.2007 16:53:02

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN725**

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL U10 BB;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.97$  mho/m;  $\epsilon_r = 51.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025 (HF); ConvF(4.16, 4.16, 4.16); Calibrated: 19.10.2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn907; Calibrated: 20.07.2006
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:**

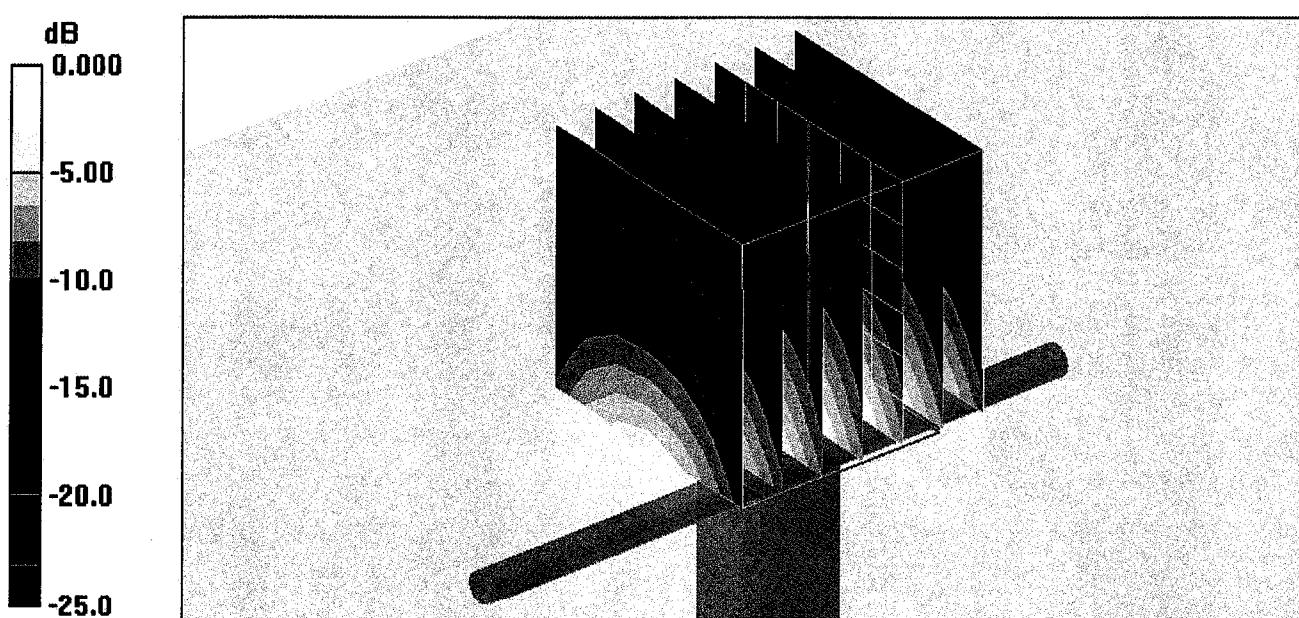
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.8 V/m; Power Drift = -0.004 dB

Peak SAR (extrapolated) = 30.8 W/kg

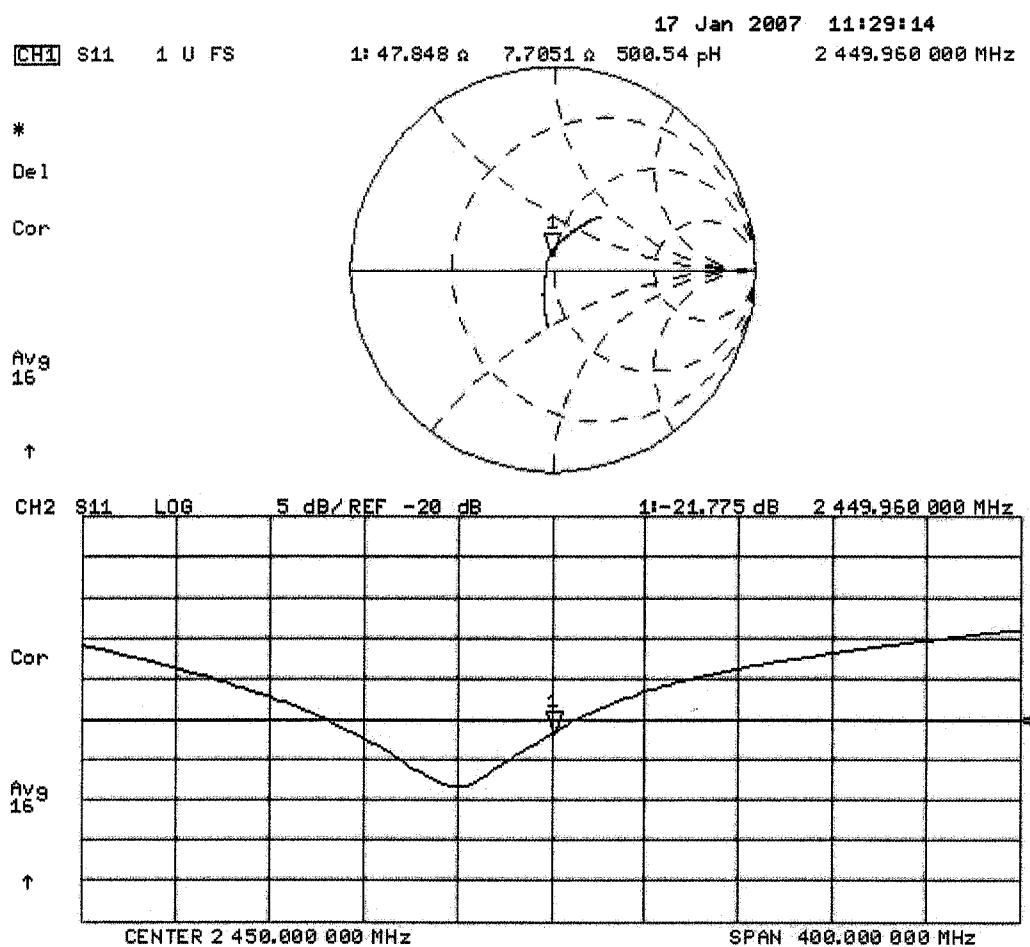
**SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.21 mW/g**

Maximum value of SAR (measured) = 15.1 mW/g



0 dB = 15.1mW/g

## Impedance Measurement Plot for Body TSL



**Test of: TAGSYS SAS  
WiFi Inventory Reader**

**To: OET Bulletin 65 Supplement C : 2001-01**

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## **Appendix 2. Measurement Methods**

### **A.2.1. Evaluation Procedure**

The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

- a) (i) The evaluation was performed in an applicable area of the phantom depending on the type of device being tested. For devices worn about the ear during normal operation, both the left and right ear positions were evaluated at the centre frequency of the band at maximum power. The side, which produced the greatest SAR, determined which side of the phantom would be used for the entire evaluation. The positioning of the head worn device relative to the phantom was dictated by the test specification identified in section 3.1 of this report.  
(ii) For body worn device or devices which can be operated within 20 cm of the body, the flat section of the phantom was used. The type of device being evaluated dictated the distance of the EUT to the outer surface of the phantom flat section.
- b) The SAR was determined by a pre-defined procedure within the DASY4 software. The exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm or appropriate resolution.
- c) A 7x7x7 matrix was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.
- d) If the EUT had any appreciable drift over the course of the evaluation, then the EUT was re-evaluated. Any unusual anomalies over the course of the test also warranted a re-evaluation.

**Test of: TAGSYS SAS  
WiFi Inventory Reader**

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#### **A.2.2. Specific Absorption Rate (SAR) Measurements to OET Bulletin 65 Supplement C: (2001-01)**

Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields

SAR measurements were performed in accordance with Appendix D of the standard FCC OET Bulletin 65 Supplement C: 2001, against appropriate limits for each measurement position in accordance with the standard.

The test was performed in a shielded enclosure with the temperature controlled to remain between +18.0°C and +25.0°C. The tissue equivalent material fluid temperature was controlled to give a maximum variation of  $\pm 2.0^{\circ}\text{C}$

Prior to any SAR measurements on the EUT, system validation and material dielectric property measurements were conducted. In the absence of a detailed procedure within the specification, system validation and material dielectric property measurements were performed in accordance with Appendix C and Appendix D of FCC OET Bulletin 65 Supplement C: 2001.

Following the successful system validation and material dielectric property measurements, a SAR versus time sweep shall be performed within 10 mm of the phantom inner surface. If the EUT power output is stable after three minutes then the measurement probe will perform a coarse surface level scan at each test position in order to ascertain the location of the maximum local SAR level. Once this area had been established, a 7x7x7 cube of 343 points (5 mm spacing in each axis  $\approx 27\text{g}$ ) will be centred at the area of concern. Extrapolation and interpolation will then be carried out on the 27g of tissue and the highest averaged SAR over a 10g cube determined.

Once the maximum interpolated SAR measurement is complete; the coarse scan is visually assessed to check for secondary peaks within 50% of the maximum SAR level. If there are any further SAR measurements required, extra 7x7x7 cubes shall be centred on each of these extra local SAR maxima.

At the end of each position test case a second time sweep shall be performed to check whether the EUT has remained stable throughout the test.

**Test of: TAGSYS SAS  
WiFi Inventory Reader**

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### **Appendix 3. SAR Distribution Scans**

This appendix contains SAR distribution scans which are not included in the total number of pages for this report.

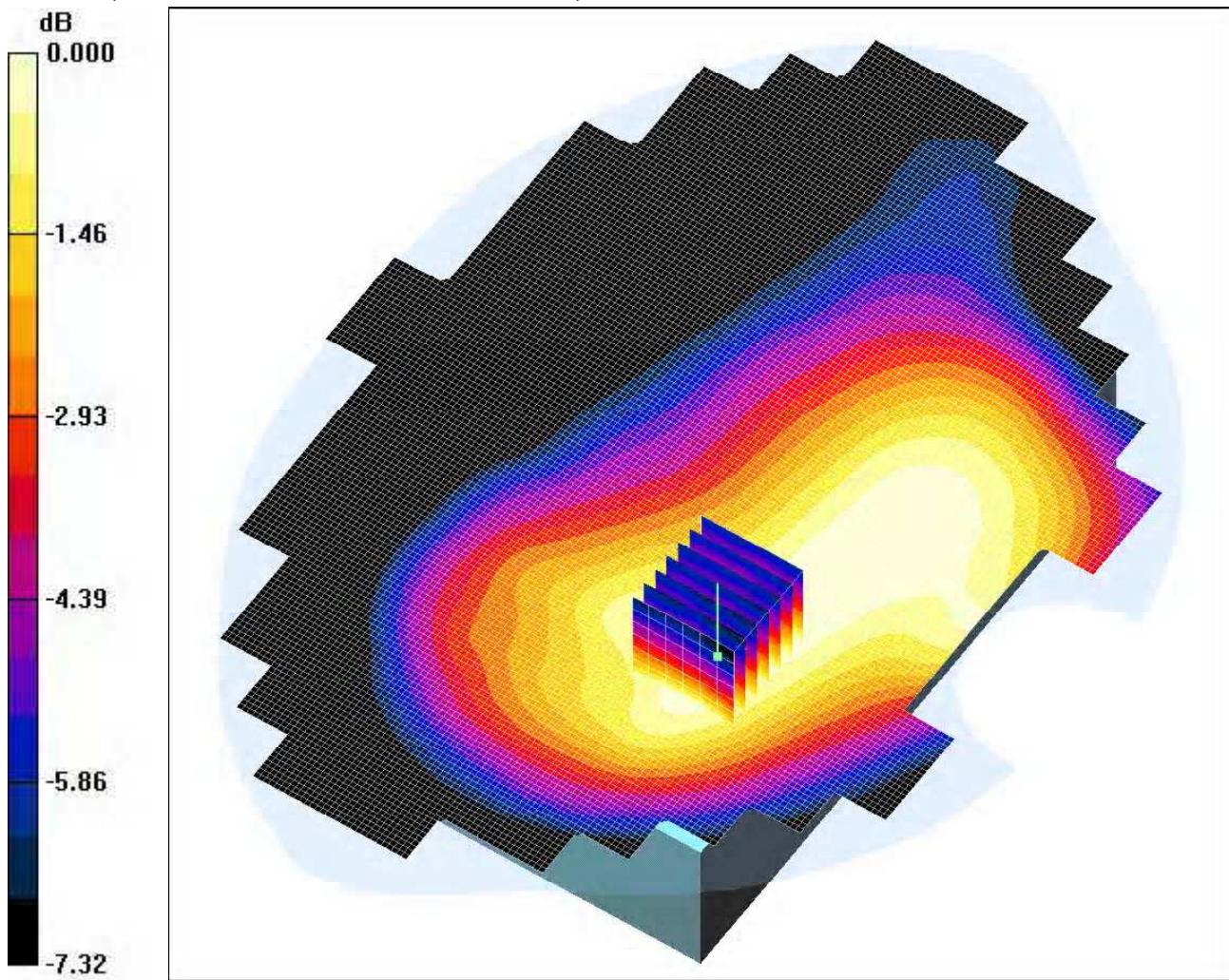
Scan Reference Number	Title
SCN/49232JD03A/001	Front Of EUT Facing Phantom With Wand antenna Attached WiFi CH7
SCN/49232JD03A/002	Rear Of EUT Facing Phantom With Wand antenna Attached WiFi CH7
SCN/49232JD03A/003	Rear Of EUT Facing Phantom With Wand antenna Attached and Belt Clip WiFi CH7
SCN/49232JD03A/004	System Performance Check D2450 Body 29 05 07

Test of: TAGSYS SAS  
WiFi Inventory Reader

To: OET Bulletin 65 Supplement C : 2001-01

001 Front Of EUT Facing Phantom with Wand antenna Attached WiFi CH7  
DUT: TAGSYS; Device ID -00000000-00409DFF-FF2C1028; Serial: E0715010B0

Date\_29\_05\_07



Communication System: WLAN; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: 2450 MHz MSL Medium parameters used (interpolated):  $f = 2442$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508add; ConvF(7.89, 7.89, 7.89); Calibrated: 16/11/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 14/06/2006
- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Front Of EUT Facing Phantom - Middle/Area Scan (131x201x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.063 mW/g

Front Of EUT Facing Phantom - Middle/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 4.06 V/m; Power Drift = -0.079 dB

Peak SAR (extrapolated) = 0.079 W/kg

**SAR(1 g) = 0.058 mW/g; SAR(10 g) = 0.044 mW/g**

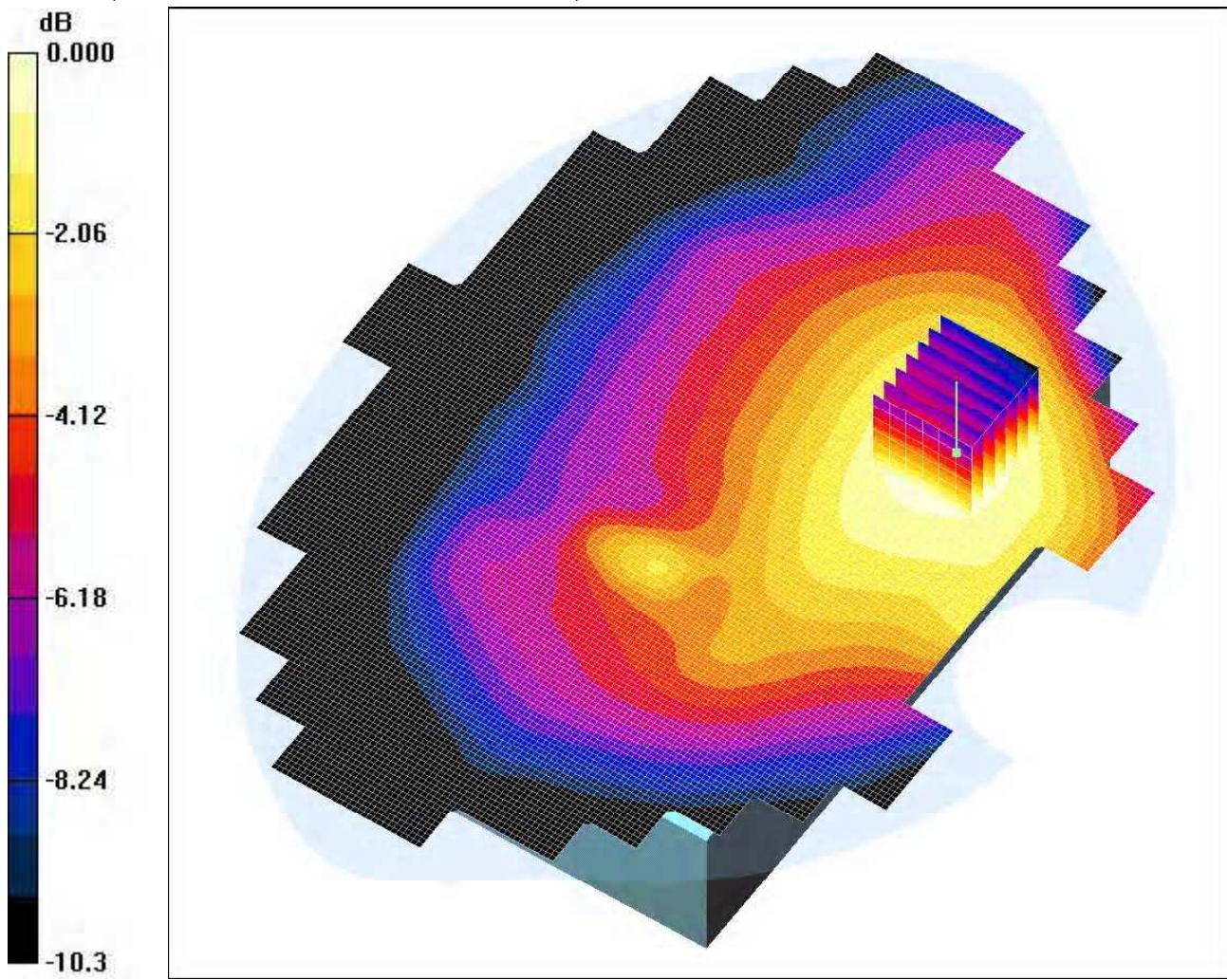
Maximum value of SAR (measured) = 0.061 mW/g

Test of: TAGSYS SAS  
WiFi Inventory Reader

To: OET Bulletin 65 Supplement C : 2001-01

002 Rear Of EUT Facing Phantom with Wand antenna Attached WiFi CH7  
DUT: TAGSYS; Device ID -00000000-00409DFF-FF2C1028; Serial: E0715010B0

Date\_29\_05\_07



Communication System: WLAN; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: 2450 MHz MSL Medium parameters used (interpolated):  $f = 2442$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508add; ConvF(7.89, 7.89, 7.89); Calibrated: 16/11/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 14/06/2006
- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Rear Of EUT Facing Phantom - Middle/Area Scan (131x201x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.071 mW/g

**Rear Of EUT Facing Phantom - Middle/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 3.99 V/m; Power Drift = 0.038 dB

Peak SAR (extrapolated) = 0.096 W/kg

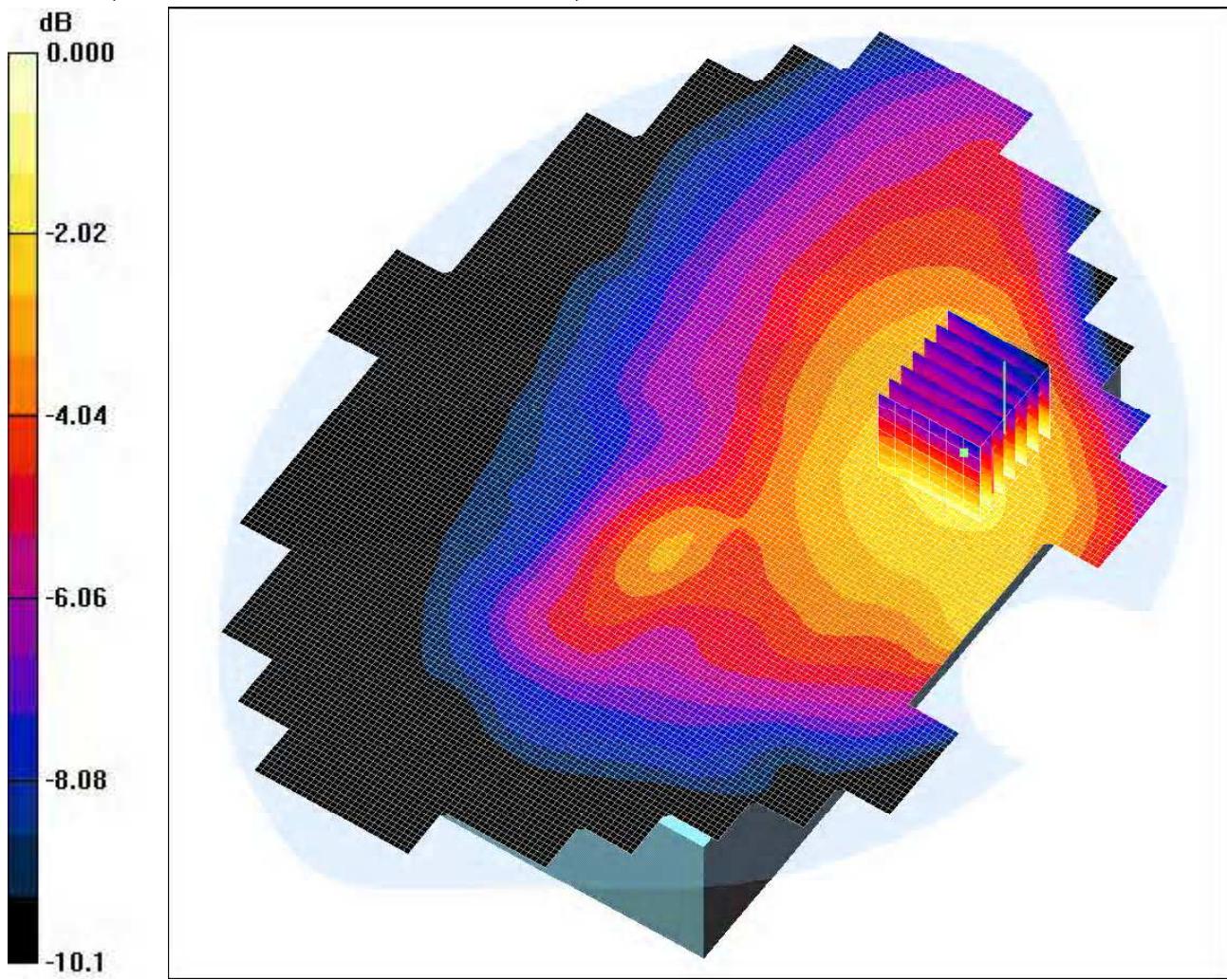
**SAR(1 g) = 0.073 mW/g; SAR(10 g) = 0.053 mW/g**

Maximum value of SAR (measured) = 0.076 mW/g

Test of: TAGSYS SAS  
WiFi Inventory Reader

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003 Rear Of EUT Facing Phantom with Wand antenna Attached and Belt Clip WiFi CH7 Date\_29\_05\_07  
DUT: TAGSYS; Device ID -00000000-00409DFF-FF2C1028; Serial: E0715010B0



Communication System: WLAN; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: 2450 MHz MSL Medium parameters used (interpolated):  $f = 2442$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508add; ConvF(7.89, 7.89, 7.89); Calibrated: 16/11/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 14/06/2006
- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Rear Of EUT Facing Phantom - Middle/Area Scan (131x201x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.029 mW/g

**Rear Of EUT Facing Phantom - Middle/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 2.64 V/m; Power Drift = -0.008 dB

Peak SAR (extrapolated) = 0.055 W/kg

**SAR(1 g) = 0.040 mW/g; SAR(10 g) = 0.029 mW/g**

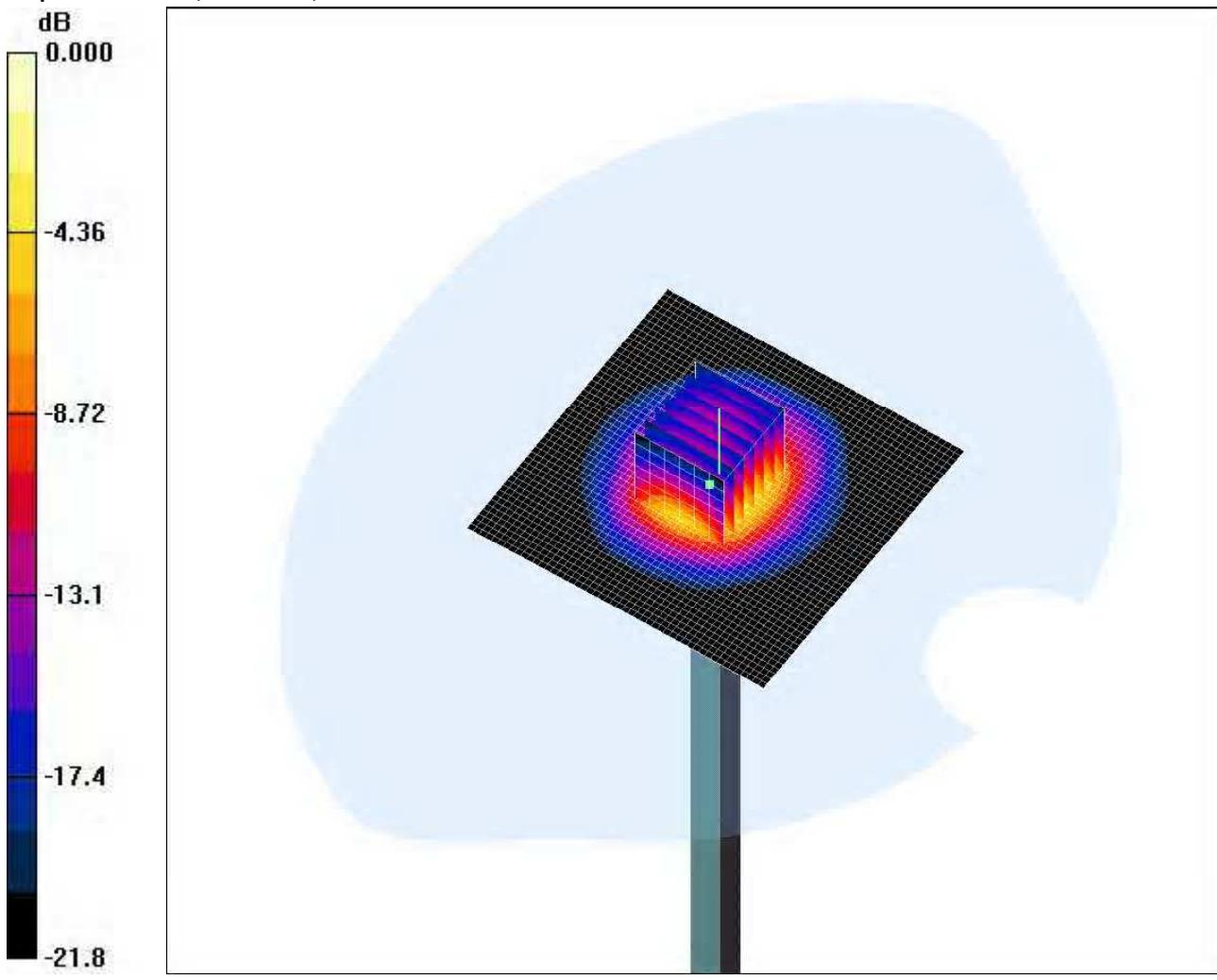
Maximum value of SAR (measured) = 0.043 mW/g

Test of: TAGSYS SAS  
WiFi Inventory Reader

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**System Performance Check\_29\_05\_07**

DUT: Dipole 2450 MHz; Device ID; Serial: D2450V2 - SN:725



Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 MHz MSL Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2$  mho/m;  $\epsilon_r = 52.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508add; ConvF(7.89, 7.89, 7.89); Calibrated: 16/11/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 14/06/2006
- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=10mm, Pin=250mW/Area Scan (51x51x1):** Measurement grid: dx=20mm, dy=20mm  
Maximum value of SAR (interpolated) = 19.5 mW/g

**d=10mm, Pin=250mW/Zoom Scan 7x7x7 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.7 V/m; Power Drift = 0.034 dB

Peak SAR (extrapolated) = 27.6 W/kg

**SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.3 mW/g**

Maximum value of SAR (measured) = 15.5 mW/g

**Test of: TAGSYS SAS  
WiFi Inventory Reader**

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## **Appendix 4. Photographs**

This appendix contains the following photographs:

Photo Reference Number	Title
PHT/49232JD03A/001	Test configuration for the measurement of Specific Absorption Rate (SAR)
PHT/49232JD03A/002	Front of EUT Facing Phantom with Inventory Antenna L-W2 Attached
PHT/49232JD03A/003	Rear of EUT Facing Phantom with Inventory Antenna L-W2 Attached
PHT/49232JD03A/004	Rear of EUT Facing Phantom with Inventory Antenna L-W2 And Belt Clip Attached
PHT/49232JD03A/005	General Set-up View
PHT/49232JD03A/006	Top View of EUT
PHT/49232JD03A/007	Rear View of EUT
PHT/49232JD03A/008	Internal View of EUT
PHT/49232JD03A/009	Top View of EUT Battery
PHT/49232JD03A/010	Rear View of EUT Battery
PHT/49232JD03A/011	Close-up View of EUT Details
PHT/49232JD03A/012	Belt Clip
PHT/49232JD03A/013	Top View of EUT Inventory Antenna L-W2
PHT/49232JD03A/014	Rear View of EUT Inventory Antenna L-W2
PHT/49232JD03A/015	Close-up View of EUT Inventory Antenna L-W2 Details
PHT/49232JD03A/016	RFID Test Tag
PHT/49232JD03A/017	2450MHz Fluid Level

Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/001: SAR Configuration

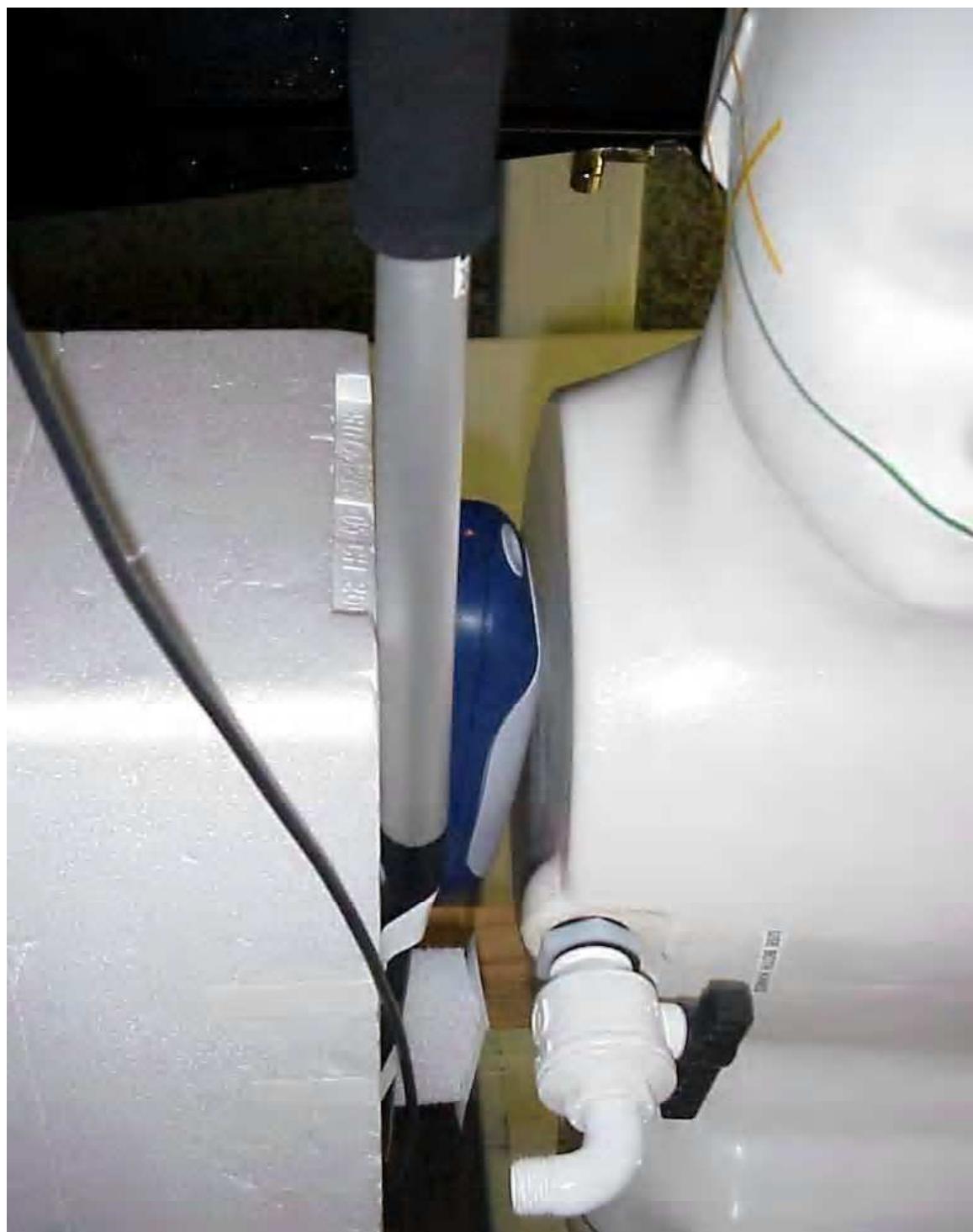


Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/002: Front of EUT Facing Phantom with Inventory Antenna L-W2 Attached



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/003: Rear of EUT Facing Phantom with Inventory Antenna L-W2 Attached



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/004: Rear of EUT Facing Phantom with Inventory Antenna L-W2 and Belt Clip Attached



Test of: TAGSYS SAS  
WiFi Inventory Reader

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**PHT/49232JD03A/005: General Set-up View**

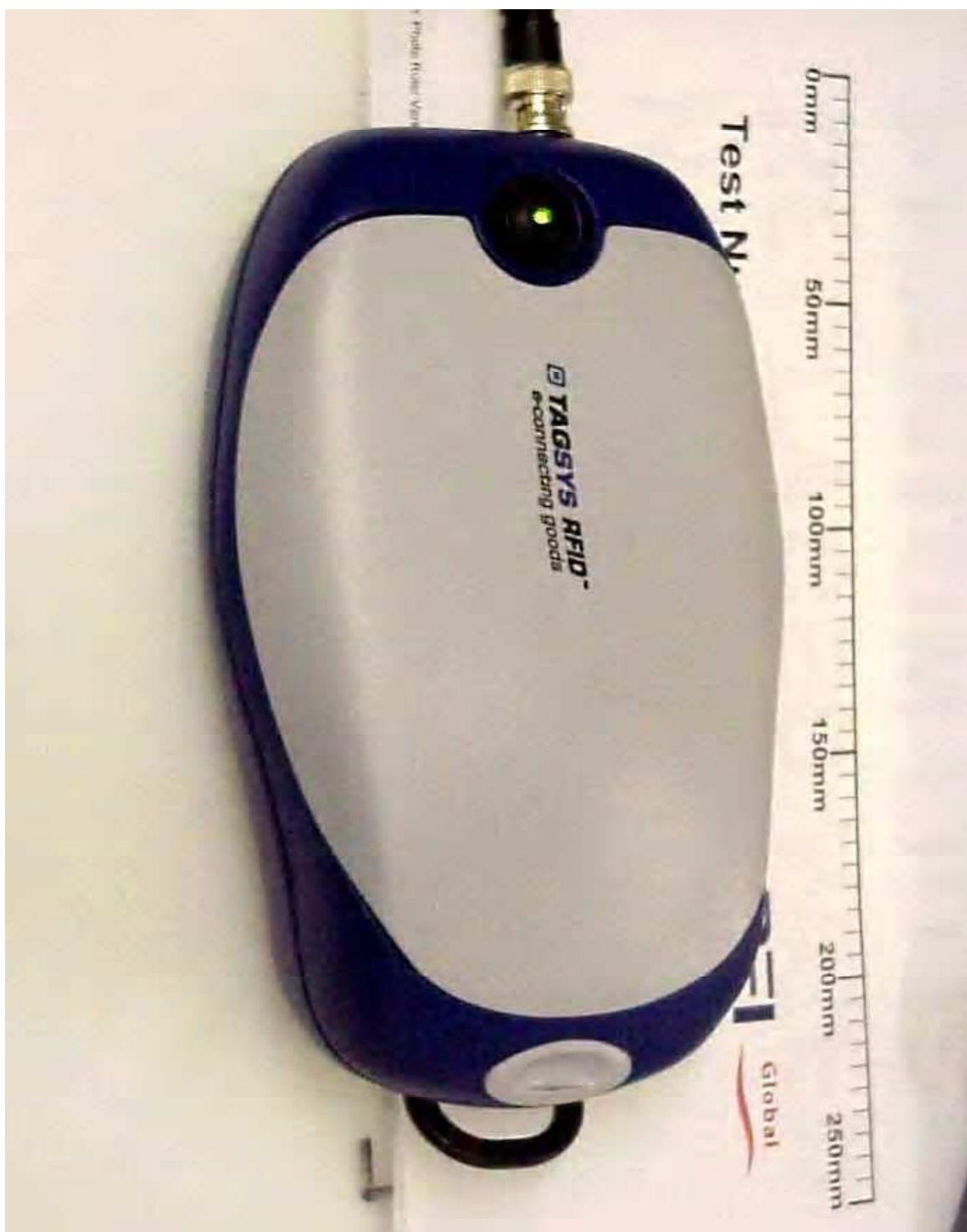


Test of: TAGSYS SAS  
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PHT/49232JD03A/006: Top View of EUT



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/007: Rear View of EUT



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/008: Internal View of EUT



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/009: Top View of EUT Battery



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/010: Rear View of EUT Battery



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/011: Close-up View of EUT Details



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/012: Belt Clip



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/013: Top View of EUT Inventory Antenna L-W2



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/014: Rear View of EUT Inventory Antenna L-W2



Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/015: Close-up View of EUT Inventory Antenna L-W2 Details

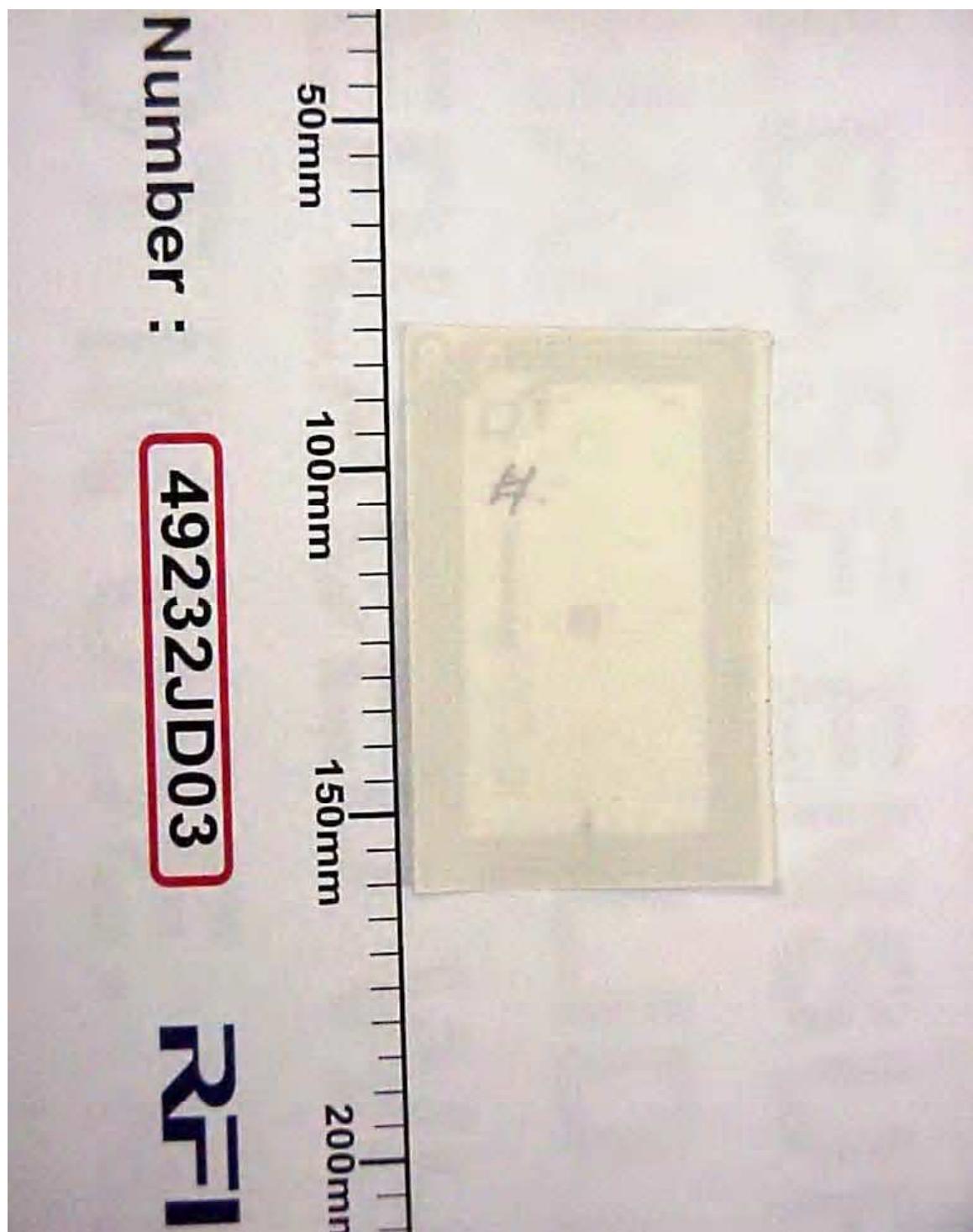


Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/016: RFID Test Tag

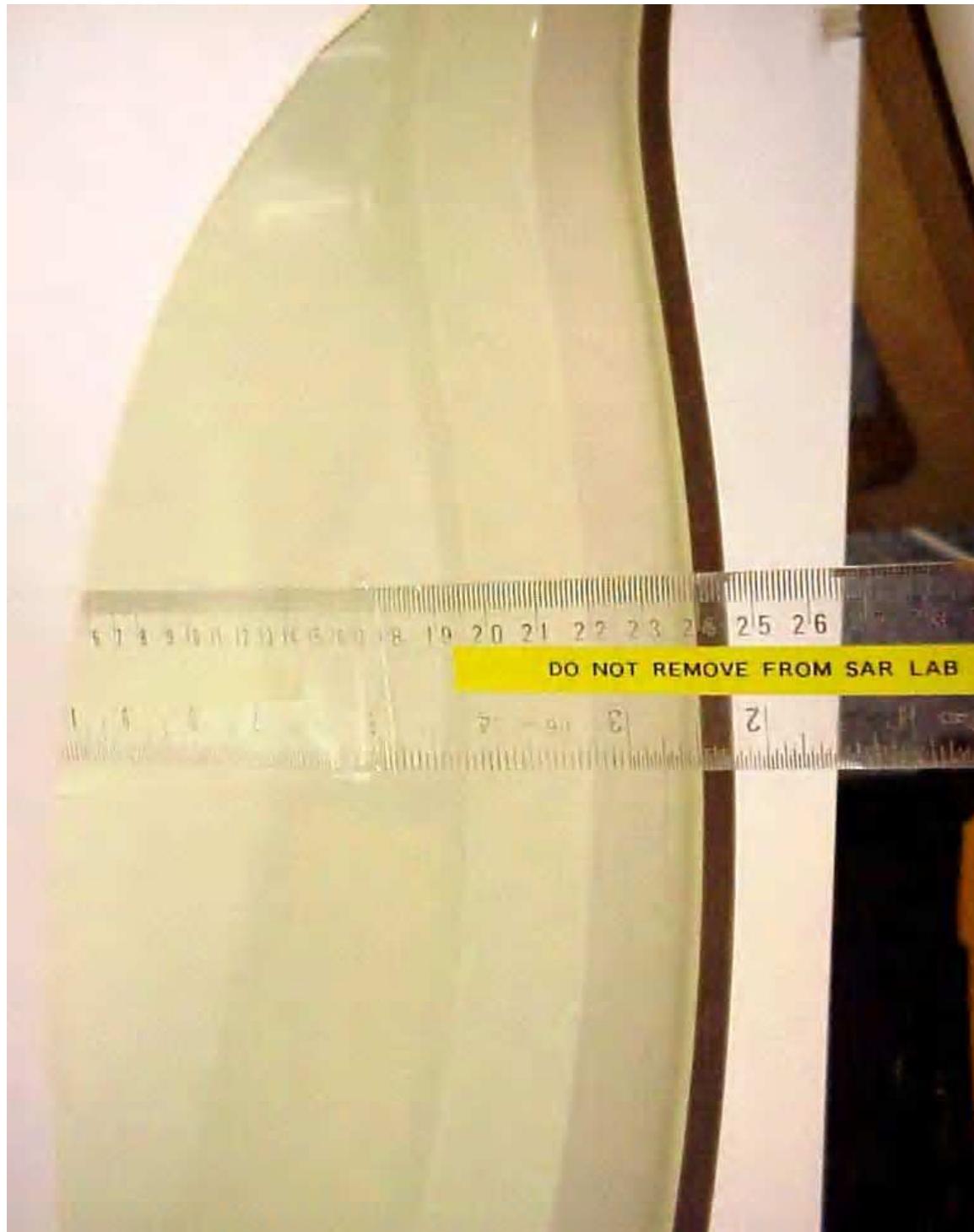


Test of: TAGSYS SAS  
WiFi Inventory Reader

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PHT/49232JD03A/017: 2450MHz Fluid Level



**Test of: TAGSYS SAS  
WiFi Inventory Reader**

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## **Appendix 5. Validation of System**

Prior to the assessment, the system was verified in the flat region of the phantom.

A 2450 MHz 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 2450 MHz dipole. The applicable verification (normalised to 1 Watt).

**Date: 29/05/2007**

**Validation Dipole and Serial Number: D2450V2; SN: 725**

Stimulant	Frequency (MHz)	Room Temperature	Liquid Temperature	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	24°C	24°C	$\epsilon_r$	52.70	52.18	-0.99	$\pm 5$
				$\sigma$	1.95	1.99	2.20	$\pm 5$
				1g SAR	53.30	54.40	2.06	$\pm 5$

**Note(s):**

1. Please refer to appendix A section A.1.1 for information on validation dipole D2450V2 SN: 725. The targeted value is detailed in the equipment calibration certificate.

Test of: TAGSYS SAS  
WiFi Inventory Reader

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## **Appendix 6. Simulated Tissues**

The body mixture consists of water and glycol. 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
	2450 MHz Body
De-Ionised Water	68.64 %
Diglycol Butyl Ether (DGBE)	31.37 %

Test of: TAGSYS SAS  
WiFi Inventory Reader

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## **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.

**Test of: TAGSYS SAS  
WiFi Inventory Reader**

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

##### **Robot System**

<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+

##### **Data Acquisition Electronic (DAE) System**

DAE3	SN:450
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##### **Cell Controller**

<b>PC:</b>	Dell Precision 340
<b>Operating System:</b>	Windows 2000
<b>Data Card:</b>	DASY4 Measurement Server
<b>Serial Number:</b>	1080

##### **Data Converter**

<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.

##### **PC Interface Card**

<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.
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Test of: TAGSYS SAS  
WiFi Inventory Reader

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**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

**Phantom**

<b>Phantom:</b>	SAM Phantom
<b>Shell Material:</b>	Fibreglass
<b>Thickness:</b>	2.0 $\pm 0.1$ mm