APPENDIX 2: SAR Measurement data

Appendix 2-1: Evaluation procedure

The SAR evaluation was performed with the following procedure:

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

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

Step 3: Around this point found in the Step 2 (area scan), a volume of 30mm(X axis)×30mm(Y axis)×30mm(Z axis) was assessed by measuring 7×7×7 points under 3GHz and a volume of 28mm(X axis)×28mm(Y axis)×22.5mm (Z axis) was assessed by measuring 8×8×6(ratio step method (*1)) points for 3-6GHz frequency band.
And for any secondary peaks found in the Step2 which are within 2dB of maximum peak (and within 3dB of SAR limit) and not with this Step3 (Zoom scan) is repeated.
On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

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

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

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

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

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

***1. Ratio step method parameters used;**
The first measurement point: 2mm from the phantom surface, the initial grid separation: 2mm, subsequent graded grid ratio: 1.5
These parameters comply with the requirement of the KDB 865664.
In the section of SAR Scan Procedures-Zoom Scan, in KDB 865664 (October 2006 revised, publication date: April 16, 2007): SAR Measurement Requirements for 3-6GHz, the graded grids requirement is as follows;
"When graded grids are used (z), the first measurement point should be within 3mm of the phantom surface for measurements below 4.5GHz and within 2mm at or above 4.5GHz. The initial grid separation, closest to the phantom, should be ≤ 2.0mm. A subsequent graded ration of 1.5 is recommended and less than 2.0 is required. "

Appendix 2-2: SAR measurement data

Step 1a: Antenna #0 (side) / Worst position search

Step 1a-1 Right-touch (separation=0mm)

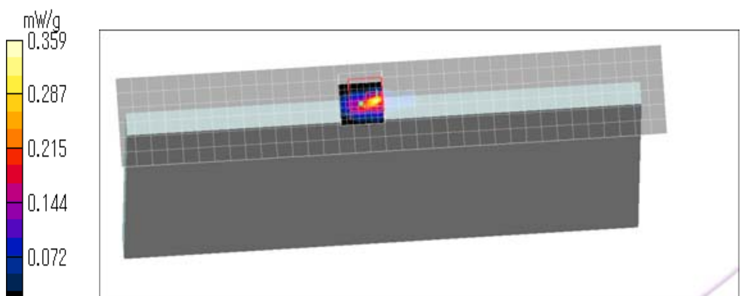
->Worst SAR(1g) of Antenna #0

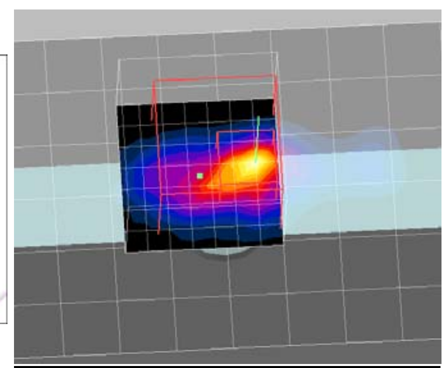
EUT: Flat Panel Sensor; Type: DR-ID 613SE; Serial: E120017
Communication System: IEEE 802.11a(6Mbps, BPSK/OFDM); Frequency: 5180 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5180 MHz; σ = 5.3 S/m; ε_r = 47.5; ρ = 1000 kg/m^3

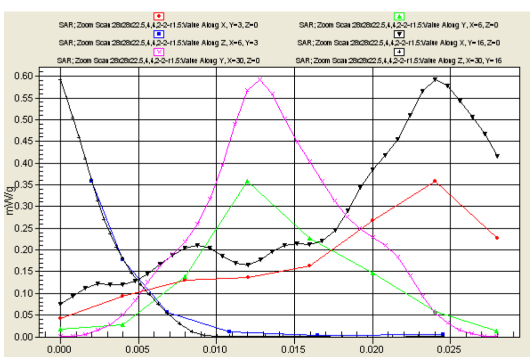
DASY4 Configuration: - Probe: EX3DV4 - SN3679; ConvF(4.1, 4.1, 4.1); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection) - Electronics: DAE4 Sn626; Calibrated: 2012/02/15
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

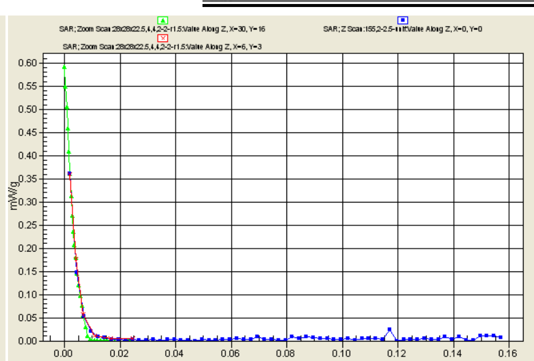
fcc,s-3,ant0,ls&d0,11a(6m,12.5d),m5180/
Area Scan(ant1):280x60,10 (36x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.216 mW/g
Area Scan(ant1):280x60,10 (351x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 0.310 mW/g
Z Scan:155,2-2.5-unif (1x1x63): Measurement grid: dx=20mm, dy=20mm, dz=2.5mm; Maximum value of SAR (measured) = 0.362 mW/g

Zoom Scan:28x28x22.5,4,4,2-2-r1.5 (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 7.06 V/m; Power Drift = 0.145 dB, Maximum value of SAR (measured) = 0.359 mW/g
Peak SAR (extrapolated) = 1.87 W/kg
SAR(1 g) = 0.123 mW/g; SAR(10 g) = 0.030 mW/g









Remarks: *. Date tested: 2012/05/22; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*.liquid depth: 143mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: 24.9deg.C. / 44 %RH,
*.liquid temperature: 23.6(start)/23.7(end)/24.5(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 1a: Antenna #0 (side) / Worst position search (cont'd)

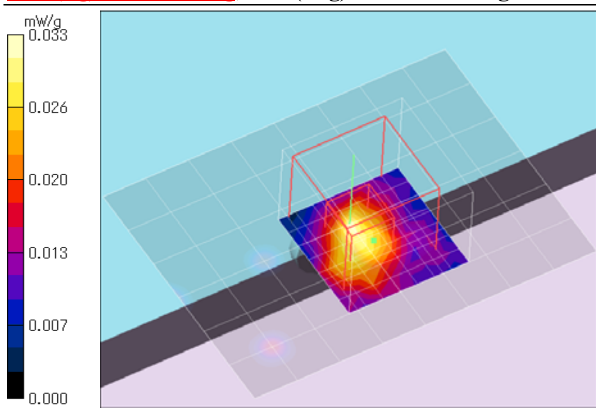
Step 1a-2 Back-touch (separation=0mm)

EUT: Flat Panel Sensor; Type: DR-ID 613SE; Serial: E120017
Communication System: IEEE 802.11a(6Mbps, BPSK/OFDM); Frequency: 5180 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5180 MHz; σ = 5.3 S/m; ε_r = 47.5; ρ = 1000 kg/m^3

DASY4 Configuration: - Probe: EX3DV4 - SN3679; ConvF(4.1, 4.1, 4.1); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection) - Electronics: DAE4 Sn626; Calibrated: 2012/02/15
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

fcc,s-5,ant0,rear&d0,11a(6m,12.5d),m5180/
Area Scan(ant1):80x60,10 (9x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.029 mW/g
Area Scan(ant1):80x60,10 (81x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 0.057 mW/g

Zoom Scan:28x28x22.5,4,4,2-2-r1.5 (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 2.57 V/m; Power Drift = -0.052 dB, Maximum value of SAR (measured) = 0.033 mW/g
Peak SAR (extrapolated) = 0.164 W/kg
SAR(1 g) = 0.015 mW/g; SAR(10 g) = 0.00258 mW/g



Remarks:
*. Date tested: 2012/05/22; Tested by: Hiroshi Naka
*. Tested place:No.7 shielded room
*. liquid depth: 143mm
*. Position: distance of EUT to phantom: 0mm (2mm to liquid)
*. ambient: 24.9deg.C. / 44 %RH
*. liquid temperature: 23.8(start)/23.8(end)/24.5(in check) deg.C.
*. White cubic: zoom scan area
*. Red cubic: big=SAR(10g)/small=SAR(1g)

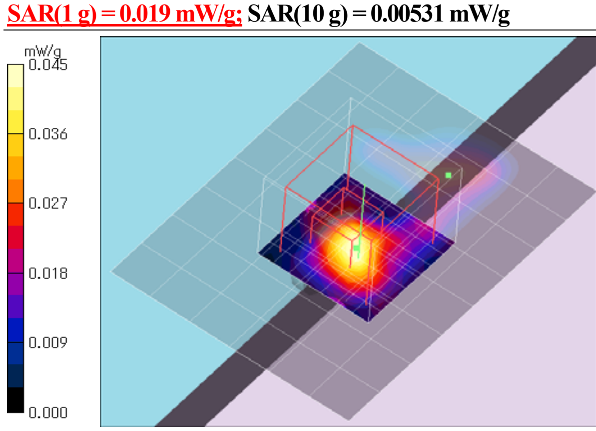
Step 1a-3 Front-touch (separation=0mm)

EUT: Flat Panel Sensor; Type: DR-ID 613SE; Serial: E120017
Communication System: IEEE 802.11a(6Mbps, BPSK/OFDM); Frequency: 5180 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5180 MHz; σ = 5.3 S/m; ε_r = 47.5; ρ = 1000 kg/m^3

DASY4 Configuration: - Probe: EX3DV4 - SN3679; ConvF(4.1, 4.1, 4.1); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection) - Electronics: DAE4 Sn626; Calibrated: 2012/02/15
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

fcc,s-6,ant0,front&d0,11a(6m,12.5d),m5180/
Area Scan(ant1):80x60,10 (9x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.037 mW/g
Area Scan(ant1):80x60,10 (81x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 0.045 mW/g

Zoom Scan:28x28x22.5,4,4,2-2-r1.5 (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 2.90 V/m; Power Drift = 0.099 dB, Maximum value of SAR (measured) = 0.045 mW/g
Peak SAR (extrapolated) = 0.191 W/kg
SAR(1 g) = 0.019 mW/g; SAR(10 g) = 0.00531 mW/g



Remarks:
*. Date tested: 2012/05/22; Tested by: Hiroshi Naka
*. Tested place:No.7 shielded room
*. liquid depth: 143mm
*. Position: distance of EUT to phantom: 0mm (2mm to liquid)
*. ambient: 24.9deg.C. / 44 %RH
*. liquid temperature: 23.8(start)/23.9(end)/24.5(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 1b: Antenna #1 (top) / Worst position search

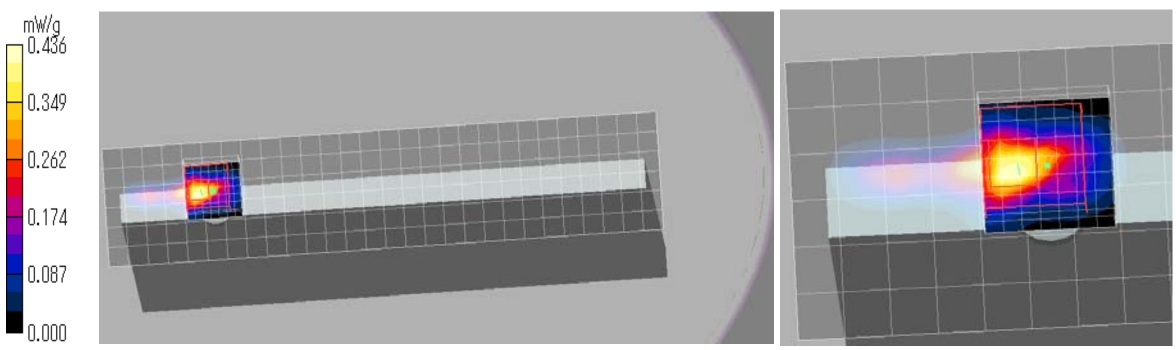
Step 1b-1 Top-touch (separation=0mm)
->Worst SAR(1g) of Antenna #1

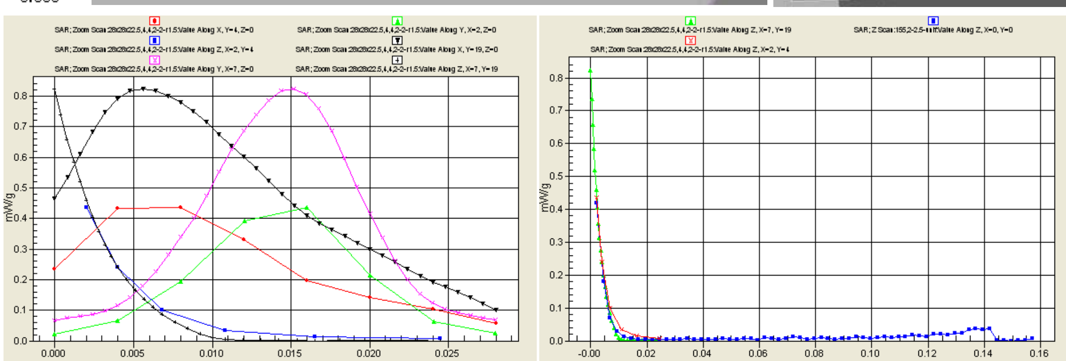
EUT: Flat Panel Sensor; Type: DR-ID 613SE; Serial: E120017
Communication System: IEEE 802.11a(6Mbps, BPSK/OFDM); Frequency: 5180 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5180 MHz; σ = 5.3 S/m; ε_r = 47.5; ρ = 1000 kg/m^3

DASY4 Configuration: - Probe: EX3DV4 - SN3679; ConvF(4.1, 4.1, 4.1); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection) - Electronics: DAE4 Sn626; Calibrated: 2012/02/15
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

fcc,s-1,ant1,ss&d0,11a(6m,12.5d),m5180/
Area Scan(ant1):280x60,10 (29x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.229 mW/g
Area Scan(ant1):280x60,10 (281x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 0.633 mW/g
Z Scan:155,2-2.5-unif (1x1x63): Measurement grid: dx=20mm, dy=20mm, dz=2.5mm; Maximum value of SAR (measured) = 0.420 mW/g

Zoom Scan:28x28x22.5,4,4,2-2-r1.5 (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 7.39 V/m; Power Drift = 0.154 dB, Maximum value of SAR (measured) = 0.436 mW/g
Peak SAR (extrapolated) = 0.824 W/kg
SAR(1 g) = 0.204 mW/g; SAR(10 g) = 0.052 mW/g





Remarks: *. Date tested: 2012/05/22; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*.liquid depth: 143mm; Position: distance of EUT to phantom: 0mm (2mm to liquid); ambient: 24.9deg.C. / 44 %RH,
*.liquid temperature: 23.7(start)/23.7(end)/24.5(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 1b: Antenna #1 (top) / Worst position search (cont'd)

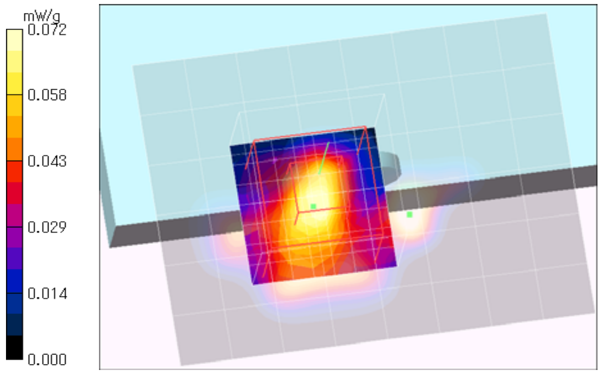
Step 1b-2 Back-touch (separation=0mm)

EUT: Flat Panel Sensor; Type: DR-ID 613SE; Serial: E120017
Communication System: IEEE 802.11a(6Mbps, BPSK/OFDM); Frequency: 5180 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5180 MHz; σ = 5.3 S/m; ε_r = 47.5; ρ = 1000 kg/m^3

DASY4 Configuration: - Probe: EX3DV4 - SN3679; ConvF(4.1, 4.1, 4.1); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection) - Electronics: DAE4 Sn626; Calibrated: 2012/02/15
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

fcc,s-8,ant1,rear&d0,11a(6m,12.5d),m5180/
Area Scan(ant1):80x60,10 2 (9x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.073 mW/g
Area Scan(ant1):80x60,10 2 (81x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 0.084 mW/g

Zoom Scan:28x28x22.5,4,4,2-2-r1.5 (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 2.09 V/m; Power Drift = -0.058 dB, Maximum value of SAR (measured) = 0.072 mW/g
Peak SAR (extrapolated) = 0.175 W/kg
SAR(1 g) = 0.035 mW/g; SAR(10 g) = 0.011 mW/g



Remarks:
*. Date tested: 2012/05/22; Tested by: Hiroshi Naka
*. Tested place:No.7 shielded room
*. liquid depth: 143mm
*. Position: distance of EUT to phantom: 0mm (2mm to liquid)
*. ambient: 24.9deg.C. / 44 %RH
*. liquid temperature: 24.1(start)/24.1(end)/24.5(in check) deg.C.
*. White cubic: zoom scan area
*. Red cubic: big=SAR(10g)/small=SAR(1g)

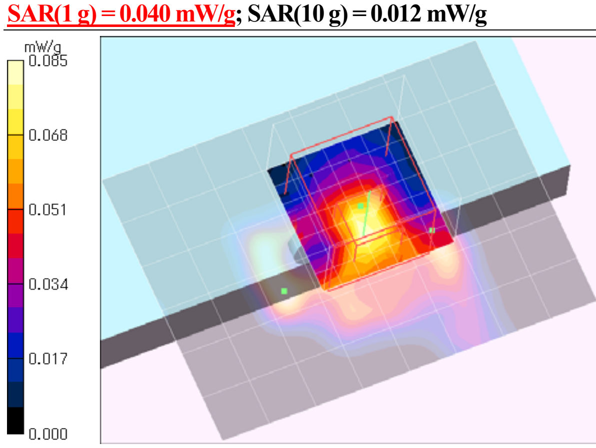
Step 1b-3 Front-touch (separation=0mm)

EUT: Flat Panel Sensor; Type: DR-ID 613SE; Serial: E120017
Communication System: IEEE 802.11a(6Mbps, BPSK/OFDM); Frequency: 5180 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5180 MHz; σ = 5.3 S/m; ε_r = 47.5; ρ = 1000 kg/m^3

DASY4 Configuration: - Probe: EX3DV4 - SN3679; ConvF(4.1, 4.1, 4.1); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection) - Electronics: DAE4 Sn626; Calibrated: 2012/02/15
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

fcc,s-7,ant1,front&d0,11a(6m,12.5d),m5180/
Area Scan(ant1):80x60,10 (9x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 0.062 mW/g
Area Scan(ant1):80x60,10 (81x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 0.132 mW/g

Zoom Scan:28x28x22.5,4,4,2-2-r1.5 (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 3.95 V/m; Power Drift = 0.008 dB, Maximum value of SAR (measured) = 0.085 mW/g
Peak SAR (extrapolated) = 0.153 W/kg
SAR(1 g) = 0.040 mW/g; SAR(10 g) = 0.012 mW/g



Remarks:
*. Date tested: 2012/05/22; Tested by: Hiroshi Naka
*. Tested place:No.7 shielded room
*. liquid depth: 143mm
*. Position: distance of EUT to phantom: 0mm (2mm to liquid)
*. ambient: 24.9deg.C. / 44 %RH
*. liquid temperature: 23.9(start)/24.0(end)/24.5(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-KSAR-01	DASY4	Schmid&Partner Engineering AG	DASY4 V4.7 B80	–	SAR	–
COTS-KSEP-01	Dielectric measurement	Agilent	85070	1	SAR	–
KSAR-01	SAR measurement system	Schmid&Partner Engineering AG	DASY4	1088	SAR	Pre Check
SSRBT-01	SAR robot	Schmid&Partner Engineering AG	RX60B L	F04/5Z71A1/A/01	SAR	2012/02/06 * 12
KDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE4	626	SAR	2012/02/15 * 12
KPB-01	Dosimetric E-Field Probe	Schmid&Partner Engineering AG	EX3DV4	3679	SAR	2011/05/19 * 12
KSDA-02	Dipole Antenna	Schmid&Partner Engineering AG	D5GHzV2	1070	SAR	2012/02/16 * 12
KPFL-01	Flat Phantom	Schmid&Partner Engineering AG	Oval flat phantom ELI 4.0	1059	SAR	2011/10/26 * 12
SSNA-01	Network Analyzer	Agilent	8753ES	US39171777	SAR	2011/12/15 * 12
KEPP-01	Dielectric probe	Agilent	85070E/8710-2036	2540	SAR	2012/02/20 * 12
KSG-08	Signal Generator	Rohde & Schwarz	SMT06	100763	SAR(daily)	2011/06/07 * 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)	2011/09/13 * 12
KIU-08	Power sensor	Rohde & Schwarz	NRV-Z4	100372	SAR(daily)	2011/09/13 * 12
KIU-09	Power sensor	Rohde & Schwarz	NRV-Z4	100371	SAR(daily)	2011/09/13 * 12
KPM-05	Power meter	Agilent	E4417A	GB41290718	SAR(daily)	2012/03/22 * 12
KPSS-01	Power sensor	Agilent	E9327A	US40440544	SAR(daily)	2012/03/22 * 12
KAT10-P1	Attenuator	Weinschel	24-10-34	BY5927	SAR(daily)	2012/02/15 * 12
KAT10-CS1	Attenuator	HUBER+SUHNER	6810.17.A	768898-1	SAR(daily)	2012/01/10 * 12
KAT10-CS2	Attenuator	HUBER+SUHNER	6810.17.A	768898-2	SAR(daily)	2012/01/10 * 12
KRU-01	Ruler(300mm)	Shinwa	13134	–	SAR	2012/03/08 * 12
KRU-04	Ruler(300mm)	Shinwa	13134	–	SAR	2012/05/29 * 12
KRU-02	Ruler(150mm,L)	Shinwa	12103	–	SAR	2012/03/08 * 12
KRU-05	Ruler(100x50mm,L)	Shinwa	12101	–	SAR	2012/05/29 * 12
KOS-13	Digtal thermometer	HANNA	Checktemp-2	KOS-13	SAR	2012/01/06 * 12
KOS-14	Thermo-Hygrometer data logger	SATO KEIRYOKI	SK-L200THII α / SK-LTHII α -2	015246/08169	SAR	2012/01/06 * 12
SOS-11	Humidity Indicator	A&D	AD-5681	4063424	SAR	2012/02/06 * 12
KPM-08	Power meter	Anritsu	ML2495A	6K00003356	Ant.pwr	2011/09/12 * 12
KPSS-04	Power sensor	Anritsu	MA2411B	012088	Ant.pwr	2011/09/12 * 12
KAT10-S3	Attenuator	Agilent	8490D 010	50924	Ant.pwr	2012/02/15 * 12
KCC-D23	Microwave cable	Hirose Electric	U.FL-2LP-066J1-A-(200)	–	Ant.pwr	Pre Check
KCC-D21	Microwave Cable	Hirose Electric	U.FL-2LP-066J1-A-(200)	–	Ant.pwr	Pre Check
KTM-G1	Terminator	Hirose Electric	HRM-TMP-05(40)	–	Ant.pwr	–
SSA-04	Spectrum Analyzer	Advantest	R3272	101100994	SAR(moni.)	2011/12/28 * 12
SWTR-03	DI water	MonotaRo	34557433	–	SAR	Pre Check
KSLM580-02	Tissue simulation liqud (5800MHz,body)	Schmid&Partner Engineering AG	SL AAM 501 AB	110520-3	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

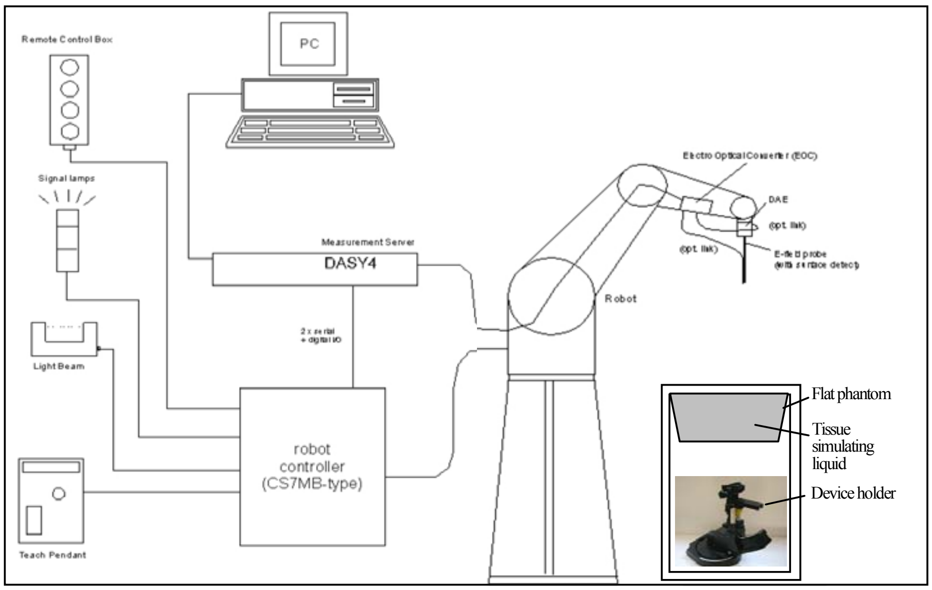
The expiration date of calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

[Test Item] SAR: Specific Absorption Rate, Ant.pwr: Antenna terminal conducted power

Appendix 3-2: Dosimetry assessment setup

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

Appendix 3-3: Configuration and peripherals



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

1	A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
2	A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3	A data acquisition electronic (DAE), which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
4	The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
5	The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
6	A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
7	A computer operating Windows XP.
8	DASY4 software.
9	Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
10	The phantom.
11	The device holder for EUT. (low-loss dielectric palette) (*. when it was used.)
12	Tissue simulating liquid mixed according to the given recipes.
13	Validation dipole kits allowing to validate the proper functioning of the system.

Appendix 3-4: System components

1) EX3DV4 Probe Specification

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

Calibration (S/N 3679):
Basic broad band calibration in air.
Conversion Factors(Head and Body): 2450, 5200, 5300, 5500, 5600, 5800MHz

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

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

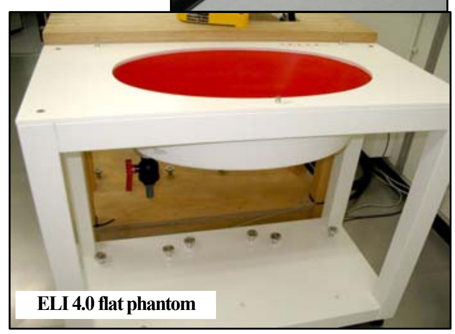
Dynamic Range:
10μW/g to > 100 mW/g; Linearity: ±0.2 dB (noise: typically < 1μW/g)

EX3DV4 E-field Probe

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

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

2) Phantom (Flat type)



ELI 4.0 flat phantom

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

Shell Thickness:
Bottom plate: 2 ±0.2mm

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

Filling Volume:
Approx. 30 liters

Device holder

3) Device Holder

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

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

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Appendix 3-5: Test system specification

RX60L Robot

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

DASY4 Measurement server

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

Data Acquisition Electronic (DAE)

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

Software

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

E-Field Probe

- Model : EX3DV4 (sn: 3679) — Construction : Symmetrical design with triangular core
- Frequency : 10MHz to 6GHz — Linearity : ±0.2dB (30MHz to 3GHz)
- Manufacture : Schmid & Partner Engineering AG

Phantom

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

Appendix 3-6: Simulated tissue composition

Used? / Liquid type	Used: ☐ / Head, HSL 5000	Used: ☒ / Body, MBBL 3500-5800V5
M/N / Control No.	SL AAH 501 AA-B / KSLH580-03	SL AAM 501 AB / KSLM580-02
Ingredient	Mixture (%)	Mixture (%)
Water	60-80 %	60-80 %
Esters, Emulsifiers, Inhibitors	20-40 %	20-40 %
Sodium salt	0-1.5 %	0-1.5 %
Manufacture	Schmid&Partner Engineering AG	Schmid&Partner Engineering AG

Appendix 3-7: Simulated tissue parameter confirmation

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

Dielectric parameter measurement results (Body tissue)

Date	Freq. [MHz]	Ambient		Liq.Temp.[deg.C.]		Liquid Depth [mm]	Parameters	Target value		Measured	Deviation for #1 (Std.)[%]	Limit [%]	Deviation for #2 (Cal.)[%]	Limit [%]
		Temp [deg.C.]	Humidity [%]	Before	After			#1:Std. (*1)	#2:Cal. (*2)					
May 22, 2012	5200	24.7	46	24.5	24.5	(143)	Relative permittivity: εr [-]	49.0	48.6	47.51	-3.1	±5	-2.2	±5
							Conductivity: σ [S/m]	5.30	5.48	5.349	+0.9	±5	-2.4	±5

*1. The target value is a parameter defined in OET65, Supplement C.
*2 For 5200MHz, the target value and limit are parameter defined in the calibration data sheet of D5GHzV2 (sn:1070) dipole calibrated by Schmid & Partner Engineering AG. (Certification No. D5GHzV2-1070_Feb12/2, the data sheet was filed in this report.)

<Standard and interpolated dielectric parameters for head and body tissue simulating liquid in the frequency range 3000 to 5800MHz>

***. Decision on Simulated Tissues of 5200MHz**
In the current standards (e.g., IEEE 1528, OET 65 Supplement C), the dielectric parameters suggested for head and body tissue simulating liquid are given at 3000MHz and 5800MHz. As an intermediate solution, dielectric parameters for the frequencies between 5000 to 5800 MHz were obtained using linear interpolation. Therefore the dielectric parameters of 5200MHz (the frequency for the validation) and 5180MHz were decided as right.

f (MHz)	Head Tissue		Body Tissue		Reference
	εr	σ [S/m]	εr	σ [S/m]	
3000	38.5	2.40	52.0	2.73	Standard
5800	35.3	5.27	48.2	6.00	Standard
5180	*36.01*	*4.635*	*49.04*	*5.276*	*Interpolated*
5200	*35.99*	*4.655*	*49.01*	*5.299*	*Interpolated*
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

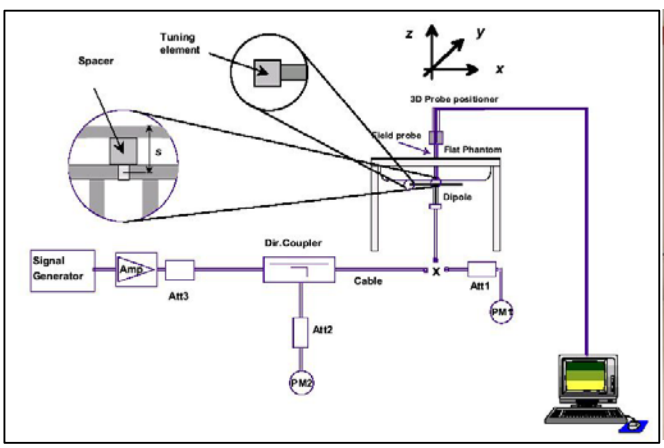
Appendix 3-8: System check data

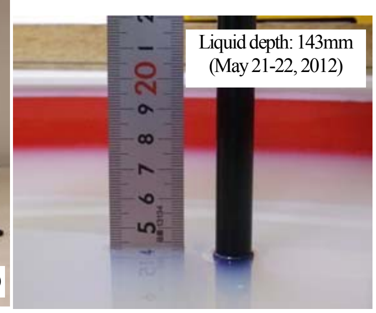
Prior to the SAR assessment of EUT, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The system check results are in the table below.

System check results (Body tissue)

Date	Freq. [MHz]	Liquid Type	Ambient		Liquid Temp. [deg.C.]			Liquid Depth [mm]	Permittivity measured εr [-]	Conductivity measured σ [S/m]]	Power drift [dB]	System dipole validation target & measured: SAR(1g) [W/kg] (at 100mW)		Deviation [%]	Limit [%]
			Temp [deg.C.]	Humidity [%]	Check	Before	After					Target value (*3)	Measured		
May 22, 2012	5200	Body	24.8	43	24.5	23.7	23.7	143	47.5	5.35	0.025	7.48	7.36	-1.6	±10

Note: *. Refer to Appendix 3-9 System check measurement data for the above result representation in plot data.
*3. The target values are the calibrated dipole parameters. (Certification No. D5GHzV2-1070_Feb12/2, the data sheet was filed in this report.)





Test setup for the system performance check

Appendix 3-9: System check measurement data

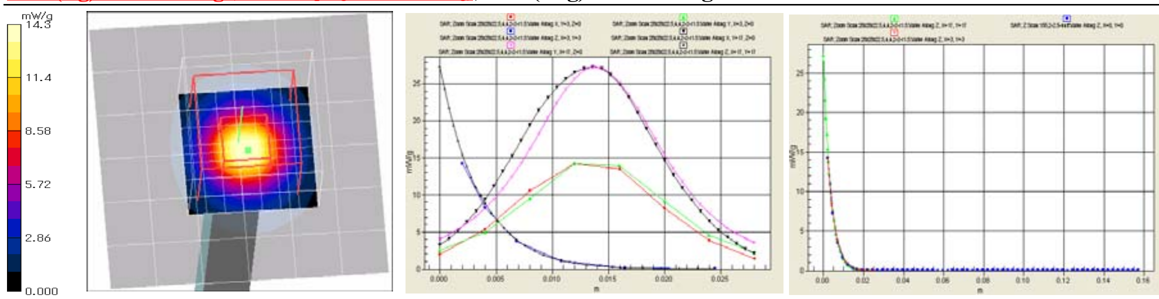
5200MHz system check (Body) / Forward conducted power: 100mW

EUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1070
Communication System: CW; Frequency: 5200 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5200 MHz; σ = 5.35 S/m; ε_r = 47.5; ρ = 1000 kg/m^3

DASY4 Configuration: - Probe: EX3DV4 - SN3679; ConvF(4.1, 4.1, 4.1); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection) - Electronics: DAE4 Sn626; Calibrated: 2012/02/15
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan:60x60,10 (7x7x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 15.0 mW/g
Area Scan:60x60,10 (61x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 15.7 mW/g
Z Scan:155,2-2.5-unif (1x1x63): Measurement grid: dx=20mm, dy=20mm, dz=2.5mm; Maximum value of SAR (measured) = 14.3 mW/g

Zoom Scan:28x28x22.5,4,4,2-2-r1.5 (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 58.5 V/m; Power Drift = 0.025 dB, Maximum value of SAR (measured) = 14.3 mW/g
Peak SAR (extrapolated) = 27.3 W/kg (-8.0%, vs. speag-cal.=29.7 W/kg)
SAR(1 g) = 7.36 mW/g (-1.6%, vs. speag-cal.=7.48 mW/g); **SAR(10 g) = 2.08 mW/g**



Remarks: *. Date tested: 2012/05/22; Tested by: Hiroshi Naka; Tested place:No.7 shielded room,
*.liquid depth: 143mm; Position: distance of dipole to phantom: 8mm (10mm to liquid); ambient: 24.8 deg.C. / 43 %RH,
*.liquid temperature: 23.7(start)/23.7(end)/24.5(in check) deg.C.; *.White cubic: zoom scan area, Red cubic: big=SAR(10g)/small=SAR(1g)

Appendix 3-10: Validation uncertainty

Uncertainty of system validation (v04)	5-6GHz	
	1g SAR	10g SAR
Combined measurement uncertainty of the measurement system (k=1)	± 11.2%	± 10.9%
Expanded uncertainty (k=2)	± 22.4%	± 21.8%

	Error Description	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g)	ui (10g)	Vi, veff
A	Measurement System						(std. uncertainty)	(std. uncertainty)	
1	Probe Calibration Error (5.2,5.3,5.5,5.6,5.8GHz±100MHz)	±6.55 %	Normal	1	1	1	±6.55 %	±6.55 %	∞
2	Axial isotropy	±4.7 %	Rectangular	√3	0.7	0.7	±1.9 %	±1.9 %	∞
3	Hemispherical isotropy (*flat phantom, <5°)	±9.6 %	Rectangular	√3	0.7	0.7	±3.9 %	±3.9 %	∞
4	Boundary effects	±4.8 %	Rectangular	√3	1	1	±2.8 %	±2.8 %	∞
5	Probe linearity	±4.7 %	Rectangular	√3	1	1	±2.7 %	±2.7 %	∞
6	System detection limit	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
7	Response Time Error (<5ms/100ms wait)	±0.0 %	Rectangular	√3	1	1	±0.0 %	±0.0 %	∞
8	Integration Time Error(100% duty cycle)	±0.0 %	Rectangular	√3	1	1	±0.0 %	±0.0 %	∞
9	System readout electronics (DAE)	±0.3 %	Normal	1	1	1	±0.3 %	±0.3 %	∞
10	RF ambient conditions-noise (<0.12mW/g)	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
11	RF ambient conditions-reflections (<0.12mW/g)	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
12	Probe positioner mechanical tolerance	±3.3 %	Rectangular	√3	1	1	±1.9 %	±1.9 %	∞
13	Probe positioning with respect to phantom shell	±6.7 %	Rectangular	√3	1	1	±3.9 %	±3.9 %	∞
14	Max.SAR evaluation	±4.0 %	Rectangular	√3	1	1	±2.3 %	±2.3 %	∞
B	Test Sample Related								
15	Dipole to liquid distance(10mm±0.2mm,<2deg.)	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2 %	∞
16	Drift of output power (measured, <0.2dB)	±2.5 %	Rectangular	√3	1	1	±1.4 %	±1.4 %	∞
C	Phantom and Setup								
17	Phantom uncertainty	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2%	∞
18	Liquid conductivity (target) (≤5%)	±5.0 %	Rectangular	√3	0.64	0.43	±1.8 %	±1.2 %	∞
19	Liquid conductivity (meas.)	±3.0 %	Normal	1	0.64	0.43	±1.9 %	±1.3 %	6
20	Liquid permittivity (target) (≤5%)	±5.0 %	Rectangular	√3	0.6	0.49	±1.7 %	±1.4 %	∞
21	Liquid permittivity (meas.)	±3.0 %	Normal	1	0.6	0.49	±1.8 %	±1.5 %	6
	Combined Standard Uncertainty						±11.2%	±10.9 %	12923
	Expanded Uncertainty (k=2)						±22.4 %	±21.8%	

*. This measurement uncertainty budget is suggested by IEEE 1528 and determined by Schmid & Partner Engineering AG (DASY4 Uncertainty Budget). [6]