# APPENDIX 3: Test instruments

## Appendix 3-1: Equipment used

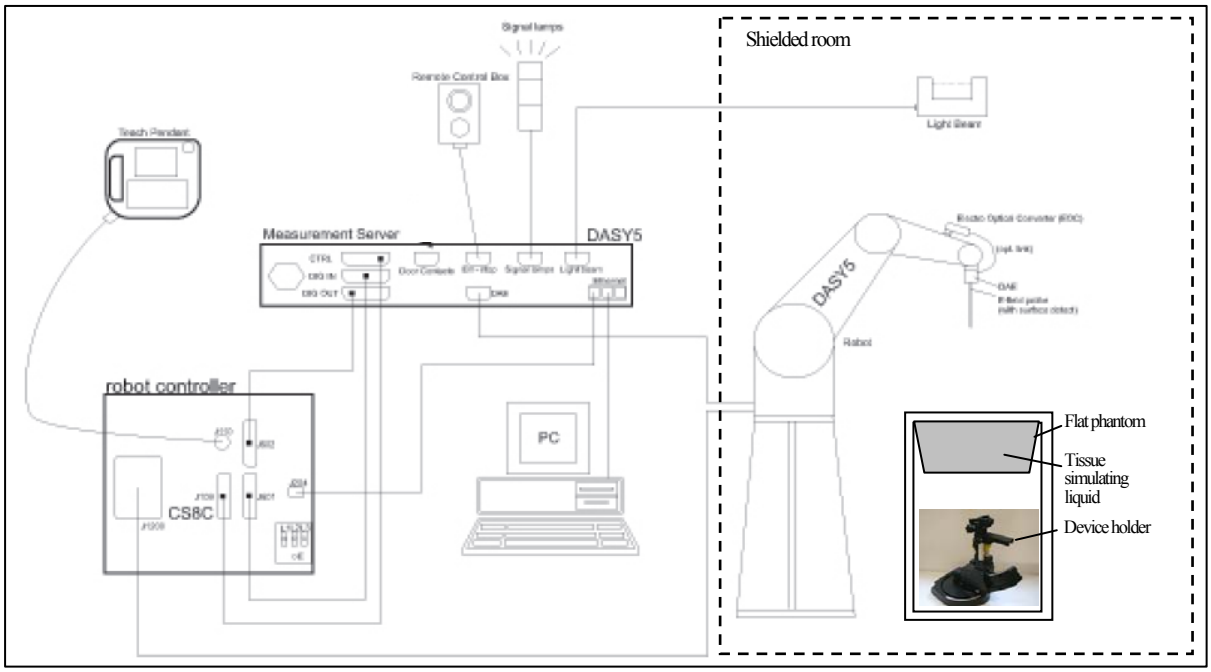
| Control No. | Instrument | Manufacturer | Model No | Serial No | Test Item | Calibration Date * Interval(month) |
|---|---|---|---|---|---|---|
| COTS-SSAR-02 | DASY52 | Schmid&Partner Engineering AG | DASY52 V8.2 B969 | - | SAR | - |
| COTS-KSEP-01 | Dielectric measurement | Agilent | 85070 | 1 | 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 | 2012/09/24 * 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 | 2012/06/21 * 12 |
| KSDA-01 | Dipole Antenna | Schmid&Partner Engineering AG | D2450V2 | 822 | SAR(daily) | 2012/01/10 * 12 |
| KSDA-02 | Dipole Antenna | Schmid&Partner Engineering AG | D5GHzV2 | 1070 | SAR(daily) | 2012/02/16 * 12 |
| KPFL-01 | Flat Phantom | Schmid&Partner Engineering AG | Oval flat phantom ELI 4.0 | 1059 | SAR | 2012/10/31 * 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) | 2012/06/26 * 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) | 2012/09/13 * 12 |
| KIU-08 | Power sensor | Rohde & Schwarz | NRV-Z4 | 100372 | SAR(daily) | 2012/09/13 * 12 |
| KIU-09 | Power sensor | Rohde & Schwarz | NRV-Z4 | 100371 | SAR(daily) | 2012/09/13 * 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-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-04 | Ruler(300mm) | Shinwa | 13134 | - | SAR | 2012/05/29 * 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-L200THIIα/SK-LTHIIα-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 | 2012/09/14 * 12 |
| KPSS-04 | Power sensor | Anritsu | MA2411B | 012088 | Ant.pwr | 2012/09/14 * 12 |
| KAT10-S3 | Attenuator | Agilent | 8490D 010 | 50924 | Ant.pwr | 2012/02/15 * 12 |
| SSA-04 | Spectrum Analyzer | Advantest | R3272 | 101100994 | SAR(moni.) | 2011/12/28 * 12 |
| SWTR-03 | DI water | MonotaRo | 34557433 | - | SAR | Pre Check |
| KSLM245-01 | Tissue simulation liqud (2450MHz,body) | Schmid&Partner Engineering AG | SL AAM 245 | - | SAR | Pre Check |
| KSLM580-02 | Tissue simulation liqud (5800MHz,body) | Schmid&Partner Engineering AG | SL AAM 501 AB | 110520-3 | SAR | Pre Check |
| No.7 Shielded Room | SAR shielded room (2.76m(W)x3.76m(D)x2.4m(H)) | TDK | - | - | SAR | (Daily check) Ambient noise: < 12mW/kg |
| | | | | | | |

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

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



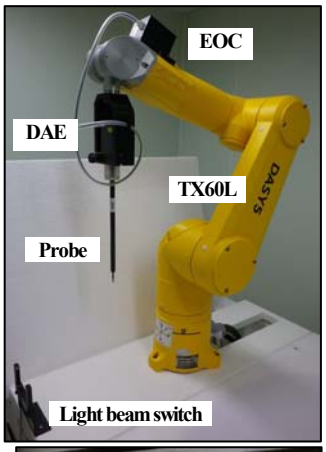

The DASY5 system for performing compliance tests consist of the following items:

| | |
|---|---|
| 1 | A standard high precision 6-axis robot (Stäubli TX/RX family) with controller, teach pendant and software.<br>An arm extension for accommodating the data acquisition electronics (DAE). |
| 2 | An isotropic field probe optimized and calibrated for the targeted measurement. |
| 3 | A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC. |
| 4 | The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server. |
| 5 | The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts. |
| 6 | The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning. |
| 7 | A computer running Win7 professional operating system and the DASY5 software. |
| 8 | R Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc. |
| 9 | The phantom. |
| 10 | The device holder for EUT. (low-loss dielectric palette) (*. when it was used.) |
| 11 | Tissue simulating liquid mixed according to the given recipes. |
| 12 | Validation dipole kits allowing to validate the proper functioning of the system. |

## Appendix 3-3: Test system specification

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

- •Number of Axes : 6
- •Repeatability : ±0.02mm
- •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 : 1µV to > 200mV (16bit resolution and 2 range settings: 4mV, 400mV)
- •Input Offset voltage : < 1µV (with auto zero)
- •Input Resistance : 200MΩ
- •Battery Power : > 10hr 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: ±0.2 dB (30MHz to 6GHz)
- •Conversion Factors : 2450, 5200, 5300, 5500, 5600, 5800MHz (Head and Body)
- •Directivity : ±0.3 dB in HSL (rotation around probe axis) ±0.5 dB in tissue material (rotation normal to probe axis)
- •Dynamic Range : 10µW/g to > 100 mW/g; Linearity: ±0.2 dB (noise: typically < 1µW/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 ±0.2mm
- •Dimensions : Bottom elliptical: 600×400mm, 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

## Appendix 3-4: Simulated tissue composition

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

| Ingredient | Mixture (%) |
|---|---|
| | **Body 5800MHz** (type: SL AAM 501 AB) |
| Water | 60-80 % |
| Esters, Emulsifiers, Inhibitors | 20-40 % |
| Sodium salt | 0-1.5 % |
| Manufacture | Schmid&Partner Engineering AG |

## Appendix 3-5: 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**

| Date | Freq. [MHz] | Ambient Temp [deg.C.] | Ambient Humidity [%RH] | Liq.T.[deg.C.] Before | Liq.T.[deg.C.] After | Liquid Depth [mm] | Parameters | Target value #1:Std. (*1) | Target value #2:Cal. (*2) | Measured | Deviation for #1 (Std.)[%] | Limit [%] | Deviation for #2 (Cal.)[%] | Limit [%] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Noveber 19, 2012 | 2450 | 21.4 | 41 | 20.6 | 20.6 | 153 | Relative permittivity: εr [-] | **52.7** | **50.6** | 50.26 | **-4.6** | ±5 | **-0.7** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **1.95** | **2.01** | 1.990 | **+2.1** | ±5 | **-1.0** | ±5 |
| Noveber 20, 2012 | 2450 | 21.9 | 44 | 21.0 | 21.0 | 153 | Relative permittivity: εr [-] | **52.7** | **50.6** | 50.38 | **-4.4** | ±5 | **-0.4** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **1.95** | **2.01** | 2.029 | **+3.4** | ±5 | **+0.9** | ±5 |
| November 27, 2012 | 5500 | 24.8 | 45 | 24.4 | 24.4 | 151 | Relative permittivity: εr [-] | **48.61** | **48.1** | 48.03 | **-1.2** | ±5 | **-0.2** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **5.65** | **5.87** | 5.463 | **+3.4** | ±5 | **-0.3** | ±5 |
| November 27, 2012 | 5800 | 24.8 | 45 | 24.4 | 24.4 | 151 | Relative permittivity: εr [-] | **48.20** | **47.5** | 47.18 | **-2.1** | ±5 | **-0.7** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **6.00** | **6.29** | 6.253 | **+4.2** | ±5 | **-0.6** | ±5 |
| November 29, 2012 | 5200 | 24.6 | 43 | 24.4 | 24.4 | 151 | Relative permittivity: εr [-] | **49.01** | **48.6** | 47.61 | **-2.9** | ±5 | **-2.0** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **5.30** | **5.48** | 5.371 | **+1.4** | ±5 | **-2.0** | ±5 |
| November 30, 2012 | 5200 | 24.8 | 48 | 24.6 | 24.6 | 151 | Relative permittivity: εr [-] | **49.01** | **48.6** | 48.37 | **-1.3** | ±5 | **-0.5** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **5.30** | **5.48** | 5.448 | **+2.8** | ±5 | **-0.6** | ±5 |
| December 1, 2012 | 5200 | 24.4 | 43 | 24.0 | 24.0 | 152 | Relative permittivity: εr [-] | **49.01** | **48.6** | 48.46 | **-1.3** | ±5 | **-0.3** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **5.30** | **5.48** | 5.376 | **+2.9** | ±5 | **-0.9** | ±5 |
| December 1, 2012 | 5500 | 24.4 | 43 | 24.0 | 24.0 | 152 | Relative permittivity: εr [-] | **48.61** | **48.1** | 47.958 | **-2.0** | ±5 | **-0.5** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **5.65** | **5.87** | 5.815 | **+2.7** | ±5 | **-2.0** | ±5 |
| December 3, 2012 | 5500 | 24.9 | 46 | 24.6 | 24.6 | 152 | Relative permittivity: εr [-] | **48.61** | **48.1** | 47.271 | **-2.7** | ±5 | **-1.7** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **5.65** | **5.87** | 5.875 | **+4.0** | ±5 | **+0.1** | ±5 |
| December 4, 2012 | 5800 | 25.0 | 50 | 24.5 | 24.5 | 150 | Relative permittivity: εr [-] | **48.20** | **47.5** | 46.684 | **-3.1** | ±5 | **-1.7** | ±5 |
| | | | | | | | Conductivity: σ [S/m] | **6.00** | **6.29** | 6.266 | **+4.4** | ±5 | **-0.4** | ±5 |

*1. The target value is a parameter defined in OET65, Supplement C.
*2. The target value is a parameter defined in the calibration data sheet of D2450V2 (sn:822) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D2450V2-822_Jan12, the data sheet was filed in this report.).

***. Decision on Simulated Tissues**

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 2000MHz, 2450, 3000 and 5800MHz. As an intermediate solution, dielectric parameters for the frequencies between 2000 to 2450 MHz, 2450-3000MHz and 5000-5800MHz were obtained using linear interpolation.
Furthermore, dielectric parameters for the frequencies above 5800MHz were obtained using linear extrapolation. Therefore the dielectric parameters of 5200MHz (the frequency for the validation) and other SAR tested frequencies in listed below were decided as following.

| Standard | | | | |
|---|---|---|---|---|
| f (MHz) | Head Tissue | | Body Tissue | |
| | εr | σ [S/m] | εr | σ [S/m] |
| (1800-)2000 | 40.0 | 1.40 | 53.3 | 1.52 |
| 2450 | 39.2 | 1.80 | 52.7 | 1.95 |
| 3000 | 38.5 | 2.40 | 52.0 | 2.73 |
| 5800 | 35.3 | 5.27 | 48.2 | 6.00 |

## Appendix 3-6: 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.

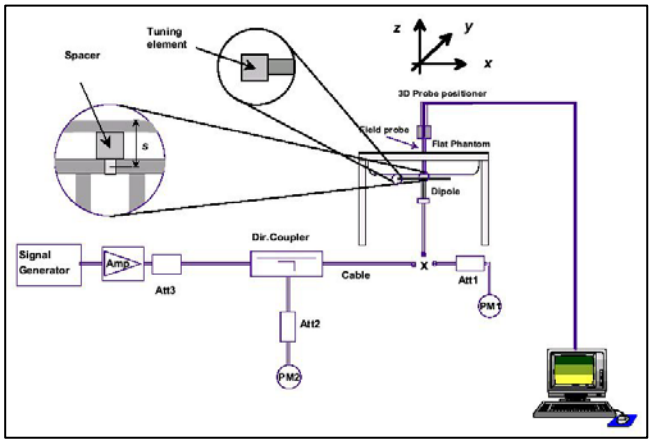
| System check results | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Freq. [MHz] | Liquid Type | Ambient | | Liquid Temp. [deg.C.] | | | Liquid Depth [mm] | Permittivity measured εr [-] | Conductivity measured σ [S/m]] | Power drift [dB] | System check target & measured | | | |
| | | | | | | | | | | | | SAR 1g [W/kg] (at 250mW) | | Deviation [%] | Limit [%] |
| | | | Temp [deg.C.] | Humidity [%RH] | Check | Before | After | | | | | Target value | Measured | | |
| November 19, 2012 | 2450 | Body | 21.4 | 41 | 20.6 | 20.6 | 20.6 | 153 | 50.26 | 1.990 | 0.00 | **13.2** (*2) | **12.7** | **-3.9** | ±10 |
| November 20, 2012 | 2450 | Body | 21.9 | 44 | 21.0 | 21.0 | 21.0 | 153 | 50.38 | 2.029 | 0.01 | **13.2** (*2) | **12.9** | **-2.3** | ±10 |

| System check results | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Freq. [MHz] | Liquid Type | Ambient | | Liquid Temp. [deg.C.] | | | Liquid Depth [mm] | Permittivity measured εr [-] | Conductivity measured σ [S/m]] | Power drift [dB] | System check target & measured | | | |
| | | | | | | | | | | | | SAR 1g [W/kg] (at 100mW) | | Deviation [%] | Limit [%] |
| | | | Temp [deg.C.] | Humidity [%RH] | Check | Before | After | | | | | Target value | Measured | | |
| November 27, 2012 | 5500 | Body | 24.8 | 45 | 24.4 | 24.4 | 24.4 | 151 | 48.03 | 5.463 | -0.06 | **8.10** (*1) | **8.14** | **+0.5** | ±10 |
| November 27, 2012 | 5800 | Body | 24.8 | 45 | 24.4 | 24.4 | 24.4 | 151 | 47.18 | 6.253 | 0.05 | **7.58** (*1) | **7.21** | **-4.9** | ±10 |
| November 29, 2012 | 5200 | Body | 24.6 | 43 | 24.4 | 24.4 | 24.4 | 151 | 47.61 | 5.371 | -0.04 | **7.49** (*1) | **7.62** | **+1.7** | ±10 |
| November 30, 2012 | 5200 | Body | 24.8 | 48 | 24.6 | 24.6 | 24.6 | 151 | 48.37 | 5.448 | -0.02 | **7.49** (*1) | **7.94** | **+6.0** | ±10 |
| December 1, 2012 | 5200 | Body | 24.4 | 43 | 24.0 | 24.0 | 24.0 | 152 | 48.46 | 5.376 | 0.01 | **7.49** (*1) | **7.90** | **+5.5** | ±10 |
| December 1, 2012 | 5500 | Body | 24.4 | 43 | 24.0 | 24.0 | 24.0 | 152 | 47.95 | 5.815 | 0.01 | **8.10** (*1) | **8.32** | **+2.7** | ±10 |
| December 3, 2012 | 5500 | Body | 24.9 | 46 | 24.6 | 24.6 | 24.6 | 152 | 47.27 | 5.875 | -0.05 | **8.10** (*1) | **8.29** | **+2.3** | ±10 |
| December 4, 2012 | 5800 | Body | 25.0 | 50 | 24.5 | 24.5 | 24.5 | 150 | 46.68 | 6.266 | -0.08 | **7.58** (*1) | **7.42** | **-2.1** | ±10 |

**Note: Refer to Appendix System Check measurement data for the above result representation in plot data.**

*1. The target value is a parameter defined in the calibration data sheet of D5GHzV2(sn:1070) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D5GHzV2-1070_Feb12, the data sheet was filed in this report.).

*2. The target value is a parameter defined in the calibration data sheet of D2450V2 (sn:822) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D2450V2-822_Jan11, the data sheet was filed in this report.).




**Test setup for the system performance check**

## Appendix 3-7: System check measurement data

## 2450MHz system check (Body) / Forward conducted power: 250mW

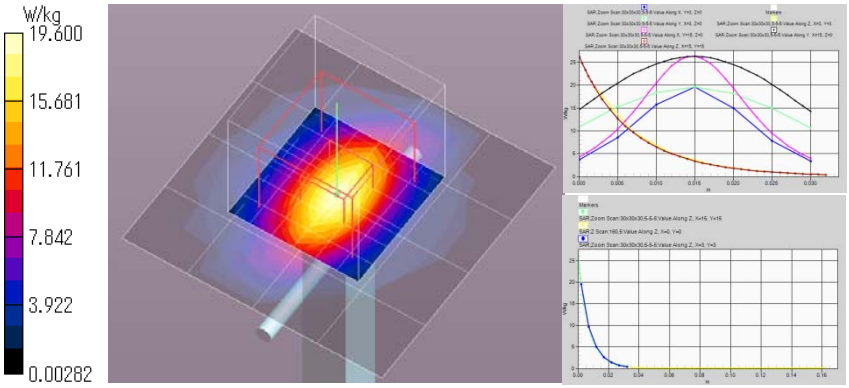
Date/Time: 2012/11/19

**EUT: Dipole(2.45GHz); Type: D2450V2; Serial: 822**
**Communication System: CW; Frequency: 2450 MHz; Crest factor: 1.0**
**Medium: MSL2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 1.99 S/m; $\varepsilon_r$ = 50.266; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(6.77, 6.77, 6.77); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0, 161.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m245,33ce0266-sh-02,121119/daily-m245,d10mm,pin=250mw/**
**Area Scan:60x60,15 (5x5x1):** Measurement grid: dx=15mm, dy=15mm, Maximum value of SAR (measured) = 19.2 W/kg
**Area Scan:60x60,15 (41x41x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm, Maximum value of SAR (interpolated) = 19.4 W/kg
**Z Scan;160,5 (1x1x33):** Measurement grid: dx=20mm, dy=20mm, dz=5mm, Maximum value of SAR (measured) = 19.5 W/kg

**Zoom Scan:30x30x30,5-5-5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.654 V/m; Power Drift = 0.00 dB, Maximum value of SAR (measured) = 19.6 W/kg
Peak SAR (extrapolated) = 26.329 mW/g
**SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.86 mW/g**



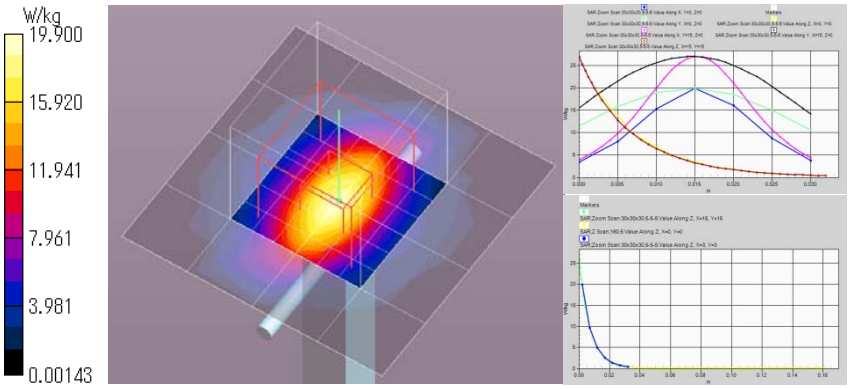

Date/Time: 2012/11/20 10:37:13

**EUT: Dipole(2.45GHz); Type: D2450V2; Serial: 822**
**Communication System: CW; Frequency: 2450 MHz; Crest factor: 1.0**
**Medium: MSL2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2.029 S/m; $\varepsilon_r$ = 50.383; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(6.77, 6.77, 6.77); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0, 161.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m245,33ce0266-sh-02,121120/daily-m245,d10mm,pin=250mw/**
**Area Scan:60x60,15 (5x5x1):** Measurement grid: dx=15mm, dy=15mm, Maximum value of SAR (measured) = 19.9 W/kg
**Area Scan:60x60,15 (41x41x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm, Maximum value of SAR (interpolated) = 19.9 W/kg
**Z Scan;160,5 (1x1x33):** Measurement grid: dx=20mm, dy=20mm, dz=5mm, Maximum value of SAR (measured) = 19.9 W/kg

**Zoom Scan:30x30x30,5-5-5 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.6 V/m; Power Drift = 0.01 dB, Maximum value of SAR (measured) = 19.9 W/kg
Peak SAR (extrapolated) = 26.980 mW/g
**SAR(1 g) = 12.9 mW/g; SAR(10 g) = 5.91 mW/g**



## 5GHz bands system check (Body) / Forward conducted power: 100mW

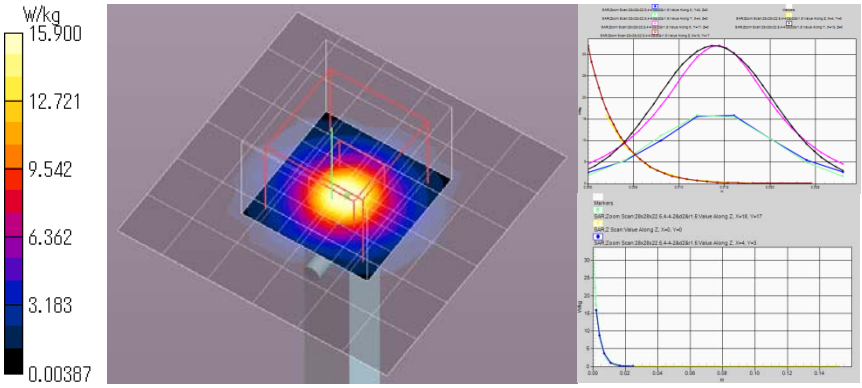
Date/Time: 2012/11/27 13:45:07

**EUT: Dipole(5GHz); Type: D5GHzV2; Serial: 1070**
**Communication System: CW; Frequency: 5500 MHz; Crest factor: 1.0**
**Medium: MSL5800; Medium parameters used: f = 5500 MHz; $\sigma$ = 5.84 S/m; $\varepsilon_r$ = 48.029; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(3.7, 3.7, 3.7); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.5, 151.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m5GHz,33ce0266-sh-02,121127/Daily_m55,d10mm,Pin=100mW/**
**Area Scan:60x60,10 (7x7x1):** Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 17.4 W/kg
**Area Scan:60x60,10 (61x61x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm, Maximum value of SAR (interpolated) = 17.4 W/kg
**Z Scan (1x1x10):** Measurement grid: dx=20mm, dy=20mm, dz=2mm, Maximum value of SAR (measured) = 16.0 W/kg

**Zoom Scan:28x28x22.5,4-4-2&d2&r1.5 (8x8x6)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 69.395 V/m; Power Drift = -0.06 dB, Maximum value of SAR (measured) = 15.9 W/kg
Peak SAR (extrapolated) = 32.117 mW/g
**SAR(1 g) = 8.14 mW/g; SAR(10 g) = 2.28 mW/g**



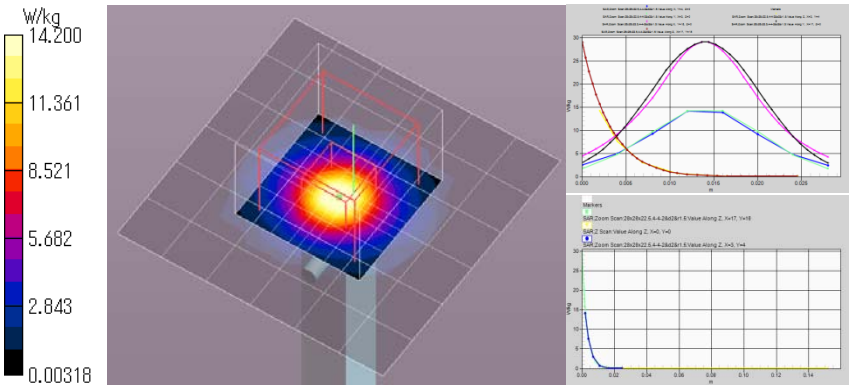

Date/Time: 2012/11/27 14:13:17

**EUT: Dipole(5GHz); Type: D5GHzV2; Serial: 1070**
**Communication System: CW; Frequency: 5800 MHz; Crest factor: 1.0**
**Medium: MSL5800; Medium parameters used: f = 5800 MHz; $\sigma$ = 6.253 S/m; $\varepsilon_r$ = 47.177; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(3.87, 3.87, 3.87); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.5, 151.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m5GHz,33ce0266-sh-02,121127/Daily_m58,d10mm,Pin=100mW/**
**Area Scan:60x60,10 (7x7x1):** Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 15.8 W/kg
**Area Scan:60x60,10 (61x61x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm, Maximum value of SAR (interpolated) = 15.8 W/kg
**Z Scan (1x1x10):** Measurement grid: dx=20mm, dy=20mm, dz=2mm, Maximum value of SAR (measured) = 14.3 W/kg

**Zoom Scan:28x28x22.5,4-4-2&d2&r1.5 (8x8x6)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 64.516 V/m; Power Drift = 0.05 dB, Maximum value of SAR (measured) = 14.2 W/kg
Peak SAR (extrapolated) = 29.126 mW/g
**SAR(1 g) = 7.21 mW/g; SAR(10 g) = 2.01 mW/g**



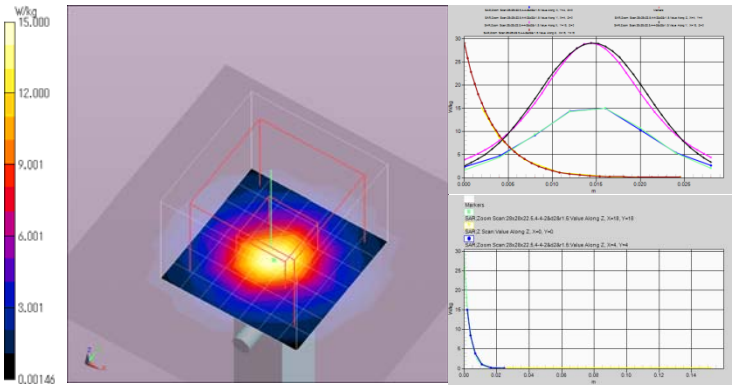
Date/Time: 2012/11/29 9:32:31

**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; $\sigma$ = 5.371 S/m; $\varepsilon_r$ = 47.608; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(4.13, 4.13, 4.13); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.5, 151.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m5GHz,33ce0266-sh-02,121129/Daily_m52,d10mm,Pin=100mW/**
**Area Scan:60x60,10 (7x7x1):** Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 16.0 W/kg
**Area Scan:60x60,10 (61x61x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm, Maximum value of SAR (interpolated) = 16.0 W/kg
**Z Scan (1x1x10):** Measurement grid: dx=20mm, dy=20mm, dz=2mm, Maximum value of SAR (measured) = 14.9 W/kg

**Zoom Scan:28x28x22.5,4-4-2&d2&r1.5 (8x8x6)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 68.259 V/m; Power Drift = -0.04 dB, Maximum value of SAR (measured) = 14.9 W/kg
Peak SAR (extrapolated) = 29.058 mW/g
**SAR(1 g) = 7.62 mW/g; SAR(10 g) = 2.17 mW/g**



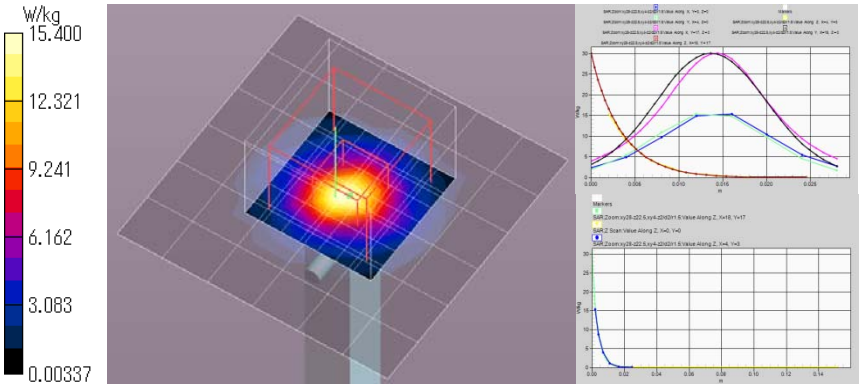

Date/Time: 2012/11/30 9:25:09

**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; $\sigma$ = 5.448 S/m; $\varepsilon_r$ = 48.37; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(4.13, 4.13, 4.13); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.5, 151.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m5GHz,33ce0266-sh-02,121129/Daily_m52,d10mm,Pin=100mW/**
**Area:60x60,10 (7x7x1):** Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 16.1 W/kg
**Area:60x60,10 (61x61x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm, Maximum value of SAR (interpolated) = 16.2 W/kg
**Z Scan (1x1x10):** Measurement grid: dx=20mm, dy=20mm, dz=2mm, Maximum value of SAR (measured) = 15.3 W/kg

**Zoom:xy28-z22.5,xy4-z2/d2/r1.5 (8x8x6)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 60.359 V/m; Power Drift = -0.02 dB, Maximum value of SAR (measured) = 15.4 W/kg
Peak SAR (extrapolated) = 30.131 mW/g
**SAR(1 g) = 7.94 mW/g; SAR(10 g) = 2.26 mW/g**



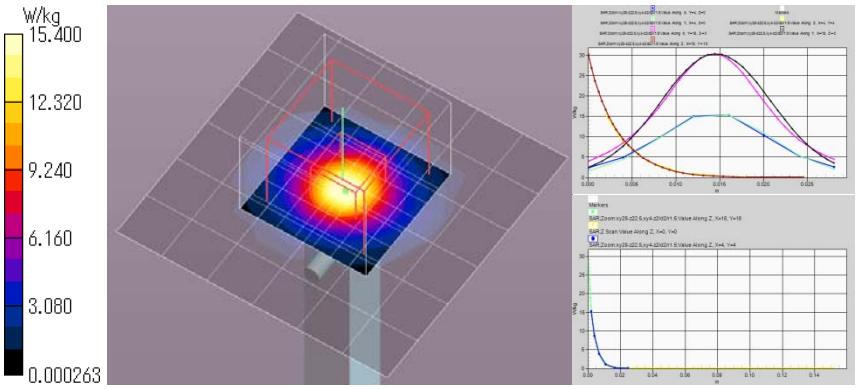
Date/Time: 2012/12/01 11:08:09

**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; $\sigma$ = 5.376 S/m; $\varepsilon_r$ = 48.463; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(4.13, 4.13, 4.13); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.5, 151.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m5GHz,33ce0266-sh-02,121201/Daily_m52,d10mm,Pin=100mW/**
**Area:60x60,10 (7x7x1):** Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 16.1 W/kg
**Area:60x60,10 (61x61x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm, Maximum value of SAR (interpolated) = 16.5 W/kg
**Z Scan (1x1x10):** Measurement grid: dx=20mm, dy=20mm, dz=2mm, Maximum value of SAR (measured) = 15.4 W/kg

**Zoom:xy28-z22.5,xy4-z2/d2/r1.5 (8x8x6)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 60.140 V/m; Power Drift = 0.01 dB, Maximum value of SAR (measured) = 15.4 W/kg
Peak SAR (extrapolated) = 30.389 mW/g
**SAR(1 g) = 7.9 mW/g; SAR(10 g) = 2.24 mW/g**



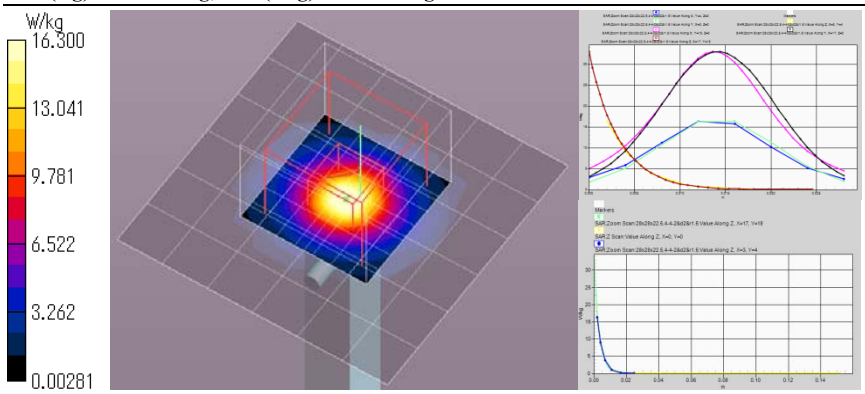

Date/Time: 2012/12/01 10:17:20

**EUT: Dipole(5GHz); Type: D5GHzV2; Serial: 1070**
**Communication System: CW; Frequency: 5500 MHz; Crest factor: 1.0**
**Medium: MSL5800; Medium parameters used: f = 5500 MHz; $\sigma$ = 5.815 S/m; $\varepsilon_r$ = 47.958; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(3.7, 3.7, 3.7); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.5, 151.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m5GHz,33ce0266-sh-02,121201/Daily_m55,d10mm,Pin=100mW/**
**Area Scan:60x60,10 (7x7x1):** Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 17.4 W/kg
**Area Scan:60x60,10 (61x61x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm, Maximum value of SAR (interpolated) = 17.6 W/kg
**Z Scan (1x1x10):** Measurement grid: dx=20mm, dy=20mm, dz=2mm, Maximum value of SAR (measured) = 16.5 W/kg

**Zoom Scan:28x28x22.5,4-4-2&d2&r1.5 (8x8x6)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 69.692 V/m; Power Drift = 0.01 dB, Maximum value of SAR (measured) = 16.3 W/kg
Peak SAR (extrapolated) = 33.021 mW/g
**SAR(1 g) = 8.32 mW/g; SAR(10 g) = 2.34 mW/g**



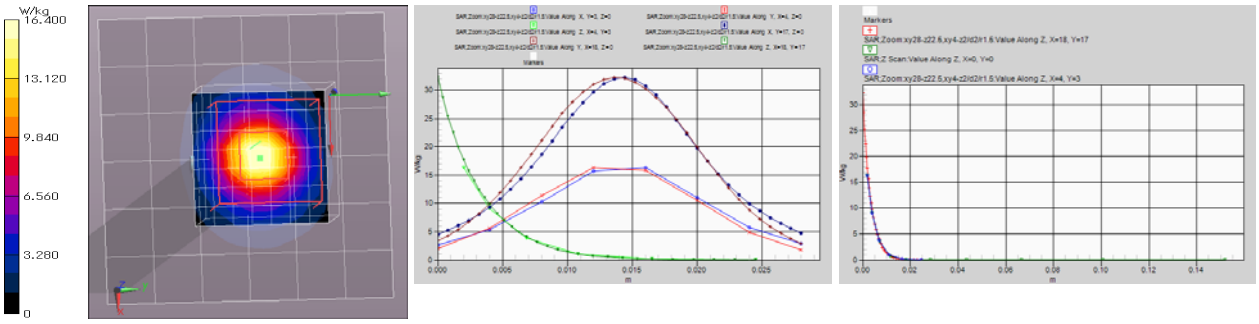
Date/Time: 2012/12/03 8:59:14

**EUT: Dipole(5GHz); Type: D5GHzV2; Serial: 1070**
**Communication System: CW; Frequency: 5500 MHz; Crest factor: 1.0**
**Medium: MSL5800; Medium parameters used: f = 5500 MHz; $\sigma$ = 5.875 S/m; $\varepsilon_r$ = 47.271; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:** -Probe: EX3DV4 - SN3679; ConvF(3.7, 3.7, 3.7); Calibrated: 2012/06/21;
-Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.5, 151.0 -Electronics: DAE4 Sn626; Calibrated: 2012/02/15
-Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**Area:60x60,10 (7x7x1):** Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (measured) = 16.1 W/kg
**Area:60x60,10 (61x61x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm; Maximum value of SAR (interpolated) = 17.3 W/kg
**Z Scan (1x1x10):** Measurement grid: dx=20mm, dy=20mm, dz=2mm; Maximum value of SAR (measured) = 16.4 W/kg

**Zoom:xy28-z22.5,xy4-z2/d2/r1.5 (8x8x6)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 58.199 V/m; Power Drift = -0.05 dB, Maximum value of SAR (measured) = 16.4 W/kg
Peak SAR (extrapolated) = 32.291 mW/g
SAR(1 g) = 8.29 mW/gSAR(10 g) = 2.33 mW/g



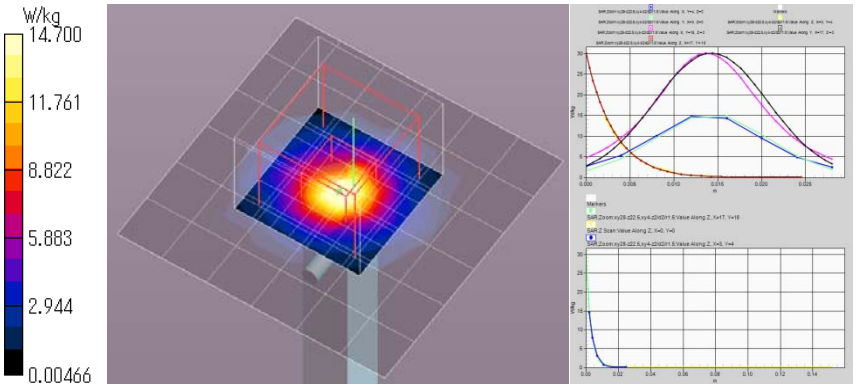

Date/Time: 2012/12/04 9:34:33

**EUT: Dipole(5GHz); Type: D5GHzV2; Serial: 1070**
**Communication System: CW; Frequency: 5800 MHz; Crest factor: 1.0**
**Medium: MSL5800; Medium parameters used: f = 5800 MHz; $\sigma$ = 6.266 S/m; $\varepsilon_r$ = 46.684; $\rho$ = 1000 kg/m$^3$**

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
**DASY Configuration:**
-Probe: EX3DV4 - SN3679; ConvF(3.87, 3.87, 3.87); Calibrated: 2012/06/21; -Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.5, 151.0
-Electronics: DAE4 Sn626; Calibrated: 2012/02/15 -Phantom: ELI v4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
-DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**daily-m5GHz,33ce0266-sh-01,121204/Daily_m58,d10mm,Pin=100mW/**
**Area:60x60,10 (7x7x1):** Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 15.7 W/kg
**Area:60x60,10 (61x61x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm, Maximum value of SAR (interpolated) = 16.0 W/kg
**Z Scan (1x1x10):** Measurement grid: dx=20mm, dy=20mm, dz=2mm, Maximum value of SAR (measured) = 14.9 W/kg

**Zoom:xy28-z22.5,xy4-z2/d2/r1.5 (8x8x6)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 56.623 V/m; Power Drift = -0.08 dB, Maximum value of SAR (measured) = 14.7 W/kg
Peak SAR (extrapolated) = 30.136 mW/g
**SAR(1 g) = 7.42 mW/g; SAR(10 g) = 2.09 mW/g**



## Appendix 3-8: System check uncertainty

| Uncertainty of system daily check (~6GHz) (Body liquid, 2.4-6GHz, ε', σ: ≤5%) (v06) | 1g SAR | 10g SAR |
|---|---|---|
| Combined measurement uncertainty of the measurement system (k=1) | ± 12.7 % | ± 12.4 % |
| Expanded uncertainty (k=2) | ± 25.4 % | ± 24.8 % |

| | Error Description | 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 (2.45,5.2,5.3,5.5,5.6,5.8GHz±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 | Probe modulation response (CW) | ±0.0 % | Rectangular | √3 | 1 | 1 | ±0.0 % | ±0.0 % | ∞ |
| 7 | System detection limit | ±1.0 % | Rectangular | √3 | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| 8 | Response Time Error (<5ms/100ms wait) | ±0.0 % | Rectangular | √3 | 1 | 1 | ±0.0 % | ±0.0 % | ∞ |
| 9 | Integration Time Error (CW) | ±0.0 % | Rectangular | √3 | 1 | 1 | ±0.0 % | ±0.0 % | ∞ |
| 10 | System readout electronics (DAE) | ±0.3 % | Normal | 1 | 1 | 1 | ±0.3 % | ±0.3 % | ∞ |
| 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 | ±4.0 % | Rectangular | √3 | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| B | **Test Sample Related** | | | | | | | | |
| 16 | Deviation of the experimental source | ±5.5 % | Normal | 1 | 1 | 1 | ±5.5 % | ±5.5 % | ∞ |
| 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) | ±2.5 % | Rectangular | √3 | 1 | 1 | ±1.4 % | ±1.4 % | ∞ |
| C | **Phantom and Setup** | | | | | | | | |
| 19 | Phantom uncertainty | ±2.0 % | Rectangular | √3 | 1 | 1 | ±1.2 % | ±1.2% | ∞ |
| 20 | Liquid conductivity (target) (≤5%) | ±5.0 % | Rectangular | √3 | 0.64 | 0.43 | ±1.8 % | ±1.2 % | ∞ |
| 21 | Liquid conductivity (meas.) | ±3.0 % | Normal | 1 | 0.64 | 0.43 | ±1.9 % | ±1.3 % | ∞ |
| 22 | Liquid permittivity (target) (≤5%) | ±5.0 % | Rectangular | √3 | 0.6 | 0.49 | ±1.7 % | ±1.4 % | ∞ |
| 23 | Liquid permittivity (meas.) | ±3.0 % | Normal | 1 | 0.6 | 0.49 | ±1.8 % | ±1.5 % | ∞ |
| 24 | Liquid Conductivity-temp.uncertainty (≤2deg.C.) | ±5.2 % | Rectangular | √3 | 0.78 | 0.71 | ±2.3 % | ±2.1 % | ∞ |
| 25 | Liquid Permittivity-temp.uncertainty (≤2deg.C.) | ±0.8 % | Rectangular | √3 | 0.23 | 0.26 | ±0.1 % | ±0.1 % | ∞ |
| | **Combined Standard Uncertainty** | | | | | | **±12.7** % | **±12.4** % | |
| | **Expanded Uncertainty (k=2)** | | | | | | **±25.4** % | **±24.8** % | |

*. This measurement uncertainty budget is suggested by IEEE 1528, IEC 62209-2 and determined by Schmid & Partner Engineering AG (DASY5 Uncertainty Budget).

**Appendix 3-9: Calibration certificate: Dipole (D2450V2) (sn:822)**

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S 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: **D2450V2-822_Jan12**

# CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 822

Calibration procedure(s): QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: January 10, 2012

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 | 05-Oct-11 (No. 217-01451) | Oct-12 |
| Power sensor HP 8481A | US37292783 | 05-Oct-11 (No. 217-01451) | Oct-12 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 29-Mar-11 (No. 217-01368) | Apr-12 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 29-Mar-11 (No. 217-01371) | Apr-12 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-11 (No. ES3-3205_Dec11) | Dec-12 |
| DAE4 | SN: 601 | 04-Jul-11 (No. DAE4-601_Jul11) | Jul-12 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-11) | In house check: Oct-12 |

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

Issued: January 10, 2012

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

**Calibration Laboratory of**
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Accreditation No.: SCS 108

**Glossary:**

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

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

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

**Additional Documentation:**

d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

## Measurement Conditions

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

| | | |
|---|---|---|
| **DASY Version** | DASY5 | V52.8.0 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 2450 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 39.2 | 1.80 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 39.2 ± 6 % | 1.85 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | --- | --- |

## SAR result with Head TSL

| **SAR averaged over 1 cm$^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.2 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **52.1 mW /g ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.12 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.3 mW /g ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 52.7 | 1.95 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 50.6 ± 6 % | 2.01 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | --- | --- |

## SAR result with Body TSL

| **SAR averaged over 1 cm$^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.2 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **51.6 mW / g ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm$^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.10 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **24.1 mW / g ± 16.5 % (k=2)** |



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## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 53.9 Ω + 4.1 jΩ |
| Return Loss | - 25.3 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 51.1 Ω + 5.3 jΩ |
| Return Loss | - 25.4 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 |

## DASY5 Validation Report for Head TSL

Date: 10.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

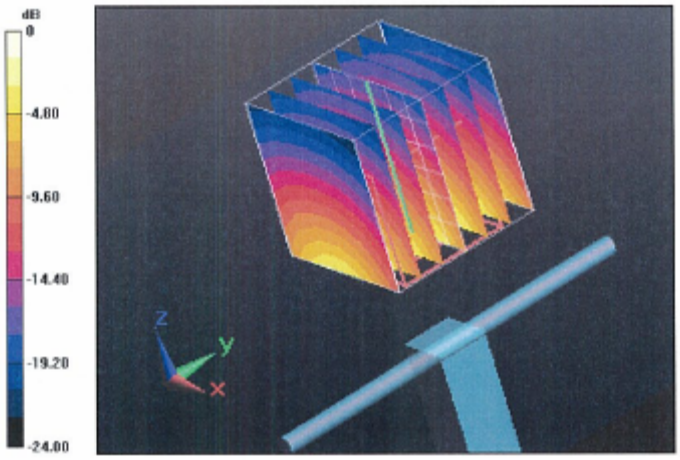
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.85 mho/m; $\varepsilon_r$ = 39.2; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

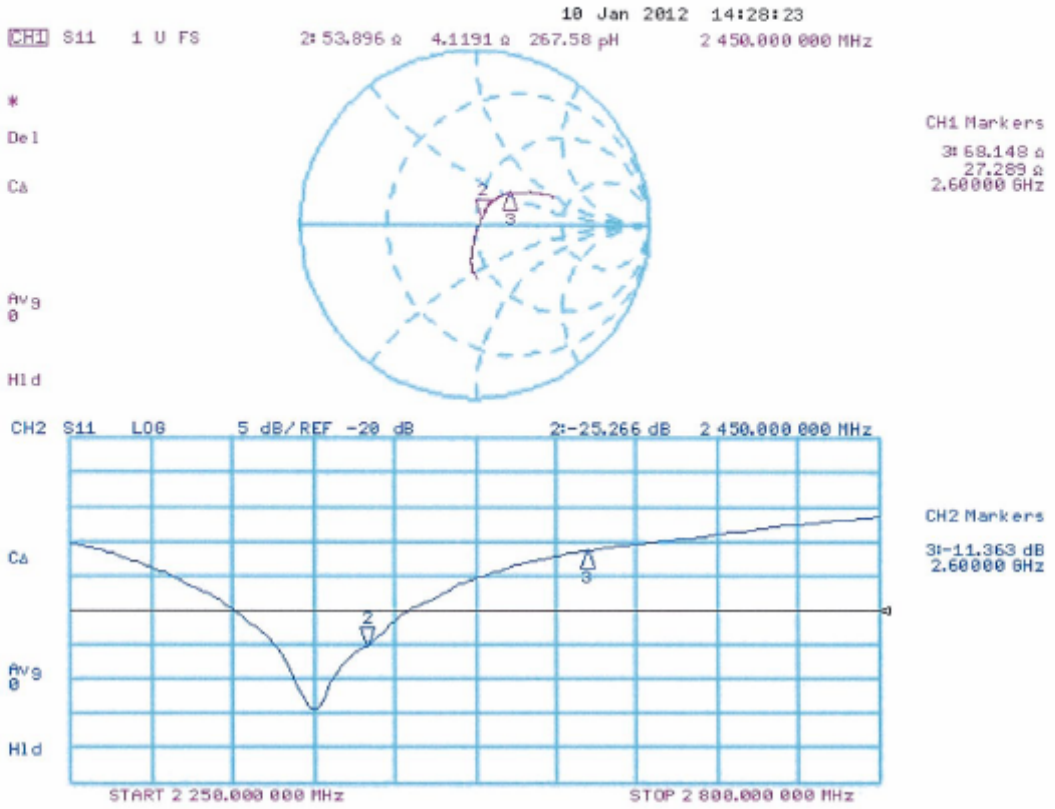
### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.405 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 27.1020
**SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.12 mW/g**
Maximum value of SAR (measured) = 16.876 mW/g




0 dB = 16.880mW/g = 24.55 dB mW/g

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 06.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

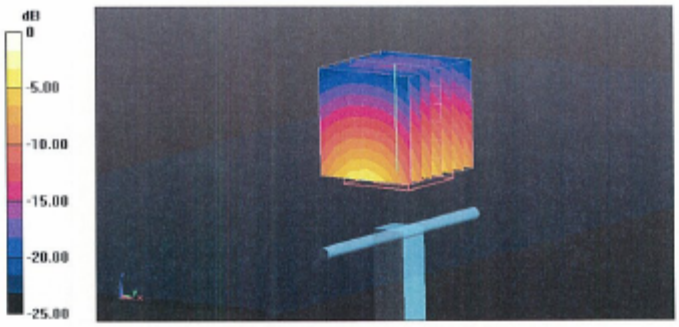
**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 822**

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.01 mho/m; $\varepsilon_r$ = 50.6; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

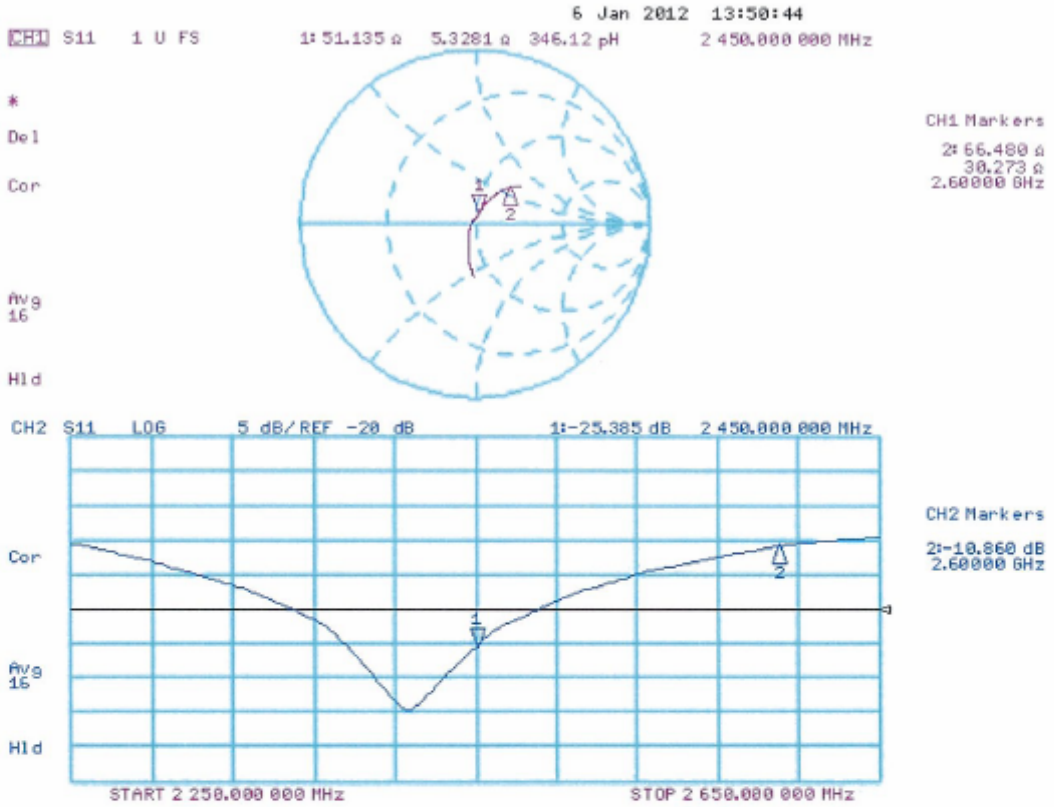
- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

**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 = 96.185 V/m; Power Drift = -0.0031 dB
Peak SAR (extrapolated) = 27.0610
**SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.1 mW/g**
Maximum value of SAR (measured) = 17.340 mW/g




0 dB = 17.340mW/g = 24.78 dB mW/g

## Impedance Measurement Plot for Body TSL

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