

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: Change the setup positions and channels

Plot 1-1: Left&LCD:Close(normal)&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;

-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0, 161.0$

-Electronics: DAE4 Sn626; Calibrated: 2013/09/17

-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m1;left&touch(d0mm)&lcd=cl,11b(1m),m2412/

Area Scan:60x96,st12(mm)(6x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.329 W/kg

Area Scan:60x96,st12(mm)(51x81x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.445 W/kg

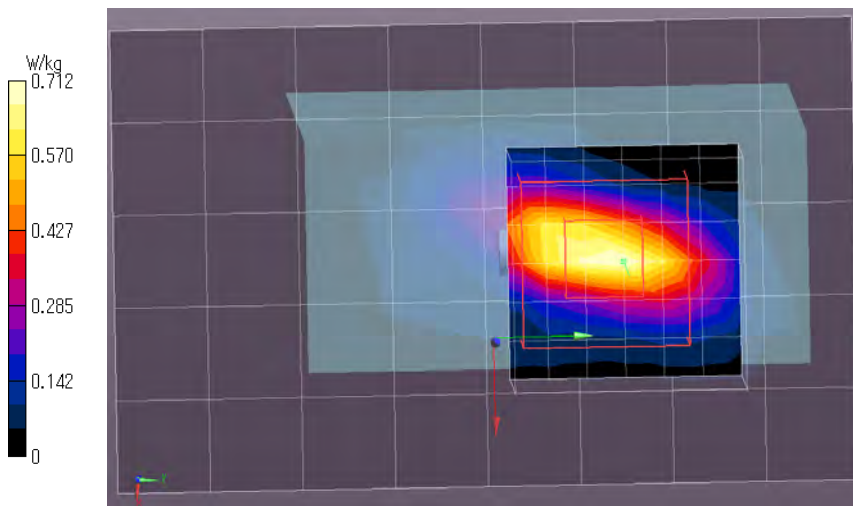
Z Scan:160,5(1x1x33): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=5\text{mm}$; Maximum value of SAR (measured) = 0.687 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 19.126 V/m; Power Drift = 0.06 dB, Maximum value of SAR (measured) = 0.712 W/kg

Peak SAR (extrapolated) = 1.043 mW/g

SAR(1 g) = 0.429 mW/g; SAR(10 g) = 0.160 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{ RH}$,
*. liquid temperature: 22.1(start)/22.1(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-2: Left-rear(tilt)&LCD:Close(normal)&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)
>Highest measured SAR(1g)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;
-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0, 161.0$ -Electronics: DAE4 Sn626; Calibrated: 2013/09/17
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m2;left-rear&touch(d0mm)&lcd=cl,11b(1m),m2412/

Area Scan:60x84,st12(mm) (6x8x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.635 W/kg

Area Scan:60x84,st12(mm) (51x71x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.871 W/kg

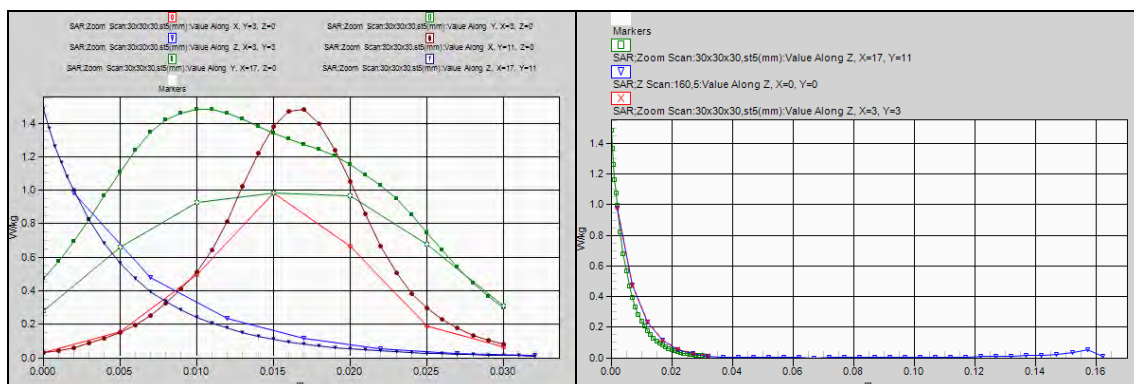
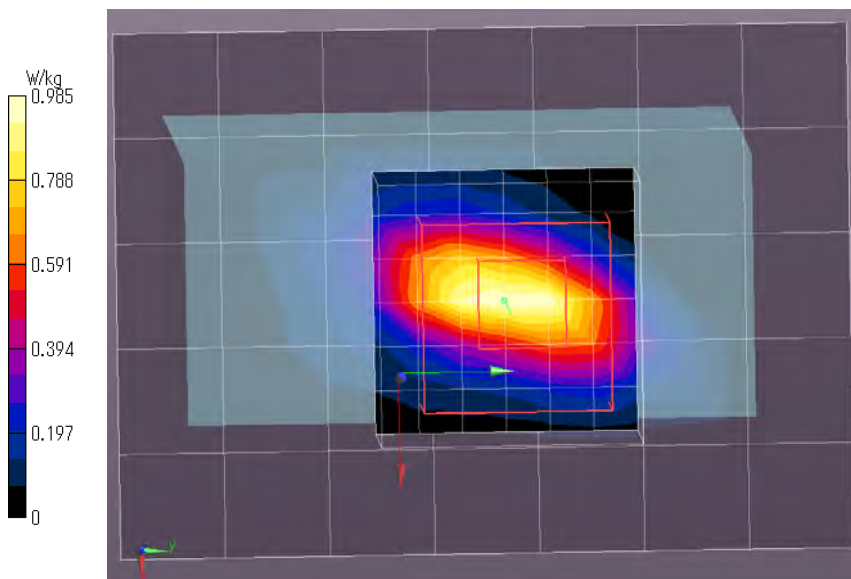
Z Scan:160,5 (1x1x33): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=5\text{mm}$; Maximum value of SAR (measured) = 0.979 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 22.980 V/m; Power Drift = -0.04 dB, Maximum value of SAR (measured) = 0.985 W/kg

Peak SAR (extrapolated) = 1.485 mW/g

SAR(1 g) = 0.595 mW/g; SAR(10 g) = 0.224 mW/g



Remarks: * Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
* liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{RH}$,
* liquid temperature: 22.1(start)/22.1(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-3: Left-rear(tilt)&LCD:Open(180degrees)&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;

-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0, 161.0$

-Electronics: DAE4 Sn626; Calibrated: 2013/09/17

-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m3;left-rear&touch(d0mm)&lcd=op(180),11b(1m),m2412/

Area Scan:60x84,st12(mm) (6x8x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.566 W/kg

Area Scan:60x84,st12(mm) (51x71x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.754 W/kg

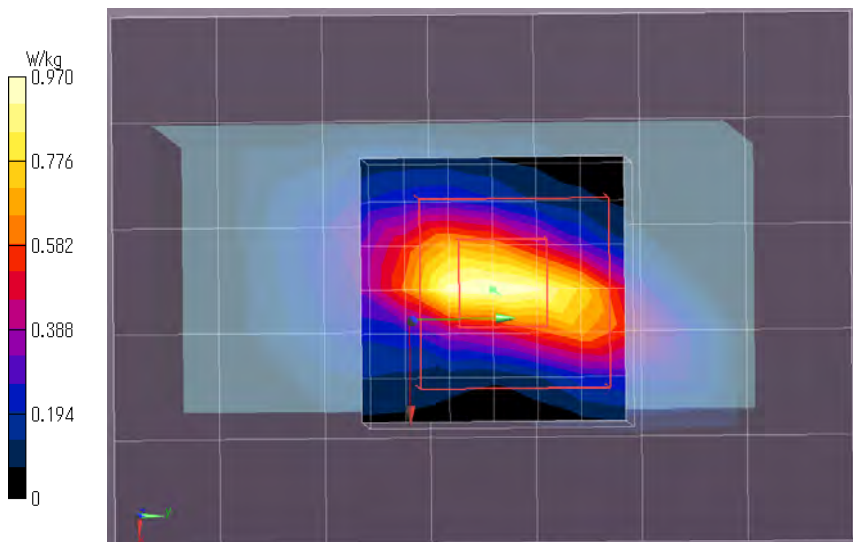
Z Scan:160,5 (1x1x33): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=5\text{mm}$; Maximum value of SAR (measured) = 0.972 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 22.651 V/m; Power Drift = 0.05 dB, Maximum value of SAR (measured) = 0.970 W/kg

Peak SAR (extrapolated) = 1.523 mW/g

SAR(1 g) = 0.556 mW/g; SAR(10 g) = 0.211 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{RH}$,
*. liquid temperature: 22.1(start)/22.1(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-4: Left-rear(tilt)&LCD:Close&touch (separation distance=0mm) / 11b(1Mbps), 2437MHz (6ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2437 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2437 \text{ MHz}$; $\sigma = 1.971 \text{ S/m}$; $\epsilon_r = 50.49$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;

-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0, 161.0$

-Electronics: DAE4 Sn626; Calibrated: 2013/09/17

-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m4;CH;left-rear&touch(d0mm)&lcd=cl,11b(1m),m2437/

Area Scan:60x84,st12(mm) (6x8x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.857 W/kg

Area Scan:60x84,st12(mm) (51x71x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.857 W/kg

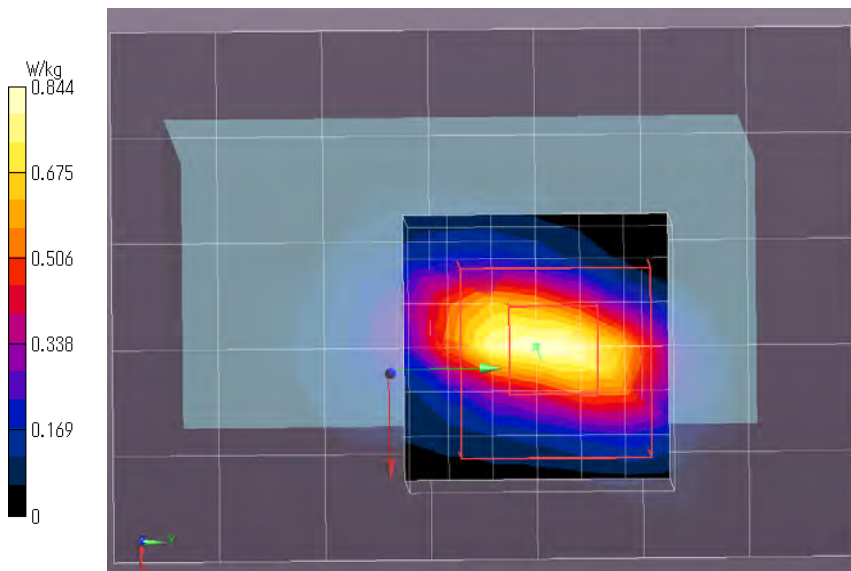
Z Scan:160,5 (1x1x33): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=5\text{mm}$; Maximum value of SAR (measured) = 0.841 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 21.079 V/m; Power Drift = -0.05 dB, Maximum value of SAR (measured) = 0.844 W/kg

Peak SAR (extrapolated) = 1.272 mW/g

SAR(1 g) = 0.508 mW/g; SAR(10 g) = 0.191 mW/g



Remarks: * Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
* liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{RH}$,
* liquid temperature: 22.1(start)/22.1(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-5: Left-rear(tilt)&LCD:Close&touch (separation distance=0mm) / 11b(1Mbps), 2462MHz (11ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2462 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2462 \text{ MHz}$; $\sigma = 1.994 \text{ S/m}$; $\epsilon_r = 50.43$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;
-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0, 161.0$ -Electronics: DAE4 Sn626; Calibrated: 2013/09/17
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m5;CH;left-rear&touch(d0mm)&lcd=cl,11b(1m),m2462/

Area Scan:60x84,st12(mm) (6x8x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.916 W/kg

Area Scan:60x84,st12(mm) (51x71x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.916 W/kg

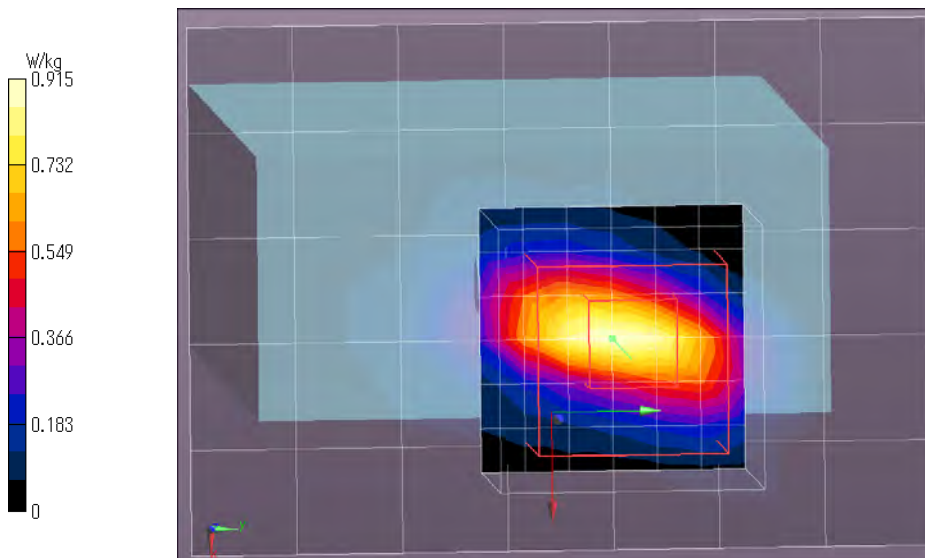
Z Scan:160,5 (1x1x33): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=5\text{mm}$; Maximum value of SAR (measured) = 0.904 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 21.746 V/m; Power Drift = -0.01 dB, Maximum value of SAR (measured) = 0.915 W/kg

Peak SAR (extrapolated) = 1.416 mW/g

SAR(1 g) = 0.534 mW/g; SAR(10 g) = 0.200 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{RH}$,
*. liquid temperature: 22.1(start)/22.1(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-6: Rear&LCD:Close&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;
-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0$ -Electronics: DAE4 Sn626; Calibrated: 2013/09/17
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m7;rear&touch(d0mm)&lcd=c,11b(1m),m2412/

Area Scan:84x144,st12(mm) (8x13x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.0172 W/kg

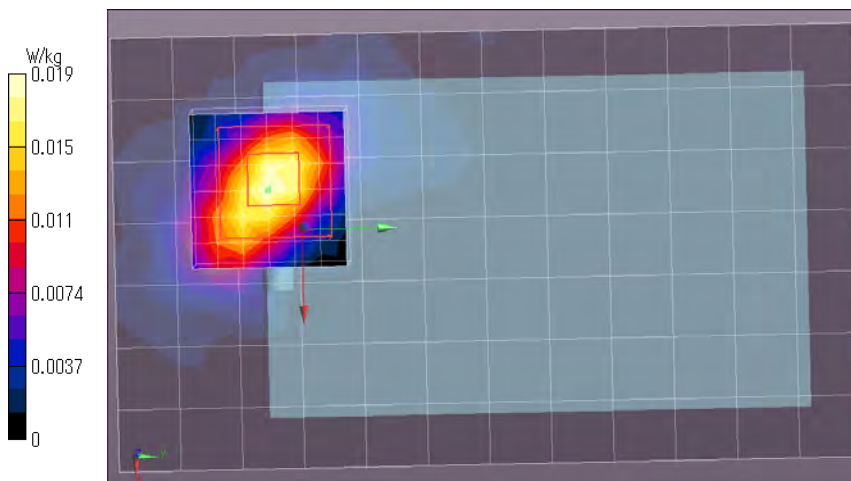
Area Scan:84x144,st12(mm) (71x121x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.0420 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 3.166 V/m; Power Drift = -0.06 dB, Maximum value of SAR (measured) = 0.0185 W/kg

Peak SAR (extrapolated) = 0.024 mW/g

SAR(1 g) = 0.012 mW/g; SAR(10 g) = 0.00471 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*.liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{RH}$,
*.liquid temperature: 22.1(start)/22.1(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-7: Rear&LCD:Open(180degrees)&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;
-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0$ -Electronics: DAE4 Sn626; Calibrated: 2013/09/17
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m8;rear&touch(d0mm)&lcd=op(180),11b(1m),m2412/

Area Scan:84x84,st12(mm) (8x8x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.0260 W/kg

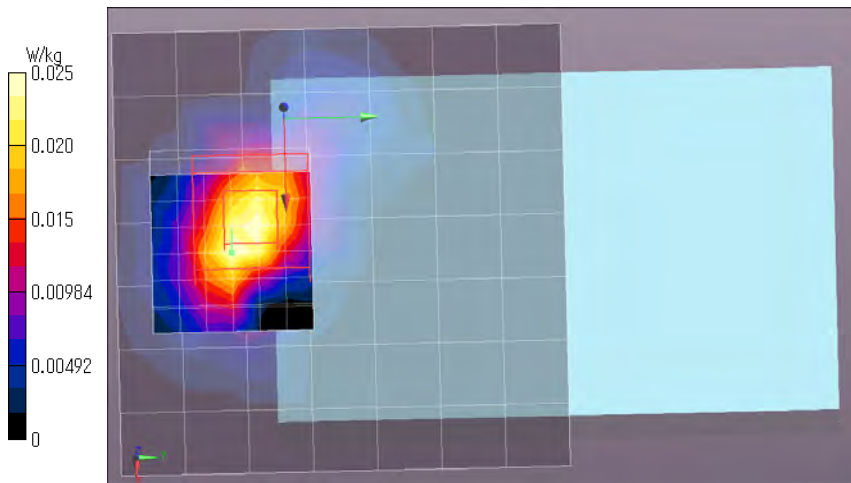
Area Scan:84x84,st12(mm) (71x71x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.0344 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 3.565 V/m; Power Drift = -0.12 dB, Maximum value of SAR (measured) = 0.0246 W/kg

Peak SAR (extrapolated) = 0.041 mW/g

SAR(1 g) = 0.014 mW/g; SAR(10 g) = 0.00433 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.}$ / $50 \pm 10 \% \text{ RH}$,
*. liquid temperature: 22.1(start)/22.1(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-8: Front-left&LCD:Close&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;

-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0$

-Electronics: DAE4 Sn626; Calibrated: 2013/09/17

-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m9;front-left&touch(d0mm)&lcd=c,l,11b(1m),m2412/

Area Scan:84x84,st12(mm) (8x8x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.170 W/kg

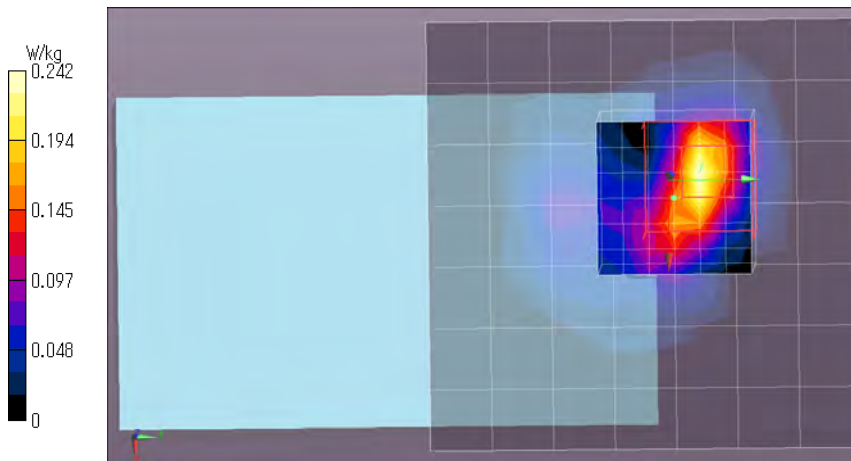
Area Scan:84x84,st12(mm) (71x71x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.171 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 9.240 V/m; Power Drift = -0.2 dB, Maximum value of SAR (measured) = 0.242 W/kg

Peak SAR (extrapolated) = 0.332 mW/g

SAR(1 g) = 0.140 mW/g; SAR(10 g) = 0.054 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{RH}$,
*. liquid temperature: 22.2(start)/22.2(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-9: Front (Lens)&LCD:Close&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;

-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0$

-Electronics: DAE4 Sn626; Calibrated: 2013/09/17

-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m10;front&touch(d0mm)&lcd=cl,11b(1m),m2412/

Area Scan:84x144,st12(mm) (8x13x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.0226 W/kg

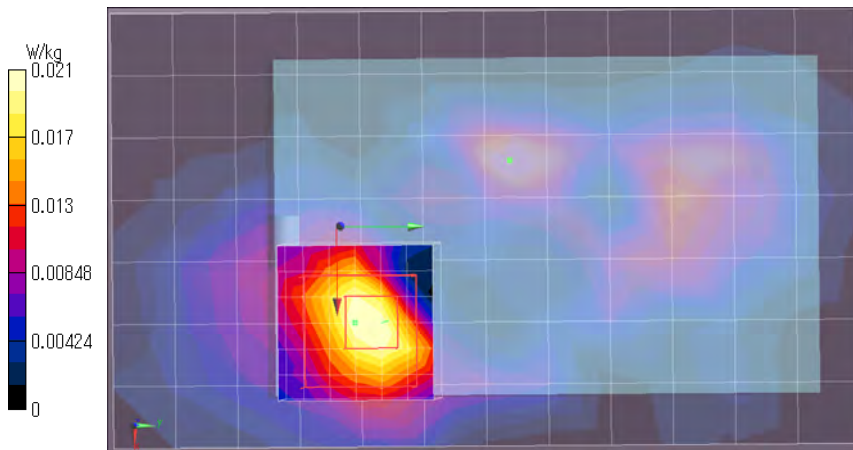
Area Scan:84x144,st12(mm) (71x121x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.0259 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 3.451 V/m; Power Drift = -0.19 dB, Maximum value of SAR (measured) = 0.0212 W/kg

Peak SAR (extrapolated) = 0.030 mW/g

SAR(1 g) = 0.015 mW/g; SAR(10 g) = 0.00647 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{RH}$,
*. liquid temperature: 22.2(start)/22.2(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-10: Right&LCD:Close&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;
-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0$ -Electronics: DAE4 Sn626; Calibrated: 2013/09/17
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m11;right&touch(d0mm)&lcd=c,11b(1m),m2412/

Area Scan:72x96,st12(mm) (7x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.00646 W/kg

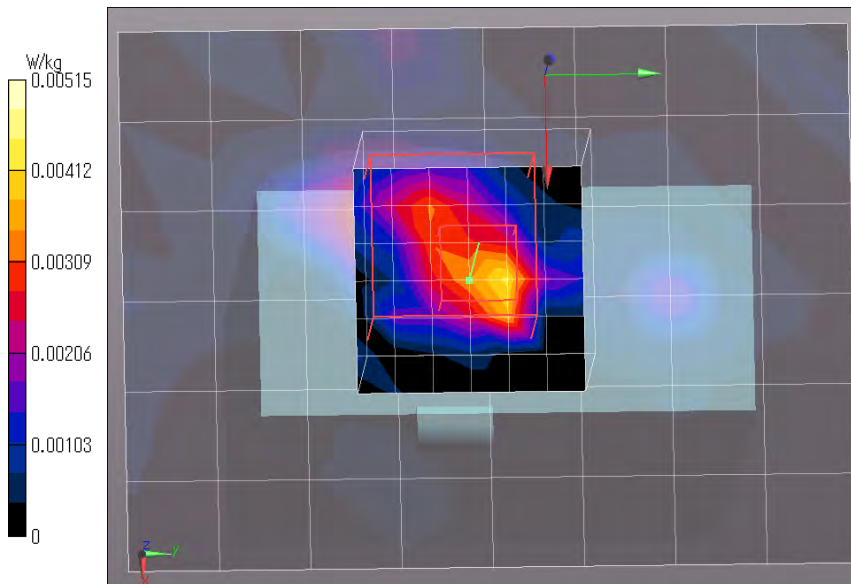
Area Scan:72x96,st12(mm) (61x81x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.00700 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 1.598 V/m; Power Drift = -0.2 dB, Maximum value of SAR (measured) = 0.00515 W/kg

Peak SAR (extrapolated) = 0.011 mW/g

SAR(1 g) = 0.00158 mW/g; SAR(10 g) = 0.00036 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{ RH}$,
*. liquid temperature: 22.2(start)/22.2(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-11: Top&LCD:Close&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;

-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0$

-Electronics: DAE4 Sn626; Calibrated: 2013/09/17

-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m12;top&touch(d0mm)&lcd=cl,11b(1m),m2412/

Area Scan:72x144,st12(mm) (7x13x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.118 W/kg

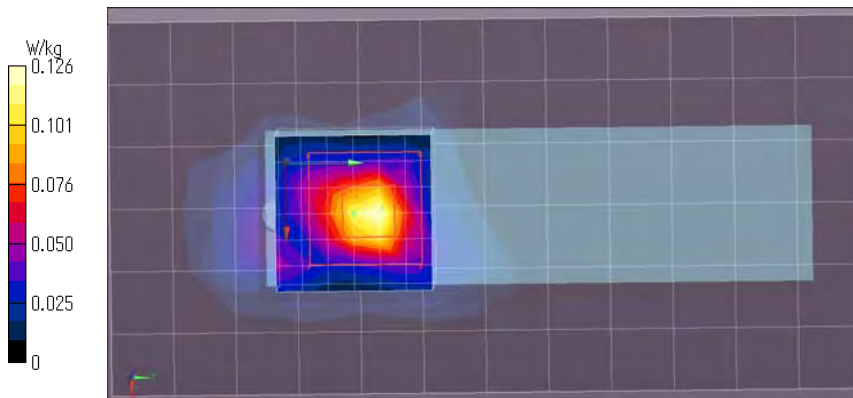
Area Scan:72x144,st12(mm) (61x121x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.121 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 7.712 V/m; Power Drift = -0.09 dB, Maximum value of SAR (measured) = 0.126 W/kg

Peak SAR (extrapolated) = 0.166 mW/g

SAR(1 g) = 0.082 mW/g; SAR(10 g) = 0.030 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{ RH}$,
*. liquid temperature: 22.2(start)/22.3(end)/22.2(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 1: Change the setup positions and channels (cont'd)

Plot 1-12: Bottom&LCD:Close&touch (separation distance=0mm) / 11b(1Mbps), 2412MHz (1ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11b(1Mbps, DBPSK/DSSS) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2412 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2412 \text{ MHz}$; $\sigma = 1.928 \text{ S/m}$; $\epsilon_r = 50.62$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;

-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0$

-Electronics: DAE4 Sn626; Calibrated: 2013/09/17

-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m13;btm&touch(d0mm)&lcd=cl,11b(1m),m2412/

Area Scan:72x144,st12(mm) (7x13x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$; Maximum value of SAR (measured) = 0.0199 W/kg

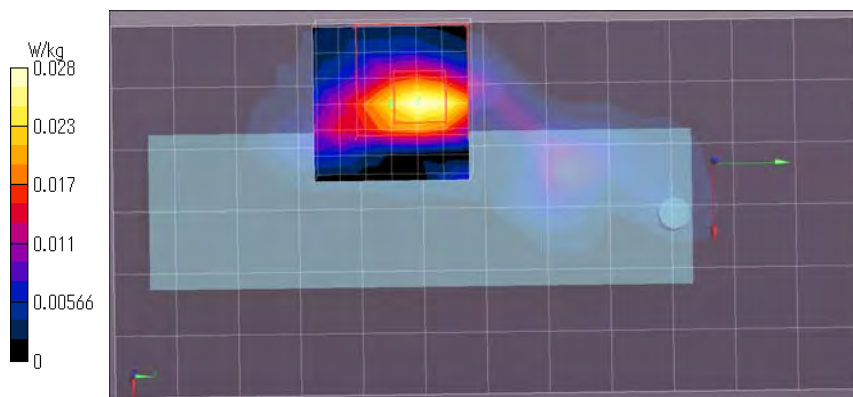
Area Scan:72x144,st12(mm) (61x121x1): Interpolated grid: $dx=1.200 \text{ mm}$, $dy=1.200 \text{ mm}$; Maximum value of SAR (interpolated) = 0.0403 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$;

Reference Value = 3.516 V/m; Power Drift = 0.07 dB, Maximum value of SAR (measured) = 0.0283 W/kg

Peak SAR (extrapolated) = 0.074 mW/g

SAR(1 g) = 0.019 mW/g; SAR(10 g) = 0.00532 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: $23.0 \pm 1 \text{ deg.C.} / 50 \pm 10 \% \text{ RH}$,
*. liquid temperature: 22.3(start)/22.3(end)/22.2(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: Change the operation mode

Plot 2-1: Left-rear&LCD:Close&touch (separation distance=0mm) / 11n(40HT)(MCS0), 2422MHz (3ch.)

EUT: Wireless module(in digital camera); Type: WM229(camera:PC2201); Serial: E4813949ECC8(camera:57)

Communication System: IEEE 802.11n(40HT)(MCS0, BPSK/OFDM) (*. Frame Length in ms: 0; PAR: 0; PMF: 1);

Frequency: 2422 MHz; Crest Factor: 1.0

Medium: M2450; Medium parameters used: $f = 2422$ MHz; $\sigma = 1.943$ S/m; $\epsilon_r = 50.59$; $\rho = 1000$ kg/m³

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22;

-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0, 161.0$

-Electronics: DAE4 Sn626; Calibrated: 2013/09/17

-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

WM229+dc1(pc2201)/m6;mode:left-rear&touch(d0mm)&lcd=c,n40(m0),m2422/

Area Scan:60x84,st12(mm) (6x8x1): Measurement grid: $dx=12$ mm, $dy=12$ mm; Maximum value of SAR (measured) = 0.595 W/kg

Area Scan:60x84,st12(mm) (51x71x1): Interpolated grid: $dx=1.200$ mm, $dy=1.200$ mm; Maximum value of SAR (interpolated) = 0.595 W/kg

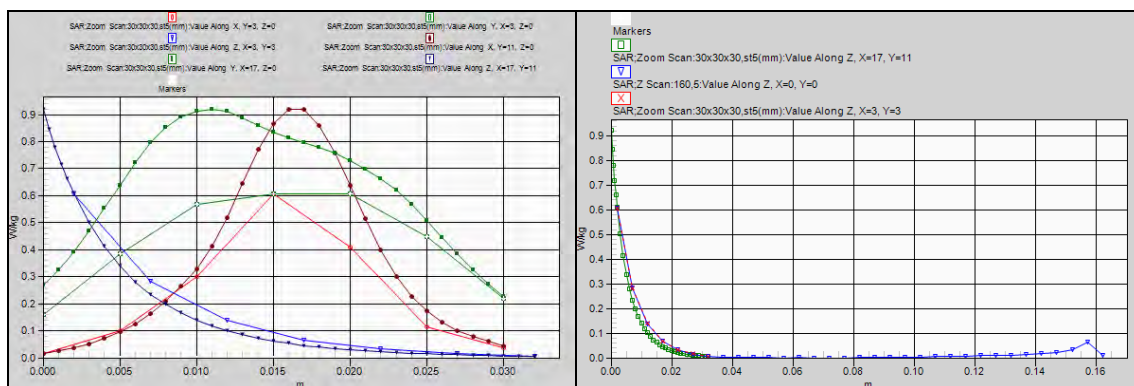
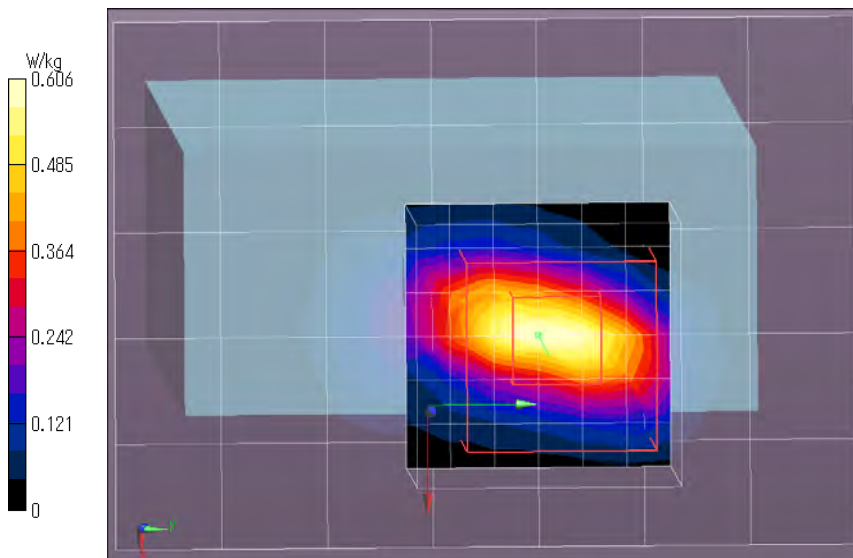
Z Scan:160,5 (1x1x33): Measurement grid: $dx=20$ mm, $dy=20$ mm, $dz=5$ mm; Maximum value of SAR (measured) = 0.609 W/kg

Zoom Scan:30x30x30,st5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm;

Reference Value = 17.848 V/m; Power Drift = 0.10 dB, Maximum value of SAR (measured) = 0.606 W/kg

Peak SAR (extrapolated) = 0.921 mW/g

SAR(1 g) = 0.368 mW/g; SAR(10 g) = 0.137 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: 23.0 ± 1 deg.C. / 50 ± 10 %RH,
*. liquid temperature: 22.1(start)/22.1(end)/22.2(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 V8.2 B969	-	SAR	-
COTS-SSEP-02	Dielectric assessment kit	Schmid&Partner Engineering AG	DAK	-	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	2013/09/02 * 12
KDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE4	626	SAR	2013/09/17 * 12
KPB-01	Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV4	3679	SAR	2013/07/13 * 12
KSDA-01	Dipole Antenna	Schmid&Partner Engineering AG	D2450V2	822	SAR(daily)	2014/01/10 * 12
KPFL-01	Flat Phantom	Schmid&Partner Engineering AG	Oval flat phantom ELI 4.0	1059	SAR	2013/10/30 * 12
SSNA-01	Network Analyzer	Agilent	8753ES	US39171777	SAR	2013/12/10 * 12
SEPP-02	Dielectric probe	Schmid&Partner Engineering AG	DAK3.5	1129	SAR	2013/08/24 * 12
KSG-08	Signal Generator	Rohde & Schwarz	SMT06	100763	SAR(daily)	2013/07/31 * 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-06	Power Meter	Rohde & Schwarz	NRVD	101599	SAR(daily)	2013/09/03 * 12
KIU-08	Power sensor	Rohde & Schwarz	NRV-Z4	100372	SAR(daily)	2013/09/03 * 12
KIU-09	Power sensor	Rohde & Schwarz	NRV-Z4	100371	SAR(daily)	2013/09/03 * 12
KAT10-P1	Attenuator	Weinschel	24-10-34	BY5927	SAR(daily)	2014/01/14 * 12
KPM-05	Power meter	Agilent	E4417A	GB41290718	SAR(daily)	2013/04/18 * 12
KPSS-01	Power sensor	Agilent	E9327A	US40440544	SAR(daily)	2013/04/18 * 12
SAT20-SAR1	Attenuator	TME	SFA-01AXPJ-20	-	SAR(daily)	2014/01/14 * 12
KRU-01	Ruler(300mm)	Shinwa	13134	-	SAR	2014/03/27 * 12
KRU-05	Ruler(100x50mm,L)	Shinwa	12101	-	SAR	2013/05/27 * 12
KOS-13	Digital thermometer	HANNA	Checktemp-2	KOS-13	SAR	2013/12/17 * 12
KOS-14	Thermo-Hygrometer data logger	SATO KEIRYOKI	SK-L200THII α / SK-LTHII α-2	015246/08169	SAR	2013/12/17 * 12
SOS-11	Humidity Indicator	A&D	AD-5681	4063424	SAR	2014/02/21 * 12
SOS-12	Digital thermometer	HANNA	Checktemp-4	SOS-12	SAR	2014/02/26 * 12
SOS-SAR1	Digital thermometer	LKMelectronic	DTM3000	3171	SAR	2013/10/01 * 12
KPM-08	Power meter	Anritsu	ML2495A	6K00003356	Ant.pwr	2013/09/04 * 12
KPSS-04	Power sensor	Anritsu	MA2411B	012088	Ant.pwr	2013/09/04 * 12
KAT10-S3	Attenuator	Agilent	8490D 010	50924	Ant.pwr	2014/01/14 * 12
SSA-04	Spectrum Analyzer	Advantest	R3272	101100994	SAR(mon.)	2013/12/26 * 12
KSDH-01	Device holder	Schmid&Partner Engineering AG	Mounting device for transmitter	-	SAR	2013/09/02 * 12
SWTR-03	DI water	MonotaRo	34557433	-	SAR	Pre Check
KSLM245-01	Tissue simulation liquid (2450MHz,body)	Schmid&Partner Engineering AG	SL AAM 245 BA	-	SAR	(Daily check) Target value ±5%
No.7 Shielded room	SAR shielded room (2.76m(W)x3.76m(D)x2.4m(H))	TDK	-	-	SAR	(Daily check) Ambient noise: < 12mW/kg

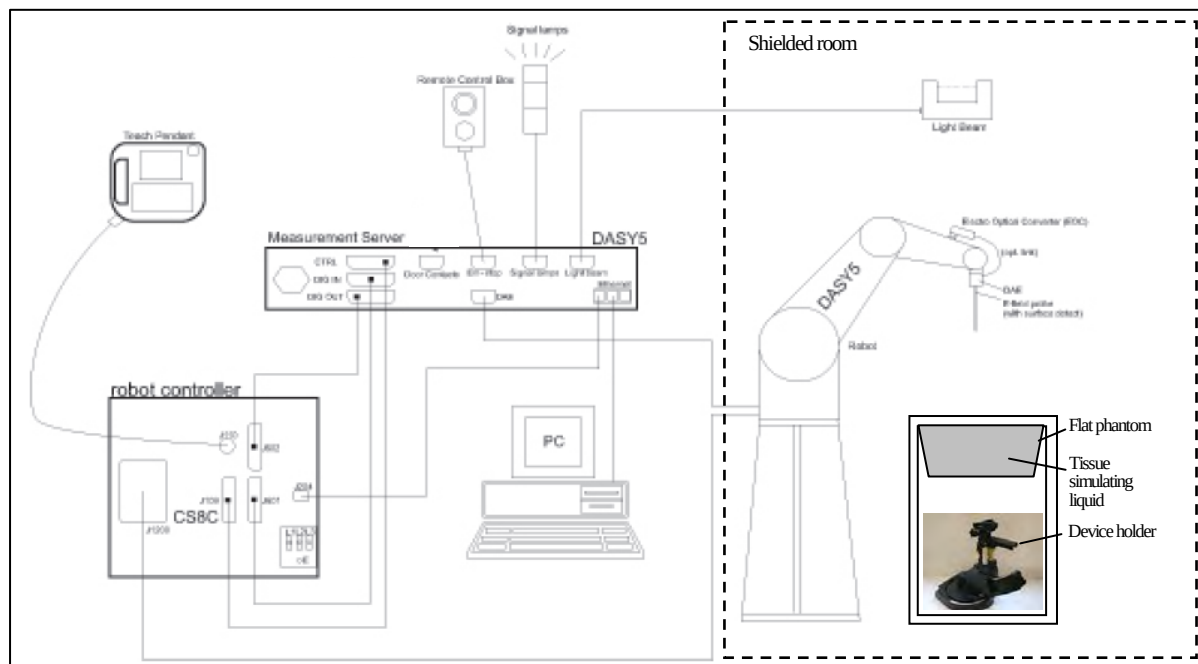
The expiration date of calibration is the end of the expired month.

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, Ant.pwr: Antenna terminal conducted power

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 : $\pm 0.02\text{mm}$
- 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 : $1\mu\text{V}$ to $> 200\text{mV}$ (16bit resolution and 2 range settings: 4mV , 400mV)
- Input Offset voltage : $< 1\mu\text{V}$ (with auto zero)
- Input Resistance : $200\text{M}\Omega$
- Battery Power : $> 10\text{hr}$ of operation (with two 9V 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

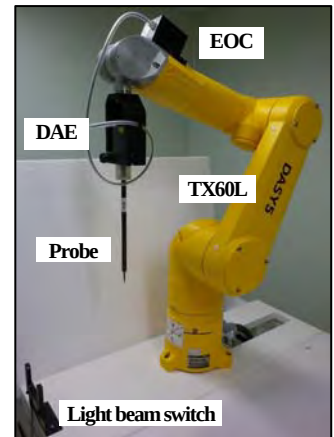
- Model : **EX3DV4 (serial number: 3679)**
- Construction : Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
- Frequency : 10MHz to 6GHz, Linearity: $\pm 0.2\text{ dB}$ (30MHz to 6GHz)
- Conversion Factors : 2450, 5200, 5300, 5500, 5600, 5800MHz (Head and Body)
- Directivity : $\pm 0.3\text{ dB}$ in HSL (rotation around probe axis)
 $\pm 0.5\text{ dB}$ in tissue material (rotation normal to probe axis)
- Dynamic Range : $10\mu\text{W/g}$ to $> 100\text{ mW/g}$; Linearity: $\pm 0.2\text{ dB}$ (noise: typically $< 1\mu\text{W/g}$)
- Dimension : 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%.
- Manufacture : Schmid & Partner Engineering AG

Phantom

- Type : **ELI 4.0 oval flat phantom**
- Shell Material : Fiberglass
- Shell Thickness : Bottom plate: $2 \pm 0.2\text{mm}$
- Dimensions : Bottom elliptical: $600 \times 400\text{mm}$, Depth: 190mm (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



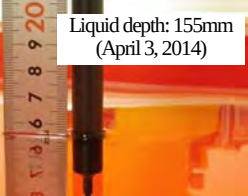
UL Japan, Inc.

Shonan EMC Lab.

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

Appendix 3-4: Simulated tissue composition and parameter confirmation

Liquid type	Body
Model No.	MSL2450V2
Product No.	SL AAM 245 BA
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.

Dielectric parameter measurement results (Body tissue)												
Date	Frequency [MHz] (Liquid)	Ambient	Temperature Liquid [deg.C.]		Liquid Depth [mm]	Parameters Relative permittivity: ϵ_r Conductivity: σ	Target value (*1)	Measured	ASAR(1g) [%] (*2)	Deviation [%]	Limit [%] (*3)	
			Before	After								
April 3, 2014	2450 (Body)	22.5deg.C. / 52%RH	22.2	22.2	(155)	ϵ_r [-]	52.7	50.48	+1.68	-4.2	-5 ≤ ϵ_r -meas ≤ 0	
						σ [S/m]	1.95	1.980		+1.5	0 ≤ σ -meas ≤ +5	

*1. The target value is a parameter defined in Appendix A of KDB865664 D01. 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		Body Tissue		f (MHz)	Head Tissue		Body Tissue	
	ϵ_r	σ [S/m]	ϵ_r	σ [S/m]		ϵ_r	σ [S/m]	ϵ_r	σ [S/m]
(1800-)2000	40.0	1.40	53.3	1.52	2412	39.27	1.766	52.75	1.914
2450	39.2	1.80	52.7	1.95	2422	39.25	1.775	52.74	1.923
3000	38.5	2.40	52.0	2.73	2437	39.22	1.788	52.72	1.938
					2462	39.18	1.813	52.68	1.967

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

$$\text{ASAR}(1g) = C_{\epsilon r} \times \Delta \epsilon_r + C_{\sigma} \times \Delta \sigma, C_{\epsilon r} = -7.854E-4 \times f^3 + 9.402E-2 \times f^2 - 7.742E-2 \times f + 0.2026 / C_{\sigma} = 9.804E-3 \times f^3 - 8.661E-2 \times f^2 + 2.981E-2 \times f + 0.7829$$

*3. Refer to KDB865664 D01, item 2), Clause 2.6; "When nominal tissue dielectric parameters are recorded in the probe calibration data; for example, only target values and tolerance are reported, the measured ϵ_r and σ of the liquid used in routine measurements must be: $\leq$ the target ϵ_r and $\geq$ the target σ values and also within 5% of the required target dielectric parameters."

*. Table: The measured electric parameters

Name : dasy50ET65 Body (full range) 22.2 deg.C. 2014/04/03 08:18:14										
Date : 0ET65 Body (full range) 22.4 deg.C. 2014/04/03 08:18:14										
Temperature [C.] : 22.4										
Probe : DAK.35										
Network Analyzer : HP8753X										
Notes :										
Measured data										
f (MHz)	eps.R	eps.I	sigma(S/m)	loss tangent	refl.R	refl.I				
2250	50.8062	14.141	1.8487	0.2783	0.2148	-0.7254	2412	50.624	14.3654	1.9276
2251	50.7945	14.1576	1.8443	0.2776	0.2149	-0.7259	2413	50.5873	14.3374	1.9246
2252	50.8113	14.1306	1.8489	0.2781	0.2142	-0.7257	2414	50.6305	14.3493	1.927
2253	50.8275	14.1703	1.8549	0.2788	0.2134	-0.7253	2415	50.5859	14.3502	1.9279
2254	50.8093	14.0964	1.846	0.2774	0.2138	-0.7262	2416	50.6315	14.4427	1.9412
2255	50.7551	14.1694	1.8564	0.2792	0.2137	-0.725	2417	50.6434	14.4077	1.9373
2256	50.8255	14.1989	1.8483	0.2776	0.2138	-0.7265	2418	50.621	14.397	1.9366
2257	50.7927	14.136	1.8536	0.2783	0.2127	-0.7258	2419	50.5754	14.3837	1.937
2258	50.8536	14.159	1.857	0.2784	0.2115	-0.726	2420	50.5844	14.3943	1.9377
2259	50.796	14.166	1.8591	0.2789	0.212	-0.7255	2421	50.6113	14.4333	1.9439
2260	50.756	14.1947	1.8636	0.2797	0.2116	-0.725	2422	50.5907	14.4187	1.9428
2261	50.77	14.1723	1.8615	0.2791	0.2115	-0.7254	2423	50.5719	14.4202	1.9438
2262	50.8127	14.1539	1.8598	0.2786	0.2107	-0.7259	2424	50.5719	14.4202	1.9438
2263	50.8326	14.1494	1.86	0.2784	0.2101	-0.7262	2425	50.5501	14.451	1.9495
2264	50.8	14.1625	1.8625	0.2788	0.2101	-0.7259	2426	50.5859	14.4241	1.9451
2265	50.8277	14.1684	1.8641	0.2788	0.2094	-0.726	2427	50.5501	14.451	1.9495
2266	50.7584	14.1736	1.8656	0.2792	0.2099	-0.7256	2428	50.5859	14.4241	1.9451
2267	50.7476	14.2182	1.8722	0.2802	0.2095	-0.725	2429	50.5501	14.451	1.9495
2268	50.7831	14.1309	1.8615	0.2783	0.2092	-0.7264	2430	50.5719	14.4202	1.9438
2269	50.7229	14.1743	1.868	0.2792	0.2087	-0.7258	2431	50.5499	14.4437	1.9534
2270	50.8011	14.2637	1.8906	0.2808	0.2075	-0.7249	2432	50.537	14.4361	1.9531
2271	50.7875	14.1922	1.872	0.2796	0.208	-0.7256	2433	50.5403	14.4795	1.9598
2272	50.7742	14.2241	1.877	0.2801	0.2074	-0.7253	2434	50.564	14.4688	1.9589
2273	50.7464	14.1888	1.8731	0.2796	0.2077	-0.7257	2435	50.5363	14.4733	1.9606
2274	50.7721	14.2345	1.8799	0.2804	0.2067	-0.7253	2436	50.5469	14.4631	1.9627
2275	50.7672	14.2261	1.8796	0.2802	0.2065	-0.7254	2437	50.4922	14.5396	1.9712
2276	50.7371	14.2248	1.8802	0.2804	0.2066	-0.7253	2438	50.5515	14.4902	1.9653
2277	50.7225	14.1555	1.8719	0.2791	0.2069	-0.7262	2439	50.4909	14.4905	1.9605
2278	50.6878	14.2791	1.888	0.2817	0.2061	-0.7244	2440	50.5497	14.5097	1.9696
2279	50.7323	14.2023	1.8796	0.2799	0.2058	-0.7257	2441	50.5348	14.4689	1.9567
2280	50.7254	14.2457	1.8862	0.2808	0.2053	-0.7252	2442	50.4703	14.4832	1.9607
2281	50.7329	14.2336	1.8854	0.2806	0.2049	-0.7254	2443	50.4703	14.4832	1.9607
2282	50.7571	14.2731	1.8914	0.2812	0.204	-0.7251	2444	50.5001	14.4906	1.9702
2283	50.7089	14.2574	1.8901	0.2812	0.2044	-0.7251	2445	50.4906	14.4906	1.9702
2284	50.7385	14.2762	1.8934	0.2814	0.2036	-0.725	2446	50.4355	14.4689	1.968
2285	50.7867	14.2873	1.8958	0.2816	0.2032	-0.7246	2447	50.5144	14.4713	1.9692
2286	50.6855	14.2989	1.8981	0.2821	0.2034	-0.7245	2448	50.5144	14.4713	1.9692
2287	50.7506	14.283	1.8967	0.2815	0.2027	-0.7251	2449	50.4666	14.5227	1.9776
2288	50.7325	14.3067	1.9006	0.282	0.2021	-0.7248	2450	50.4666	14.5227	1.9776
2289	50.6899	14.2734	1.897	0.2816	0.2026	-0.725	2451	50.5144	14.4713	1.9692
2290	50.7352	14.261	1.8961	0.2811	0.2017	-0.7255	2452	50.4666	14.5227	1.9776
2291	50.6651	14.2572	1.8964	0.2814	0.2024	-0.7252	2453	50.4666	14.5227	1.9776
2292	50.7011	14.3049	1.9035	0.2823	0.2017	-0.7246	2454	50.4666	14.5227	1.9776
2293	50.6975	14.3252	1.9071	0.2826	0.2006	-0.7246	2455	50.4666	14.5227	1.9776
2294	50.6583	14.2892	1.9031	0.2821	0.2013	-0.7249	2456	50.4666	14.5227	1.9776
2295	50.6945	14.3071	1.9062	0.2822	0.2009	-0.7249	2457	50.4666	14.5227	1.9776
2296	50.6436	14.3359	1.9109	0.2831	0.2005	-0.7243	2458	50.4666	14.5227	1.9776
2297	50.6604	14.2953	1.9063	0.2822	0.2002	-0.725	2459	50.4666	14.5227	1.9776
2298	50.6295	14.3536	1.9148	0.2835	0.1999	-0.7241	2460	50.4666	14.5227	1.9776
2299	50.7021	14.2912	1.9073	0.2819	0.199	-0.7254	2461	50.4666	14.5227	1.9776
2300	50.6316	14.3597	1.9172	0.2836	0.1992	-0.7241	2462	50.4666	14.5227	1.9776
2301	50.6726	14.3339	1.9146	0.2829	0.1985	-0.7247	2463	50.4666	14.5227	1.9776
2302	50.6749	14.3217	1.9138	0.2826	0.1982	-0.725	2464	50.4666	14.5227	1.9776
2303	50.6443	14.3393	1.9169	0.2831	0.1982	-0.7246	2465	50.4666	14.5227	1.9776
2304	50.6496	14.3255	1.9159	0.2828	0.1979	-0.7246	2466	50.4666	14.5227	1.9776
2305	50.6605	14.3439	1.9191	0.2831	0.1973	-0.7247	2467	50.4666	14.5227	1.9776
2306	50.6298	14.3818	1.925	0.2841	0.1971	-0.7241	2468	50.4666	14.5227	1.9776
2307	50.6531	14.326	1.9183	0.2828	0.1968	-0.725	2469	50.4666	14.5227	1.9776
2308	50.6123	14.3939	1.9282	0.2844	0.1966	-0.7239	2470	50.4666	14.5227	1.9776
2309	50.6286	14.3429	1.9221	0.2833	0.1964	-0.7247	2471	50.4666	14.5227	1.9776
2310	50.655	14.3072	1.9282	0.2837	0.1956	-0.7246	2472	50.4666	14.5227	1.9776
2311	50.6191	14.3218	1.9209	0.2829	0.196	-0.725	2473	50.4666	14.5227	1.9776
							2474	50.4666	14.5227	1.9776
							2475	50.4666	14.5227	1.9776
							2476	50.4666	14.5227	1.9776
							2477	50.4666	14.5227	1.9776
							2478	50.4666	14.5227	1.9776
							2479	50.4666	14.5227	1.9776
							2480	50.4666	14.5227	1.9776
							2481	50.4666	14.5227	1.9776
							2482	50.4666	14.5227	1.9776

Appendix 3-5: System check results

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

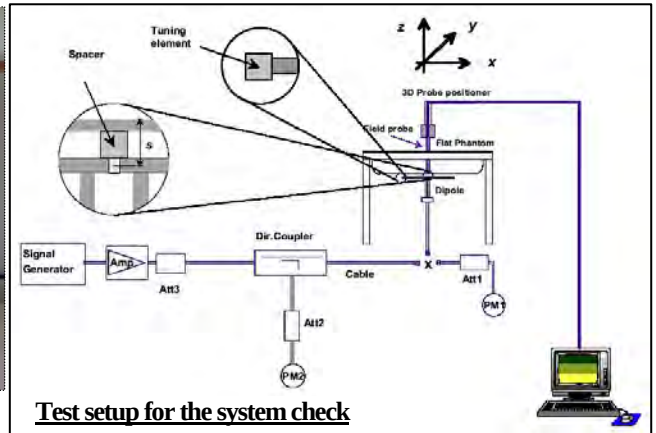
System check results															
Date	Freq. [MHz]	Liquid Type	Ambient	Liquid Temp. [deg.C.]			Liquid Depth [mm]	Dielectric parameter		Power drift [dB]	System check target & measured				
				Check	Before	After		ϵ_r [-]	σ [S/m]		SAR (1g) [W/kg]		Deviation [%]	Limit [%]	
											Measured (*1)				Target
April 3, 2014	2450	Body	23.5deg.C /42%RH	22.2	22.3	22.2	155	50.48	1.980	-0.03	49.96 (1W scaled)		none (*2)	-	-
											(12.7 (250mW)-> Δ SAR-corrected:12.49)		50.0 (*3)	-0.1	$\pm$ 10

*. Calculating formula: Δ SAR corrected SAR (1g) (W/kg) = (Observed SAR(1g) (W/kg)) $\times$ (100 - (Δ SAR(%)) / 100

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

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

*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_Jan14, 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, cal.=52.8W/kg, +0.8% 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 system check target.



Test setup for the system check

Appendix 3-6: System 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; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.98$ S/m; $\epsilon_r = 50.48$; $\rho = 1000$ kg/m³

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration: -Probe: EX3DV4 - SN3679; ConvF(6.82, 6.82, 6.82); Calibrated: 2013/07/22; -DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)
-Sensor-Surface: 2mm (Mechanical Surface Detection), $z = 1.0, 31.0, 161.0$ -Electronics: DAE4 Sn626; Calibrated: 2013/09/17
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section

Area Scan:60x60,stp15(mm) (5x5x1): Measurement grid: $dx=15$ mm, $dy=15$ mm; Maximum value of SAR (measured) = 19.2 W/kg

Area Scan:60x60,stp15(mm) (41x41x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm; Maximum value of SAR (interpolated) = 19.2 W/kg

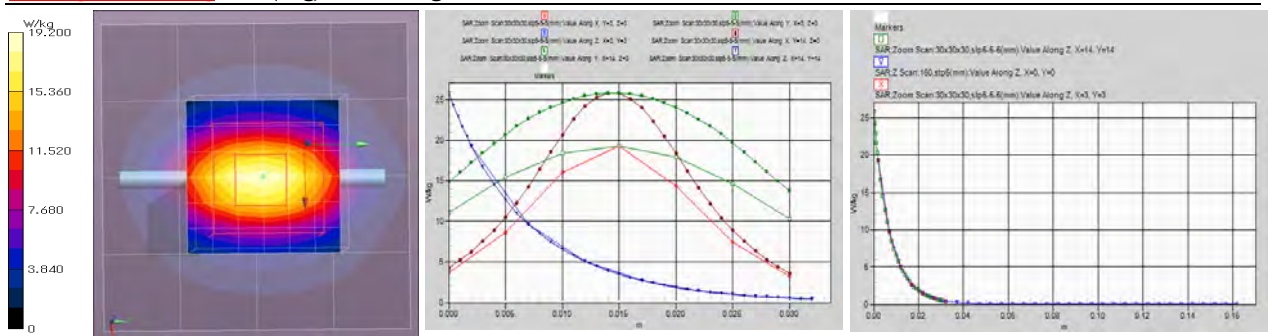
Z Scan:160,stp5(mm) (1x1x33): Measurement grid: $dx=20$ mm, $dy=20$ mm, $dz=5$ mm; Maximum value of SAR (measured) = 19.3 W/kg

Zoom Scan:30x30x30,stp5-5-5(mm) (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm;

Reference Value = 100.0 V/m; Power Drift = -0.03 dB, Maximum value of SAR (measured) = 19.2 W/kg

Peak SAR (extrapolated) = 25.833 mW/g (-0.6% vs. IEEE std.1528=26mW/g/-2.5% vs. speag.-cal.=26.5mW/g)

SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.88 mW/g



Remarks: *. Date tested: 2014/04/03; Tested by: Hiroshi Naka; Tested place: No.7 shielded room,
*. liquid depth: 155mm; Position: distance of dipole to phantom: 8mm (10mm to liquid); ambient: 22.3 deg.C. / 55 %RH,
*. liquid temperature: 22.3(start)/22.2(end)/22.2(in check) deg.C.; *. White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

Appendix 3-7: System check uncertainty

Uncertainty of system 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 (2.45,5.25,3.5,5.5,6.5,8GHz±100MHz)	±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 (ε,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, 8064 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
S Service suisse d'étalonnage
C 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 (PTT)**

Certificate No: **EX3-3679_Jul13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3679**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **July 22, 2013**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
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-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Isaac El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 23, 2013

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

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 108**

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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., $\theta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- 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
- 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:

- NORM_{x,y,z}:** Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,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.
- DCP_{x,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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 $f \leq 800$ 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 NORM_{x,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.

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

EX3DV4 – SN:3679

July 22, 2013

Probe EX3DV4

SN:3679

Manufactured: September 9, 2008
Calibrated: July 22, 2013

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

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

EX3DV4- SN:3679

July 22, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3679

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.58	0.54	0.53	± 10.1 %
DCP (mV) ^B	96.0	99.1	102.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	185.2	±2.7 %
		Y	0.0	0.0	1.0		163.9	
		Z	0.0	0.0	1.0		173.5	

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 E²-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.

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

EX3DV4- SN:3679

July 22, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3679

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	Depth (mm)	Unct. (k=2)
2450	39.2	1.80	6.81	6.81	6.81	0.57	0.67	± 12.0 %
5200	36.0	4.66	4.86	4.86	4.86	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.81	4.81	4.81	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.66	4.66	4.66	0.30	1.80	± 13.1 %
5600	35.5	5.07	4.40	4.40	4.40	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.49	4.49	4.49	0.35	1.80	± 13.1 %

^C Frequency validity 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.

^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.

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

EX3DV4- SN:3679

July 22, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3679

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	Depth (mm)	Unct. (k=2)
2450	52.7	1.95	6.82	6.82	6.82	0.72	0.62	± 12.0 %
5200	49.0	5.30	4.30	4.30	4.30	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.16	4.16	4.16	0.40	1.90	± 13.1 %
5500	48.6	5.65	3.83	3.83	3.83	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.84	3.84	3.84	0.40	1.90	± 13.1 %
5800	48.2	6.00	4.14	4.14	4.14	0.45	1.90	± 13.1 %

^C Frequency validity 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.

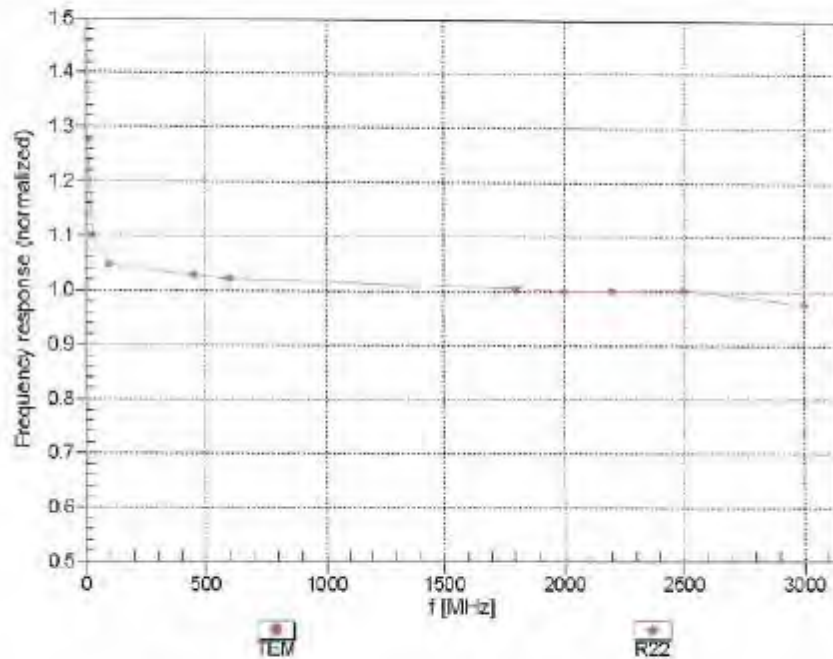
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

EX3DV4- SN:3679

July 22, 2013

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



Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

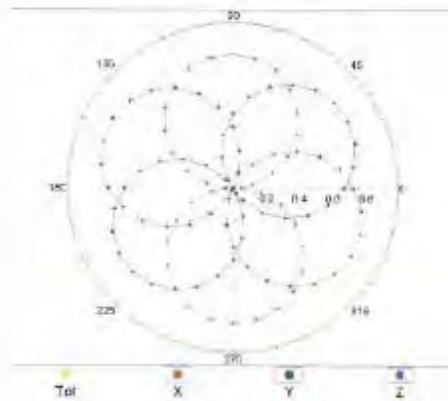
Appendix 3-8: Calibration certificate: E-Field Probe (EX3DV4) (cont'd)

EX3DV4- SN:3679

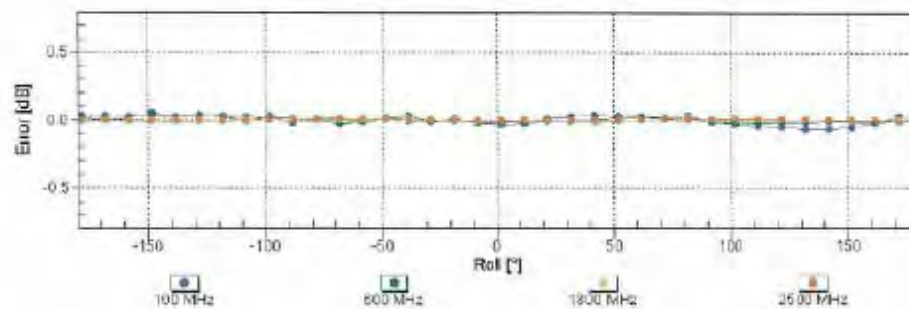
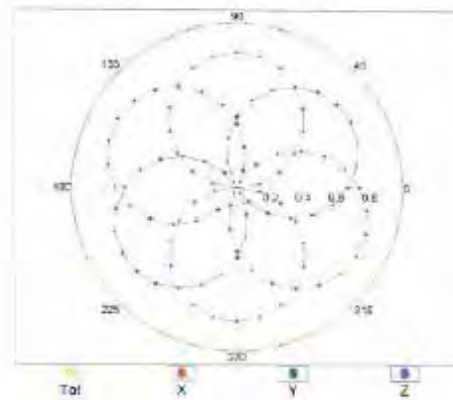
July 22, 2013

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM



f=1800 MHz,R22



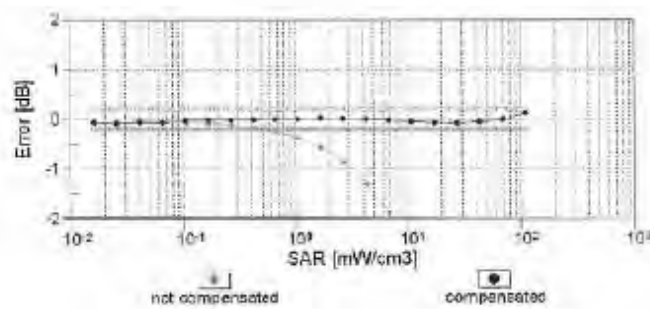
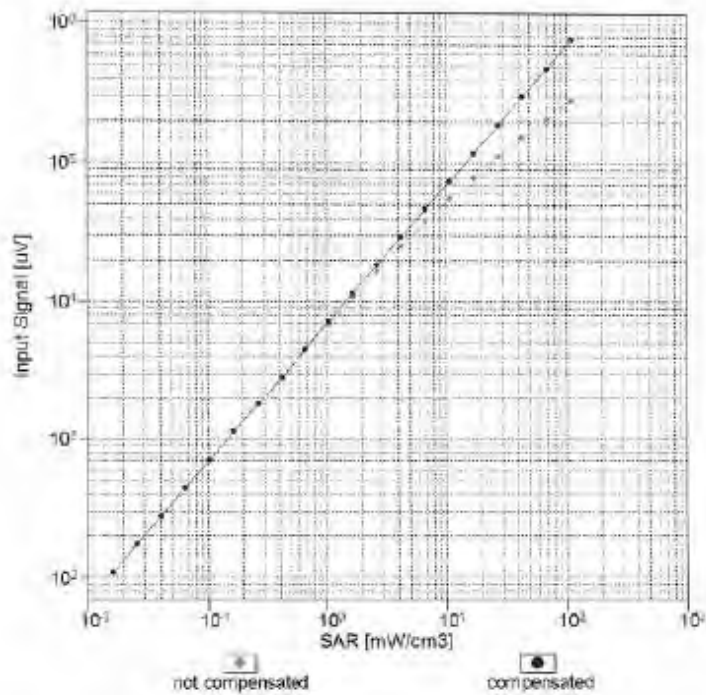
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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

EX3DV4- SN:3679

July 22, 2013

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)



Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Certificate No: EX3-3679_Jul13

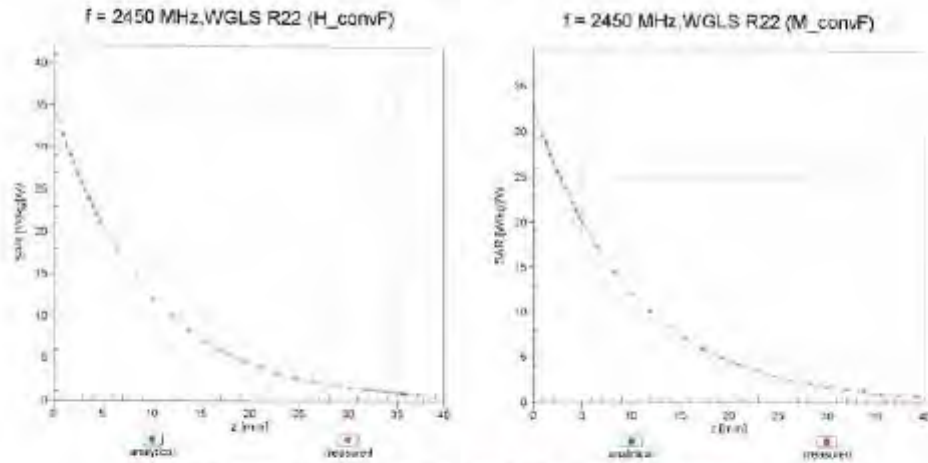
Page 9 of 11

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

EX3DV4- SN:3679

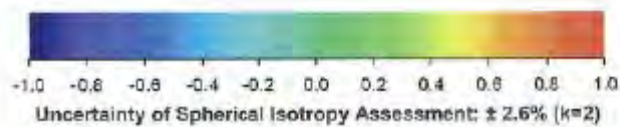
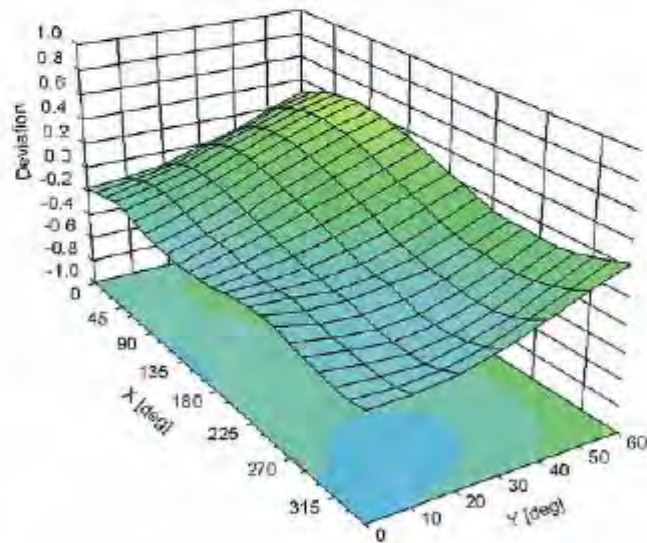
July 22, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900$ MHz



Certificate No: EX3-3679_Jul13

Page 10 of 11

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

EX3DV4- SN:3679

July 22, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3679

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	11.8
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	2 mm

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

**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
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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 108**

Client **UL Japan (PTT)**

Certificate No: **D2450V2-822_Jan14**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 822**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **January 10, 2014**

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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5056 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name Jeton Kastati	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 13, 2014

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

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



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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
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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%.

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	V52.8.7
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 $\pm$ 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 $\pm$ 0.2) °C	39.3 $\pm$ 6 %	1.83 mho/m $\pm$ 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	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg $\pm$ 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 $\pm$ 0.2) °C	51.8 $\pm$ 6 %	2.00 mho/m $\pm$ 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	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.0 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.84 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.1 W/kg $\pm$ 16.5 % (k=2)

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.9 \Omega + 3.6 j\Omega$
Return Loss	- 25.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.9 \Omega + 5.5 j\Omega$
Return Loss	- 25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.159 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

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

DASY5 Validation Report for Head TSL

Date: 10.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.83$ S/m; $\epsilon_r = 39.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

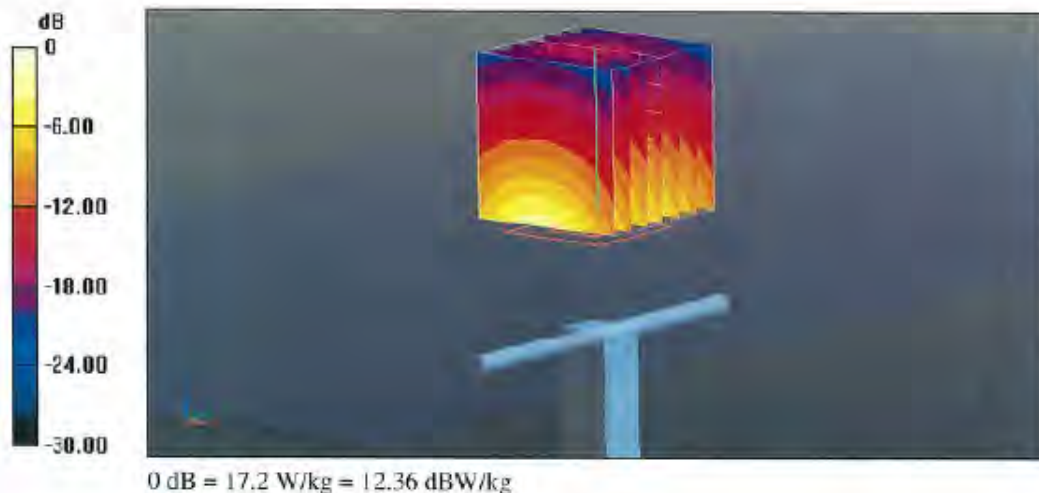
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.6 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.5 W/kg

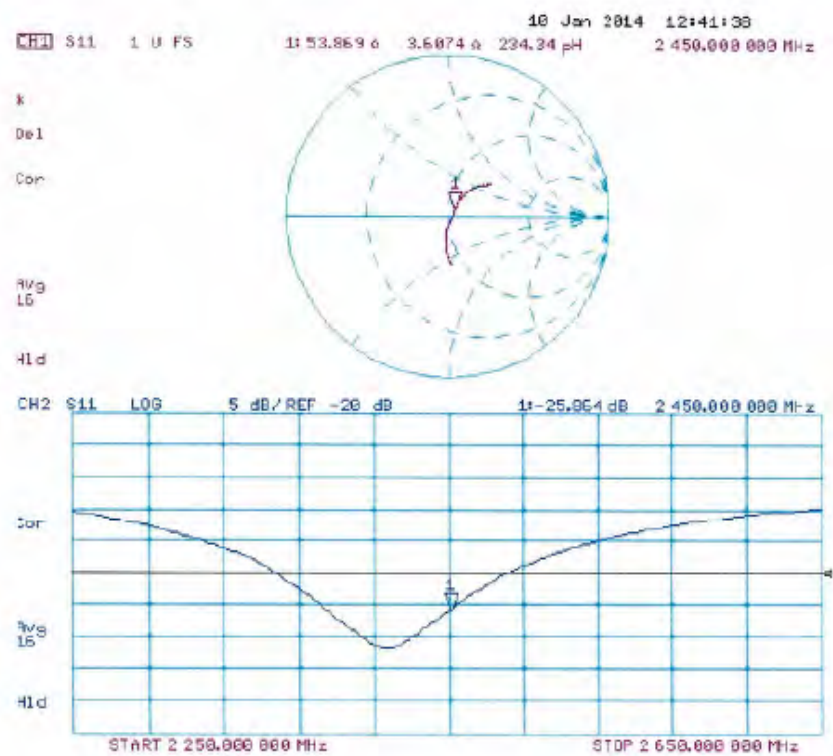
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.18 W/kg

Maximum value of SAR (measured) = 17.2 W/kg



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

Impedance Measurement Plot for Head TSL



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

DASY5 Validation Report for Body TSL

Date: 10.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2$ S/m; $\epsilon_r = 51.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

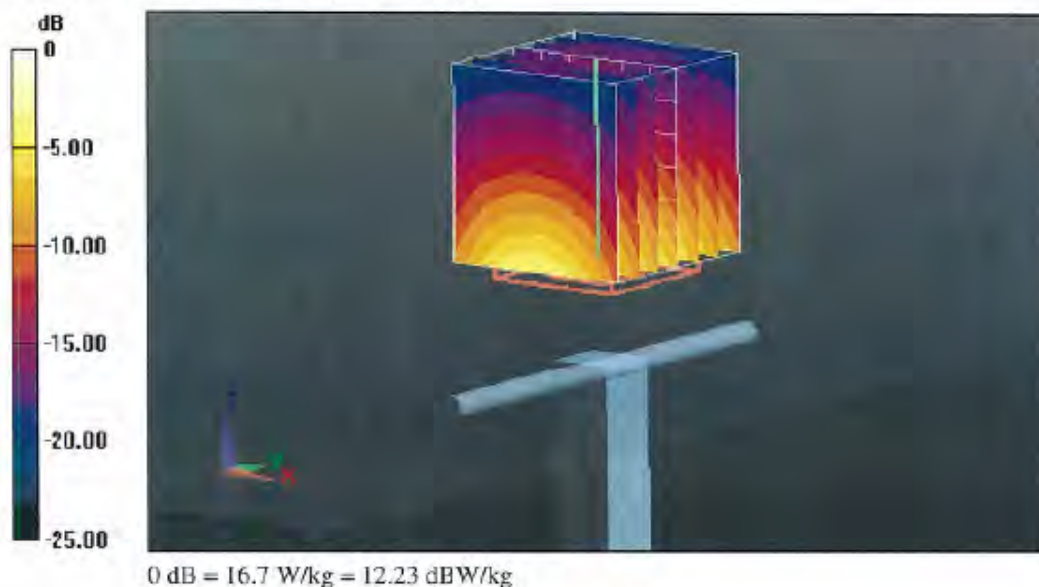
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.276 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 26.5 W/kg

SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.84 W/kg

Maximum value of SAR (measured) = 16.7 W/kg



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

Impedance Measurement Plot for Body TSL

