# 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) (or more) was assessed by measuring 7×7×7 points (or more) under 3GHz.
And for any secondary peaks found in the Step2 which are within 2dB of the SAR limit (1.6W/kg), 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. 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). 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: SAR measurement data

### Step 1: Worst SAR search of DSSS mode

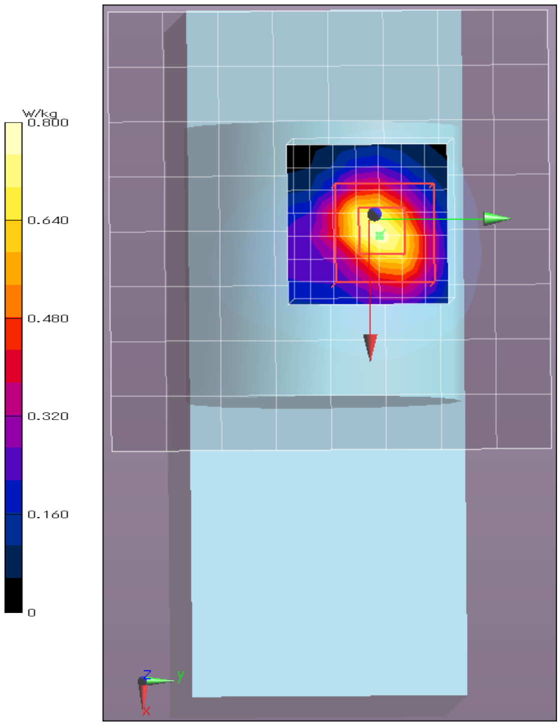
**Plot 1-1: Channel / Setup: Top & touch (separation distance=0mm) / 11b (1Mbps), 2437 MHz**
**->Highest reported SAR(1g) of this platform**

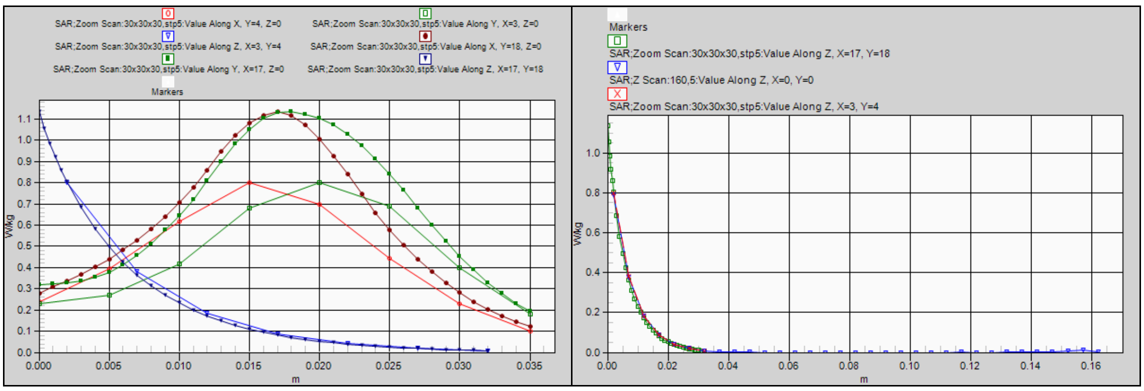
**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; σ = 1.983 S/m; $\varepsilon_r$ = 50.61; ρ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -Electronics: DAE4 Sn626; Calibrated: 2015/09/15
-Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), 2mm (Mechanical Surface Detection), z = 1.0, 31.0, 161.0
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**kdb248227,body/b2,ch;top-frt&touch,b(1m,set:12),b2437/**
**Area Scan:96x96,stp12 (9x9x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.777 W/kg
**Area Scan:96x96,stp12 (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm' Maximum value of SAR (interpolated) = 0.802 W/kg
**Z Scan:160,5 (1x1x33):** Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 0.792 W/kg

**Zoom Scan:35x35x30,stp5 (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 20.28 V/m; Power Drift = 0.01 dB; Maximum value of SAR (measured) = 0.800 W/kg; Peak SAR (extrapolated) = 1.14 W/kg
**SAR(1 g) = 0.508 W/kg; SAR(10 g) = 0.218 W/kg**



Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.4(start)/22.4(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

Appendix 2-2: SAR measurement data / Step 1: Worst SAR search of DSSS mode (cont'd)

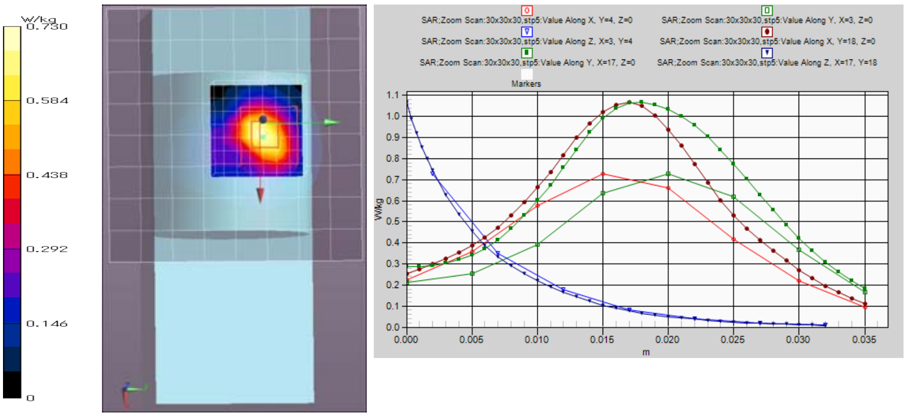
**Plot 1-2: Setup: Top & touch (separation distance=0mm) / 11b (1Mbps), 2412 MHz** (*. maximum measured power channel)

**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2412 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2412 MHz; $\sigma$ = 1.948 S/m; $\varepsilon_r$ = 50.78; $\rho$ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)
-Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0 -Electronics: DAE4 Sn626; Calibrated: 2015/09/15
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

**kdb248227,body/b1,top-frt&touch,b(1m,set:12),b2412/**
**Area Scan:96x96,stp12 (9x9x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.771 W/kg
**Area Scan:96x96,stp12 (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.789 W/kg

**Zoom Scan:35x35x30,stp5 (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 20.07 V/m; Power Drift = -0.06 dB; Maximum value of SAR (measured) = 0.730 W/kg; Peak SAR (extrapolated) = 1.07 W/kg
**SAR(1 g) = 0.470 W/kg; SAR(10 g) = 0.204 W/kg**




Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.4(start)/22.4(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

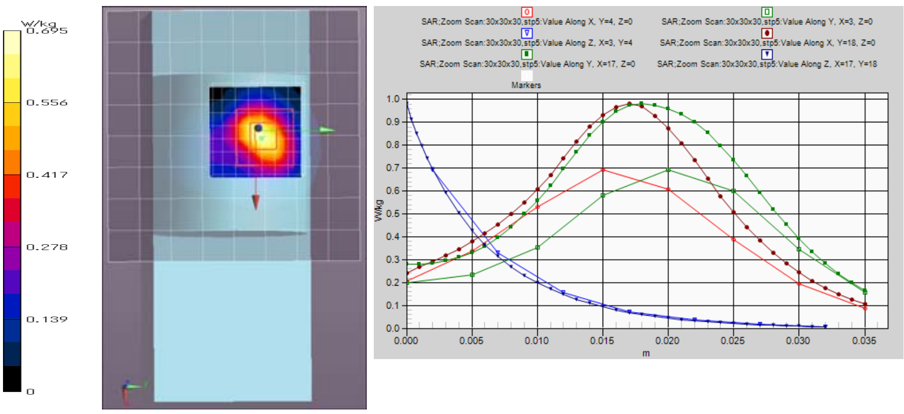
**Plot 1-3: Channel / Setup: Top & touch (separation distance=0mm) / 11b (1Mbps), 2462 MHz**

**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2462 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2462 MHz; $\sigma$ = 2.016 S/m; $\varepsilon_r$ = 50.57; $\rho$ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -Electronics: DAE4 Sn626; Calibrated: 2015/09/15
-Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**kdb248227,body/b3,ch;top-frt&touch,b(1m,set:12),b2462/**
**Area Scan:96x96,stp12 (9x9x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.689 W/kg
**Area Scan:96x96,stp12 (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.709 W/kg

**Zoom Scan:35x35x30,stp5 (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 18.83 V/m; Power Drift = -0.01 dB; Maximum value of SAR (measured) = 0.695 W/kg; Peak SAR (extrapolated) = 0.982 W/kg
**SAR(1 g) = 0.438 W/kg; SAR(10 g) = 0.186 W/kg**




Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.4(start)/22.4(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

**Appendix 2-2: SAR measurement data / Step 1: Worst SAR search of DSSS mode (cont'd)**

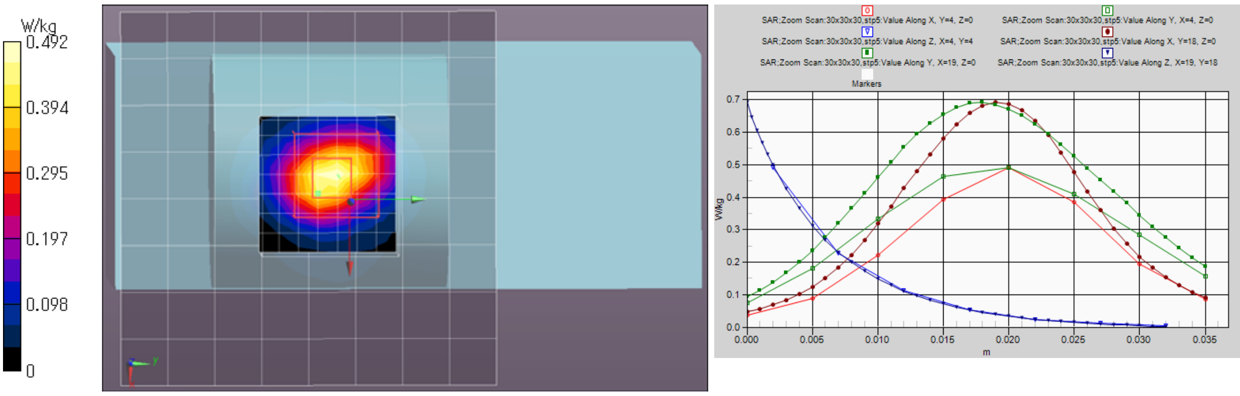
## Plot 1-4: Setup: Top-front & touch (separation distance=0mm) / 11b (1Mbps), 2437 MHz

**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; σ = 1.983 S/m; $\varepsilon_r$ = 50.61; ρ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0; -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section; -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331); -Electronics: DAE4 Sn626; Calibrated: 2015/09/15

**kdb248227,body/b9,top-frt-tilt&touch,b(1m,set:12),b2437/**
**Area Scan:96x96,stp12 (9x9x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.562 W/kg
**Area Scan:96x96,stp12 (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.597 W/kg

**Zoom Scan:35x35x30,stp5 (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 17.21 V/m; Power Drift = -0.07 dB; Maximum value of SAR (measured) = 0.492 W/kg; Peak SAR (extrapolated) = 0.692 W/kg
**SAR(1 g) = 0.312 W/kg; SAR(10 g) = 0.134 W/kg**




Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.5(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

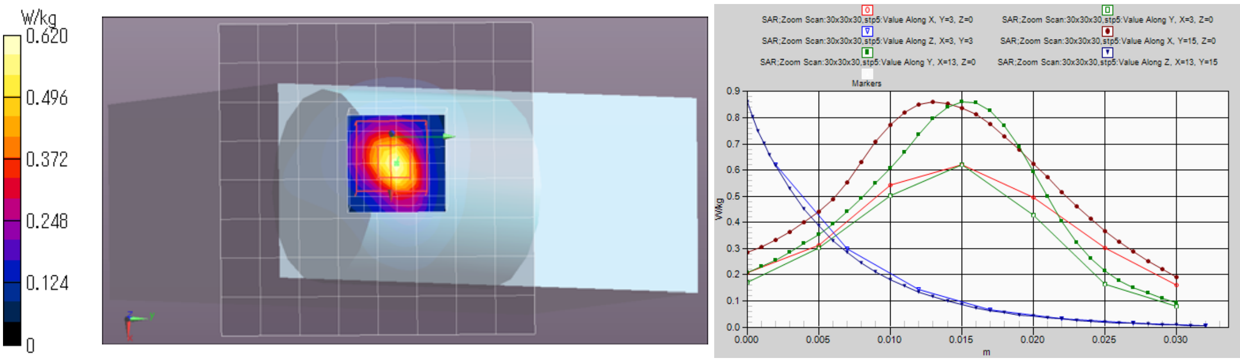
## Plot 1-5: Setup: Top-left-front & touch (separation distance=0mm) / 11b (1Mbps), 2437 MHz

**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; σ = 1.983 S/m; $\varepsilon_r$ = 50.61; ρ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0; -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section; -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331); -Electronics: DAE4 Sn626; Calibrated: 2015/09/15

**kdb248227,body/b6,top-frt-left-tilt&touch,b(1m,set:12),b2437/**
**Area Scan:96x96,stp12 (9x9x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.364 W/kg
**Area Scan:96x96,stp12 (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.462 W/kg

**Zoom Scan:30x30x30,stp5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 18.32 V/m; Power Drift = -0.02 dB; Maximum value of SAR (measured) = 0.620 W/kg; Peak SAR (extrapolated) = 0.860 W/kg
**SAR(1 g) = 0.382 W/kg; SAR(10 g) = 0.156 W/kg**




Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.5(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

**Appendix 2-2: SAR measurement data / Step 1: Worst SAR search of DSSS mode (cont'd)**

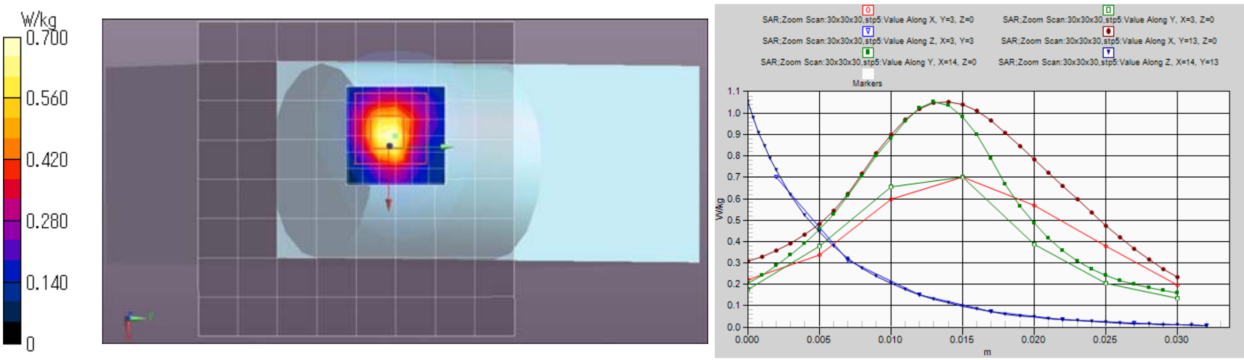
## Plot 1-6: Setup: Top-front-left & touch (separation distance=0mm) / 11b (1Mbps), 2437 MHz

**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; σ = 1.983 S/m; $\varepsilon_r$ = 50.61; ρ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)
-Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0 -Electronics: DAE4 Sn626; Calibrated: 2015/09/15
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

**kdb248227,body/b11,top-frt-left-tilt(near-left)&touch,b(1m,set:12),b2437/**
**Area Scan:96x96,stp12 (9x9x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.699 W/kg
**Area Scan:96x96,stp12 (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.702 W/kg

**Zoom Scan:30x30x30,stp5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 19.14 V/m; Power Drift = 0.01 dB; Maximum value of SAR (measured) = 0.700 W/kg; Peak SAR (extrapolated) = 1.05 W/kg
**SAR(1 g) = 0.438 W/kg; SAR(10 g) = 0.178 W/kg**




Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.5(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

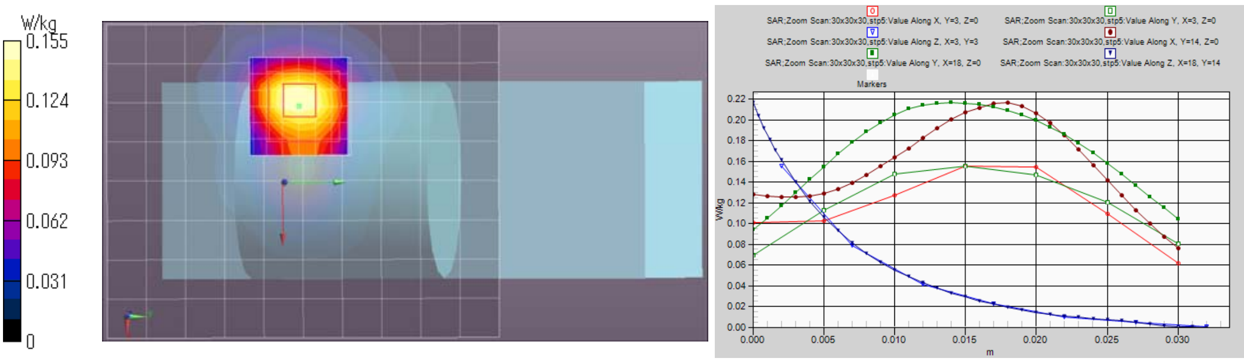
## Plot 1-7: Setup: Top-right & touch (separation distance=0mm) / 11b (1Mbps), 2437 MHz

**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; σ = 1.983 S/m; $\varepsilon_r$ = 50.61; ρ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)
-Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0 -Electronics: DAE4 Sn626; Calibrated: 2015/09/15
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

**kdb248227,body/b12,top-right-tilt&touch,b(1m,set:12),b2437/**
**Area Scan:96x120,stp12 (9x11x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.162 W/kg
**Area Scan:96x120,stp12 (81x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.163 W/kg

**Zoom Scan:30x30x30,stp5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 9.073 V/m; Power Drift = -0.07 dB; Maximum value of SAR (measured) = 0.155 W/kg; Peak SAR (extrapolated) = 0.216 W/kg
**SAR(1 g) = 0.109 W/kg; SAR(10 g) = 0.053 W/kg**




Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.5(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

**Appendix 2-2: SAR measurement data / Step 1: Worst SAR search of DSSS mode (cont'd)**

## Plot 1-8: Setup: Front-top & touch (separation distance=0mm) / 11b (1Mbps), 2437 MHz

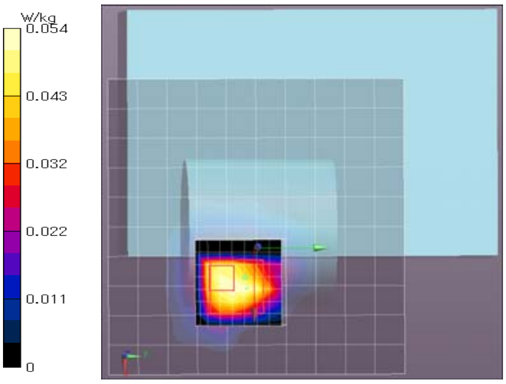
**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; $\sigma$ = 1.983 S/m; $\varepsilon_r$ = 50.61; $\rho$ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0; -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section; -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331); -Electronics: DAE4 Sn626; Calibrated: 2015/09/15

**kdb248227,body/b7,frt-top-tilt&touch,b(1m,set:12),b2437/**
**Area Scan:120x120,stp12 (11x11x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.0528 W/kg
**Area Scan:120x120,stp12 (101x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.0640 W/kg

**Zoom Scan:35x35x30,stp5 (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 4.892 V/m; Power Drift = -0.10 dB; Maximum value of SAR (measured) = 0.0540 W/kg; Peak SAR (extrapolated) = 0.162 W/kg

**SAR(1 g) = 0.047 W/kg; SAR(10 g) = 0.021 W/kg**




Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.5(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

## Plot 1-9: Setup: Rear & touch (separation distance=0mm) / 11b (1Mbps), 2437 MHz

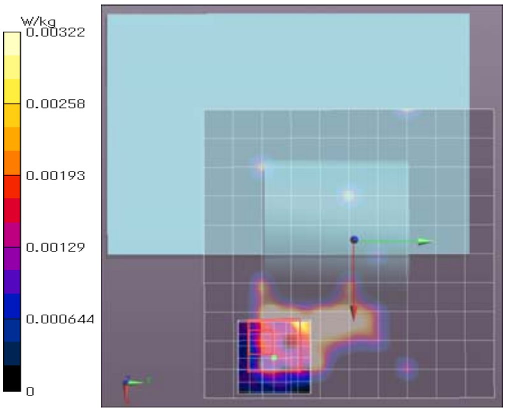
**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11b(1Mbps,DBPSK/DSSS)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; $\sigma$ = 1.983 S/m; $\varepsilon_r$ = 50.61; $\rho$ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0; -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section; -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331); -Electronics: DAE4 Sn626; Calibrated: 2015/09/15

**kdb248227,body/b8,rear&touch,b(1m,set:12),b2437/**
**Area Scan:120x120,stp12 (11x11x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.00572 W/kg
**Area Scan:120x120,stp12 (101x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.00580 W/kg

**Zoom Scan:30x30x30,stp5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 0.6890 V/m; Power Drift = -0.20 dB; Maximum value of SAR (measured) = 0.00322 W/kg; Peak SAR (extrapolated) = 0.00482 W/kg

**SAR(1 g) = 0.000102 W/kg; SAR(10 g) = 2.81e-005 W/kg**




Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.5(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

**Appendix 2-2: SAR measurement data (cont'd)**

## Step 2: OFDM mode

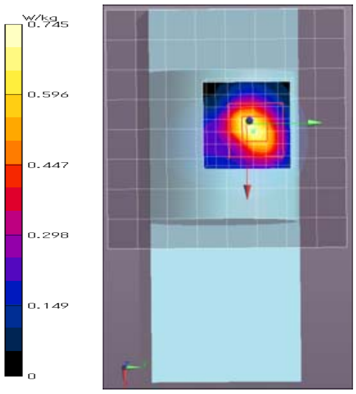
### Plot 2-1: (*. At worst setup condition of DSSS mode) Top & touch (separation distance=0mm) / 11g (6Mbps), 2437 MHz

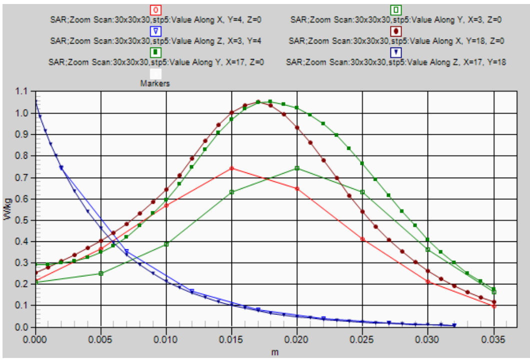
**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: 11g(6Mbps,BPSK/OFDM)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; σ = 1.983 S/m; $\varepsilon_r$ = 50.61; ρ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -Electronics: DAE4 Sn626; Calibrated: 2015/09/15
-Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**kdb248227,body/b4,mode(OFDM);top-frt&touch,g(6m,set:12),b2437/**
**Area Scan:96x96,stp12 (9x9x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.714 W/kg
**Area Scan:96x96,stp12 (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.736 W/kg

**Zoom Scan:35x35x30,stp5 (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 19.57 V/m; Power Drift = 0.04 dB; Maximum value of SAR (measured) = 0.745 W/kg; Peak SAR (extrapolated) = 1.05 W/kg
**SAR(1 g) = 0.469 W/kg; SAR(10 g) = 0.201 W/kg**






Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.4(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

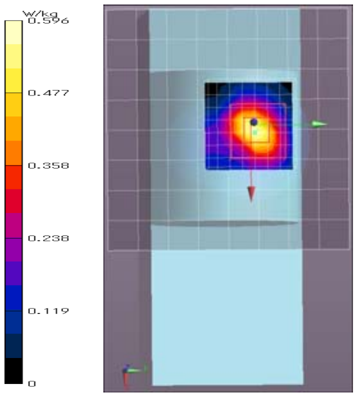
### Plot 2-2: (*. At worst setup condition of DSSS mode) Top & touch (separation distance=0mm) / 11n(20HT)(MCS0), 2437 MHz

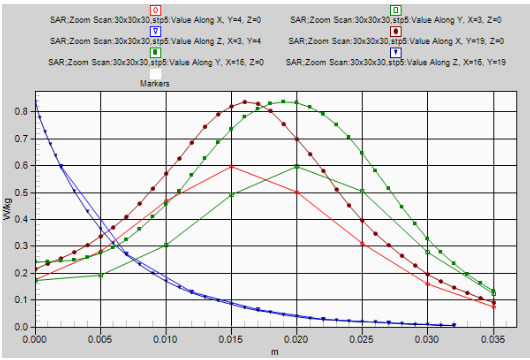
**EUT: Wireless module (in digital camera); Type: ES200 (camera:DS126601); Serial: 2 (camera:526)**
**Mode: n20(MCS0,BPSK/OFDM)**(UID 0, Frame Length in ms: 0; PAR: 0; PMF: 1); **Frequency: 2437 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2437 MHz; σ = 1.983 S/m; $\varepsilon_r$ = 50.61; ρ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -Electronics: DAE4 Sn626; Calibrated: 2015/09/15
-Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

**kdb248227,body/b5,mode(OFDM);top-frt&touch,n20(m0,set:11),b2437/**
**Area Scan:96x96,stp12 (9x9x1):** Measurement grid: dx=12mm, dy=12mm; Maximum value of SAR (measured) = 0.548 W/kg
**Area Scan:96x96,stp12 (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm; Maximum value of SAR (interpolated) = 0.567 W/kg

**Zoom Scan:35x35x30,stp5 (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 17.19 V/m; Power Drift = 0.08 dB; Maximum value of SAR (measured) = 0.596 W/kg; Peak SAR (extrapolated) = 0.837 W/kg
**SAR(1 g) = 0.368 W/kg; SAR(10 g) = 0.156 W/kg**






Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of EUT to phantom: 0 mm (2 mm to liquid); ambient: 23.5 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.5(start)/22.5(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

# APPENDIX 3: Test instruments

## Appendix 3-1: Equipment used

| Control No. | Instrument | Manufacturer | Model No | Serial No | Test Item | Calibration Date * Interval(month) |
|---|---|---|---|---|---|---|
| COTS-SSAR-02 | DASY52 | Schmid&Partner Engineering AG | DASY52(ver.52.8.(1222)) | - | SAR | - |
| COTS-SSEP-02 | Dielectric assessment kit | Schmid&Partner Engineering AG | DAK(ver1.10.317.11) | - | SAR | - |
| SSAR-02 | SAR measurement system | Schmid&Partner Engineering AG | DASY5 | 1324 | SAR | Pre Check |
| SSRBT-02 | SAR robot | Schmid&Partner Engineering AG | TX60 Lspeag | F12/5L2QA1/A/01 | SAR | 2015/09/10 * 12 |
| KDAE-01 | Data Acquisition Electronics | Schmid&Partner Engineering AG | DAE4 | 626 | SAR | 2015/09/15 * 12 |
| SPB-02 | Dosimetric E-Field Probe | Schmid&Partner Engineering AG | EX3DV4 | 3907 | SAR | 2015/04/23 * 12 |
| KSDA-01 | Dipole Antenna | Schmid&Partner Engineering AG | D2450V2 | 822 | SAR(daily) | 2016/01/14 * 12 |
| KPFL-01 | Flat Phantom | Schmid&Partner Engineering AG | Oval flat phantom ELI 4.0 | 1059 | SAR | 2015/08/06 * 12 |
| SSNA-01 | Network Analyzer | Agilent | 8753ES | US39171777 | SAR | 2015/12/24 * 12 |
| SEPP-02 | Dielectric probe | Schmid&Partner Engineering AG | DAK3.5 | 1129 | SAR | 2015/08/11 * 12 |
| KSG-08 | Signal Generator | Rohde & Schwarz | SMT06 | 100763 | SAR(daily) | 2015/07/02 * 12 |
| KPA-12 | RF Power Amplifier | MILMEGA | AS2560-50 | 1018582 | SAR(daily) | Pre Check |
| KCPL-07 | Directional Coupler | Pulsar Microwave Corp. | CCS30-B26 | 0621 | SAR(daily) | Pre Check |
| KPM-01 | Power Meter | Rohde & Schwarz | NRVD | 829268/039 | SAR(daily) | 2015/04/01 * 12 |
| KIU-08 | Power sensor | Rohde & Schwarz | NRV-Z4 | 100372 | SAR(daily) | 2015/09/08 * 12 |
| KIU-09 | Power sensor | Rohde & Schwarz | NRV-Z4 | 100371 | SAR(daily) | 2015/09/08 * 12 |
| KAT10-P1 | Attenuator | Weinschel | 24-10-34 | BY5927 | SAR(daily) | 2015/12/24 * 12 |
| KPM-05 | Power meter | Agilent | E4417A | GB41290718 | SAR(daily) | 2016/04/13 * 12 |
| KPSS-01 | Power sensor | Agilent | E9327A | US40440544 | SAR(daily) | 2016/04/13 * 12 |
| SAT20-SAR1 | Attenuator | TME | SFA-01AXPJ-20 | - | SAR(daily) | 2015/12/24 * 12 |
| SCC-SAR2 | Coaxial Cable | HUBER+SUHNER | SF104A/11PC3542/11N451/4M | MY699/4A | SAR | Pre Check |
| KRU-01 | Ruler(300mm) | Shinwa | 13134 | - | SAR | 2016/02/24 * 12 |
| KRU-02 | Ruler(150mm,L) | Shinwa | 12103 | - | SAR | 2016/02/24 * 12 |
| KRU-05 | Ruler(100x50mm,L) | Shinwa | 12101 | - | SAR | 2015/05/21 * 12 |
| SOS-12 | Digtal thermometer | HANNA | Checktemp-4 | SOS-12 | SAR | 2016/02/24 * 12 |
| KOS-13 | Digtal thermometer | HANNA | Checktemp-2 | KOS-13 | SAR | 2015/12/07 * 12 |
| KOS-14 | Thermo-Hygrometer data logger | SATO KEIRYOKI | SK-L200THIIα/SK-LTHIIα-2 | 015246/08169 | SAR | 2015/12/07 * 12 |
| SOS-11 | Humidity Indicator | A&D | AD-5681 | 4063424 | SAR | 2015/12/07 * 12 |
| SOS-SAR1 | Digtal thermometer | LKMelectonic | DTM3000 | 3171 | SAR | 2015/10/20 * 12 |
| SSA-04 | Spectrum Analyzer | Advantest | R3272 | 101100994 | SAR(moni.) | Pre Check |
| KSDH-01 | Device holder | Schmid&Partner Engineering AG | Mounting device for transmitter | - | SAR | 2015/09/10 * 12 |
| SWTR-03 | DI water | MonotaRo | 34557433 | - | SAR | Pre Check |
| KSLM245-01 | Tissue simulation liqud (2450MHz,body) | Schmid&Partner Engineering AG | MSL2450V2 | SL AAM 245 BA | SAR | Pre Check |
| No.7 Shielded room | SAR shielded room (2.76m(W)x3.76m(D)x2.4m(H)) | TDK | - | - | SAR | *(Daily check) Ambient noise: < 12mW/kg* |

The expiration date of 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 valid calibrations. Each measurement data is traceable to the national or international standards.

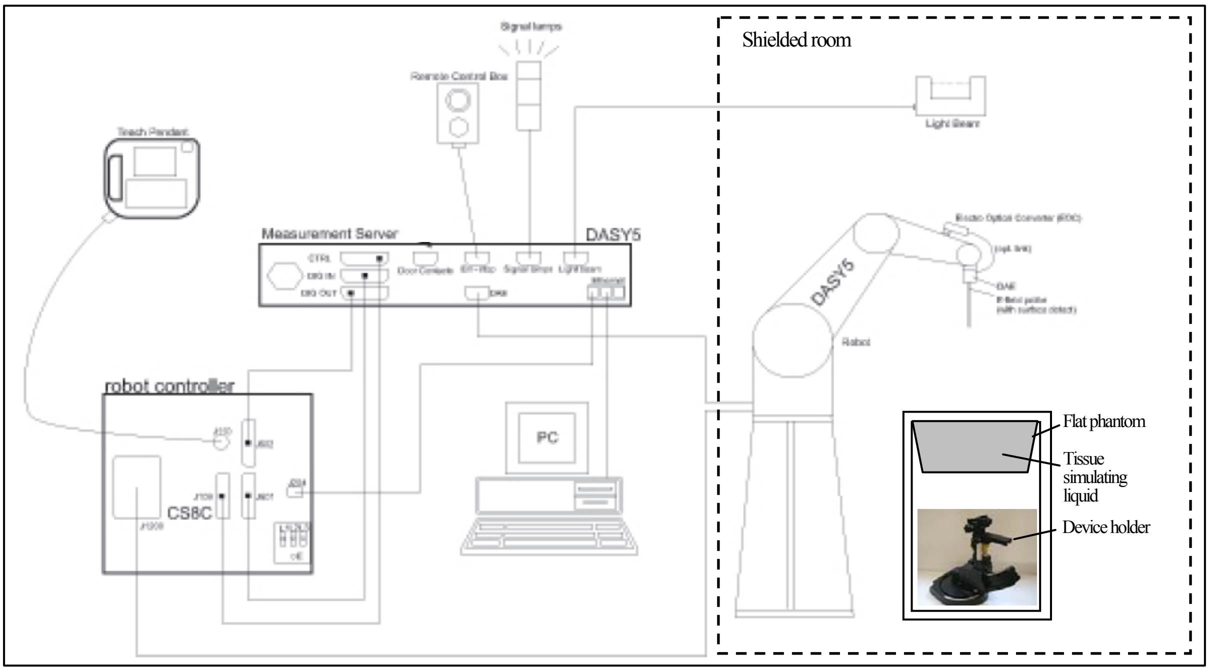
**[Test Item]** SAR: Specific Absorption Rate

*. Equipment used for antenna terminal conducted power measurement refers to the ENC report: 10840757S-G, UL Japan published.


1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN
Telephone: +81 463 50 6400 / Facsimile: +81 463 50 6401

## Appendix 3-2: Configuration and peripherals

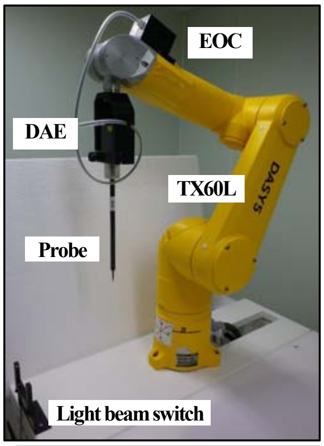
These measurements were performed with the automated near-field scanning system DASY5 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot), which positions the probes with a positional repeatability of better than ± 0.02 mm. Special E- and H-field probes have been 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 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.




The DASY5 system for performing compliance tests consist of the following items:

| | |
|---|---|
| 1 | A standard high precision 6-axis robot (Stäubli TX/RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE). |
| 2 | An isotropic field probe optimized and calibrated for the targeted measurement. |
| 3 | A data acquisition electronics (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 from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted 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 | The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning. |
| 7 | A computer running Win7 professional operating system and the DASY5 software. |
| 8 | R Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc. |
| 9 | The phantom. |
| 10 | The device holder for EUT. (low-loss dielectric palette) (*. when it was used.) |
| 11 | Tissue simulating liquid mixed according to the given recipes. |
| 12 | Validation dipole kits allowing to validate the proper functioning of the system. |

## Appendix 3-3: Test system specification





**TX60 Lsepag robot/CS8Csepag-TX60 robot controller**

- Number of Axes : 6 •Repeatability : ±0.02 mm
- Manufacture : Stäubli Unimation Corp.

**DASY5 Measurement server**

- Features : The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV Celeron, 128MB chip-disk and 128MB RAM. The necessary circuits for communication with the DAE4 electronics box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY5 I/O board, which is directly connected to the PC/104 bus of the CPU board.
- Calibration : No calibration required.
- 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 DASY5 embedded system (fully remote controlled). 2 step probe touch detector for mechanical surface detection and emergency robot stop (not in -R version)
- Measurement Range : 1 μV to > 200 mV (16bit resolution and 2 range settings: 4 mV, 400 mV)
- Input Offset voltage : < 1 μV (with auto zero)
- Input Resistance : 200 MΩ
- Battery Power : > 10 hr of operation (with two 9 V battery)
- Manufacture : Schmid & Partner Engineering AG

**Electro-Optical Converter (EOC61)**

- Manufacture : Schmid & Partner Engineering AG

**Light Beam Switch (LB5/80)**

- Manufacture : Schmid & Partner Engineering AG

**SAR measurement software**

- Item : Dosimetric Assessment System DASY5
- Software version : DASY52, V8.2 B969
- Manufacture : Schmid & Partner Engineering AG


**E-Field Probe**

- Model : <u>**EX3DV4 (serial number: 3907)**</u>
- Construction : Symmetrical design with triangular core.
  Built-in shielding against static charges.
  PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
- Frequency : 10MHz to 6GHz, Linearity: ±0.2 dB (30 MHz to 6 GHz)
- Conversion Factors : 2.45, 5.2, 5.25, 5.30, 5.5, 5.6, 5.75, 5.8 GHz (Head)
  : 2.45, 5.25, 5.6, 5.75 GHz (Body)
- 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 < 1 μW/g)
- Dimension : Overall length: 330 mm (Tip: 20 mm)
  Tip diameter: 2.5 mm (Body: 12 mm)
  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%.
- Manufacture : Schmid & Partner Engineering AG


**Phantom**

- Type : <u>**ELI 4.0 oval flat phantom**</u>
- Shell Material : Fiberglass •Shell Thickness : Bottom plate: 2 ±0.2 mm
- Dimensions : Bottom elliptical: 600×400 mm, Depth: 190 mm (Volume: Approx. 30 liters)
- Manufacture : Schmid & Partner Engineering AG


**Device Holder**

☒ Urethane foam

☒ KSDH-01: In combination with the 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.

•Material : POM •Manufacture : Schmid & Partner Engineering AG

## Appendix 3-4: Simulated tissue composition and parameter confirmation

| Liquid type | Body |
|---|---|
| Model No. / Product No. | MSL2450V2 / SL AAM 245 BA |
| Control number | KSLM245-01 |
| Ingredient: Mixture (%) | Water:52-75%, DGBE:25-48%, NaCl:<1.0% |
| Manufacture | Schmid & Partner Engineering AG |

*. The dielectric parameters were checked prior to assessment using the DAK3.5 dielectric probe kit.

| Measured date | Freq. [MHz] | Liquid type | Ambient [deg.C.] /[%RH] | Liquid temp. [deg.C.] Before/After | Liquid Depth [mm] | Liquid parameters (*1) | | | | | | | | ΔSAR (1g) [%] (*2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Permittivity (εr) [-] | | | | Conductivity [S/m] | | | | |
| | | | | | | Target | Measured Meas. | Measured Δεr[%] | Limit | Target | Measured Meas. | Measured Δσ[%] | Limit | |
| April 21, 2016 | 2450 | Body | 24.1/45 | 22.5/22.5 | (155) | ***52.7*** | 50.63 | -3.9 | ±5% | ***1.95*** | 1.997 | +2.4 | ±5% | +2.04 |

*1. The target value is a parameter defined in Appendix A of KDB865664 D01 (v01r04). The dielectric parameters suggested for head and body tissue simulating liquid are given at 2000, 2450 and 3000MHz. As an intermediate solution, dielectric parameters for the frequencies between 2000- 2450 and 2450-3000MHz were obtained using linear interpolation.

| Standard | | | | | *Interpolated* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| f (MHz) | Head Tissue εr | Head Tissue σ [S/m] | Body Tissue εr | Body Tissue σ [S/m] | f (MHz) | Head Tissue εr | Head Tissue σ [S/m] | Body Tissue εr | Body Tissue σ [S/m] |
| (1800-)2000 | **40.0** | **1.40** | **53.3** | **1.52** | *2412* | *not use* | *not use* | *52.75* | *1.914* |
| 2450 | **39.2** | **1.80** | **52.7** | **1.95** | *2437* | *not use* | *not use* | *52.72* | *1.938* |
| 3000 | **38.5** | **2.40** | **52.0** | **2.73** | *2462* | *not use* | *not use* | *52.68* | *1.967* |

*2. The coefficients are parameters defined in IEEE Std. 1528(2013).

**ΔSAR(1g)= Cεr ×Δεr + Cσ ×Δσ,** $C\varepsilon r = -7.854E\text{-}4 \times f^3 + 9.402E\text{-}3 \times f^2 - 2.742E\text{-}2 \times f - 0.2026$ / $C\sigma = 9.804E\text{-}3 \times f^3 - 8.661E\text{-}2 \times f^2 + 2.981E\text{-}2 \times f + 0.7829$

## Appendix 3-5: Daily check results

Prior to the SAR assessment of EUT, the daily check (system check) was performed to test whether the SAR system was operating within its target of ±10%. The daily check results are in the table below. (*. Refer to Appendix 3-6 of measurement data.)

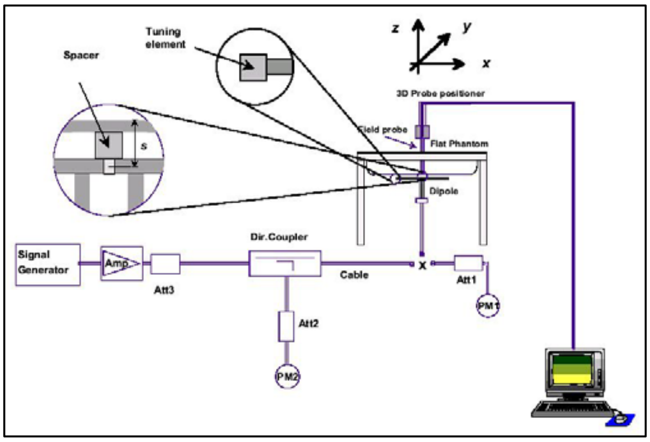
| Daily check results | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Freq. [MHz] | Liquid Type | Ambient [deg.C.] /[%RH] | Liquid Temp. [deg.C.] | | | Liquid Depth [mm] | Dielectric parameter | | Power drift [dB] | Daily check target & measured | | | |
| | | | | | | | | | | | SAR (1g) [W/kg] | | Deviation [%] | Limit [%] |
| | | | | Check | Before | After | | εr [-] | σ [S/m] | | Measured (*3) | Target | | |
| April 21, 2016 | 2450 | Body | 23.5/52 | 22.5 | 22.4 | 22.4 | 155 | 50.63 | 1.997 | -0.01 | **52.12 (1W scaled)** | **none** (*4) | - | - |
| | | | | | | | | | | | (13.3 (250mW)->ΔSAR-corrected:13.03) | **51.2** (*5) | **+1.8** | ±10 |

*. Calculating formula: ΔSAR corrected SAR (1g) (W/kg) = (Observed SAR(1g) (W/kg)) × (100 - (ΔSAR(%)) / 100

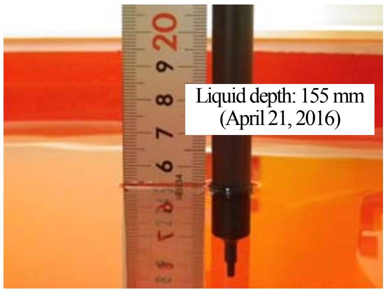
*3. The measured SAR value of daily check was compensated for tissue dielectric deviations (delta-SAR) and scaled to 1W of output power in order to compare with the manufacture's calibration target value which was normalized.

*4. The target value (normalized to 1W) is defined in IEEE Std.1528 (2013).

*5. 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_Jan16, the data sheet was filed in this report). For 2.45GHz, the manufacture's calibration data of dipole for head liquid were within 1% of IEEE Std 1528 head liquid target value (=52.4W/kg, calibration (normalized to 1W)=51.4W/kg, -1.9% vs. standard). This calibration result is enough, using this dipole as a reference. We decided to use body liquid calibration data of this dipole for the daily check target.








**Test setup for the system performance check**

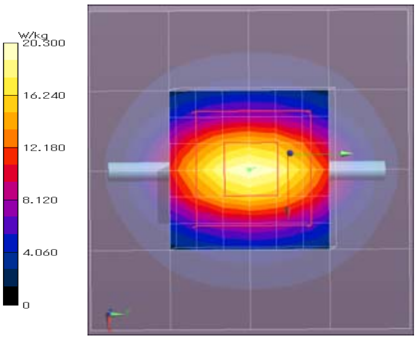
## Appendix 3-6: Daily check measurement data

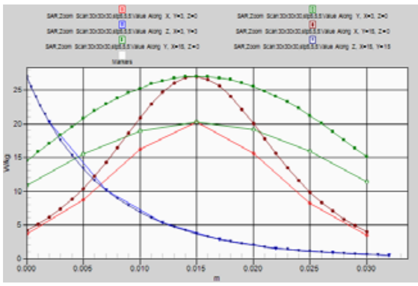
**EUT: Dipole(2.45GHz); Type: D2450V2; Serial: 822; Forward conducted power: 250mW**
**Communication System: CW** (*. Frame Length in ms: 0; PAR: 0; PMF: 1)**; Frequency: 2450 MHz; Crest Factor: 1.0**
**Medium: M2450(1604); Medium parameters used: f = 2450 MHz; σ = 1.997 S/m; $\varepsilon_r$ = 50.63; ρ = 1000 kg/m$^3$**
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

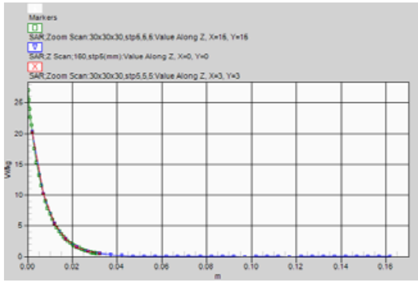
**DASY Configuration:** -Probe: EX3DV4 - SN3907; ConvF(7.17, 7.17, 7.17); Calibrated: 2015/04/23; -DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)
-Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0, 161.0 -Electronics: DAE4 Sn626; Calibrated: 2015/09/15
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

**Area Scan:60x60,stp15 (5x5x1):** Measurement grid: dx=15mm, dy=15mm; Maximum value of SAR (measured) = 20.3 W/kg
**Area Scan:60x60,stp15 (41x41x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm; Maximum value of SAR (interpolated) = 20.3 W/kg
**Z Scan;160,stp5(mm) (1x1x33):** Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 20.3 W/kg

**Zoom Scan:30x30x30,stp5,5,5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 102.1 V/m; Power Drift = -0.01 dB; Maximum value of SAR (measured) = 20.3 W/kg
Peak SAR (extrapolated) = 27.0 W/kg (+2.7 %, vs. speag.cal.=26.3 W/kg)
**SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.19 W/kg**





Remarks: *. Date tested: 2016/04/21; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*. liquid depth: 155 mm; Position: distance of dipole to phantom: 8mm (10mm to liquid); ambient: 23.5 deg.C. / 52 %RH,
*. liquid temperature: 22.4(start)/22.4(end)/22.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g )/small=SAR(1g)

## Appendix 3-7: Daily check uncertainty

| Uncertainty of daily check (2.4~6GHz) (*.ε&σ tolerance: ≤±5%, DAK3.5, CW) (v08) | 1g SAR | 10g SAR |
|---|---|---|
| Combined measurement uncertainty of the measurement system (k=1) | ± 11.0 % | ± 10.9 % |
| Expanded uncertainty (k=2) | ± 22.1 % | ± 21.8 % |

| | Error Description (v08) | Uncertainty Value | Probability distribution | Divisor | ci (1g) | ci (10g) | ui (1g) | ui (10g) | Vi, veff |
|---|---|---|---|---|---|---|---|---|---|
| A | **Measurement System** (DASY5) | | | | | | (std. uncertainty) | (std. uncertainty) | |
| 1 | Probe Calibration Error | ±6.55 % | Normal | 1 | 1 | 1 | ±6.55 % | ±6.55 % | ∞ |
| 2 | Axial isotropy error | ±4.7 % | Rectangular | √3 | √0.5 | √0.5 | ±1.9 % | ±1.9 % | ∞ |
| 3 | Hemispherical isotropy error | ±9.6 % | Rectangular | √3 | 0 | 0 | 0 % | 0 % | ∞ |
| 4 | Probe linearity | ±4.7 % | Rectangular | √3 | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| 5 | Probe modulation response (CW) | ±0.0 % | Rectangular | √3 | 1 | 1 | 0 % | 0 % | ∞ |
| 6 | System detection limit | ±1.0 % | Rectangular | √3 | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| 7 | Boundary effects | ±4.8 % | Rectangular | √3 | 1 | 1 | ±2.8 % | ±2.8 % | ∞ |
| 8 | System readout electronics (DAE) | ±0.3 % | Normal | 1 | 1 | 1 | ±0.3 % | ±0.3 % | ∞ |
| 9 | Response Time Error (<5ms/100ms wait) | ±0.0 % | Rectangular | √3 | 1 | 1 | 0 % | 0 % | ∞ |
| 10 | Integration Time Error (CW) | ±0.0 % | Rectangular | √3 | 1 | 1 | 0 % | 0 % | ∞ |
| 11 | RF ambient conditions-noise | ±3.0 % | Rectangular | √3 | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| 12 | RF ambient conditions-reflections | ±3.0 % | Rectangular | √3 | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| 13 | Probe positioner mechanical tolerance | ±3.3 % | Rectangular | √3 | 1 | 1 | ±1.9 % | ±1.9 % | ∞ |
| 14 | Probe positioning with respect to phantom shell | ±6.7 % | Rectangular | √3 | 1 | 1 | ±3.9 % | ±3.9 % | ∞ |
| 15 | Max. SAR evaluation (Post-processing) | ±4.0 % | Rectangular | √3 | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| B | **Test Sample Related** | | | | | | | | |
| 16 | Deviation of the experimental source | ±3.5 % | Normal | 1 | 1 | 1 | ±3.5 % | ±3.5 % | ∞ |
| 17 | Dipole to liquid distance (10mm±0.2mm,<2deg.) | ±2.0 % | Rectangular | √3 | 1 | 1 | ±1.2 % | ±1.2 % | ∞ |
| 18 | Drift of output power (measured, <0.2dB) | ±2.3 % | Rectangular | √3 | 1 | 1 | ±1.3 % | ±1.3 % | ∞ |
| C | **Phantom and Setup** | | | | | | | | |
| 19 | Phantom uncertainty | ±2.0 % | Rectangular | √3 | 1 | 1 | ±1.2 % | ±1.2% | ∞ |
| 20 | Algorithm for correcting SAR (e',σ: ≤5%) | ±1.2 % | Normal | 1 | 1 | 0.84 | ±1.2 % | ±0.97 % | ∞ |
| 21 | Liquid conductivity (meas.) (DAK3.5) | ±3.0 % | Normal | 1 | 0.78 | 0.71 | ±2.3 % | ±2.1 % | ∞ |
| 22 | Liquid permittivity (meas.) (DAK3.5) | ±3.1 % | Normal | 1 | 0.23 | 0.26 | ±0.7 % | ±0.8 % | ∞ |
| 23 | Liquid Conductivity-temp.uncertainty (≤2deg.C.) | ±5.3 % | Rectangular | √3 | 0.78 | 0.71 | ±2.4 % | ±2.2 % | ∞ |
| 24 | Liquid Permittivity-temp.uncertainty (≤2deg.C.) | ±0.9 % | Rectangular | √3 | 0.23 | 0.26 | ±0.1 % | ±0.1 % | ∞ |
| | **Combined Standard Uncertainty** | | | | | | ±11.0 % | ±10.9 % | |
| | **Expanded Uncertainty (k=2)** | | | | | | ±22.1 % | ±21.8 % | |

*. This measurement uncertainty budget is suggested by IEEE Std. 1528(2013) and determined by Schmid & Partner Engineering AG (DASY5 Uncertainty Budget).

## Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4)

**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 0108

Client: UL Japan (Vitec)

Certificate No: EX3-3907_Apr15

# CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3907

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: April 23, 2015

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 | 01-Apr-15 (No. 217-02128) | Mar-16 |
| Power sensor E4412A | MY41498087 | 01-Apr-15 (No. 217-02128) | Mar-16 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 01-Apr-15 (No. 217-02129) | Mar-16 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 01-Apr-15 (No. 217-02132) | Mar-16 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 01-Apr-15 (No. 217-02133) | Mar-16 |
| Reference Probe ES3DV2 | SN: 3013 | 30-Dec-14 (No. ES3-3013_Dec14) | Dec-15 |
| DAE4 | SN: 660 | 14-Jan-15 (No. DAE4-660_Jan15) | Jan-16 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Apr-13) | In house check: Apr-16 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-14) | In house check: Oct-15 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Israe Elnaouq | Laboratory Technician | [signature] |
| Approved by: | Katja Pokovic | Technical Manager | [signature] |

Issued: April 25, 2015

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (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 0108**

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A, B, C, D | modulation dependent linearization parameters |
| 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 |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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 affect 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 with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**



# Probe EX3DV4

## SN:3907

Manufactured: September 4, 2012
Calibrated: April 23, 2015

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)



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**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**

EX3DV4– SN:3907 April 23, 2015

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3907

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$)[A] | 0.44 | 0.43 | 0.46 | ± 10.1 % |
| DCP (mV)[B] | 99.8 | 102.0 | 106.3 | |

## Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB√μV | C | D dB | VR mV | Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 149.7 | ±3.3 % |
| | | Y | 0.0 | 0.0 | 1.0 | | 149.0 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 130.7 | |

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 Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**

EX3DV4– SN:3907

April 23, 2015

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3907

## Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha [G] | Depth [G] (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 2450 | 39.2 | 1.80 | 7.00 | 7.00 | 7.00 | 0.37 | 0.80 | ± 12.0 % |
| 5200 | 36.0 | 4.66 | 5.16 | 5.16 | 5.16 | 0.35 | 1.80 | ± 13.1 % |
| 5250 | 35.9 | 4.71 | 5.04 | 5.04 | 5.04 | 0.35 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 4.94 | 4.94 | 4.94 | 0.35 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 4.80 | 4.80 | 4.80 | 0.35 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.61 | 4.61 | 4.61 | 0.35 | 1.80 | ± 13.1 % |
| 5750 | 35.4 | 5.22 | 4.66 | 4.66 | 4.66 | 0.40 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.48 | 4.48 | 4.48 | 0.40 | 1.80 | ± 13.1 % |

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**



# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3907

## Calibration Parameter Determined in Body Tissue Simulating Media

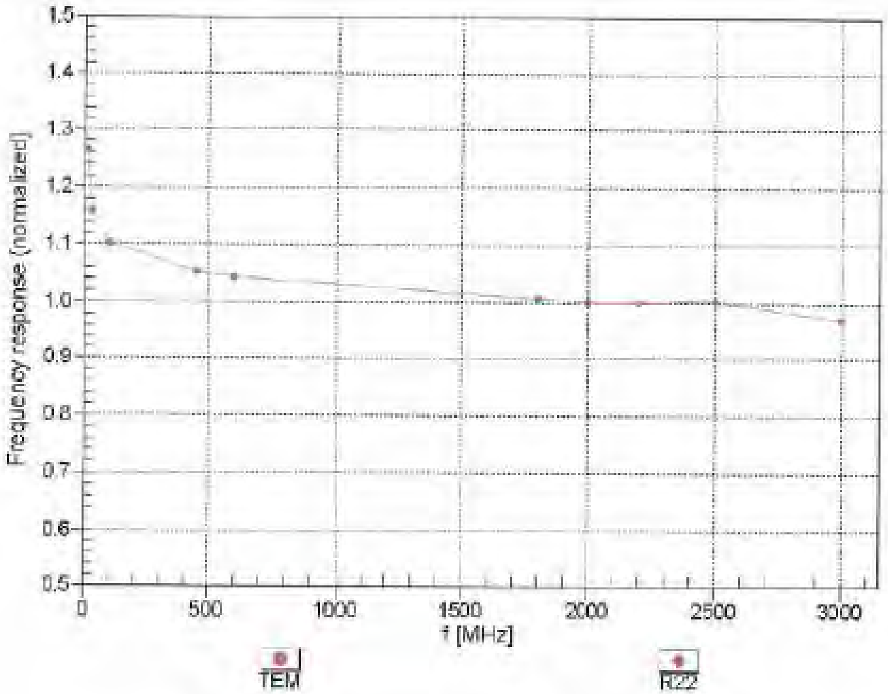
| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha [G] | Depth [G] (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 2450 | 52.7 | 1.95 | 7.17 | 7.17 | 7.17 | 0.32 | 0.85 | ± 12.0 % |
| 5250 | 48.9 | 5.36 | 4.53 | 4.53 | 4.53 | 0.40 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 3.78 | 3.78 | 3.78 | 0.50 | 1.90 | ± 13.1 % |
| 5750 | 48.3 | 5.94 | 4.06 | 4.06 | 4.06 | 0.50 | 1.90 | ± 13.1 % |

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**

EX3DV4– SN:3907 April 23, 2015

## Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)




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



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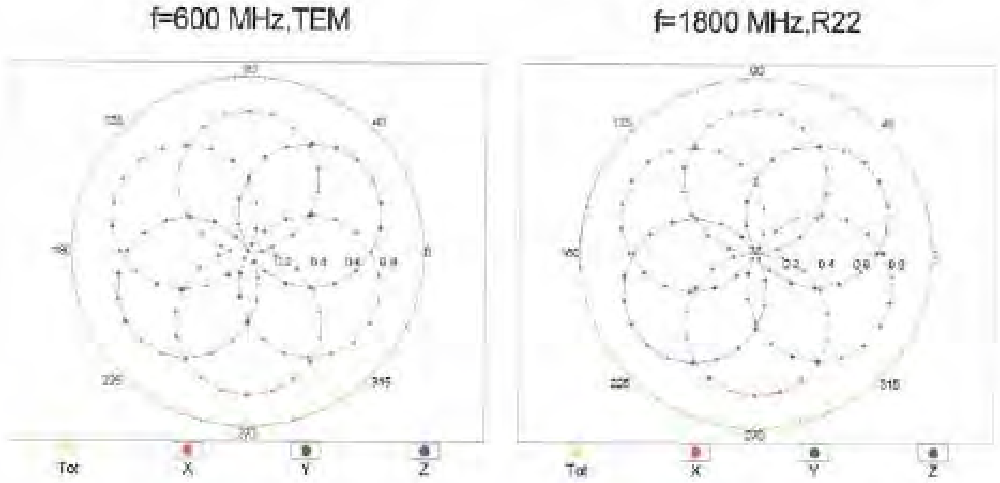
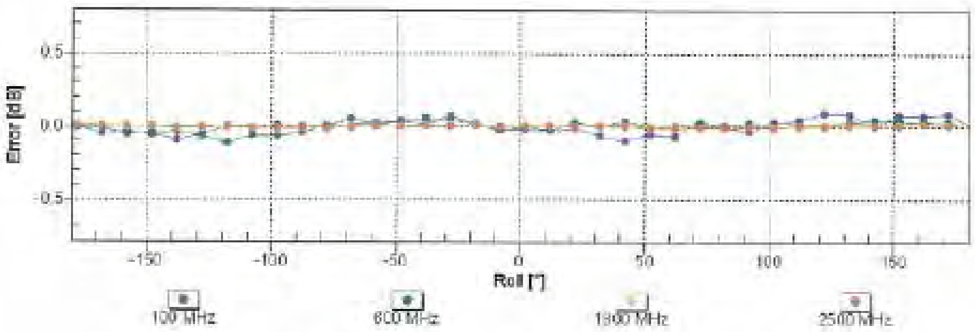
**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**



## Receiving Pattern (ϕ), ϑ = 0°




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



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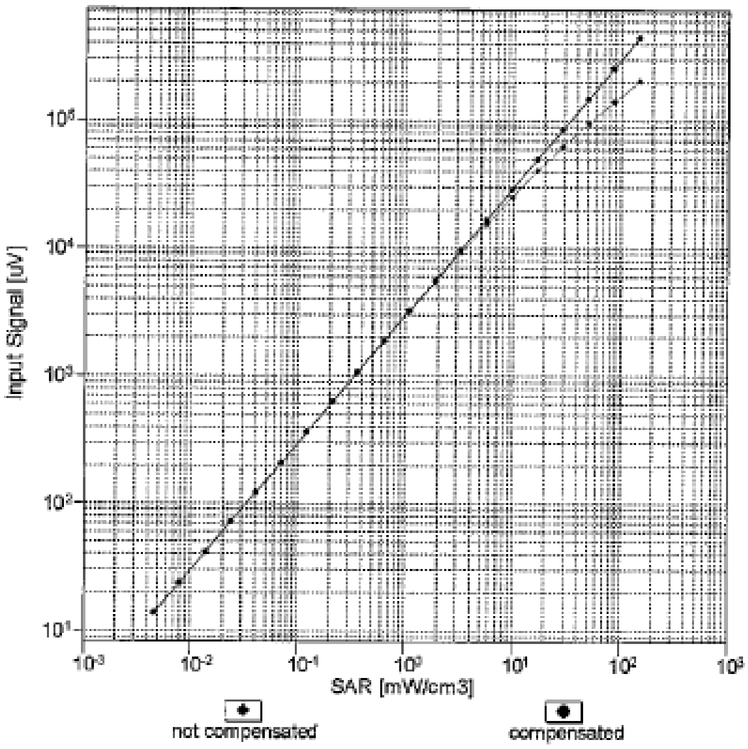
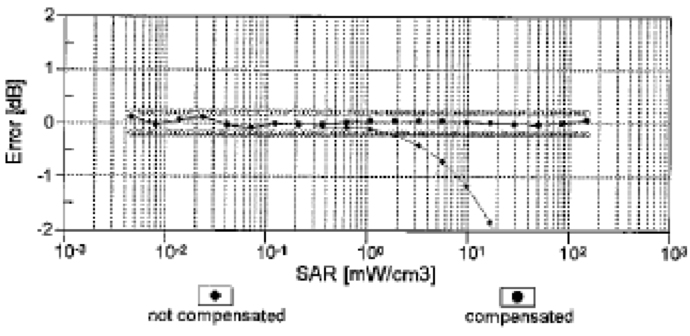
**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**

EX3DV4– SN:3907 April 23, 2015

# Dynamic Range f(SAR$_{head}$)

**(TEM cell , f$_{eval}$= 1900 MHz)**




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



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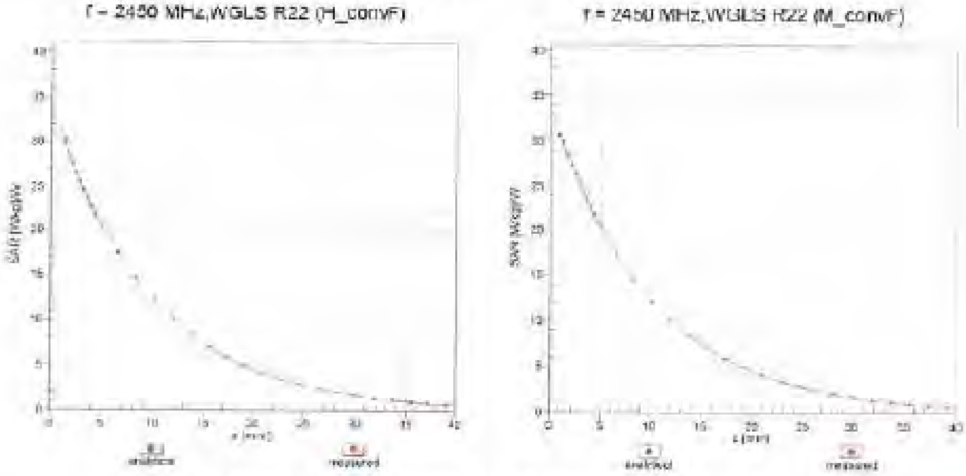
**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**

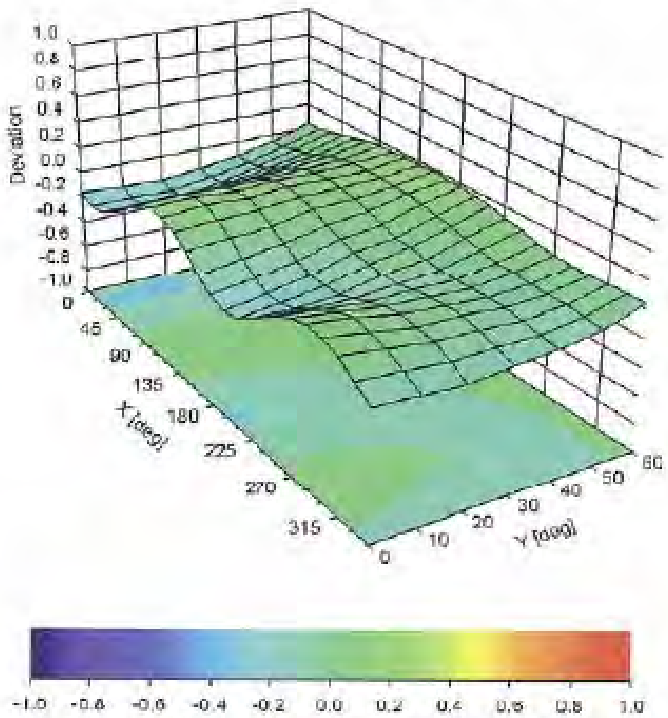
EX3DV4– SN:3907 April 23, 2015

## Conversion Factor Assessment




## Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz




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



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**Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)**

EX3DV4– SN:3907

April 23, 2015

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3907

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 112 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 1.4 mm |



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## Appendix 3-9: Calibration certificate: Dipole (D2450V2)

**Calibration Laboratory of**
Schmid & Partner
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**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
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**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 0108**

Client **UL Japan Shonan (Vitec)**

Certificate No: **D2450V2-822_Jan16**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN:822 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | January 14, 2016 |

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 EPM-442A | GB37480704 | 07-Oct-15 (No. 217-02222) | Oct-16 |
| Power sensor HP 8481A | US37292783 | 07-Oct-15 (No. 217-02222) | Oct-16 |
| Power sensor HP 8481A | MY41092317 | 07-Oct-15 (No. 217-02223) | Oct-16 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 01-Apr-15 (No. 217-02131) | Mar-16 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 01-Apr-15 (No. 217-02134) | Mar-16 |
| Reference Probe EX3DV4 | SN: 7349 | 31-Dec-15 (No. EX3-7349_Dec15) | Dec-16 |
| DAE4 | SN: 601 | 30-Dec-15 (No. DAE4-601_Dec15) | Dec-16 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100972 | 15-Jun-15 (in house check Jun-15) | In house check: Jun-18 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-15) | In house check: Oct-16 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Michael Weber | Laboratory Technician | M.Weber |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: January 15, 2016

**Appendix 3-9: Calibration certificate: Dipole (D2450V2) (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 0108**

**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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

e) 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.

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%.



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**Appendix 3-9: Calibration certificate: Dipole (D2450V2) (cont'd)**

## Measurement Conditions

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

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **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 | 37.8 ± 6 % | 1.87 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.2 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **51.4 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.09 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.0 W/kg ± 16.5 % (k=2)** |

## 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 | 52.1 ± 6 % | 2.04 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °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 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **51.2 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.12 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **24.2 W/kg ± 16.5 % (k=2)** |



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**Appendix 3-9: Calibration certificate: Dipole (D2450V2) (cont'd)**

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 54.9 Ω + 4.1 jΩ |
| Return Loss | - 24.3 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.6 Ω + 6.3 jΩ |
| Return Loss | - 24.1 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.158 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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 |



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**Appendix 3-9: Calibration certificate: Dipole (D2450V2) (cont'd)**

## DASY5 Validation Report for Head TSL

Date: 14.01.2016

Test Laboratory: SPEAG, Zurich, Switzerland

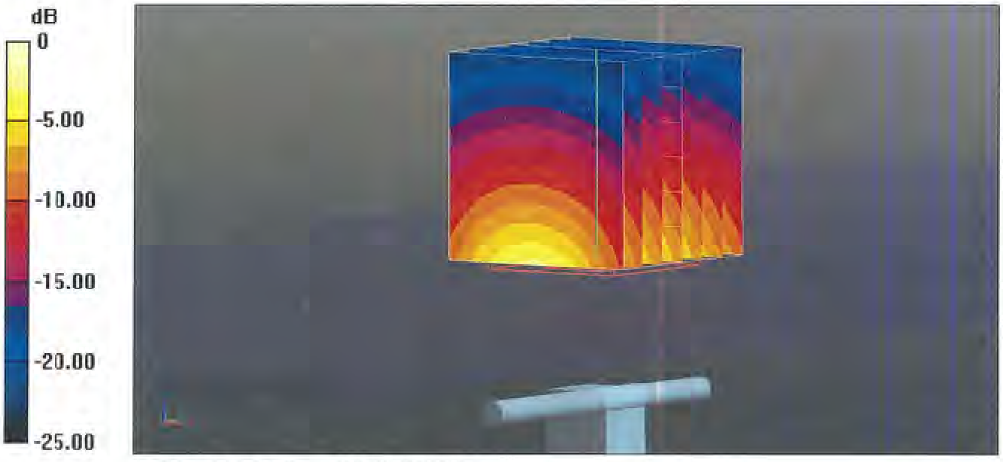
**DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN: 822**

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.87 S/m; $\varepsilon_r$ = 37.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.76, 7.76, 7.76); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

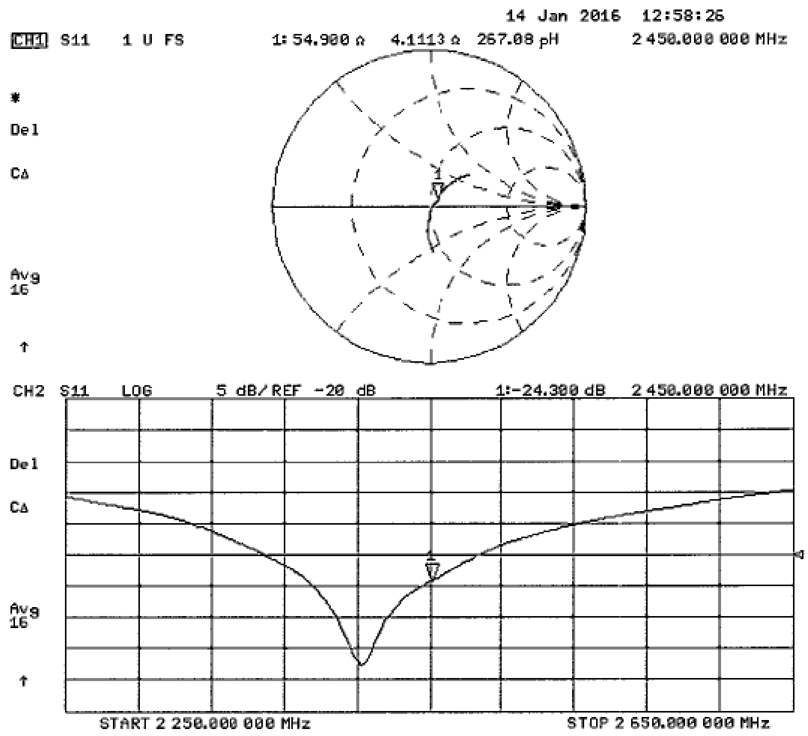
**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 114.0 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.0 W/kg
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kg**
Maximum value of SAR (measured) = 21.9 W/kg




0 dB = 21.9 W/kg = 13.40 dBW/kg

**Appendix 3-9: Calibration certificate: Dipole (D2450V2) (cont'd)**

### Impedance Measurement Plot for Head TSL



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**Appendix 3-9: Calibration certificate: Dipole (D2450V2) (cont'd)**

## DASY5 Validation Report for Body TSL

Date: 14.01.2016

Test Laboratory: SPEAG, Zurich, Switzerland

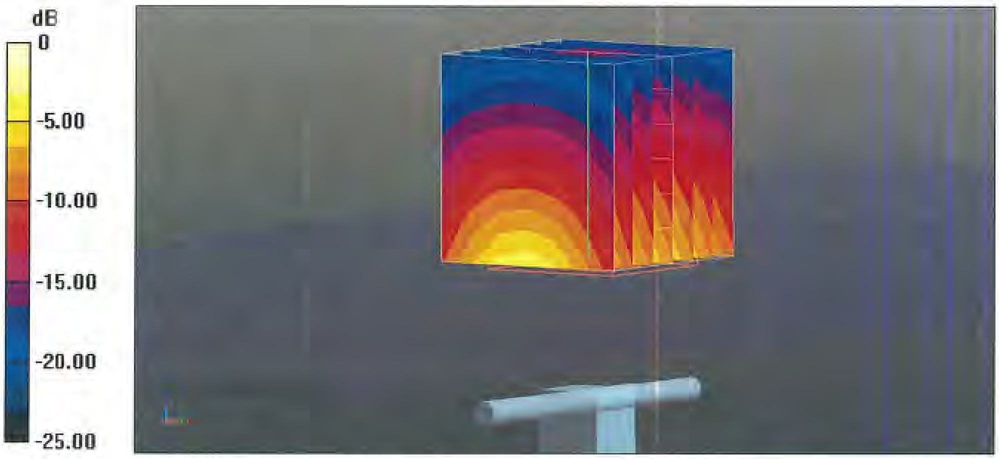
**DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN: 822**

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.04 S/m; $\varepsilon_r$ = 52.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.0 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.3 W/kg
**SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.12 W/kg**
Maximum value of SAR (measured) = 21.2 W/kg




0 dB = 21.2 W/kg = 13.26 dBW/kg



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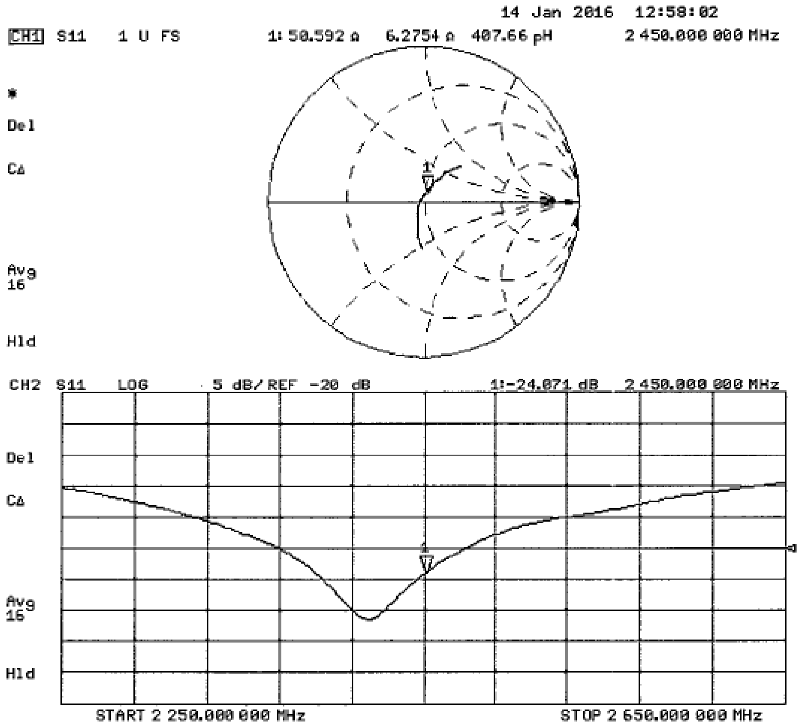
**Appendix 3-9: Calibration certificate: Dipole (D2450V2) (cont'd)**

## Impedance Measurement Plot for Body TSL



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