# APPENDIX 2: SAR Measurement data

## Appendix 2-1: Evaluation procedure

The SAR evaluation was performed with the following procedure:

**Step 1:** Measurement of the E-field at a fixed location above the central position of flat phantom was used as a reference value for assessing the power drop.

**Step 2:** The SAR distribution at the exposed side of head or body position was measured at a distance of each device from the inner surface of the shell. The area covered the entire dimension of the antenna of EUT and suitable horizontal grid spacing of EUT. Based on these data, the area of the maximum absorption was determined by splines interpolation.

**Step 3:** Around this point found in the Step 2 (area scan), a volume of 30mm(X axis)×30mm(Y axis)×30mm(Z axis) was assessed by measuring 7×7×7 points under 3GHz. And for any secondary peaks found in the Step2 which are within 2dB of maximum peak and not with this Step3 (Zoom scan) is repeated.
On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

(1) The data at the surface were extrapolated, since the center of the dipoles is 1mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 2mm. The extrapolation was based on a least square algorithm [4]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

(2) The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed by the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the "Not a knot"-condition (in x, y and z-directions) [4], [5]. The volume was integrated with the trapezoidal-algorithm. One thousand points (10×10×10) were interpolated to calculate the average.

(3) All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

**Step 4**: Re-measurement of the E-field at the same location as in Step 1 for the assessment of the power drift.

**Step 5**: Repeat Step 1-Step 4 with other condition or/and setup of EUT.

## Appendix 2-2: Measurement data

### Step 1: Worst setup position search

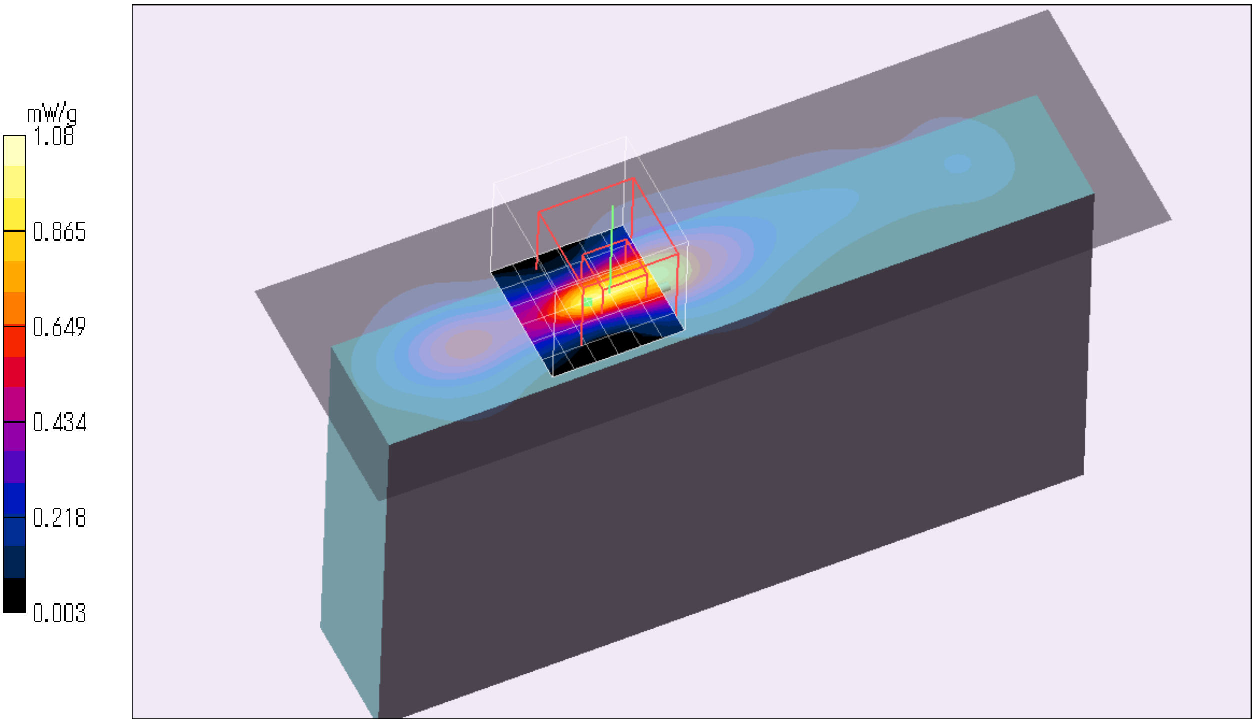
### Step 1-1 Top (distance=0mm)

**Communication System: 802.11b (1Mbps); Frequency: 2437 MHz(6ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma = 2$ mho/m; $\varepsilon_r = 51.6$; $\rho = 1000$ kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.979 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 16.2 V/m; Power Drift = -0.056 dB
Peak SAR (extrapolated) = 1.56 W/kg
**SAR(1 g) = 0.634 mW/g; SAR(10 g) = 0.242 mW/g**
Maximum value of SAR (measured) = 1.08 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.8 deg.C; liquid temperature: (before) 22.3 deg.C. /(after) 22.3 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 1: Worst setup position search (cont'd)**

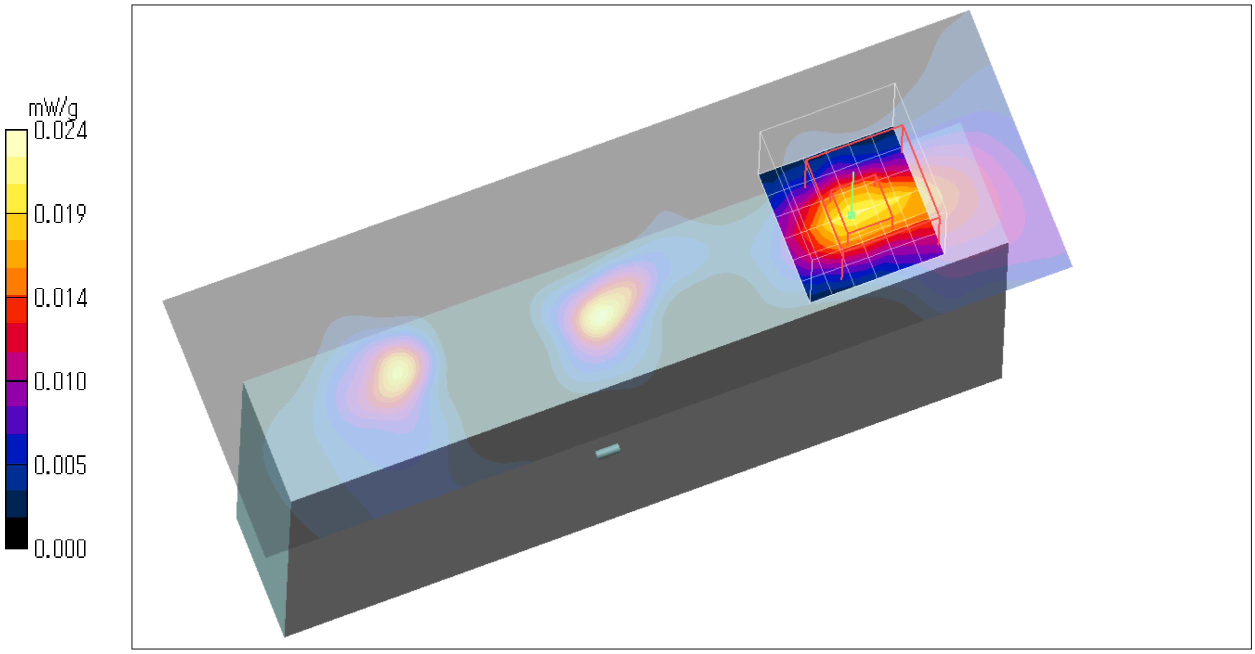
**Step 1-2 Bottom (distance=0mm)**

**Communication System: 802.11b (1Mbps); Frequency: 2437 MHz(6ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2.02 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.024 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.65 V/m; Power Drift = -0.2 dB
Peak SAR (extrapolated) = 0.029 W/kg
**SAR(1 g) = 0.014 mW/g; SAR(10 g) = 0.00656 mW/g**
Maximum value of SAR (measured) = 0.021 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.0 deg.C; liquid temperature: (before) 225 deg.C. /(after) 22.4 deg.C. (2010.0421,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 1: Worst setup position search (cont'd)**

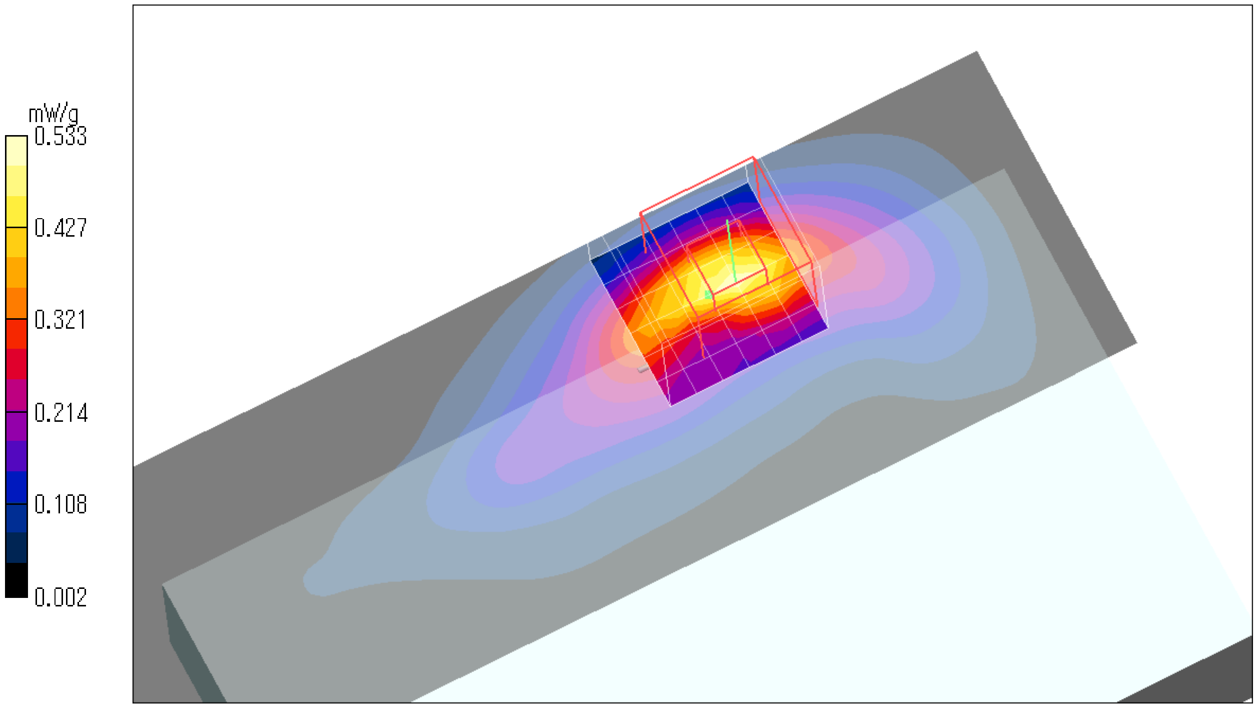
**Step 1-3 Front (distance=0mm)**

**Communication System: 802.11b (1Mbps); Frequency: 2437 MHz(6ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.533 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.95 V/m; Power Drift = 0.032 dB
Peak SAR (extrapolated) = 0.742 W/kg
**SAR(1 g) = 0.332 mW/g; SAR(10 g) = 0.152 mW/g**
Maximum value of SAR (measured) = 0.533 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.8 deg.C; liquid temperature: (before) 22.4 deg.C. /(after) 22.3 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 1: Worst setup position search (cont'd)**

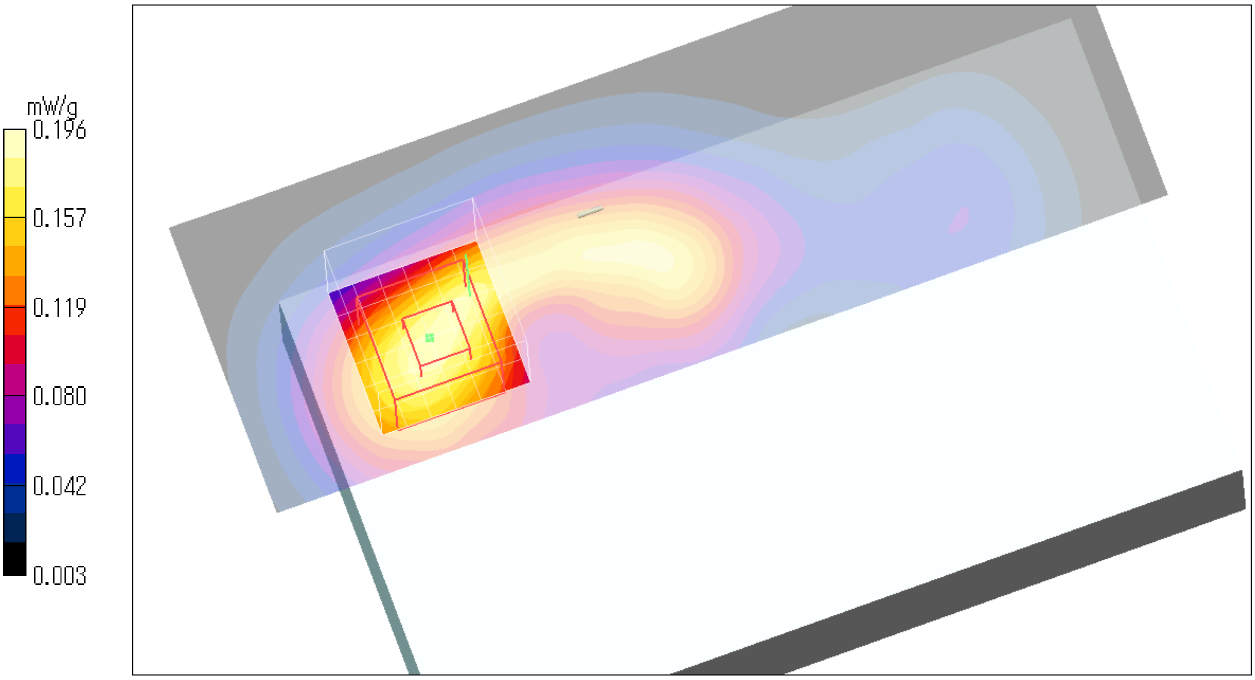
**Step 1-4 Rear (distance=0mm)**

**Communication System: 802.11b (1Mbps); Frequency: 2437 MHz(6ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2.02 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.196 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.71 V/m; Power Drift = -0.025 dB
Peak SAR (extrapolated) = 0.255 W/kg
**SAR(1 g) = 0.140 mW/g; SAR(10 g) = 0.081 mW/g**
Maximum value of SAR (measured) = 0.193 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.0 deg.C; liquid temperature: (before) 226 deg.C. /(after) 22.5 deg.C. (2010.0421,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 1: Worst setup position search (cont'd)**

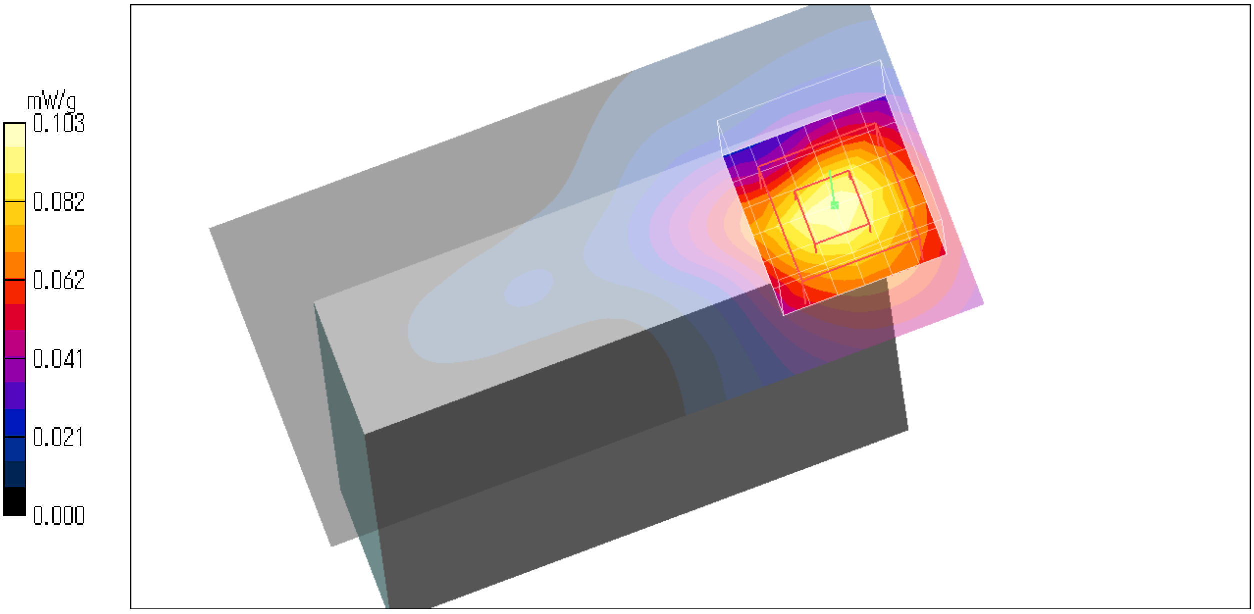
**Step 1-5 Left side (distance=0mm)**

**Communication System: 802.11b (1Mbps); Frequency: 2437 MHz(6ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2.02 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:120x60,step=15 (81x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.098 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.85 V/m; Power Drift = -0.2 dB
Peak SAR (extrapolated) = 0.132 W/kg
**SAR(1 g) = 0.072 mW/g; SAR(10 g) = 0.038 mW/g**
Maximum value of SAR (measured) = 0.103 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.0 deg.C; liquid temperature: (before) 224 deg.C. /(after) 22.4 deg.C. (2010.0421,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 1: Worst setup position search (cont'd)**

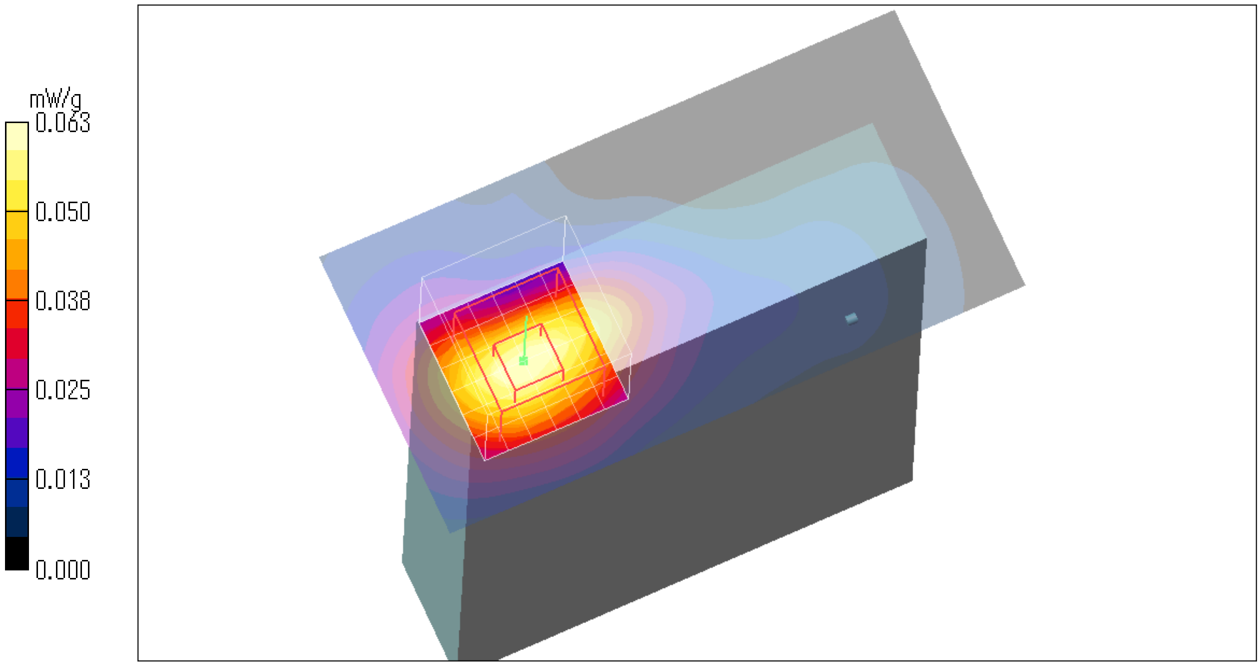
**Step 1-6 Right side (distance=0mm)**

**Communication System: 802.11b (1Mbps); Frequency: 2437 MHz(6ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; σ = 2.02 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:120x60,step=15 (81x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.063 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.19 V/m; Power Drift = 0.047 dB
Peak SAR (extrapolated) = 0.081 W/kg
**SAR(1 g) = 0.044 mW/g; SAR(10 g) = 0.023 mW/g**
Maximum value of SAR (measured) = 0.063 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.0 deg.C; liquid temperature: (before) 224 deg.C. /(after) 22.4 deg.C. (2010.0421,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**

**Step 2: Change to high and low channel (11b, 1Mbps)**

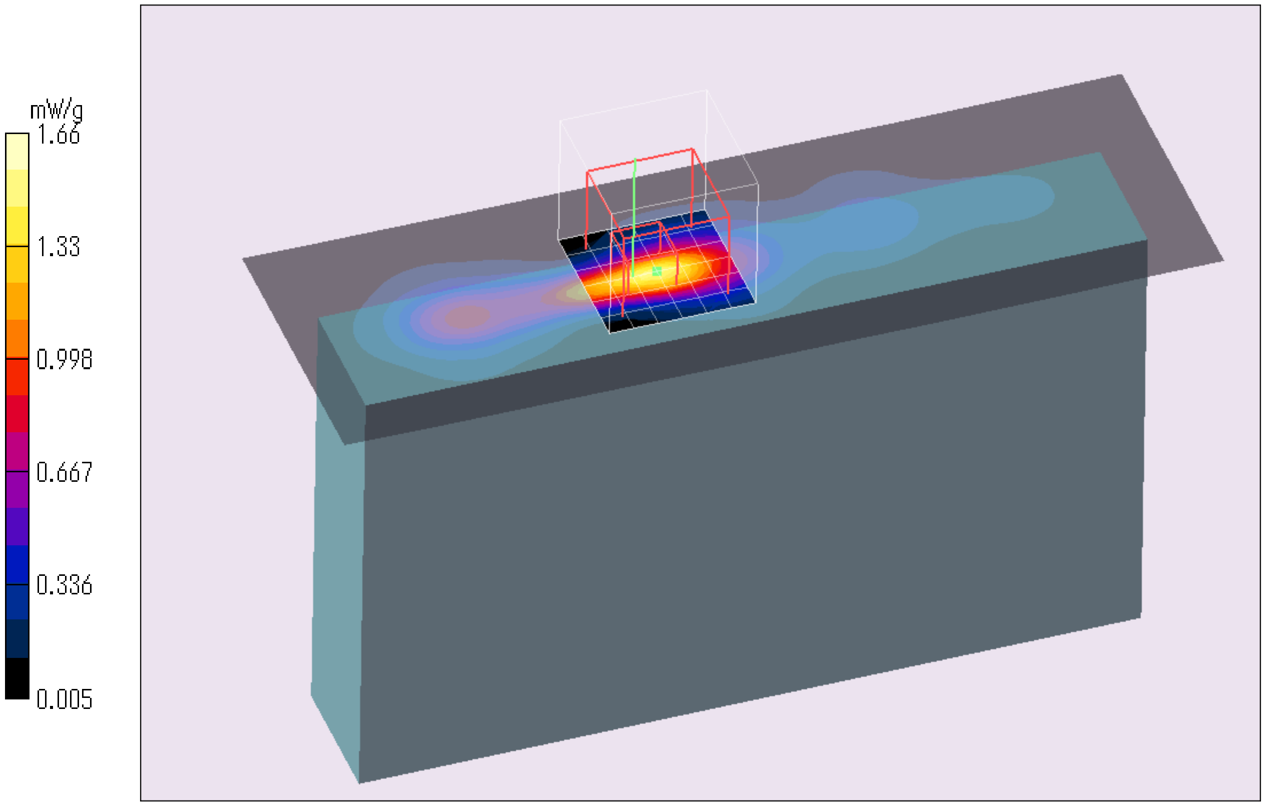
**Step 2-1 High channel: 2462MHz, Top side (distance=0mm)**

**Communication System: 802.11b (1Mbps); Frequency: 2462 MHz(11ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.51 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.5 V/m; Power Drift = -0.111 dB
Peak SAR (extrapolated) = 2.31 W/kg
**SAR(1 g) = 0.963 mW/g; SAR(10 g) = 0.394 mW/g**
Maximum value of SAR (measured) = 1.66 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.8 deg.C; liquid temperature: (before) 22.3 deg.C. /(after) 22.3 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 2: Change to high and low channel (11b, 1Mbps) (cont'd)**

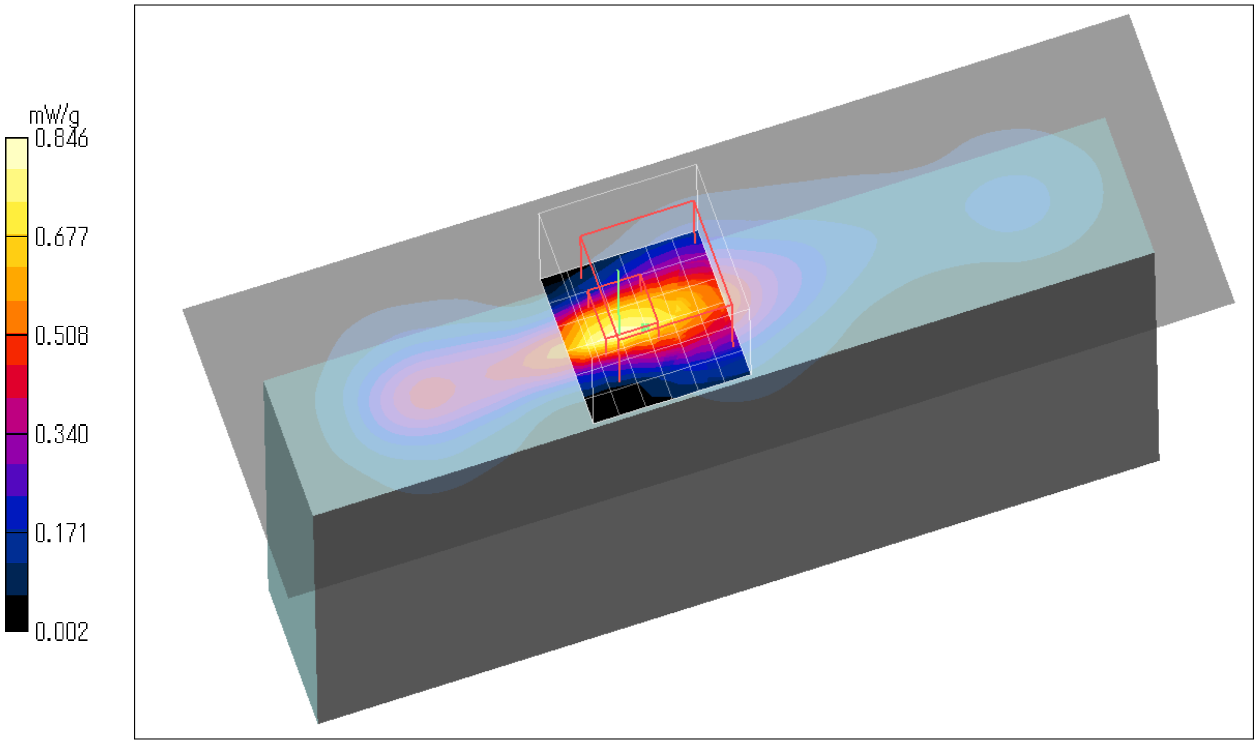
**Step 2-2 Low channel:2412MHz, Top side (distance=0mm)**

**Communication System: 802.11b (1Mbps); Frequency: 2412 MHz(1ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma = 2$ mho/m; $\varepsilon_r = 51.6$; $\rho = 1000$ kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.856 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.3 V/m; Power Drift = -0.054 dB
Peak SAR (extrapolated) = 1.26 W/kg
**SAR(1 g) = 0.513 mW/g; SAR(10 g) = 0.214 mW/g**
Maximum value of SAR (measured) = 0.846 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.8 deg.C; liquid temperature: (before) 22.3 deg.C. /(after) 22.3 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**

**Step 3: Worst modulation check (11b, 2Mbps)**

**Step 3-1 11b, 2Mbps, High channel:2462MHz, Top side (distance=0mm)**

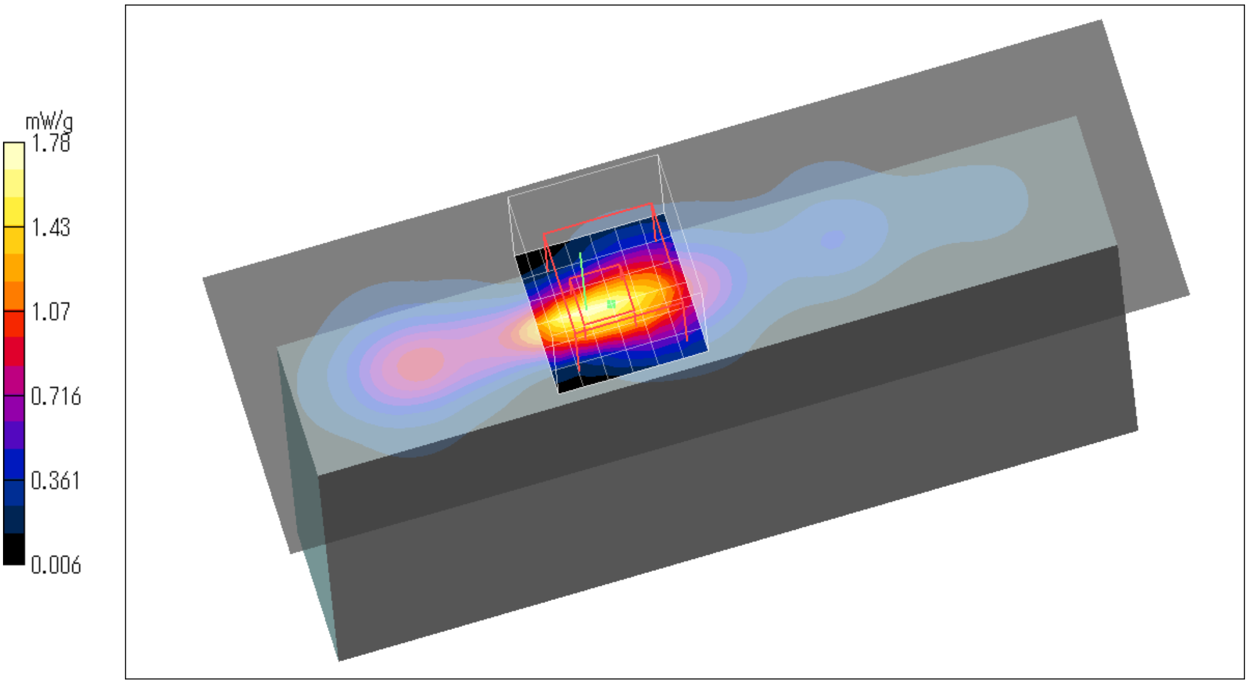
**Communication System: 802.11b (2Mbps); Frequency: 2462 MHz(11ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.73 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.7 V/m; Power Drift = -0.090 dB,
Peak SAR (extrapolated) = 2.56 W/kg
**SAR(1 g) = 1.09 mW/g; SAR(10 g) = 0.450 mW/g**
Maximum value of SAR (measured) = 1.78 mW/g

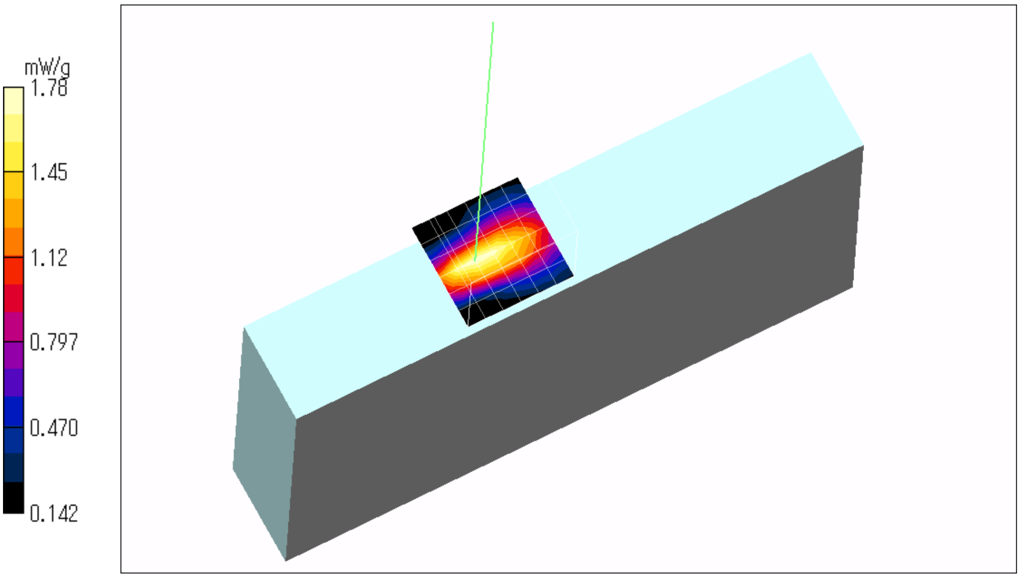
**SAR(1 g) / SAR(10 g)**

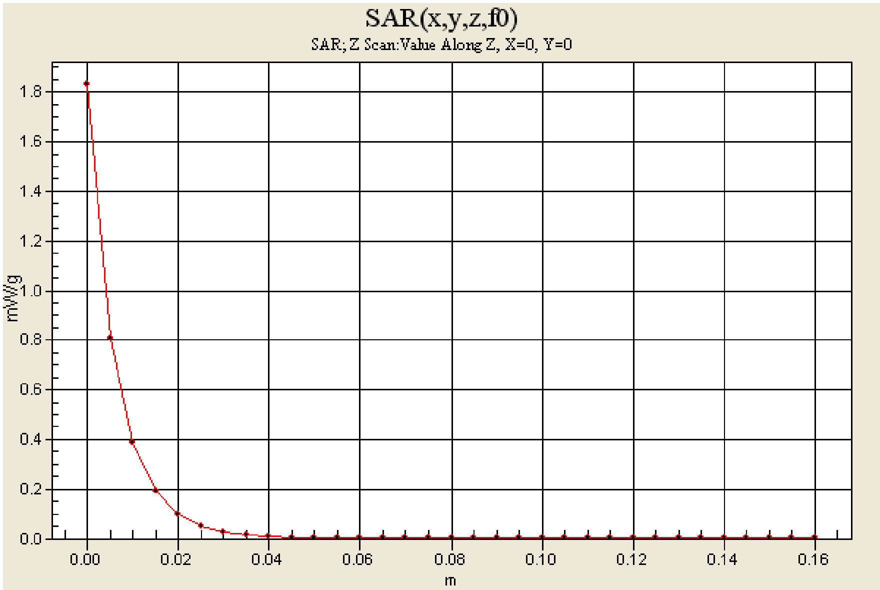


**Appendix 2-2: Measurement data (cont'd)**
**Step 3: Worst modulation check (11b, 2Mbps) (cont'd)**
**Step 3-1 11b, 2Mbps, High channel:2462MHz, Top side (distance=0mm) (cont'd)**

**Z scan**
**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.7 V/m; Power Drift = -0.090 dB
Maximum value of SAR (measured) = 1.78 mW/g

**Z Scan (1x1x33):** Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.83 mW/g
Maximum value of Total (measured) = 30.3 V/m




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.3 deg.C; liquid temperature: (before) 22.3 deg.C. /(after) 22.2 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 3: Worst modulation check (11b, 2Mbps) (cont'd)**

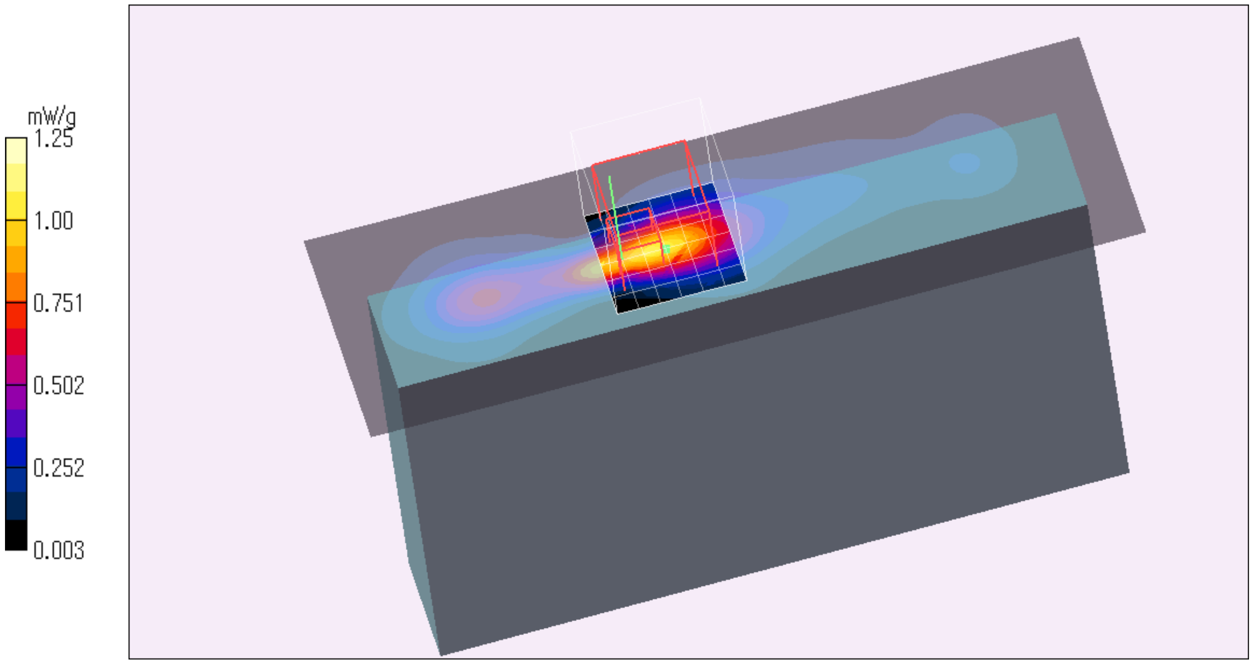
**Step 3-2 11b, 2Mbps, Middle channel:2437MHz, Top side (distance=0mm)**

**Communication System: 802.11b (2Mbps); Frequency: 2437 MHz(6ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; σ = 2 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/$m^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.06 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.7 V/m; Power Drift = -0.034 dB
Peak SAR (extrapolated) = 1.84 W/kg
**SAR(1 g) = 0.741 mW/g; SAR(10 g) = 0.303 mW/g**
Maximum value of SAR (measured) = 1.25 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.3 deg.C; liquid temperature: (before) 22.2 deg.C. /(after) 22.1 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 3: Worst modulation check (11b, 2Mbps) (cont'd)**

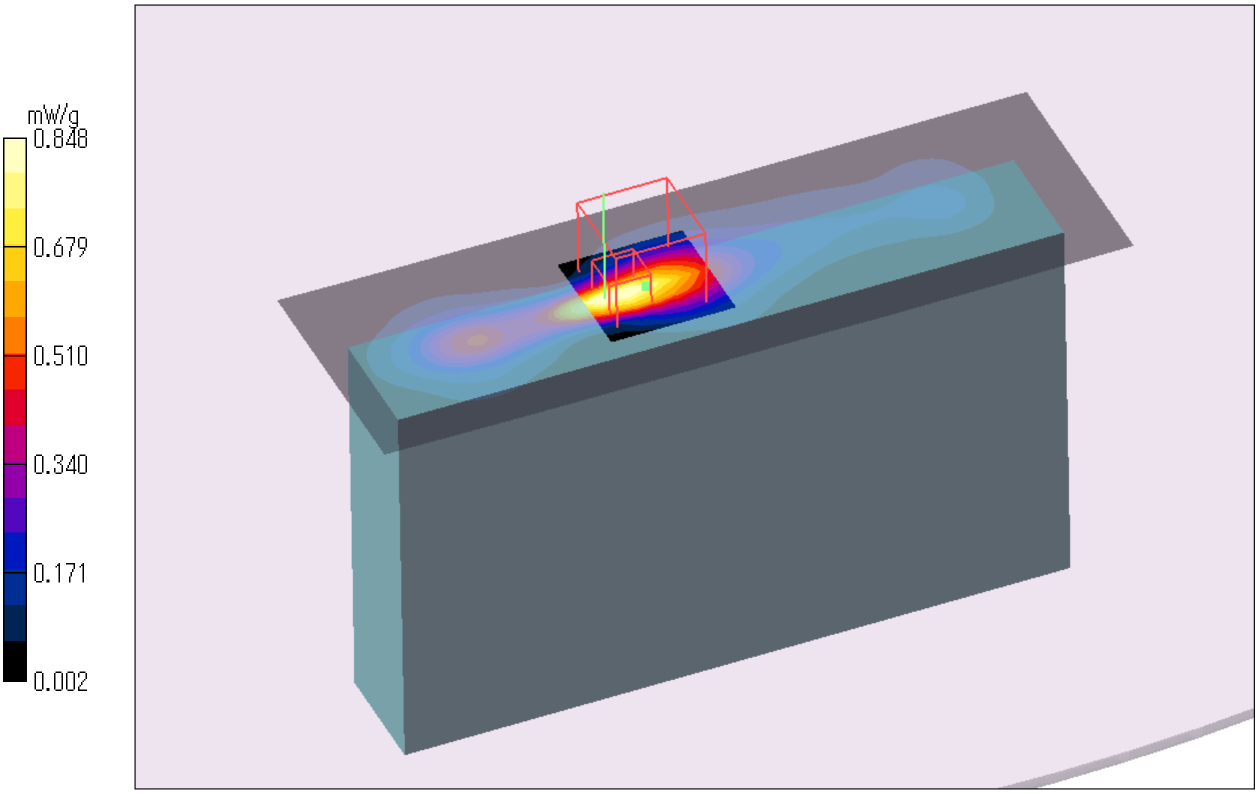
**Step 3-3 11b, 2Mbps, Low channel:2412MHz, Top side (distance=0mm)**

**Communication System: 802.11b (2Mbps); Frequency: 2412 MHz(1ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; σ = 2 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059 Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.848 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 16.0 V/m; Power Drift = -0.054 dB
Peak SAR (extrapolated) = 1.35 W/kg
**SAR(1 g) = 0.548 mW/g; SAR(10 g) = 0.227 mW/g**
Maximum value of SAR (measured) = 0.937 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 23.4 deg.C; liquid temperature: (before) 22.1 deg.C. /(after) 22.1 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**

**Step 4: With cradle & charging operation**

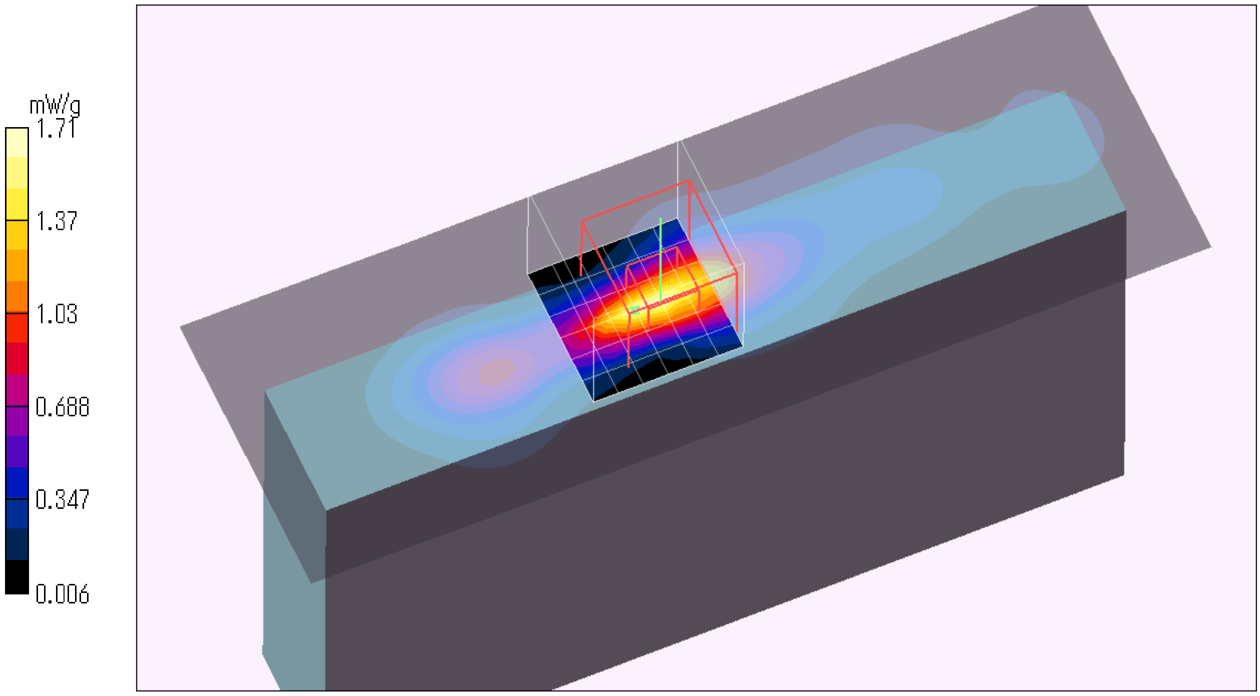
**Step 4-1 With cradle, 11b, 11Mbps, High channel:2462MHz, Top side (distance=0mm)**

**Communication System: 802.11b (11Mbps); Frequency: 2462 MHz(11ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; σ = 2 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.53 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 27.1 V/m; Power Drift = 0.017 dB
Peak SAR (extrapolated) = 2.41 W/kg
**SAR(1 g) = 0.998 mW/g; SAR(10 g) = 0.396 mW/g**
Maximum value of SAR (measured) = 1.71 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 24.0 deg.C; liquid temperature: (before) 22.5 deg.C. /(after) 22.5 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 4: With cradle & charging operation (cont'd)**

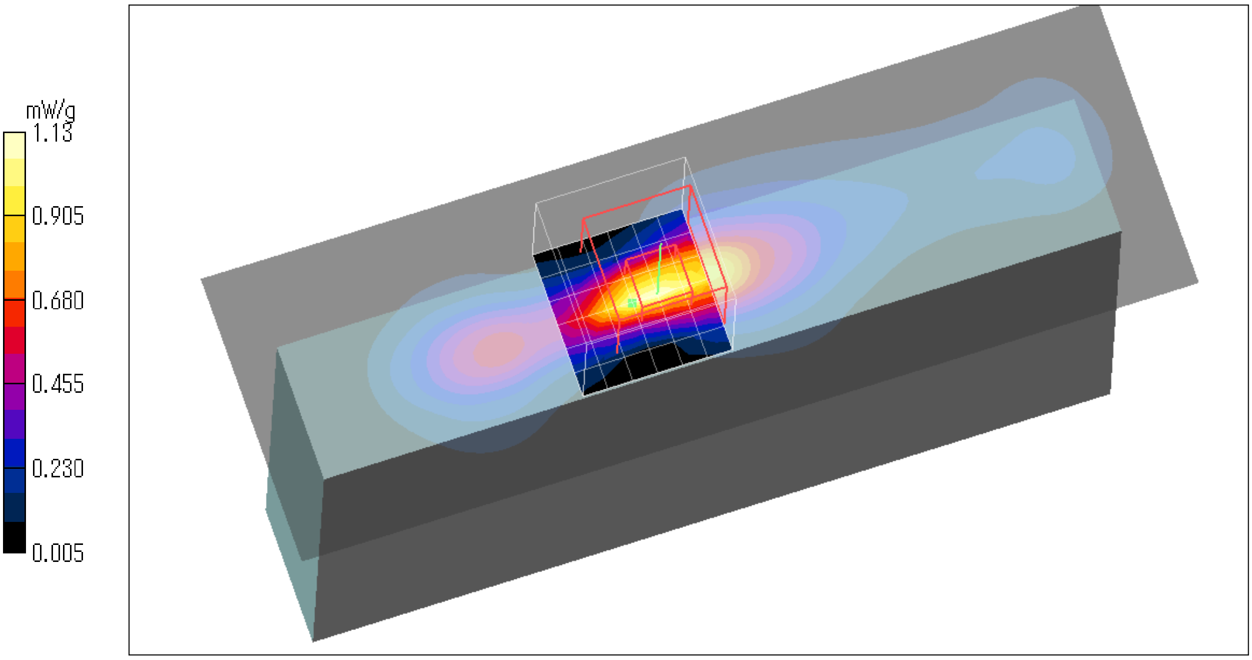
**Step 4-2 With cradle, 11b, 11Mbps, Middle channel:2437MHz, Top side (distance=0mm)**

**Communication System: 802.11b (11Mbps); Frequency: 2437 MHz(6ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.09 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.2 V/m; Power Drift = -0.069 dB
Peak SAR (extrapolated) = 1.67 W/kg
**SAR(1 g) = 0.676 mW/g; SAR(10 g) = 0.266 mW/g**
Maximum value of SAR (measured) = 1.13 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 24.0 deg.C; liquid temperature: (before) 22.5 deg.C. /(after) 22.5 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**
**Step 4: With cradle & charging operation (cont'd)**

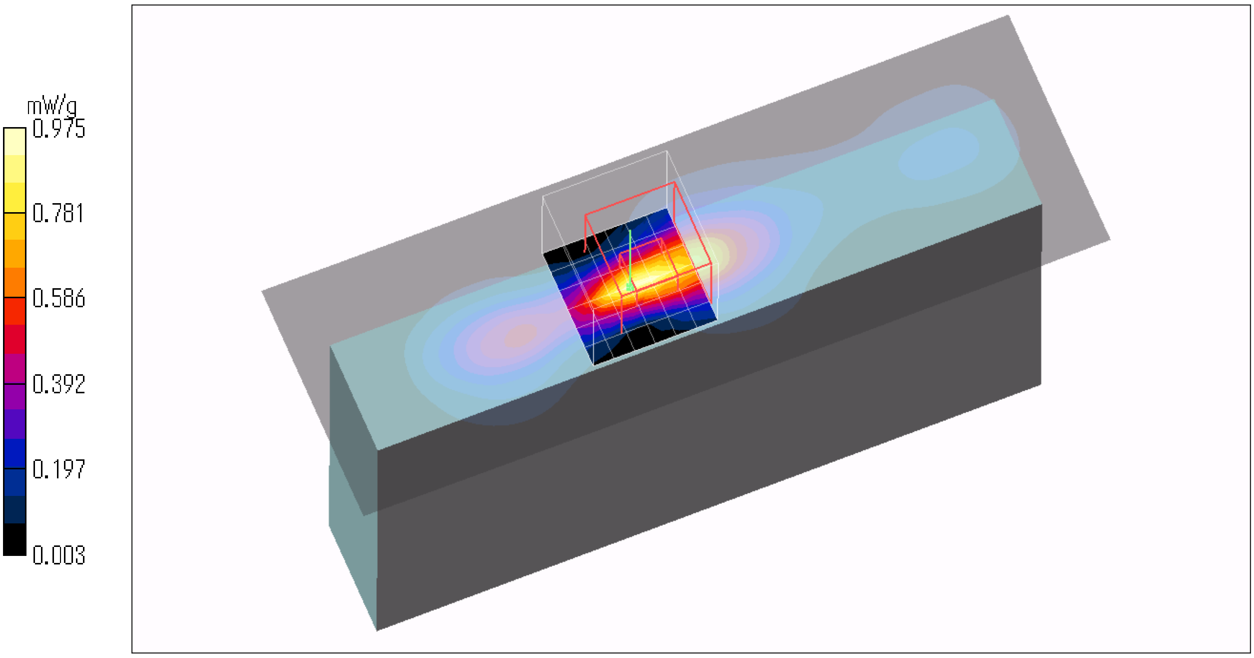
**Step 4-3 With cradle, 11b, 11Mbps, Low channel:2412MHz, Top side (distance=0mm)**

**Communication System: 802.11b (11Mbps); Frequency: 2412 MHz(1ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; σ = 2 mho/m; $\varepsilon_r$ = 51.6; ρ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.965 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.2 V/m; Power Drift = -0.028 dB
Peak SAR (extrapolated) = 1.41 W/kg
**SAR(1 g) = 0.571 mW/g; SAR(10 g) = 0.231 mW/g**
Maximum value of SAR (measured) = 0.975 mW/g




Additional information: position of distance of DUT to SAM: 0mm (2mm to liquid), liquid depth: 151mm
ambient temperature: 24.0 deg.C; liquid temperature: (before) 22.5 deg.C. /(after) 22.5 deg.C. (2010.0420,3S/R, Tested by H. Naka)

**Appendix 2-2: Measurement data (cont'd)**

**Step 5: Separation check**
**Step 5-1 11b, 2Mbps, High channel:2462MHz, Top side (distance=5mm)**

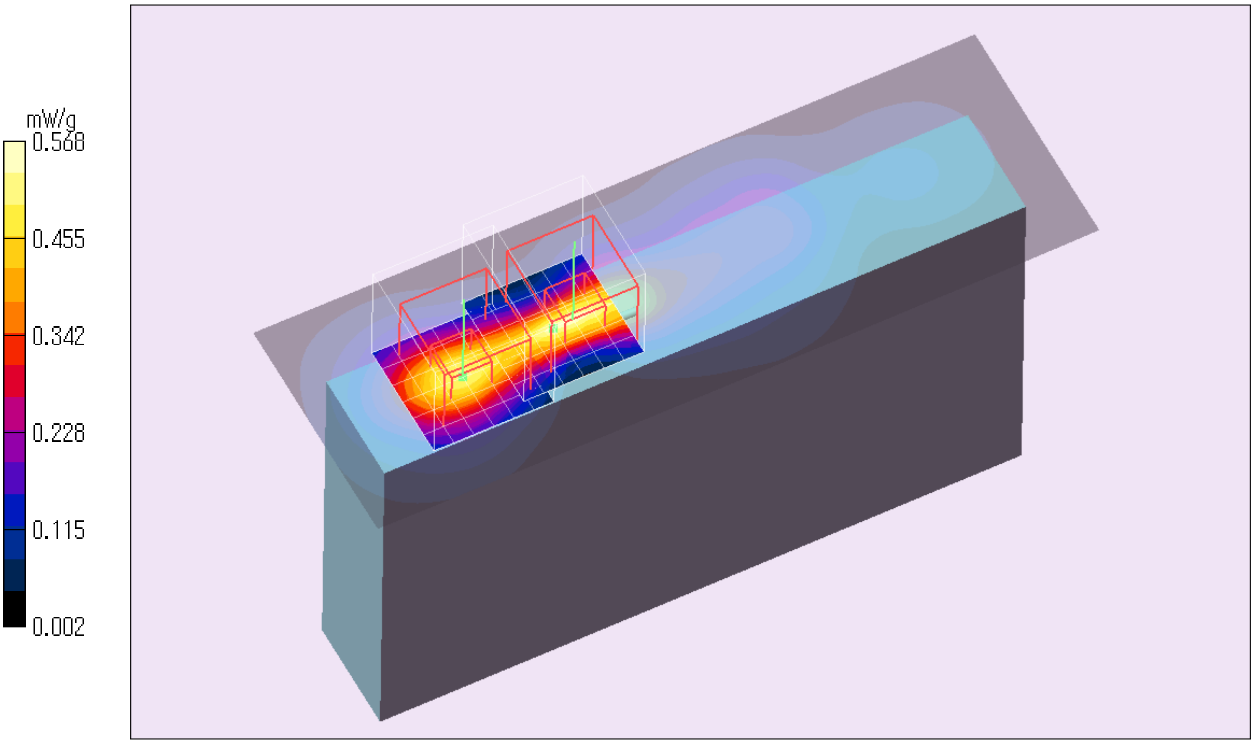
**Communication System: 802.11b (2Mbps); Frequency: 2462 MHz(11ch); Duty Cycle: 1:1**
**DUT: Network remote controller; Type: RMN-U1; Serial: 6**

Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma = 2$ mho/m; $\varepsilon_r = 51.6$; $\rho = 1000$ kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:180x60,step=15 (121x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.546 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 1st peak:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.1 V/m; Power Drift = -0.017 dB
Peak SAR (extrapolated) = 0.764 W/kg
**SAR(1 g) = 0.361 mW/g; SAR(10 g) = 0.161 mW/g**
Maximum value of SAR (measured) = 0.568 mW/g

**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 2nd peak:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.1 V/m; Power Drift = -0.017 dB
Peak SAR (extrapolated) = 0.646 W/kg
**SAR(1 g) = 0.349 mW/g; SAR(10 g) = 0.181 mW/g**
Maximum value of SAR (measured) = 0.498 mW/g




Additional information: position of distance of DUT to SAM: 5mm (7mm to liquid), liquid depth: 151mm
ambient temperature: 24.0 deg.C; liquid temperature: (before) 22.5 deg.C. /(after) 22.5 deg.C. (2010.0420,3S/R, Tested by H. Naka)

# APPENDIX 3: Test instruments

## Appendix 3-1: Equipment used

SAR test equipment

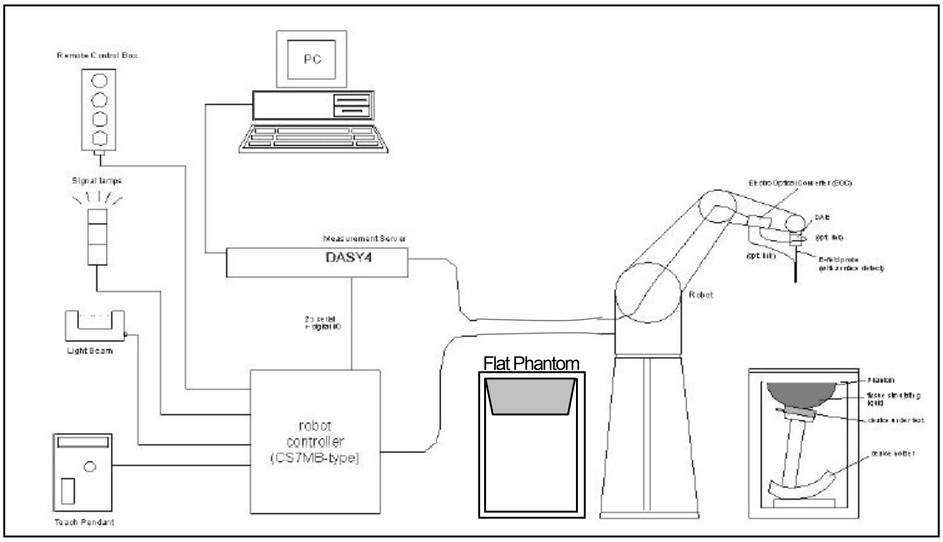
| Control No. | Instrument | Manufacturer | Model No | Serial No | Test Item | Calibration Date * Interval(month) |
|---|---|---|---|---|---|---|
| COTS-KSAR-01 | DASY4 | Schmid&Partner Engineering AG | DASY4 V4.7 B80 | - | SAR | - |
| KSAR-01 | SAR measurement system | Schmid&Partner Engineering AG | DASY4 | 1088 | SAR | Pre Check |
| KDAE-01 | Data Acquisition Electronics | Schmid&Partner Engineering AG | DAE4 | 626 | SAR | 2010/03/10 * 12 |
| KPB-R02 | Dosimetric E-Field Probe | Schmid&Partner Engineering AG | EX3DV4 | 3540 | SAR | 2009/06/26 * 12 |
| KSDA-01 | Dipole Antenna | Schmid&Partner Engineering AG | D2450V2 | 822 | SAR | 2009/03/10 * 24 |
| KPFL-01 | Flat Phantom | Schmid&Partner Engineering AG | Oval flat phantom ELI 4.0 | 1059 | SAR | Pre Check |
| KSNA-01 | Network Analyzer | Agilent | 8753ES | US39171777 | SAR | 2010/01/14 * 12 |
| KEPP-01 | Dielectric probe | Agilent | 8710-2036 | 2540 | SAR | Pre Check |
| KSG-08 | Signal Generator | Rohde & Schwarz | SMT06 | 100763 | SAR | 2009/06/26 * 12 |
| KPA-11 | RF Power Amplifier | MILMEGA | AS0825-65 | 1018581 | SAR | 2009/09/02 * 12 |
| KIU-09 | Power sensor | Rohde & Schwarz | NRV-Z4 | 100371 | SAR | 2009/08/11 * 12 |
| KPM-06 | Power Meter | Rohde & Schwarz | NRVD | 101599 | SAR | 2009/08/11 * 12 |
| KCPL-07 | Directional Coupler | Pulsar Microwave Corp. | CCS30-B26 | 0621 | SAR | Pre Check |
| KPM-05 | Power meter | Agilent | E4417A | GB41290718 | SAR | 2010/02/23 * 12 |
| KPSS-01 | Power sensor | Agilent | E9327A | US40440544 | SAR | 2010/02/23 * 12 |
| KAT10-P1 | Attenuator | Weinschel | 24-10-34 | BY5927 | SAR | 2010/02/24 * 12 |
| KAT20-P1 | Attenuator | TME | SFA-01AXPJ | - | SAR | 2010/02/23 * 12 |
| KPM-08 | Power meter | Anritsu | ML2495A | 6K00003356 | AT | 2009/10/30 * 12 |
| KPSS-04 | Power sensor | Anritsu | MA2411B | 012088 | AT | 2009/10/30 * 12 |
| KAT10-S2 | Attenuator | Agilent | 8490D 010 | 06036 | AT | 2009/12/17 * 12 |
| KSA-06 | Spectrum Analyzer | Agilent | N9320A | CN0163000425 | SAR | 2009/10/23 * 12 |
| KRU-01 | Ruler(300mm) | Shinwa | 13134 | - | SAR | 2010/03/29 * 12 |
| KRU-02 | Ruler(150mm,L) | Shinwa | 12103 | - | SAR | 2010/03/29 * 12 |
| KOS-04 | Humidity Indicator | SATO | PC-5000TRH | B-08 | SAR | 2009/07/23 * 12 |
| KOS-14 | Thermo-Hygrometer data logger | SATO KEIRYOKI | SK-L200THIIα/SK-LTHIIα-2 | 015246/08169 | SAR | 2010/01/28 * 12 |
| KSLM245-01 | Tissue simulation liqud (2450MHz,body) | Schmid&Partner Engineering AG | SL AAM 245 | - | SAR | (Daily check) Target value ±5% |
| No.3 Shielded room | SAR shielded room (4m(W)x5m(D)x2.7m(H)) | JSE | - | - | SAR | (Daily check) Ambient noize: < 0.012W/kg |
| | | | | | | |

The expiration date of the calibration is the end of the expired month .
As for some calibrations performed after the tested dates , those test equipment have been controlled by means of an unbroken chains of calibrations .
All equipment is calibrated with traceable calibrations . Each calibration is traceable to the national or international standards.
[Test Item] SAR: Specific Absorption Rate, AT: Antenna terminal disturbance voltage

## Appendix 3-2: Dosimetry assessment setup

These measurements were performed with the automated near-field scanning system DASY4 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9 m), which positions the probes with a positional repeatability of better than +/- 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetry probes EX3DV4, SN: 3540 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [2] with accuracy of better than +/-10%. The spherical isotropy was evaluated with the procedure described in [3] and found to be better than +/- 0.25 dB.

## Appendix 3-3: Configuration and peripherals




The DASY4 system for performing compliance tests consist of the following items:

| | |
|---|---|
| 1 | A standard high precision 6-axis robot (Stäubli RX family) with controller and software.<br>An arm extension for accommodating the data acquisition electronics (DAE). |
| 2 | A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system. |
| 3 | A data acquisition electronic (DAE), which 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. |
| 4 | 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.<br>The EOC is connected to the measurement server. |
| 5 | 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. |
| 6 | A probe alignment unit which improves the (absolute) accuracy of the probe positioning. |
| 7 | A computer operating Windows XP. |
| 8 | DASY4 software. |
| 9 | Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc. |
| 10 | The phantom. |
| 11 | The device holder for EUT. (low-loss dielectric palette) |
| 12 | Tissue simulating liquid mixed according to the given recipes. |
| 13 | Validation dipole kits allowing to validate the proper functioning of the system. |

## Appendix 3-4: System components

### 1) EX3DV4 Probe Specification

**Construction:**
- Symmetrical design with triangular core.
- Built-in shielding against static charges.
- PEEK enclosure material (resistant to organic solvents, e.g., DGBE).

**Calibration (S/N 3540):**
Basic broad band calibration in air.
Conversion Factors(Head and Body): 2450, 5200, 5300, 5500, 5600, 5800MHz

**Frequency:**
10 MHz to > 6GHz, Linearity: ±0.2 dB (30MHz to 6GHz)

Directivity:
±0.3 dB in HSL (rotation around probe axis)
±0.5 dB in tissue material (rotation normal to probe axis)

**Dynamic Range:**
10µW/g to > 100 mW/g; Linearity: ±0.2 dB (noise: typically < 1µW/g)


EX3DV3 E-field Probe

**Dimensions:**
Overall length: 330mm (Tip: 20mm)
Tip diameter: 2.5mm (Body: 12mm)
Typical distance from probe tip to dipole centers: 1mm

**Application:**
High precision dosimetric measurement in any exposure scenario (e.g., very strong gradient fields).Only probe which enables compliance testing for frequencies up to 6GHz with precision of better 30%.

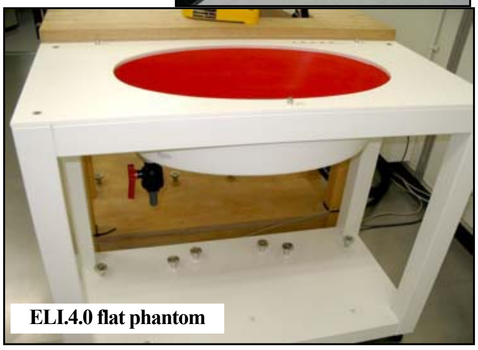
### 2) Phantom (Flat type)

**Construction:**
A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom position and measurement grids by manually teaching three points with the robot.

**Shell Thickness:**
Bottom plate: 2 ±0.2mm

**Dimensions:**
Bottom elliptical: 600×400mm, Depth: 190mm

**Filling Volume:**
Approx 30 liters


ELI.4.0 flat phantom

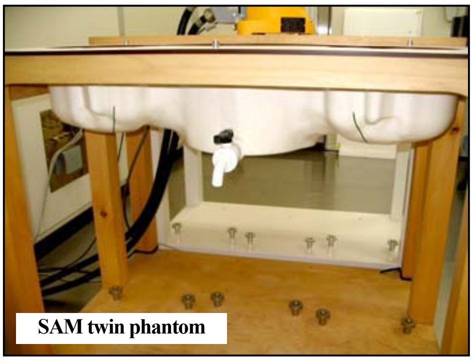
### 2) Phantom (SAM twin type)

**Construction:**
The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC EN 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 manually teaching three points with the robot.

**Shell Thickness:**
Flat section: 2 ±0.2mm, ERP: 6 ±0.2mm

**Filling Volume:**
Approx. 25 liters

**Dimensions:**
810×1000×500mm (H×L×W)


SAM twin phantom

### 3) Device Holder

For this measurement, the urethane foam was used as device holder.

In combination with the Twin SAM Phantom V4.0/V4.0c or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Transmitter devices can be easily and accurately positioned.
The low-loss dielectric urethane foam was used for the mounting section of device holder.


Device holder

## Appendix 3-5: Test system specification

**RX60L Robot**

- Number of Axes : 6 • Payload : 1.6 kg
- Reach : 800mm • Repeatability : ±0.025mm
- Control Unit : CS7M • Programming Language : V+
- Manufacture : Stäubli Unimation Corp. Robot Model: RX60

**DASY4 Measurement server**

- Features : 166MHz low power Pentium MMX.
  32MB chipdisk and 64MB RAM Serial link to DAE (with watchdog supervision) 16 Bit A/D converter for surface detection system. Two serial links to robot (one for real-time communication which is supervised by watchdog) Ethernet link to PC (with watchdog supervision).
  Emergency stop relay for robot safety chain. Two expansion slots for future applications.
- Manufacture : Schmid & Partner Engineering AG

**Data Acquisition Electronic (DAE)**

- Features : Signal amplifier, multiplexer, A/D converter and control logic.
  Serial optical link for communication with DASY4 embedded system (fully remote controlled).
  2 step probe touch detector for mechanical surface detection and emergency robot stop (not in -R version)
- Measurement Range : 1μV to > 200mV (16bit resolution and two range settings: 4mV, 400mV)
- Input Offset voltage : < 1μV (with auto zero)
- Input Resistance : 200MΩ • Battery Power : > 10hr of operation (with two 9V battery)
- Dimension : 60×60×68mm • Manufacture : Schmid & Partner Engineering AG

**Software**

- Item : Dosimetric Assessment System DASY4
- Software version No. : DASY4, V4.7 B80 • Manufacture / Origin : Schmid & Partner Engineering AG

**E-Field Probe**

- Model : EX3DV4 (sn: 3540) • Construction : Symmetrical design with triangular core
- Frequency : 10MHz to 6GHz • Linearity : ±0.2dB (30MHz to 3GHz)
- Manufacture : Schmid & Partner Engineering AG

**Phantom (1)**

- Type : ELI 4.0 oval flat phantom • Shell Material : Fiberglass
- Shell Thickness : Bottom plate: 2 ±0.2mm • Dimensions : Bottom elliptical: 600×400mm, Depth: 190mm
- Manufacture : Schmid & Partner Engineering AG

**Phantom (2)**

- Type : Flat phantom • Shell Material : Fiberglass
- Shell Thickness : flat section: 2 ±0.2mm, ERP: 6 ±0.2mm
- Manufacture : Schmid & Partner Engineering AG

## Appendix 3-6: Simulated tissue composition

| Ingredient | Mixture (%) |
|---|---|
| | **Body 2450MHz** (type: SL AAM 245) |
| Water | 52-75 % |
| $C_8H_{18}O_3$ (Diethylene glycol monobutyl ether (DGBE)) | 25-48% |
| NaCl | <1.0% |

## Appendix 3-7: Simulated tissue parameter confirmation

The dielectric parameters were checked prior to assessment using the 85070E dielectric probe kit.
The dielectric parameters measurement are reported in each correspondent section.

| Dielectric parameter measurement results | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Freq. [MHz] | Liquid Type | Ambient | | Liquid Temp. [deg.C.] | | Liquid Depth [mm] | Parameters | Target value | Measured | Deviation [%] | Limit [%] |
| | | | Temp [deg.C.] | Humidity [%] | Before | After | | | | | | |
| April 20, 2010 | 2450 | Body | 23..5 | 44 | 22.8 | - | - | Relative permittivity: εr [-] | **52.7** (*1) | 51.6 | **-2.1** | ±5 |
| | | | | | | | | Conductivity: σ [S/m] | **1.95** (*1) | 2.00 | **+2.4** | ±5 |
| | | | | | | | | Relative permittivity: εr [-] | **54.3** (*2) | 51.6 | **-5.0** | ±5 |
| | | | | | | | | Conductivity: σ [S/m] | **1.99** (*2) | 2.00 | **+0.3** | ±5 |
| April 21, 2010 | 2450 | Body | 23.1 | 51 | 22.9 | - | - | Relative permittivity: εr [-] | **52.7** (*1) | 51.6 | **-2.1** | ±5 |
| | | | | | | | | Conductivity: σ [S/m] | **1.95** (*1) | 2.02 | **+3.4** | ±5 |
| | | | | | | | | Relative permittivity: εr [-] | **54.3** (*2) | 51.6 | **-5.0** | ±5 |
| | | | | | | | | Conductivity: σ [S/m] | **1.99** (*2) | 2.02 | **+1.3** | ±5 |

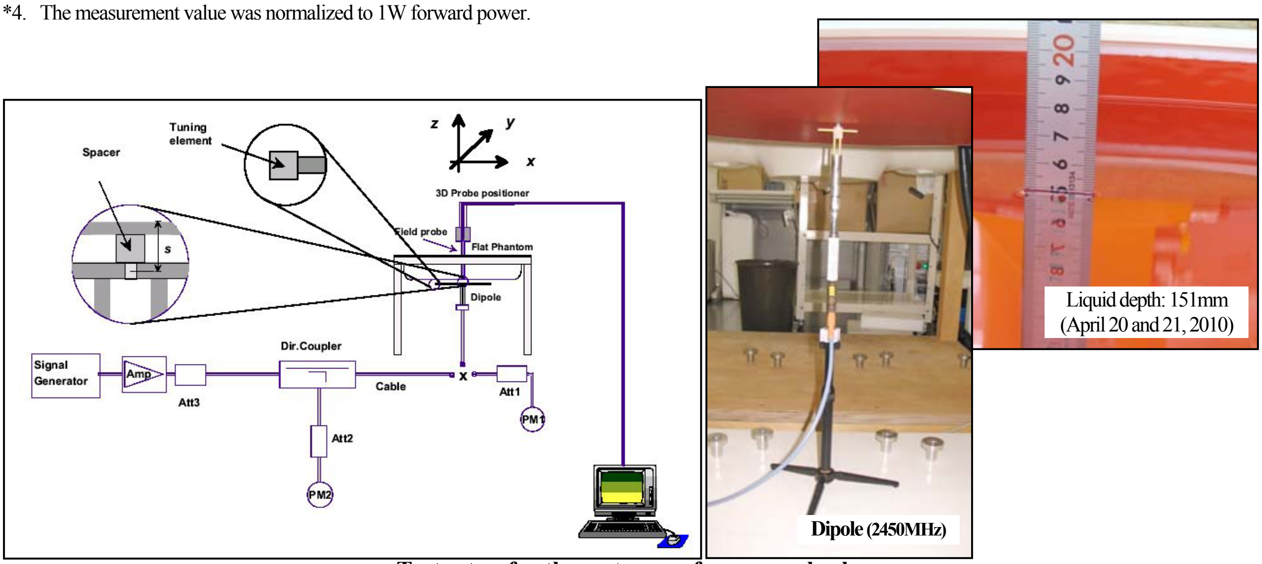
*1. The target value is a parameter defined in OET65 Sup.C.
*2. The target value is a parameter defined in the calibration data sheet of D2450V2 (sn:822) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D2450V2-822_Mar09, the data sheet was failed in this report.).

## Appendix 3-8: System validation data

Prior to the SAR assessment of EUT, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are in the table below.

| System validation results | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Freq. [MHz] | Liquid Type | Ambient | | Liquid Temp. [deg.C.] | | | Liquid Depth [mm] | Permittivity measured εr [-] | Conductivity measured σ [S/m]] | Power drift [dB] | System dipole validation target & measured SAR 1g [Wkg] (at 1W) | | | |
| | | | Temp [deg.C.] | Humidity [%] | Check | Before | After | | | | | Target value (*3) | Measured (*4) | Deviation [%] | Limit [%] |
| April 20, 2010 | 2450 | Body | 23.3 | 44 | 22.8 | 22.5 | 22.4 | 151 | 51.6 | 2.00 | -0.077 | **52.1** | 54.8 (13.7 (at 250mW)) | **+5.2** | ±10 |
| April 21, 2010 | 2450 | Body | 23.1 | 51 | 22.9 | 22.8 | 22.7 | 151 | 51.6 | 2.02 | 0.086 | **52.1** | 55.6 (13.9 (at 250mW)) | **+6.7** | ±10 |

**Note: Refer to Appendix 3-10 Validation measurement data for the above result representation in plot data.**
*3. The target value is a parameter defined in the calibration data sheet of D2450V2 (sn:822) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D2450V2-822_Mar09, the data sheet was failed in this report.).
*. We performed the system validation based on FCC requirement, [The 1-g or 10-g SAR values measured using the required tissue dielectric parameters should be within 10% of manufacturer calibrated dipole SAR values. However these manufacturer calibrated dipole target SAR values should be substantially similar to those defined in IEEE Standard 1528. ] and FCC permits [SAR system verification with the actual liquid used for DUT SAR measurement should be the default operating procedures.]
We confirmed the this dipole manufacture's validation data for head is within 5% against IEEE Standard 1528. so we can only use Body liquid validation data for our system verification
*4. The measurement value was normalized to 1W forward power.




Test setup for the system performance check

## Appendix 3-9: Validation uncertainty

| Uncertainty of system check setup | Under 3GHz | |
|---|---|---|
| | 1g SAR | 10g SAR |
| combined measurement uncertainty of the measurement system (k=1) | ± 9.9% | ± 9.6% |
| expanded uncertainty (k=2) | ± 19.9% | ± 19.3% |

[Under 3GHz]

| | Error Description | Uncertainty Value | Probability distribution | Divisor | ci (1g) | ci (10g) | ui (1g) | ui (10g) | vi, veff |
|---|---|---|---|---|---|---|---|---|---|
| A | Measurement System | | | | | | (std. uncertainty) | (std. uncertainty) | |
| 1 | Probe calibration | ±5.9 % | Normal | 1 | 1 | 1 | ±5.9 % | ±5.9 % | ∞ |
| 2 | Axial isotropy | ±4.7 % | Rectangular | √3 | 0.7 | 0.7 | ±1.9 % | ±1.9 % | ∞ |
| 3 | Hemispherical isotropy (flat, <5°) | ±2.6 % | Rectangular | √3 | 0.7 | 0.7 | ±1.1 % | ±1.1 % | ∞ |
| 4 | Boundary effects | ±1.0 % | Rectangular | √3 | 1 | 1 | ±1.2 % | ±1.2 % | ∞ |
| 5 | Probe linearity | ±4.7 % | Rectangular | √3 | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| 6 | System detection limit | ±1.0 % | Rectangular | √3 | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| 7 | System readout electronics | ±0.3 % | Normal | 1 | 1 | 1 | ±0.3 % | ±0.3 % | ∞ |
| 8 | Response time | ±0.0 % | Rectangular | √3 | 1 | 1 | ±0.0 % | ±0.0 % | ∞ |
| 9 | Integration time | ±0.0 % | Rectangular | √3 | 1 | 1 | ±0.0 % | ±0.0 % | ∞ |
| 10 | RF ambient - noise | ±3.0 % | Rectangular | √3 | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| 11 | RF ambient - reflections | ±3.0 % | Rectangular | √3 | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| 12 | Probe positioner mechanical tolerance | ±0.4 % | Rectangular | √3 | 1 | 1 | ±0.2 % | ±0.2 % | ∞ |
| 13 | Probe positioning with respect to phantom shell | ±2.9 % | Rectangular | √3 | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| 14 | Max.SAR evaluation | ±1.0 % | Rectangular | √3 | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| B | Dipole | | | | | | | | |
| 15 | Dipole axis to liquid distance | ±2.0 % | Rectangular | √3 | 1 | 1 | ±1.2 % | ±1.2 % | ∞ |
| 16 | Input power and SAR drift measurement | ±4.7 % | Rectangular | √3 | 1 | 1 | ±4.7 % | ±4.7 % | 3 |
| C | Phantom and Setup | | | | | | | | |
| 17 | Phantom uncertainty | ±4.0 % | Rectangular | √3 | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| 18 | Liquid conductivity (target) | ±5.0 % | Rectangular | √3 | 0.64 | 0.43 | ±1.8 % | ±1.2 % | ∞ |
| 19 | Liquid conductivity (meas.) | ±2.9 % | Normal | 1 | 0.64 | 0.43 | ±1.9 % | ±1.2 % | 3 |
| 20 | Liquid permittivity (target) | ±5.0 % | Rectangular | √3 | 0.6 | 0.49 | ±1.7 % | ±1.4 % | ∞ |
| 21 | Liquid permittivity (meas.) | ±2.9 % | Normal | 1 | 0.6 | 0.49 | ±1.7 % | ±1.4 % | 3 |
| | **Combined Standard Uncertainty** | | | | | | **±9.9 %** | **±9.6 %** | 88 |
| | **Expanded Uncertainty (k=2)** | | | | | | **±19.9 %** | **±19.3 %** | |

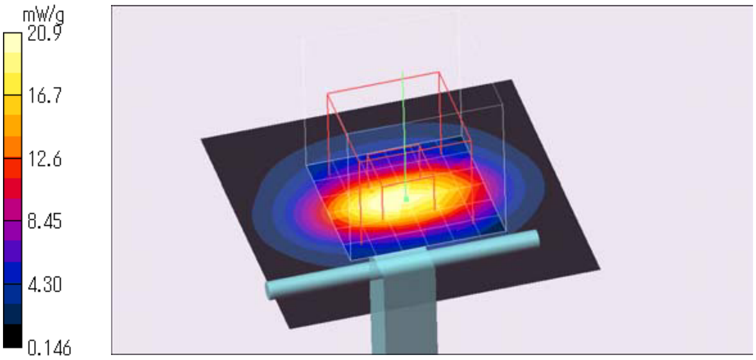
*. This measurement uncertainty budget is suggested by IEEE 1528 and determined by Schmid & Partner Engineering AG.[5]

## Appendix 3-10: Validation measurement data

### 1. (April 20, 2010) 2450MHz system check (Body) / Forward conducted power: 250mW

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 822**
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:60x60,step=15 (41x41x1):** Measurement grid: dx=15mm, dy=15mm,
Maximum value of SAR (interpolated) = 21.2 mW/g
**Zoom Scan:30x30x30,step=5 (7x7x7):** Measurement grid: dx=5mm, dy=5mm, dz=5mm,
Reference Value = 103.5 V/m; Power Drift = -0.077 dB, Peak SAR (extrapolated) = 27.8 W/kg (+4.9%, vs.26.5W/kg at 250mW-sepag cal.)
**SAR(1 g) = 13.7 mW/g;** SAR(10 g) = 6.46 mW/g, Maximum value of SAR (measured) = 20.9 mW/g

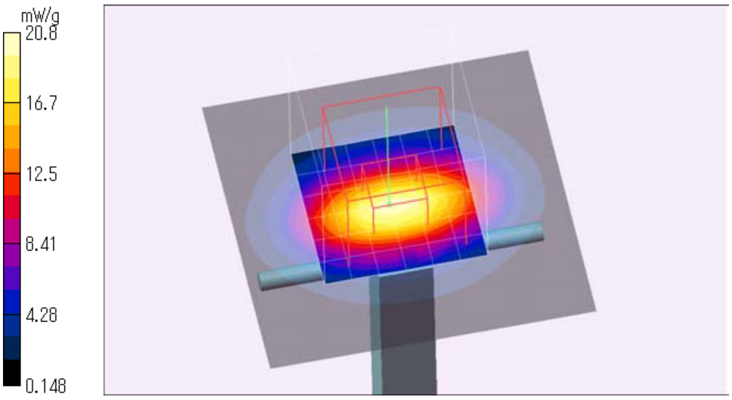



Additional information: position of distance of DUT to SAM: 8mm (10mm to liquid), liquid depth: 151mm
ambient temperature: 23.3 deg.C; liquid temperature: (before) 22.5 deg.C. /(after) 22.4 deg.C. (2010.0420,3S/R, Tested by H. Naka)

### 2. (April 21, 2010) 2450MHz system check (Body) / Forward conducted power: 250mW

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 822**
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: M2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2.02 mho/m; $\varepsilon_r$ = 51.6; $\rho$ = 1000 kg/m$^3$
DASY4 Configuration:
- Probe: EX3DV4 - SN3540; ConvF(7.87, 7.87, 7.87); Calibrated: 2009/06/26
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059, Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

**Area Scan:60x60,step=15 (41x41x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 20.1 mW/g
**Zoom Scan:30x30x30,step=5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.3 V/m; Power Drift = 0.086 dB, Peak SAR (extrapolated) = 28.0 W/kg (+5.7%, vs.26.5W/kg at 250mW-sepag cal.)
**SAR(1 g) = 13.9 mW/g**; SAR(10 g) = 6.49 mW/g, Maximum value of SAR (measured) = 20.8 mW/g




Additional information: position of distance of DUT to SAM: 8mm (10mm to liquid), liquid depth: 151mm
ambient temperature: 23.1 deg.C; liquid temperature: (before) 22.8 deg.C. /(after) 22.7 deg.C. (2010.0421,3S/R, Tested by H. Naka)

## Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822)

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client: UL Japan

Certificate No: D2450V2-822_Mar09

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN: 822 |
| Calibration procedure(s) | QA CAL-05.v7<br>Calibration procedure for dipole validation kits |
| Calibration date: | March 10, 2009 |
| Condition of the calibrated item | In Tolerance |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 08-Oct-08 (No. 217-00898) | Oct-09 |
| Power sensor HP 8481A | US37292783 | 08-Oct-08 (No. 217-00898) | Oct-09 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 01-Jul-08 (No. 217-00864) | Jul-09 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 01-Jul-08 (No. 217-00867) | Jul-09 |
| Reference Probe ES3DV2 | SN: 3025 | 28-Apr-08 (No. ES3-3025_Apr08) | Apr-09 |
| DAE4 | SN: 601 | 14-Mar-08 (No. DAE4-601_Mar08) | Mar-09 |
| DAE4 | SN: 601 | 07-Mar-09 (No. DAE4-601_Mar09) | Mar-10 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-07) | In house check: Oct-09 |
| RF generator R&S SMT-06 | 100005 | 4-Aug-99 (in house check Oct-07) | In house check: Oct-09 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-08) | In house check: Oct-09 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Jeton Kastrati | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: March 13, 2009

Certificate No: D2450V2-822_Mar09 Page 1 of 9

**Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)**

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V5.0 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom V5.0 | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 2450 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 39.2 | 1.80 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 38.0 ± 6 % | 1.82 mho/m ± 6 % |
| **Head TSL temperature during test** | (21.0 ± 0.2) °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.6 mW / g |
| SAR normalized | normalized to 1W | 54.4 mW / g |
| SAR for nominal Head TSL parameters [1] | normalized to 1W | **53.7 mW /g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.29 mW / g |
| SAR normalized | normalized to 1W | 25.2 mW / g |
| SAR for nominal Head TSL parameters [1] | normalized to 1W | **25.0 mW /g ± 16.5 % (k=2)** |

[1] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"



*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 52.7 | 1.95 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 54.3 ± 6 % | 1.99 mho/m ± 6 % |
| Body TSL temperature during test | (21.1 ± 0.2) °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 $cm^3$ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.1 mW / g |
| SAR normalized | normalized to 1W | 52.4 mW / g |
| SAR for nominal Body TSL parameters [2] | normalized to 1W | **52.1 mW /g ± 17.0 % (k=2)** |

| SAR averaged over 10 $cm^3$ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.13 mW / g |
| SAR normalized | normalized to 1W | 24.5 mW / g |
| SAR for nominal Body TSL parameters [2] | normalized to 1W | **24.5 mW /g ± 16.5 % (k=2)** |

[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"



*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 54.9 Ω + 2.7 jΩ |
| Return Loss | - 25.4 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 49.6 Ω + 4.8 jΩ |
| Return Loss | - 26.3 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.161 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | December 11, 2008 |



*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

## DASY5 Validation Report for Head TSL

Date/Time: 03.03.2009 14:56:44

Test Laboratory: SPEAG, Zurich, Switzerland

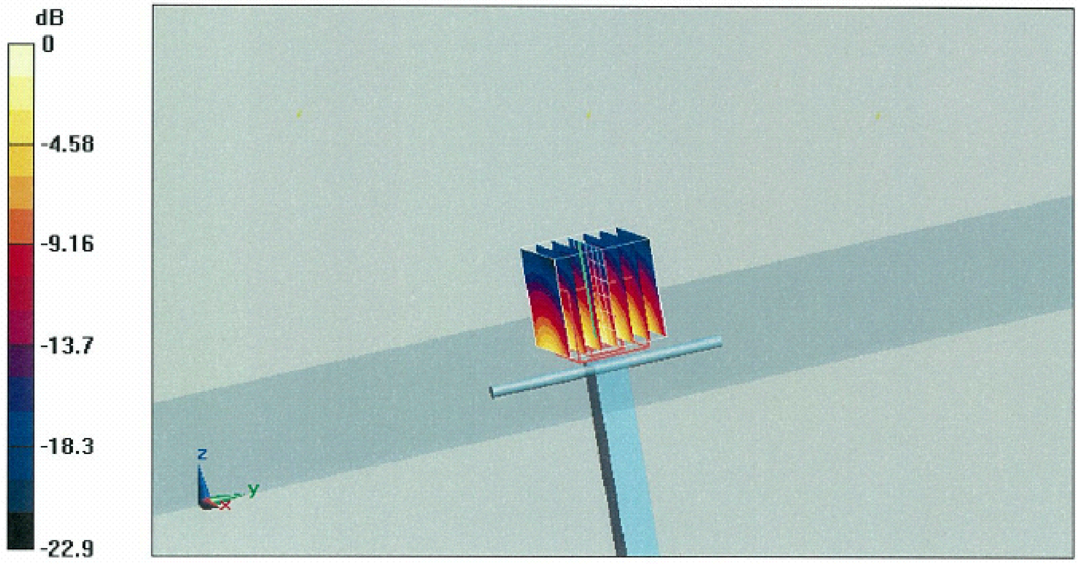
**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN822**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL U10 BB
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.83 mho/m; $\varepsilon_r$ = 38.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.3 V/m; Power Drift = 0.063 dB
Peak SAR (extrapolated) = 28.8 W/kg
**SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.29 mW/g**
Maximum value of SAR (measured) = 16.7 mW/g



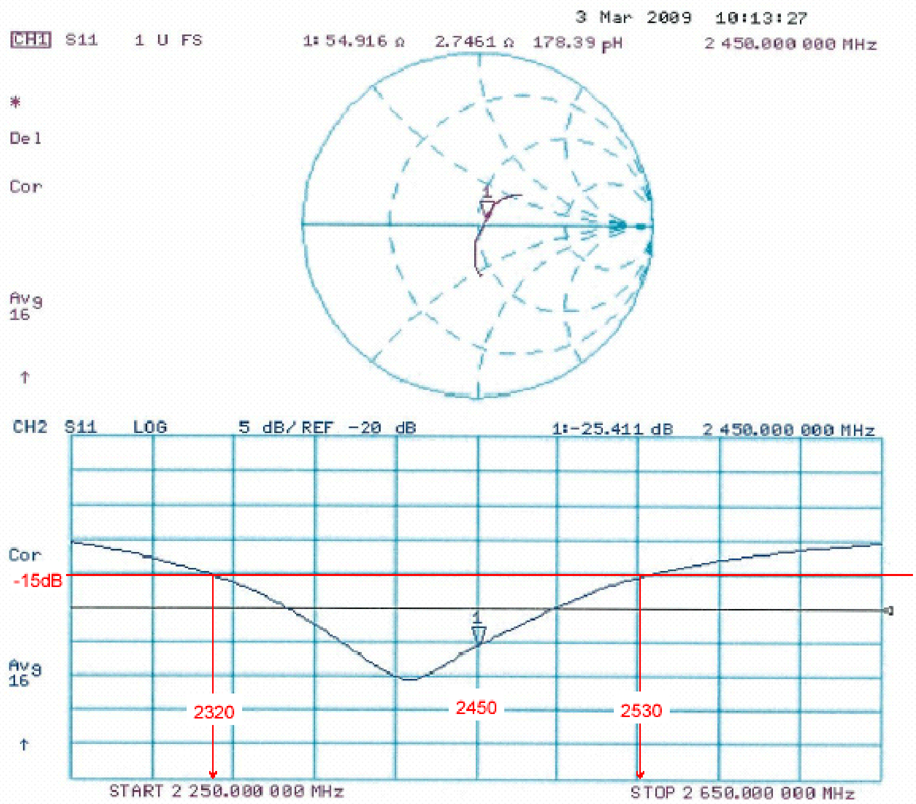

0 dB = 16.7mW/g



*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

**Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)**

## Impedance Measurement Plot for Head TSL




Certificate No: D2450V2-822_Mar09 Page 7 of 9

**Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)**

## DASY5 Validation Report for Body TSL

Date/Time: 10.03.2009 15:02:43

Test Laboratory: SPEAG, Zurich, Switzerland

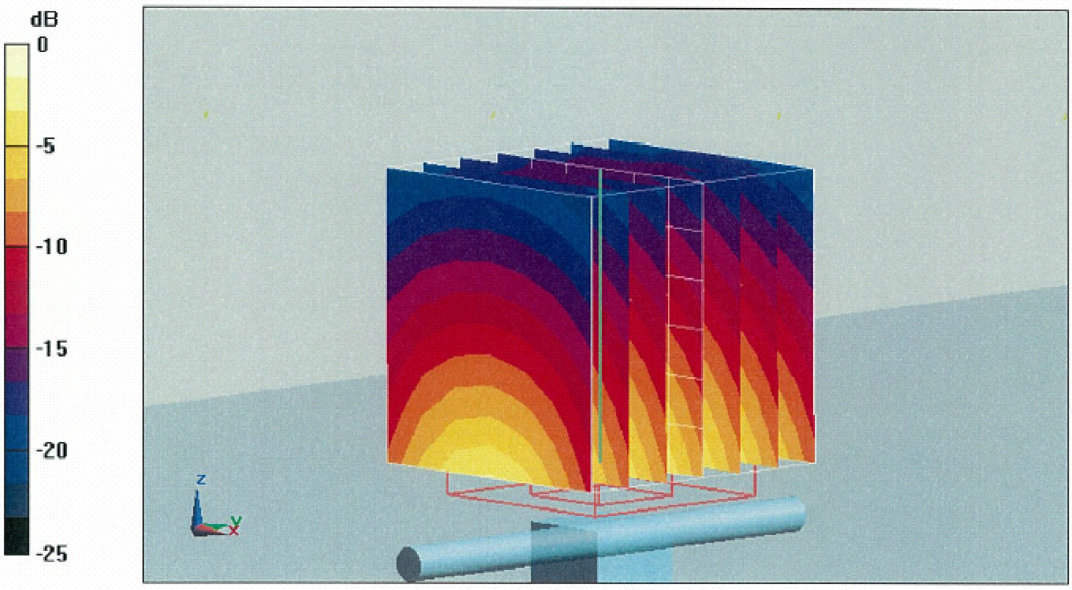
**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:822**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL U10 BB
Medium parameters used: f = 2450 MHz; $\sigma$ = 2 mho/m; $\varepsilon_r$ = 54.4; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.07, 4.07, 4.07); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.1 V/m; Power Drift = -0.013 dB
Peak SAR (extrapolated) = 26.5 W/kg
**SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.13 mW/g**
Maximum value of SAR (measured) = 16.3 mW/g

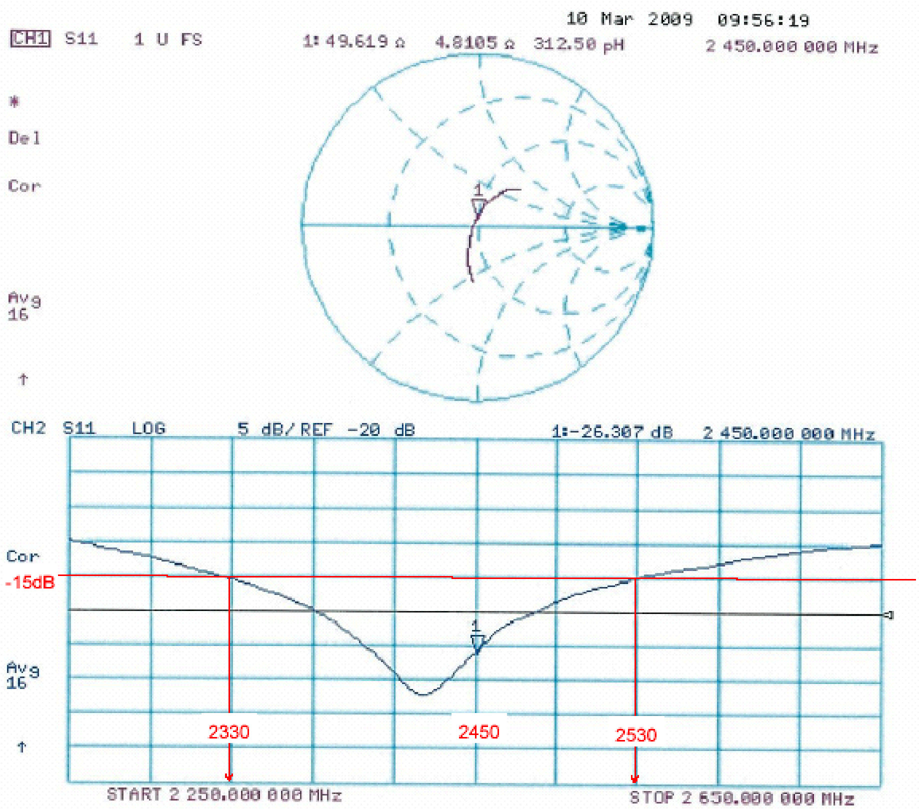



0 dB = 16.3mW/g

Certificate No: D2450V2-822_Mar09 Page 8 of 9

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

## Impedance Measurement Plot for Body TSL



**Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540)**

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 108**

Client PTT

Certificate No: **EX3-3540_Jun09**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:3540 |
| Calibration procedure(s) | QA CAL-01.v6, QA CAL-14.v3 and QA CAL-23.v3<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | June 26, 2009 |
| Condition of the calibrated item | In Tolerance |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter E4419B | GB41293874 | 1-Apr-09 (No. 217-01030) | Apr-10 |
| Power sensor E4412A | MY41495277 | 1-Apr-09 (No. 217-01030) | Apr-10 |
| Power sensor E4412A | MY41498087 | 1-Apr-09 (No. 217-01030) | Apr-10 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 31-Mar-09 (No. 217-01026) | Mar-10 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 31-Mar-09 (No. 217-01028) | Mar-10 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 31-Mar-09 (No. 217-01027) | Mar-10 |
| Reference Probe ES3DV2 | SN: 3013 | 2-Jan-09 (No. ES3-3013_Jan09) | Jan-10 |
| DAE4 | SN: 660 | 9-Sep-08 (No. DAE4-660_Sep08) | Sep-09 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Oct-07) | In house check: Oct-09 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-08) | In house check: Oct-09 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Katja Pokovic | Technical Manager | |
| Approved by: | Niels Kuster | Quality Manager | |

Issued: June 26, 2009

Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540) (cont'd)

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
Servizio svizzero di taratura
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 108**

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| Polarization φ | φ rotation around probe axis |
| Polarization ϑ | ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the $E^2$-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.



*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

**Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540) (cont'd)**

# Probe EX3DV4

# SN:3540

| | |
|---|---|
| Manufactured: | August 23, 2005 |
| Last calibrated: | March 12, 2008 |
| Recalibrated: | June 26, 2009 |

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: EX3-3540_Jun09 Page 3 of 9

Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540) (cont'd)

EX3DV4 SN:3540 June 26, 2009

# DASY - Parameters of Probe: EX3DV4 SN:3540

## Sensitivity in Free Space[A]

| | | |
|---|---|---|
| NormX | **0.46** ± 10.1% | $\mu V/(V/m)^2$ |
| NormY | **0.50** ± 10.1% | $\mu V/(V/m)^2$ |
| NormZ | **0.58** ± 10.1% | $\mu V/(V/m)^2$ |

## Diode Compression[B]

| | |
|---|---|
| DCP X | **91** mV |
| DCP Y | **91** mV |
| DCP Z | **93** mV |

## Sensitivity in Tissue Simulating Liquid (Conversion Factors)

**Please see Page 8.**

## Boundary Effect

**TSL 2450 MHz Typical SAR gradient: 10 % per mm**

| Sensor Center to Phantom Surface Distance | | **2.0 mm** | **3.0 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 6.9 | 4.4 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.7 | 0.6 |

**TSL 5200 MHz Typical SAR gradient: 25 % per mm**

| Sensor Center to Phantom Surface Distance | | **2.0 mm** | **3.0 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 22.2 | 16.2 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.8 | 0.5 |

## Sensor Offset

Probe Tip to Sensor Center **1.0** mm

**The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.**

[A] The uncertainties of NormX,Y,Z do not affect the $E^2$-field uncertainty inside TSL (see Page 8).

[B] Numerical linearization parameter: uncertainty not required.



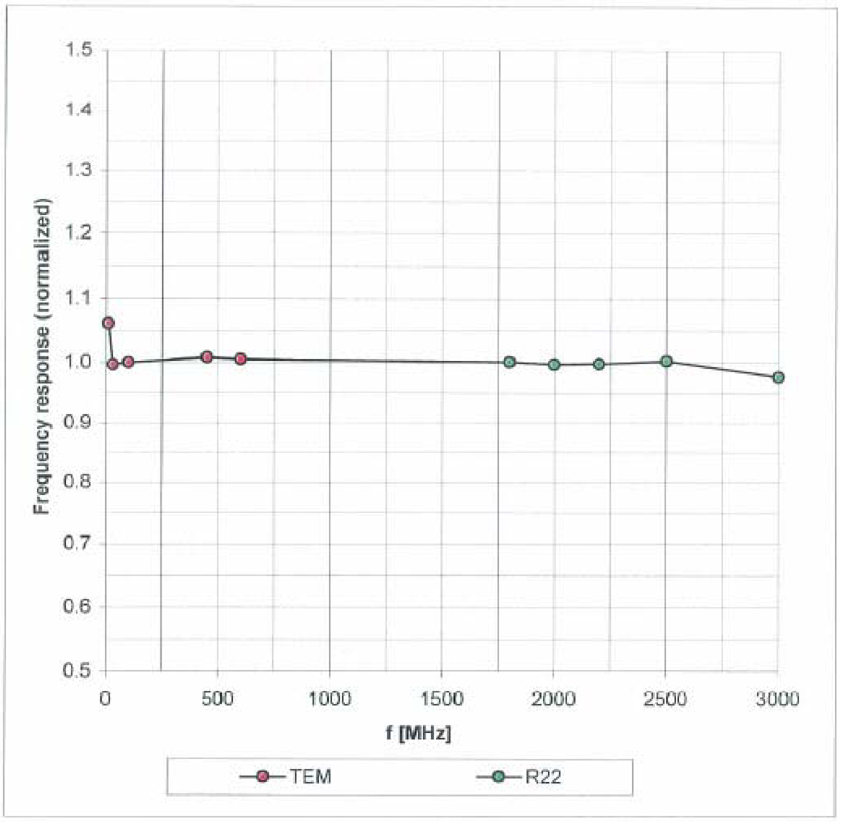
*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

**Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540) (cont'd)**

EX3DV4 SN:3540 June 26, 2009

# Frequency Response of E-Field

**(TEM-Cell:ifi110 EXX, Waveguide: R22)**




Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

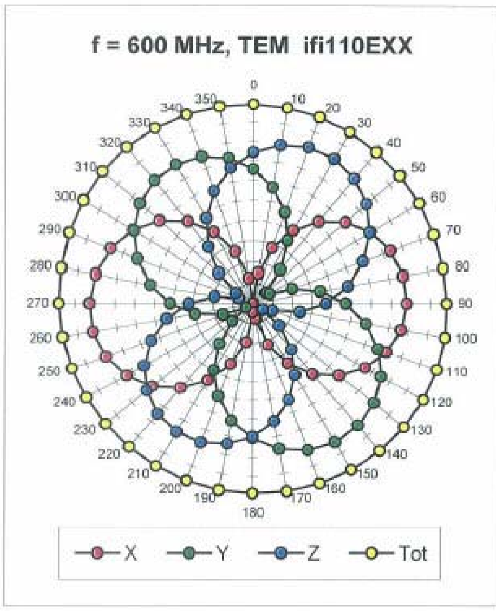


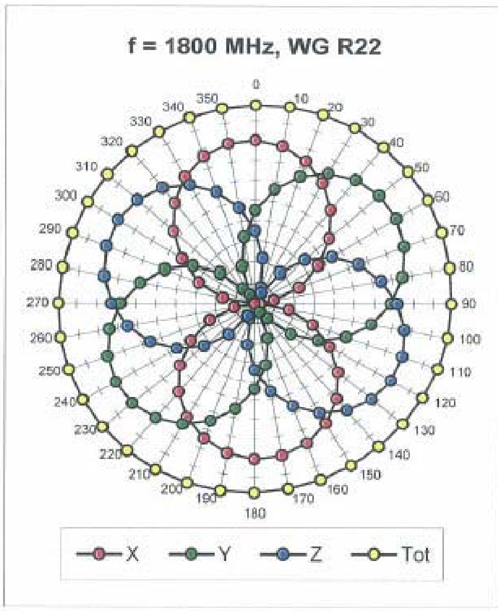
*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

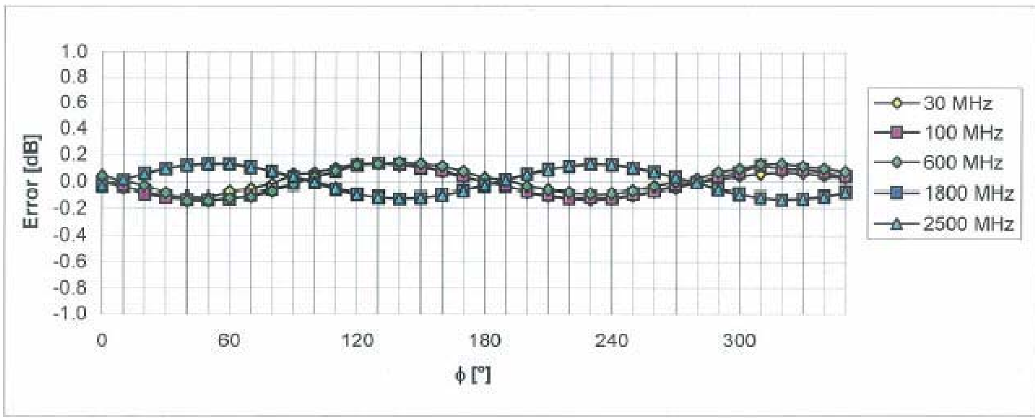
**Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540) (cont'd)**

EX3DV4 SN:3540 June 26, 2009

## Receiving Pattern (ϕ), ϑ = 0°




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)



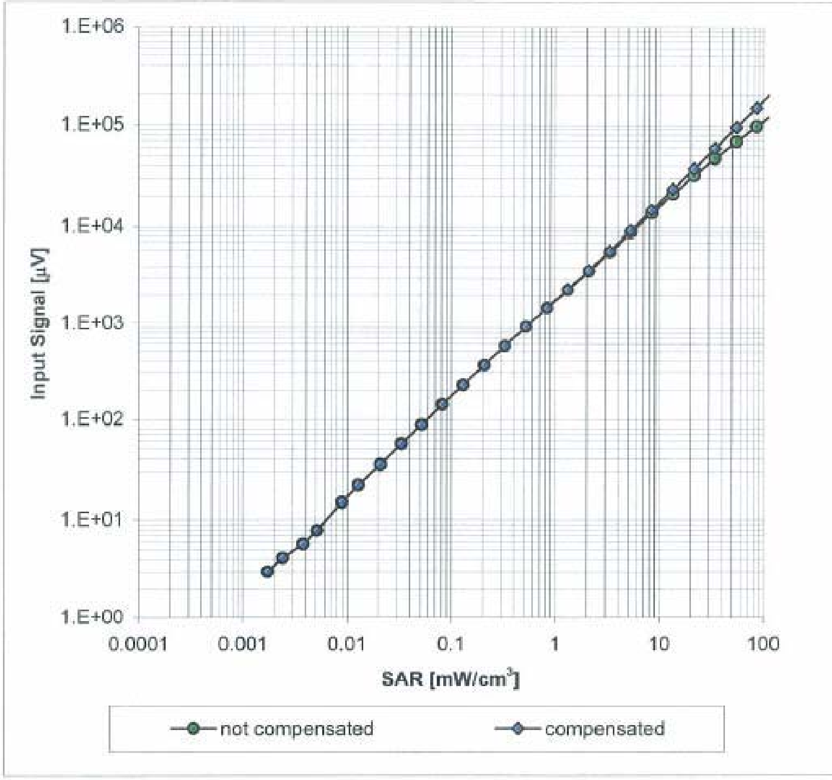
*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

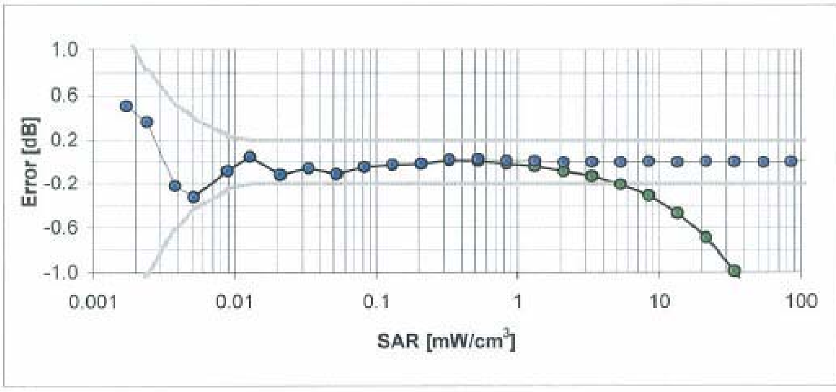
Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540) (cont'd)

EX3DV4 SN:3540 June 26, 2009

# Dynamic Range f($SAR_{head}$)

(Waveguide R22, f = 1800 MHz)




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

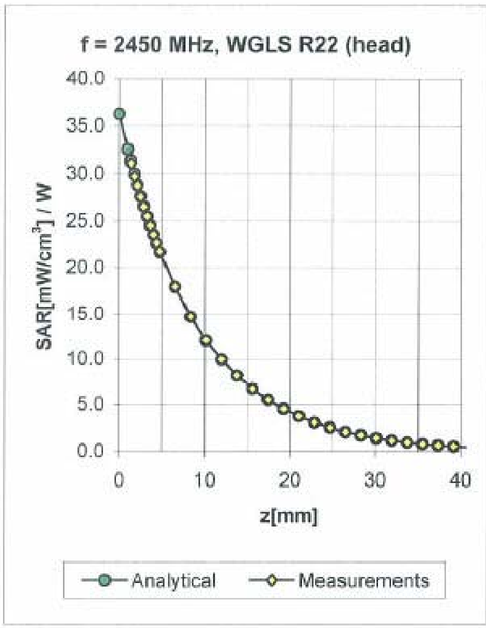


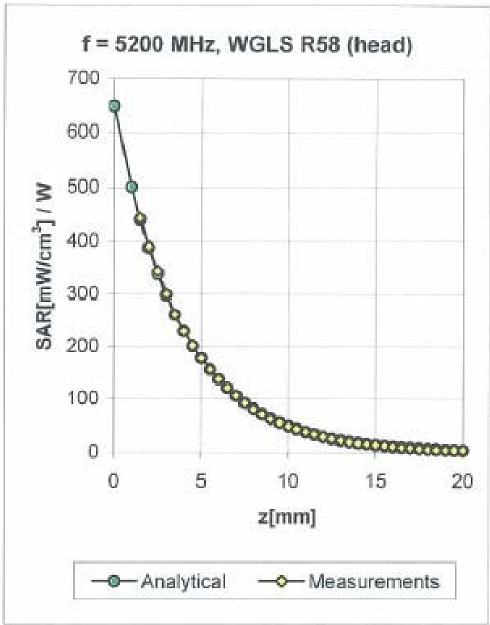
*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540) (cont'd)

EX3DV4 SN:3540 June 26, 2009

## Conversion Factor Assessment




| f [MHz] | Validity [MHz][C] | TSL | Permittivity | Conductivity | Alpha | Depth | ConvF | Uncertainty |
|---|---|---|---|---|---|---|---|---|
| 2450 | ± 50 / ± 100 | Head | 39.2 ± 5% | 1.80 ± 5% | 0.28 | 0.89 | 7.65 | ± 11.0% (k=2) |
| 5200 | ± 50 / ± 100 | Head | 36.0 ± 5% | 4.66 ± 5% | 0.40 | 1.80 | 4.64 | ± 13.1% (k=2) |
| 5300 | ± 50 / ± 100 | Head | 35.9 ± 5% | 4.76 ± 5% | 0.50 | 1.80 | 4.18 | ± 13.1% (k=2) |
| 5500 | ± 50 / ± 100 | Head | 35.6 ± 5% | 4.96 ± 5% | 0.50 | 1.80 | 4.16 | ± 13.1% (k=2) |
| 5600 | ± 50 / ± 100 | Head | 35.5 ± 5% | 5.07 ± 5% | 0.50 | 1.80 | 4.02 | ± 13.1% (k=2) |
| 5800 | ± 50 / ± 100 | Head | 35.3 ± 5% | 5.27 ± 5% | 0.50 | 1.80 | 4.10 | ± 13.1% (k=2) |
| 2450 | ± 50 / ± 100 | Body | 52.7 ± 5% | 1.95 ± 5% | 0.26 | 0.96 | 7.87 | ± 11.0% (k=2) |
| 5200 | ± 50 / ± 100 | Body | 49.0 ± 5% | 5.30 ± 5% | 0.60 | 1.90 | 3.95 | ± 13.1% (k=2) |
| 5300 | ± 50 / ± 100 | Body | 48.5 ± 5% | 5.42 ± 5% | 0.60 | 1.90 | 3.70 | ± 13.1% (k=2) |
| 5500 | ± 50 / ± 100 | Body | 48.6 ± 5% | 5.65 ± 5% | 0.60 | 1.90 | 3.63 | ± 13.1% (k=2) |
| 5600 | ± 50 / ± 100 | Body | 48.5 ± 5% | 5.77 ± 5% | 0.60 | 1.90 | 3.40 | ± 13.1% (k=2) |
| 5800 | ± 50 / ± 100 | Body | 48.2 ± 5% | 6.00 ± 5% | 0.55 | 1.90 | 3.50 | ± 13.1% (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.



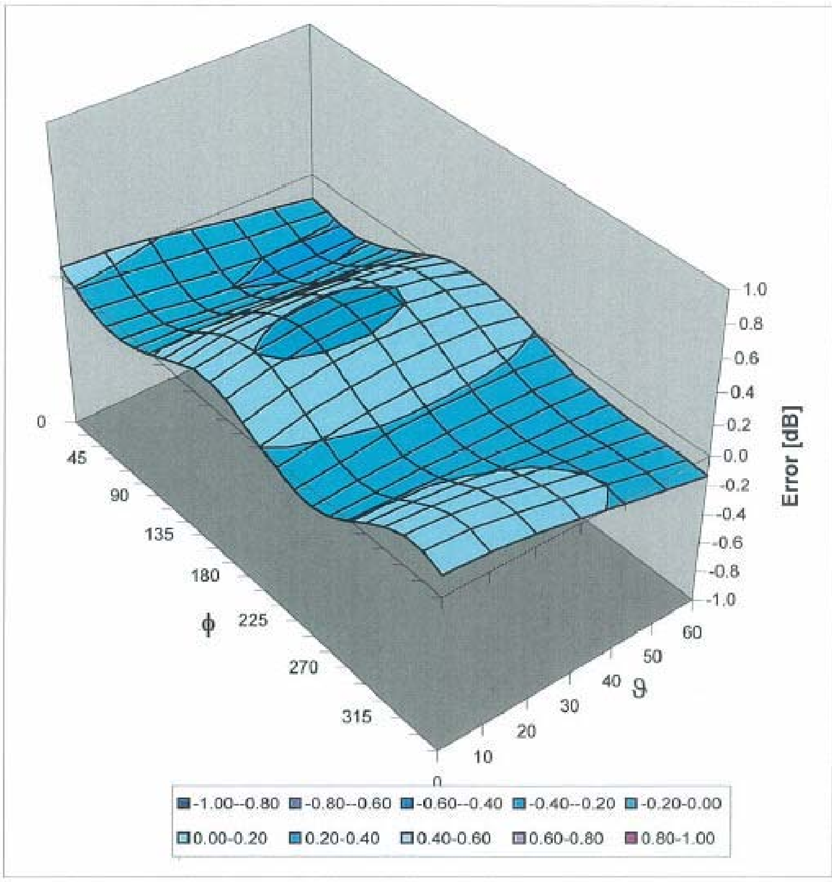
*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3540) (cont'd)

EX3DV4 SN:3540 June 26, 2009

# Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz




Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)



*UL Japan, Inc.*
*YAMAKITA EMC LAB.*
907 Kawanishi, Yamakita-machi, Ashigarakami-gun, Kanagawa-ken, 258-0124 JAPAN
Telephone: +81 465 77 1011 / Facsimile: +81 465 77 2112

## Appendix 3-13: Reference

[1] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.
[2] Katja Pokovic, Thomas Schmid, and Niels Kuster, "Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM '97, Dubrovnik, October 15-17, 1997, pp. 120-124.
[3] Katja Pokovic, Thomas Schmid, and Niels Kuster, "E-_field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23-25 June, 1996, pp.172-175.
[4] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.
[5] W. H. Press, S. A. Teukolsky,W. T. Vetterling, and B. P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.
[6] SPEAG uncertainty document for DASY 4 System from SPEAG (Schmid & Partner Engineering AG).