

The Testcenter facility 'Dosimetric Test Lab' within IMST GmbH is accredited by the German National 'Deutsche Akkreditierungsstelle GmbH (DAkkS)' for testing according to the scope as listed in the accreditation certificate: D-PL-12139-01-01.

Appendix for the Report

Dosimetric Assessment of the Portable Device Datalogic SKORPIO X3 (Model No. 3)

Contains FCC ID: U4G004W

Contains IC: 3862E-004W

According to the FCC Requirements

Calibration Data

May 23, 2012

IMST GmbH
Carl-Friedrich-Gauß-Str. 2
D-47475 Kamp-Lintfort

Customer
7layers AG
Borsigstrasse 11
D-40880 Ratingen

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



S Schweizerischer Kalibrierdienst
S 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 **IMST**

Certificate No: EX3-3536_Sep11

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3536**

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: **September 26, 2011**

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 | 31-Mar-11 (No. 217-01372) | Apr-12 |
| Power sensor E4412A | MY41498087 | 31-Mar-11 (No. 217-01372) | Apr-12 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 29-Mar-11 (No. 217-01369) | Apr-12 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 29-Mar-11 (No. 217-01367) | Apr-12 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 29-Mar-11 (No. 217-01370) | Apr-12 |
| Reference Probe ES3DV2 | SN: 3013 | 29-Dec-10 (No. ES3-3013_Dec10) | Dec-11 |
| DAE4 | SN: 654 | 3-May-11 (No. DAE4-654_May11) | May-12 |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-10) | In house check: Oct-11 |

| | | | |
|---|-----------------------|-------------------------------|----------------------------|
| Calibrated by: | Name Katja Pokovic | Function Technical Manager | Signature |
| Approved by: | Niels Kuster | Quality Manager | |
| | | | Issued: September 27, 2011 |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. | | | |



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: SCS 108

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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 | 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., $\vartheta = 0$ 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 $\vartheta = 0$ ($f \leq 900$ 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 E^2 -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}; VR_{x,y,z}**: A, B, C 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.

Probe EX3DV4

SN:3536

Manufactured: April 30, 2004
Calibrated: September 26, 2011

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3536

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|--------------|
| Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A | 0.44 | 0.43 | 0.36 | $\pm 10.1\%$ |
| DCP (mV) ^B | 101.1 | 97.3 | 100.2 | |

Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dB | C dB | VR mV | Unc ^E (k=2) |
|-------|---------------------------|------|---|---------|---------|---------|----------|---------------------------|
| 10000 | CW | 0.00 | X | 0.00 | 0.00 | 1.00 | 108.8 | $\pm 2.7\%$ |
| | | | Y | 0.00 | 0.00 | 1.00 | 101.4 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 97.4 | |

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3536

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) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 1950 | 40.0 | 1.40 | 8.07 | 8.07 | 8.07 | 0.80 | 0.60 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.45 | 7.45 | 7.45 | 0.79 | 0.59 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.28 | 7.28 | 7.28 | 0.71 | 0.63 | ± 12.0 % |
| 3500 | 37.9 | 2.91 | 7.32 | 7.32 | 7.32 | 0.26 | 1.25 | ± 13.1 % |
| 5200 | 36.0 | 4.66 | 5.27 | 5.27 | 5.27 | 0.38 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 4.90 | 4.90 | 4.90 | 0.40 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.61 | 4.61 | 4.61 | 0.50 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.53 | 4.53 | 4.53 | 0.50 | 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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3536

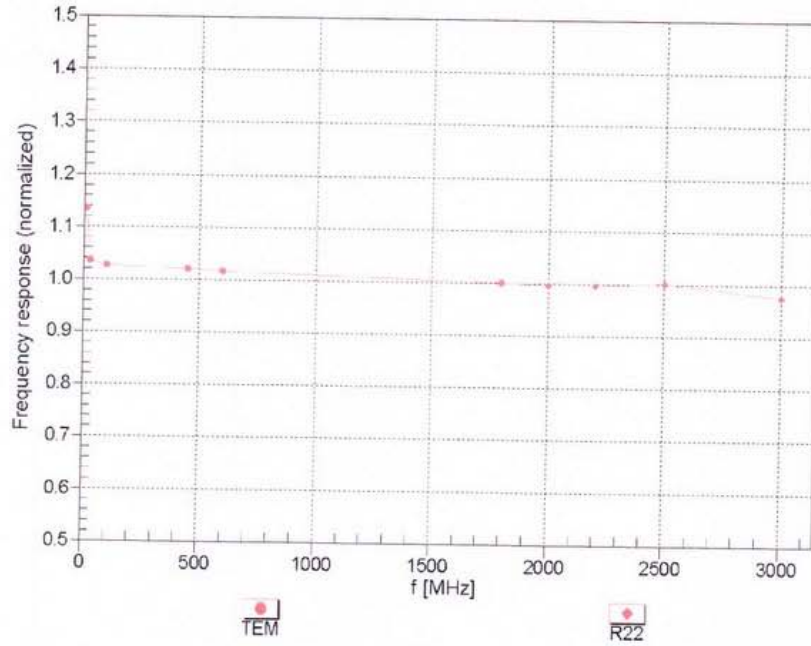
Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) ^C | Relative Permittivity ^F | Conductivity (S/m) ^F | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 1950 | 53.3 | 1.52 | 8.03 | 8.03 | 8.03 | 0.80 | 0.62 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.42 | 7.42 | 7.42 | 0.80 | 0.50 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.39 | 7.39 | 7.39 | 0.80 | 0.50 | ± 12.0 % |
| 3500 | 51.3 | 3.31 | 6.82 | 6.82 | 6.82 | 0.34 | 1.21 | ± 13.1 % |
| 5200 | 49.0 | 5.30 | 4.43 | 4.43 | 4.43 | 0.60 | 1.95 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 4.18 | 4.18 | 4.18 | 0.60 | 1.95 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 3.92 | 3.92 | 3.92 | 0.65 | 1.95 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 4.03 | 4.03 | 4.03 | 0.65 | 1.95 | ± 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 $\pm 10\%$ 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 $\pm 5\%$. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

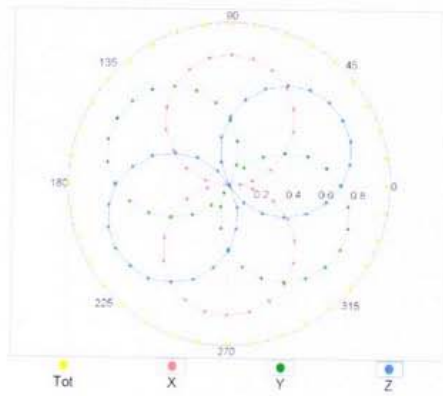
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



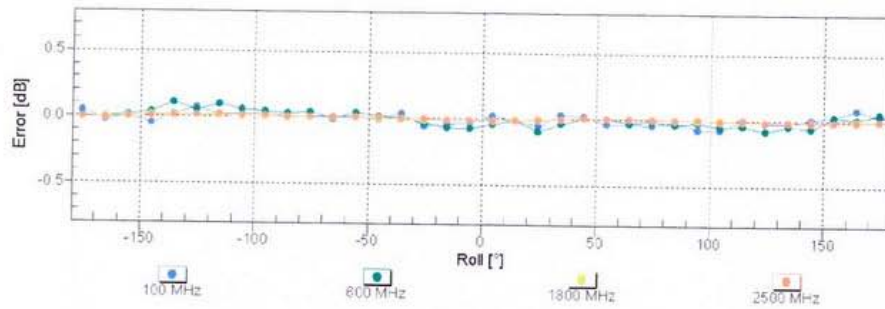
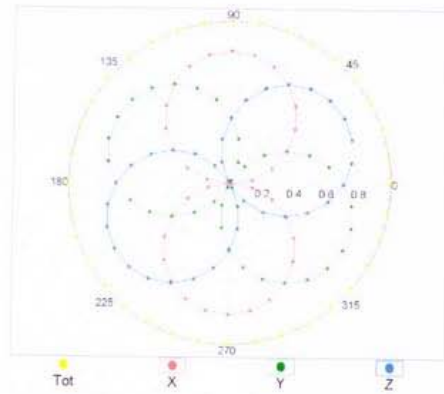
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

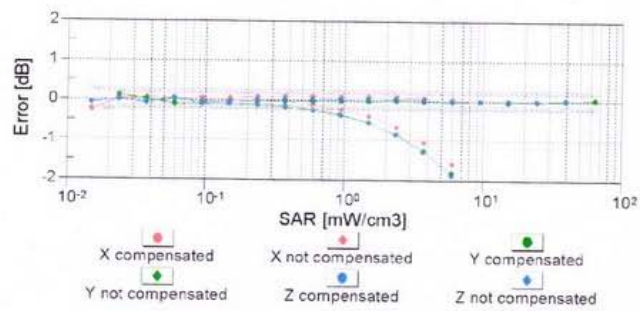
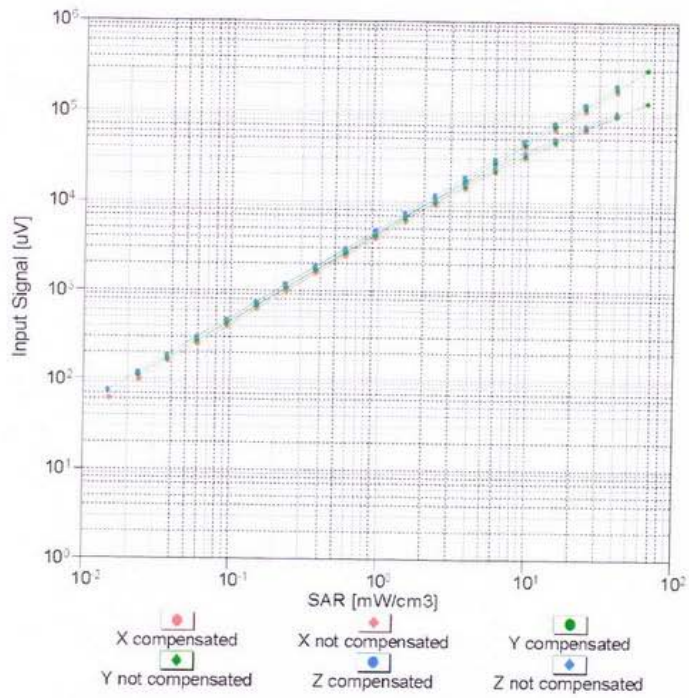


f=1800 MHz,R22



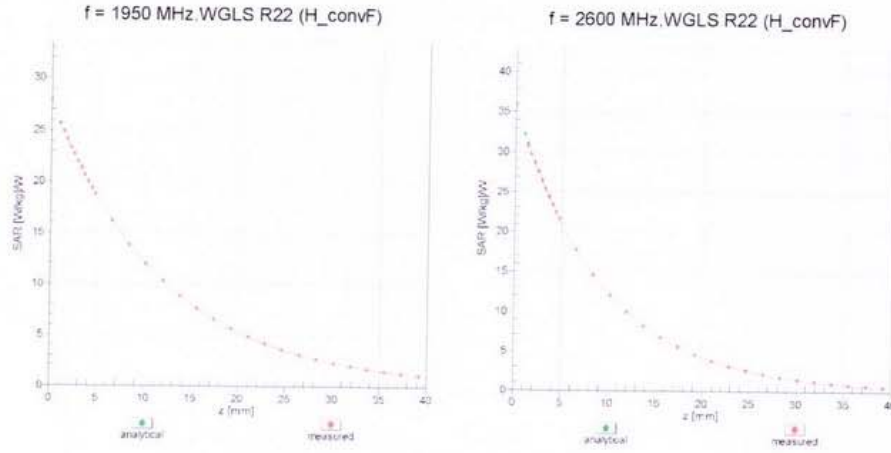
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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



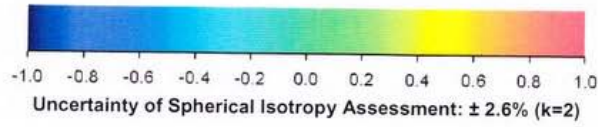
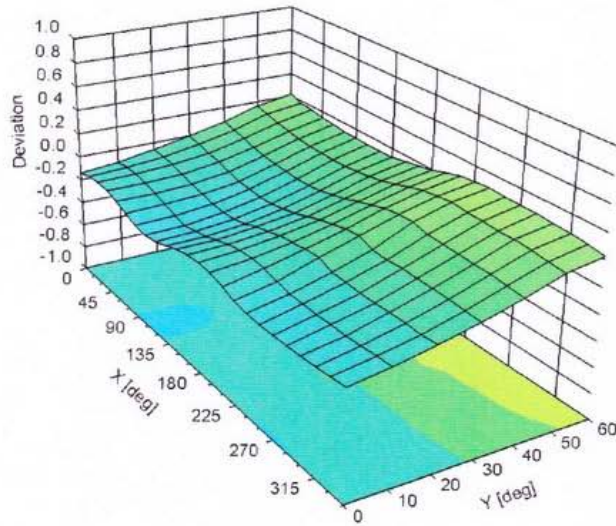
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3536**Other Probe Parameters**

| | |
|---|----------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | Not applicable |
| 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 |

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Calibration Certificate

Certificate No: Cal_D2450V2_SN709_1211
 Object: D2450V2 SN: 709
 Date of Calibration: December 30, 2011
 Next Calibration: December 2013
 Object Condition: In Tolerance

Calibration Equipment used:

| Test Equipment | Serial Number | Last calibration | Calibrated by | Next calibration |
|-------------------------|---------------|------------------|---|------------------|
| Powermeter E4416A | GB41050414 | Nov 10 | Rohde&Schwarz (200954-D-K-15012-01-00-2010-11) | Nov 12 |
| Power Sensor E9301H | US40010212 | Nov 10 | Rohde&Schwarz (200944-D-K-15012-01-00-2010-11) | Nov 12 |
| Powermeter E4417A | GB41050441 | Nov 10 | Rohde&Schwarz (200952-D-K-15012-01-00-2010-11) | Nov 12 |
| Power Sensor E9301A | MY41495584 | Nov 10 | Rohde&Schwarz (200953-D-K-15012-01-00-2010-11) | Nov 12 |
| Network Analyzer E5071C | MY46103220 | Aug 11 | Rohde& Schwarz (14967-DKD-00201-2009-08) | Aug 13 |
| Reference Probe EX3DV4 | SN 3536 | Sep 11 | SPEAG, No EX-3-3536_Sep11 | Sep 12 |
| DAE4 | SN 661 | Sep 11 | SPEAG, No DAE4-661_Sep11 | Sep 12 |

Calibration is performed according the following standards:**IEEE 1528-2003**

"IEEE Recommended Practice for Determining the Peak Spatial - Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Technique", December 2003

EN 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 3GHz)", March 2007

Federal Communications Commission Office of Engineering & Technologies (FCCOET)

"Evaluating Compliance wit 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: DASY 4 System Handbook

prepared by:



Alexander Rahn
test engineer

reviewed by:



André van den Bosch
quality assurance engineer

| Measurement Conditions | | |
|-------------------------------|---------------------|-------------|
| DASY Version: | Dasy 4; | V4.7 |
| Phantom: | SAM Phantom | 1340 |
| Distance Dipole Center – TSL: | 10mm | With spacer |
| Zoom Scan res. | dx, dy, dz = 5mm | |
| Frequency: | 2450 MHz \pm 1MHz | |

| Head TSL Parameters | | | |
|------------------------------|-------------|----------------|-------------------|
| | Temperature | Permittivity | Conductivity |
| Nominal Head TSL Parameters | 22.0 | 39.20 | 1.80 |
| Measured Head TSL Parameters | 21.6 | 39.90 \pm 6% | 1.84 S/m \pm 6% |

| SAR Result with Head TSL | | | |
|--------------------------|-------------------------------------|-------------------|---|
| Averaged over 1g | SAR measured | 250mW input power | 13.90 mW/g |
| | SAR normalized | normalized to 1W | 55.60 mW/g |
| | SAR for nominal Head TSL parameters | normalized to 1W | 55.23 mW/g \pm 16.5 % (k=2) |
| Averaged over 10g | SAR measured | 250mW input power | 6.26 mW/g |
| | SAR normalized | normalized to 1W | 25.04 mW/g |
| | SAR for nominal Head TSL parameters | normalized to 1W | 24.97 mW/g \pm 16.5 % (k=2) |

| Body TSL Parameters | | | |
|------------------------------|-------------|--------------|---------------|
| | Temperature | Permittivity | Conductivity |
| Nominal Body TSL Parameters | 22.0 | 52.70 | 1.95 |
| Measured Body TSL Parameters | 21.5 | 51.20 ± 6% | 2.00 S/m ± 6% |

| SAR Result with Body TSL | | | |
|--------------------------|-------------------------------------|-------------------|--------------------------------------|
| Averaged over 1g | SAR measured | 250mW input power | 13.70 mW/g |
| | SAR normalized | normalized to 1W | 54.80 mW/g |
| | SAR for nominal Body TSL parameters | normalized to 1W | 53.77 mW/g ± 16.5 % (k=2) |
| Averaged over 10g | SAR measured | 250mW input power | 6.15 mW/g |
| | SAR normalized | normalized to 1W | 24.60 mW/g |
| | SAR for nominal Body TSL parameters | normalized to 1W | 24.33 mW/g ± 16.5 % (k=2) |

| General Antenna Parameters | | |
|---|--------------------------------------|--------------------|
| Antenna Parameters with Head TSL | Impedance, transformed to feed point | 48.64 jΩ - 2.97 jΩ |
| | Return Loss | -29.60 dB |
| Antenna Parameter with Body TSL | Impedance, transformed to feed point | 48.98 jΩ - 1.17 jΩ |
| | Return Loss | -36.09 dB |
| <p>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 semigrd 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.</p> | | |

| Additional EUT Data | |
|---------------------|--------------|
| Manufactured by: | SPEAG |
| Manufactured on: | July 5, 2002 |

SAR Result with Head TSL

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: [29122011_y_3536.da4](#)

DUT: Dipole 2450 MHz SN: 709; Type: D2450V2; Serial: D2450V2 - SN:709

Program Name: System Performance Check at 2450 MHz

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2450$ MHz; $\sigma = 1.84$ mho/m; $\epsilon_r = 39.9$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(7.45, 7.45, 7.45); Calibrated: 26.09.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

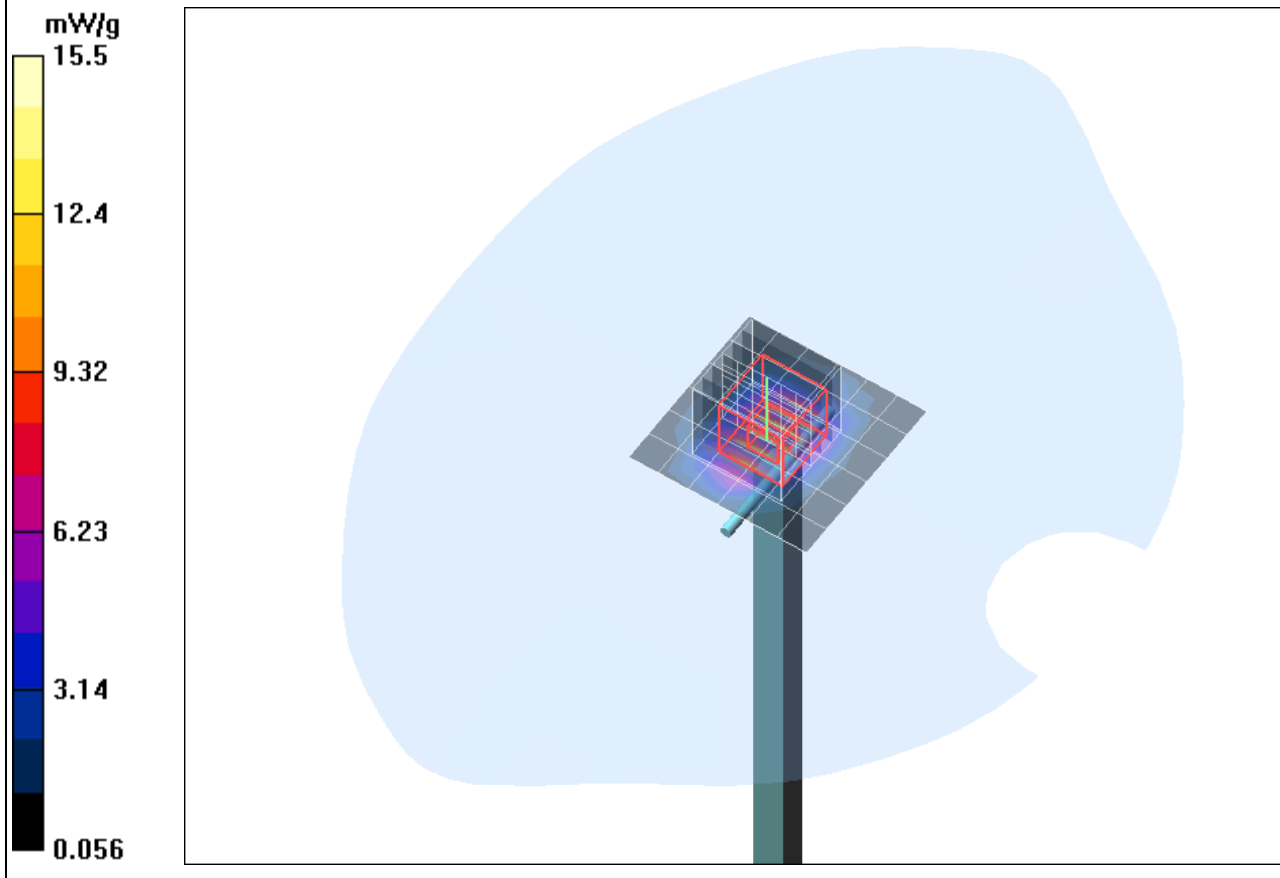
Maximum value of SAR (measured) = 15.5 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.7 V/m; Power Drift = 0.030 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.26 mW/g



SAR Result with Body TSL

Test Laboratory: Imst GmbH, DASY Yellow (II); File Name: [301211_y_3536_2450.da4](#)

DUT: Dipole 2450 MHz SN: 709; Type: D2450V2; Serial: D2450V2 - SN:709
Program Name: System Performance Check at 2450 MHz

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2450$ MHz; $\sigma = 2$ mho/m; $\epsilon_r = 51.2$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(7.42, 7.42, 7.42); Calibrated: 26.09.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- Phantom: SAM Glycol 1340; Type: QD 000 P40 CB; Serial: TP-1340
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 15.5 mW/g

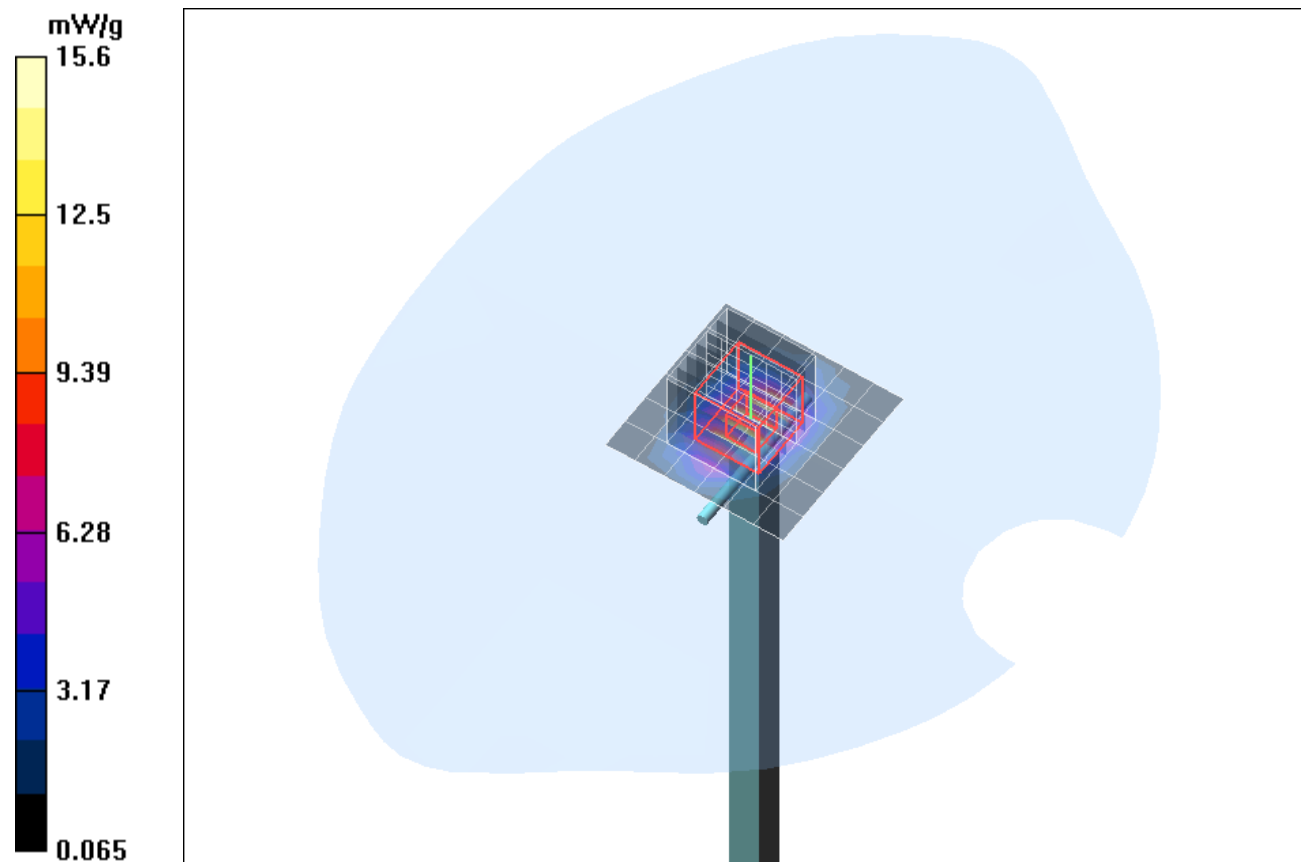
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.7 V/m; Power Drift = -0.036 dB

Peak SAR (extrapolated) = 30.2 W/kg

SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.15 mW/g

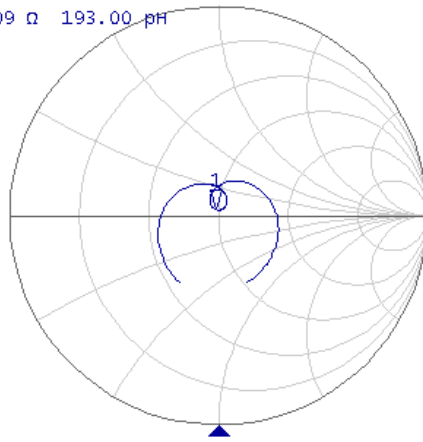
Maximum value of SAR (measured) = 15.6 mW/g



Impedance Measurements Plot for Head TSL

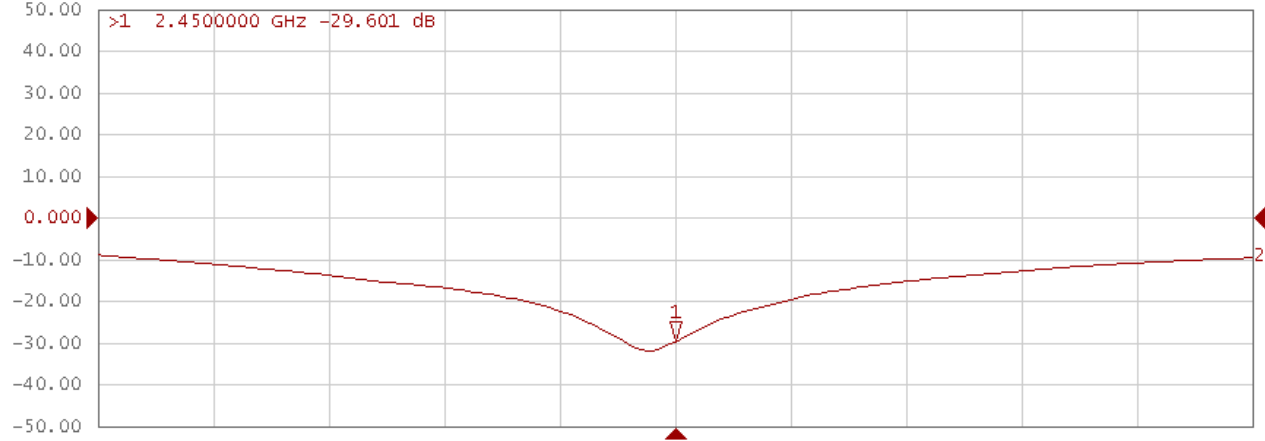
Tr1 S11 Smith (R+jX) scale 1.000u [F1]

>1 2.4500000 GHz 48.640 Ω 2.9709 Ω 193.00 pF



Tr2 S11 Log Mag 10.00dB/ Ref 0.000dB [F1]

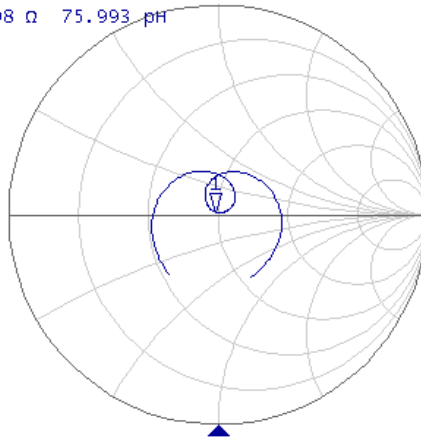
>1 2.4500000 GHz -29.601 dB



Impedance Measurements Plot for Body TSL

Tr1 S11 Smith (R+jX) scale 1.000U [F1]

>1 2.4500000 GHz 48.978 Ω 1.1698 Ω 75.993 μH



Tr2 S11 Log Mag 10.00dB/ Ref 0.000dB [F1]

>1 2.4500000 GHz -36.086 dB





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Calibration Certificate

Certificate No: Cal_D5GHzV2_SN1028_0412
 Object: D5GHzV2 SN: 1028
 Date of Calibration: April 20, 2012
 Next Calibration: April 2014
 Object Condition: In Tolerance

Calibration Equipment used:

| Test Equipment | Serial Number | Last calibration | Calibrated by | Next calibration |
|-------------------------|---------------|------------------|---|------------------|
| Powermeter E4416A | GB41050414 | Nov 10 | Rohde&Schwarz (200954-D-K-15012-01-00-2010-11) | Nov 12 |
| Power Sensor E9301H | US40010212 | Nov 10 | Rohde&Schwarz (200944-D-K-15012-01-00-2010-11) | Nov 12 |
| Powermeter E4417A | GB41050441 | Nov 10 | Rohde&Schwarz (200952-D-K-15012-01-00-2010-11) | Nov 12 |
| Power Sensor E9301A | MY41495584 | Nov 10 | Rohde&Schwarz (200953-D-K-15012-01-00-2010-11) | Nov 12 |
| Network Analyzer E5071C | MY46103220 | Aug 11 | Agilent (1-3503689015-1) | Aug 13 |
| Reference Probe EX3DV4 | SN 3536 | Sep 11 | SPEAG No EX-3536_Sep09 | Sep 12 |
| DAE4 | SN 335 | Sep 11 | SPEAG No DAE3-335_Feb10 | Feb 13 |

| | |
|--|---|
| Calibration is performed according the following standards: | |
| IEEE 1528-2003 | |
| "IEEE Recommended Practice for Determining the Peak Spatial - Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Technique", 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 3GHz)", February 2005 | |
| IEC 62209-2 | |
| "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures ", Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters" Edition 1.0, 2010-01 | |
| Federal Communications Commission Office of Engineering & Technologies (FCCOET) | |
| "Evaluating Compliance wit 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: DASY 4/5 System Handbook | |
| prepared by:  Alexander Rahn test engineer | reviewed by:  André van den Bosch quality assurance engineer |

| Measurement Conditions | | |
|-------------------------------|---|-------------|
| DASY Version: | Dasy 4; | V4.7 |
| Phantom: | SAM Phantom | 1176 |
| Distance Dipole Center – TSL: | 10mm | With spacer |
| Area Scan resolution | dx, dy = 7.5mm | |
| Zoom Scan resolution | dx, dy = 4.3mm, dz = 3mm | |
| Frequency: | 5200 MHz \pm 1MHz 5500 MHz \pm 1MHz 5800 MHz \pm 1MHz | |

| Head TSL Parameters at 5200 MHz | | | |
|---------------------------------|-------------|----------------|-------------------|
| | Temperature | Permittivity | Conductivity |
| Nominal Head TSL Parameters | 22.0 | 36.00 | 4.66 |
| Measured Head TSL Parameters | 22.1 | 34.70 \pm 6% | 4.46 S/m \pm 6% |

| SAR Result with Head TSL at 5200 MHz | | | |
|--------------------------------------|-------------------------------------|--------------------|---|
| Averaged over 1g | SAR measured | 250 mW input power | 21.60 mW/g |
| | SAR normalized | normalized to 1W | 86.40 mW/g |
| | SAR for nominal Head TSL parameters | normalized to 1W | 85.68 mW/g \pm 16.5 % (k=2) |
| Averaged over 10g | SAR measured | 250 mW input power | 6.27 mW/g |
| | SAR normalized | normalized to 1W | 25.08 mW/g |
| | SAR for nominal Head TSL parameters | normalized to 1W | 24.79 mW/g \pm 16.5 % (k=2) |

| Head TSL Parameters at 5500 MHz | | | |
|---------------------------------|-------------|--------------|---------------|
| | Temperature | Permittivity | Conductivity |
| Nominal Head TSL Parameters | 22.0 | 35.60 | 4.96 |
| Measured Head TSL Parameters | 22.1 | 34.20 ± 6% | 4.82 S/m ± 6% |

| SAR Result with Head TSL at 5500 MHz | | | |
|--------------------------------------|-------------------------------------|--------------------|--------------------------------------|
| Averaged over 1g | SAR measured | 250 mW input power | 21.30 mW/g |
| | SAR normalized | normalized to 1W | 85.20 mW/g |
| | SAR for nominal Head TSL parameters | normalized to 1W | 84.43 mW/g ± 16.5 % (k=2) |
| Averaged over 10g | SAR measured | 250 mW input power | 6.06 mW/g |
| | SAR normalized | normalized to 1W | 24.24 mW/g |
| | SAR for nominal Head TSL parameters | normalized to 1W | 23.96 mW/g ± 16.5 % (k=2) |

| Head TSL Parameters at 5800 MHz | | | |
|---------------------------------|-------------|--------------|---------------|
| | Temperature | Permittivity | Conductivity |
| Nominal Head TSL Parameters | 22.0 | 35.30 | 5.27 |
| Measured Head TSL Parameters | 22.1 | 33.90 ± 6% | 5.49 S/m ± 6% |

| SAR Result with Head TSL at 5800 MHz | | | |
|--------------------------------------|-------------------------------------|--------------------|--------------------------------------|
| Averaged over 1g | SAR measured | 250 mW input power | 21.60 mW/g |
| | SAR normalized | normalized to 1W | 86.40 mW/g |
| | SAR for nominal Head TSL parameters | normalized to 1W | 85.88 mW/g ± 16.5 % (k=2) |
| Averaged over 10g | SAR measured | 250 mW input power | 6.19 mW/g |
| | SAR normalized | normalized to 1W | 24.76 mW/g |
| | SAR for nominal Head TSL parameters | normalized to 1W | 24.54 mW/g ± 16.5 % (k=2) |

| Body TSL Parameters at 5200 MHz | | | |
|---------------------------------|-------------|--------------|---------------|
| | Temperature | Permittivity | Conductivity |
| Nominal Body TSL Parameters | 22.0 | 49.00 | 5.30 |
| Measured Body TSL Parameters | 22.0 | 48.00 ± 6% | 5.19 S/m ± 6% |

| SAR Result with Body TSL at 5200 MHz | | | |
|--------------------------------------|-------------------------------------|--------------------|--------------------------------------|
| Averaged over 1g | SAR measured | 250 mW input power | 20.50 mW/g |
| | SAR normalized | normalized to 1W | 82.00 mW/g |
| | SAR for nominal Body TSL parameters | normalized to 1W | 81.62 mW/g ± 16.5 % (k=2) |
| Averaged over 10g | SAR measured | 250 mW input power | 5.93 mW/g |
| | SAR normalized | normalized to 1W | 23.72 mW/g |
| | SAR for nominal Body TSL parameters | normalized to 1W | 23.57 mW/g ± 16.5 % (k=2) |

| Body TSL Parameters at 5500 MHz | | | |
|---------------------------------|-------------|--------------|---------------|
| | Temperature | Permittivity | Conductivity |
| Nominal Body TSL Parameters | 22.0 | 48.60 | 5.65 |
| Measured Body TSL Parameters | 22.0 | 48.20 ± 6% | 5.57 S/m ± 6% |

| SAR Result with Body TSL at 5500 MHz | | | |
|--------------------------------------|-------------------------------------|--------------------|--------------------------------------|
| Averaged over 1g | SAR measured | 250 mW input power | 21.00 mW/g |
| | SAR normalized | normalized to 1W | 84.00 mW/g |
| | SAR for nominal Body TSL parameters | normalized to 1W | 83.81 mW/g ± 16.5 % (k=2) |
| Averaged over 10g | SAR measured | 250 mW input power | 5.91 mW/g |
| | SAR normalized | normalized to 1W | 23.64 mW/g |
| | SAR for nominal Body TSL parameters | normalized to 1W | 23.57 mW/g ± 16.5 % (k=2) |

| Body TSL Parameters at 5800 MHz | | | |
|--|--------------------|---------------------|---------------------|
| | Temperature | Permittivity | Conductivity |
| Nominal Body TSL Parameters | 22.0 | 48.20 | 5.65 |
| Measured Body TSL Parameters | 22.1 | 47.90 ± 6% | 6.19 S/m ± 6% |

| SAR Result with Body TSL at 5800 MHz | | | |
|---|-------------------------------------|--------------------|--------------------------------------|
| Averaged over 1g | SAR measured | 250 mW input power | 19.60 mW/g |
| | SAR normalized | normalized to 1W | 78.40 mW/g |
| | SAR for nominal Body TSL parameters | normalized to 1W | 78.41 mW/g ± 16.5 % (k=2) |
| Averaged over 10g | SAR measured | 250 mW input power | 5.49 mW/g |
| | SAR normalized | normalized to 1W | 21.96 mW/g |
| | SAR for nominal Body TSL parameters | normalized to 1W | 21.95 mW/g ± 16.5 % (k=2) |

| General Antenna Parameters at 5200 MHz | | |
|--|--------------------------------------|-------------------|
| Antenna Parameters with Head TSL | Impedance, transformed to feed point | 45.6 Ω – 6.62 jΩ |
| | Return Loss | -21.62 dB |
| Antenna Parameter with Body TSL | Impedance, transformed to feed point | 46.5 Ω - 5.02 jΩ |
| | Return Loss | -24.00 dB |
| General Antenna Parameters at 5500 MHz | | |
| Antenna Parameters with Head TSL | Impedance, transformed to feed point | 50.0 Ω - -3.03 jΩ |
| | Return Loss | -30.35 dB |
| Antenna Parameter with Body TSL | Impedance, transformed to feed point | 51.4 Ω - -3.81 jΩ |
| | Return Loss | -27.96 dB |
| General Antenna Parameters at 5800 MHz | | |
| Antenna Parameters with Head TSL | Impedance, transformed to feed point | 59.1 Ω - 1.91 jΩ |
| | Return Loss | -21.37 dB |
| Antenna Parameter with Body TSL | Impedance, transformed to feed point | 58.6 Ω - 2.59 jΩ |
| | Return Loss | -21.64 dB |
| <p>After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured. The dipole is made of standard semigrd 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.</p> | | |

| Additional EUT Data | |
|----------------------------|--------------|
| Manufactured by: | SPEAG |
| Manufactured on: | July 9, 2004 |

SAR Result with Head TSL at 5200 MHz

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: [200412_b_3536_5200.da4](#)

DUT: Dipole 5GHz SN: 1028; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028
Program Name: System Performance Check at 5200 MHz

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5200$ MHz; $\sigma = 4.46$ mho/m; $\epsilon_r = 34.7$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(5.27, 5.27, 5.27); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (14x14x1): Measurement grid: dx=7.5mm, dy=7.5mm

Maximum value of SAR (measured) = 35.2 mW/g

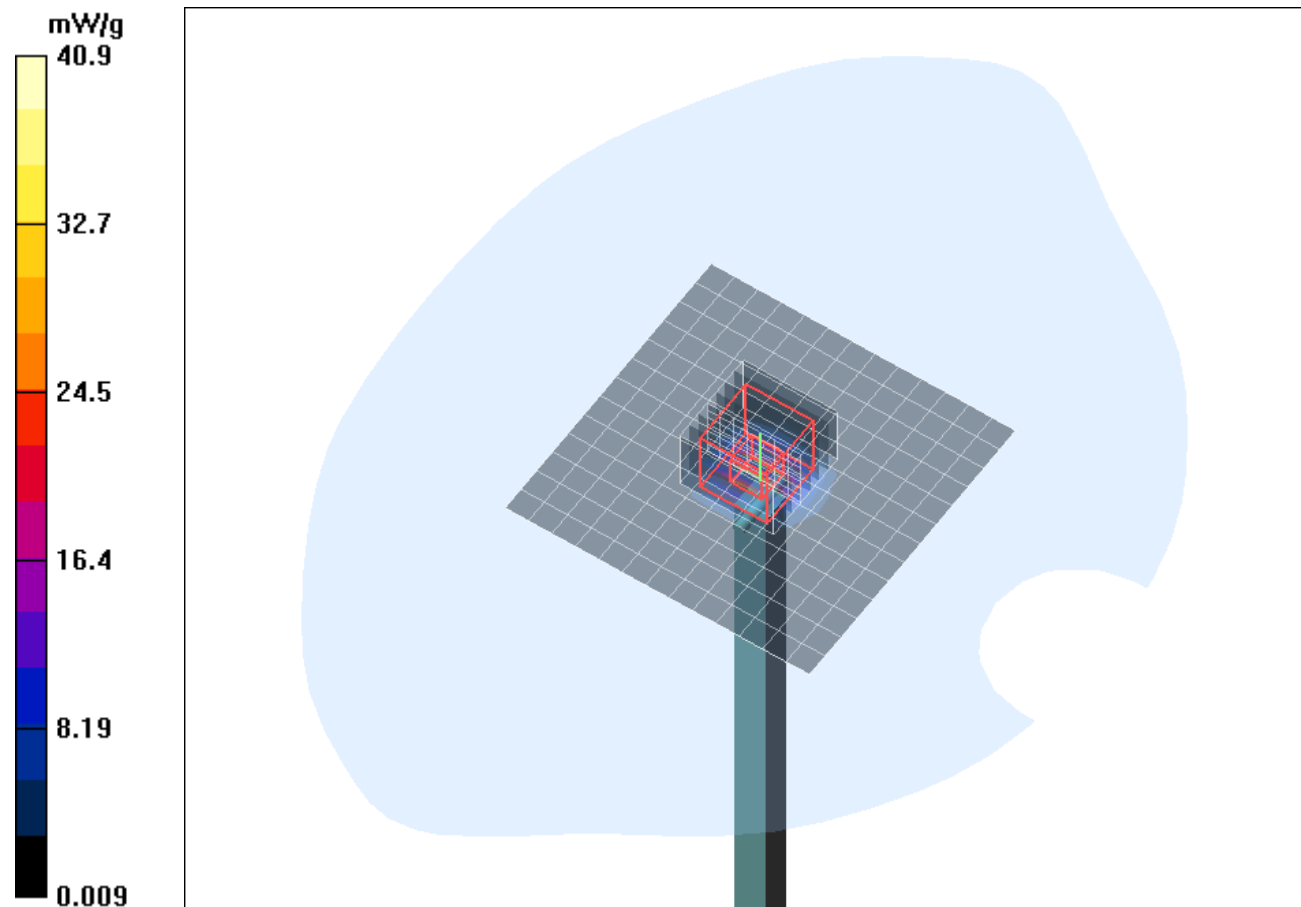
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 97.7 V/m; Power Drift = -0.004 dB

Peak SAR (extrapolated) = 84.2 W/kg

SAR(1 g) = 21.6 mW/g; SAR(10 g) = 6.27 mW/g

Maximum value of SAR (measured) = 40.9 mW/g



SAR Result with Head TSL at 5500 MHz**Test Laboratory:** IMST GmbH, DASY Blue (I); **File Name:** [200412_b_3536_5500.da4](#)**DUT:** Dipole 5GHz SN: 1028; **Type:** D5GHzV2; **Serial:** D5GHzV2 - SN:1028
Program Name: System Performance Check at 5500 MHzCommunication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5500$ MHz; $\sigma = 4.82$ mho/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³
Phantom section: Flat Section**DASY4 Configuration:**

- Probe: EX3DV4 - SN3536; ConvF(4.61, 4.61, 4.61); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (14x14x1): Measurement grid: dx=7.5mm, dy=7.5mm

Maximum value of SAR (measured) = 35.2 mW/g

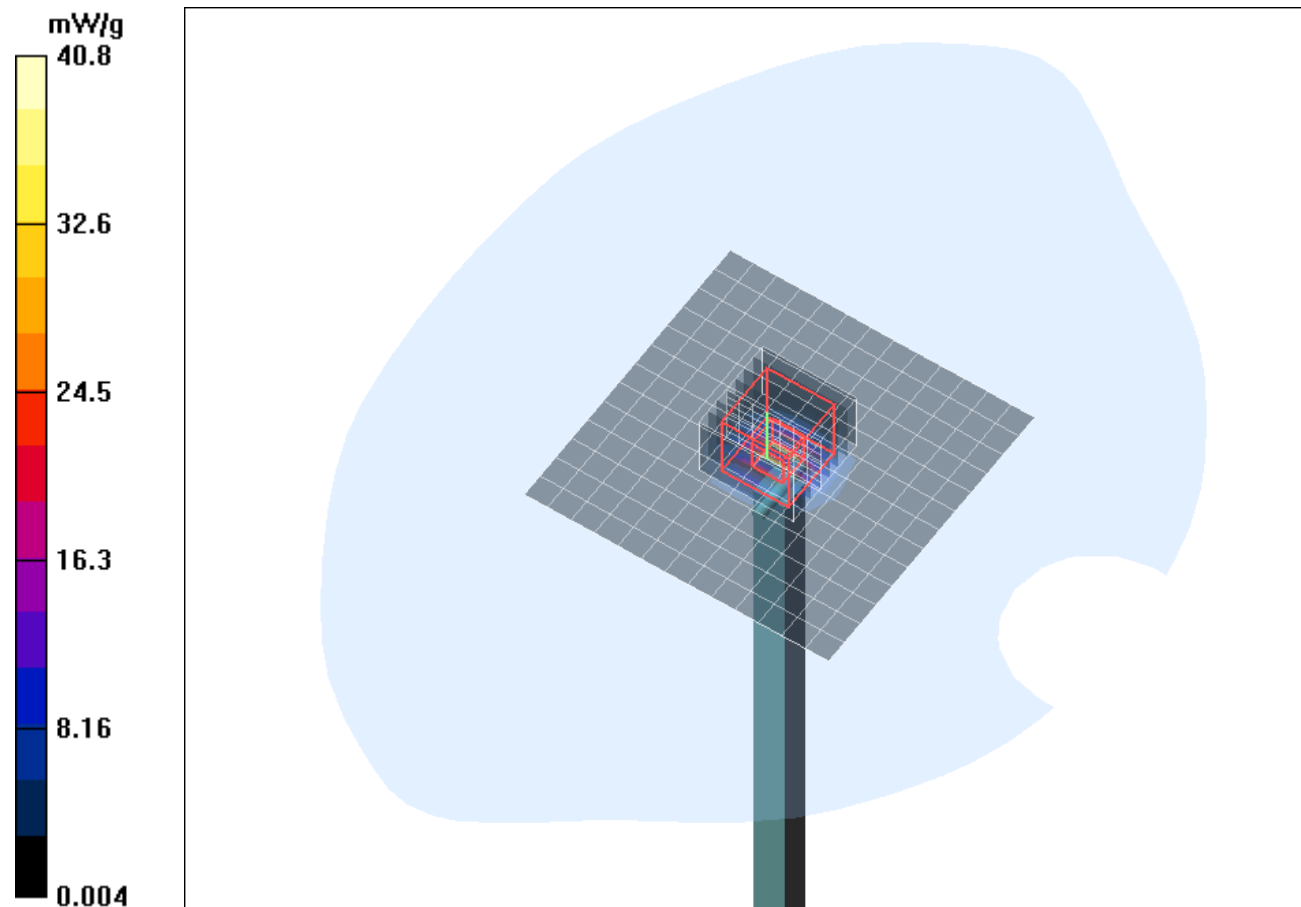
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 96.3 V/m; Power Drift = 0.018 dB

Peak SAR (extrapolated) = 83.2 W/kg

SAR(1 g) = 21.3 mW/g; SAR(10 g) = 6.06 mW/g

Maximum value of SAR (measured) = 40.8 mW/g



SAR Result with Head TSL at 5800 MHz

Test Laboratory: IMST GmbH, DASY Blue (I); **File Name:** [200412_b_3536_5800.da4](#)

DUT: Dipole 5GHz SN: 1028; **Type:** D5GHzV2; **Serial:** D5GHzV2 - SN:1028
Program Name: System Performance Check at 5800 MHz

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 5.49 \text{ mho/m}$; $\epsilon_r = 33.9$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(4.53, 4.53, 4.53); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (14x14x1): Measurement grid: $dx=7.5\text{mm}$, $dy=7.5\text{mm}$

Maximum value of SAR (measured) = 37.6 mW/g

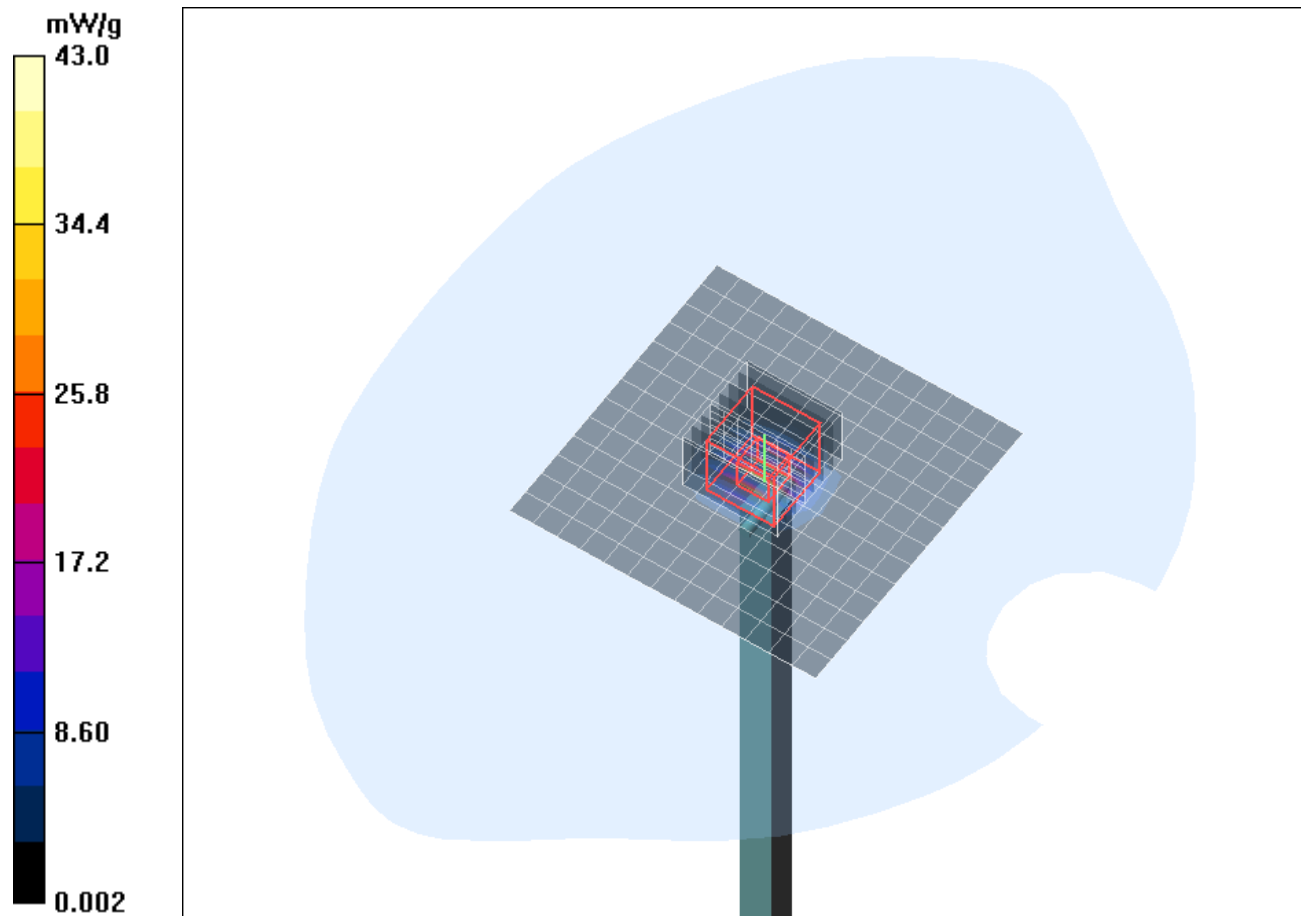
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: $dx=4.3\text{mm}$, $dy=4.3\text{mm}$, $dz=3\text{mm}$

Reference Value = 89.2 V/m; Power Drift = 0.027 dB

Peak SAR (extrapolated) = 89.4 W/kg

SAR(1 g) = 21.6 mW/g; SAR(10 g) = 6.19 mW/g

Maximum value of SAR (measured) = 43.0 mW/g



SAR Result with Body TSL at 5200 MHz

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: [300412_b_3536_5200.da4](#)

DUT: Dipole 5GHz SN: 1028; Type: D5GHzV2; Serial: D5GHzV2 - SN:1028
 Program Name: System Performance Check at 5200 MHz

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5200$ MHz; $\sigma = 5.19$ mho/m; $\epsilon_r = 48$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(4.43, 4.43, 4.43); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (14x14x1): Measurement grid: dx=7.5mm, dy=7.5mm

Maximum value of SAR (measured) = 36.4 mW/g

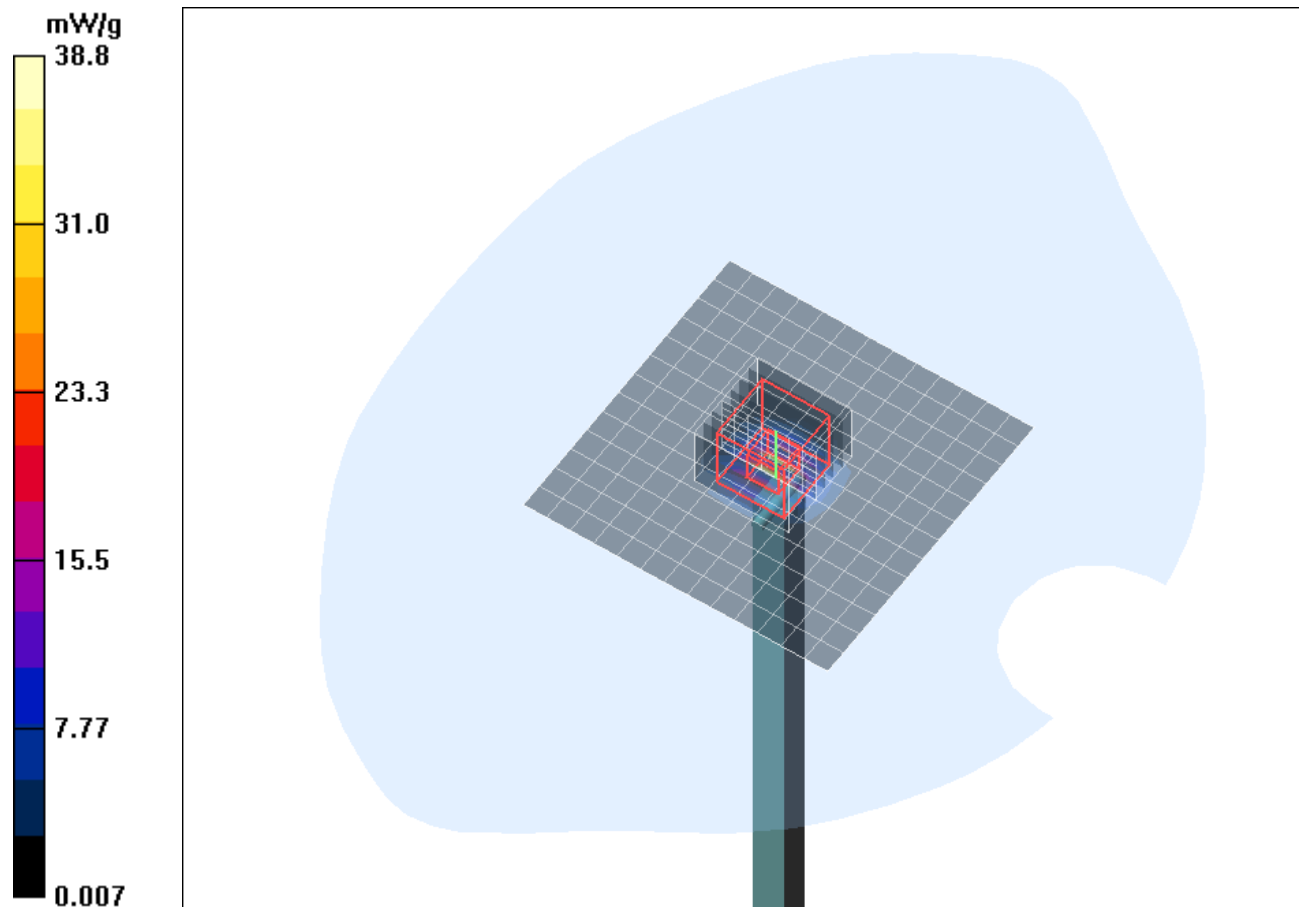
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 92.3 V/m; Power Drift = -0.003 dB

Peak SAR (extrapolated) = 67.7 W/kg

SAR(1 g) = 20.5 mW/g; SAR(10 g) = 5.93 mW/g

Maximum value of SAR (measured) = 38.8 mW/g



SAR Result with Body TSL at 5500 MHz

Test Laboratory: IMST GmbH, DASY Blue (I); **File Name:** [300412_b_3536_5500.da4](#)

DUT: Dipole 5GHz SN: 1028; **Type:** D5GHzV2; **Serial:** D5GHzV2 - SN:1028
Program Name: System Performance Check at 5500 MHz

Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 5.57 \text{ mho/m}$; $\epsilon_r = 48.2$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3536; ConvF(3.92, 3.92, 3.92); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (14x14x1): Measurement grid: $dx=7.5\text{mm}$, $dy=7.5\text{mm}$

Maximum value of SAR (measured) = 37.9 mW/g

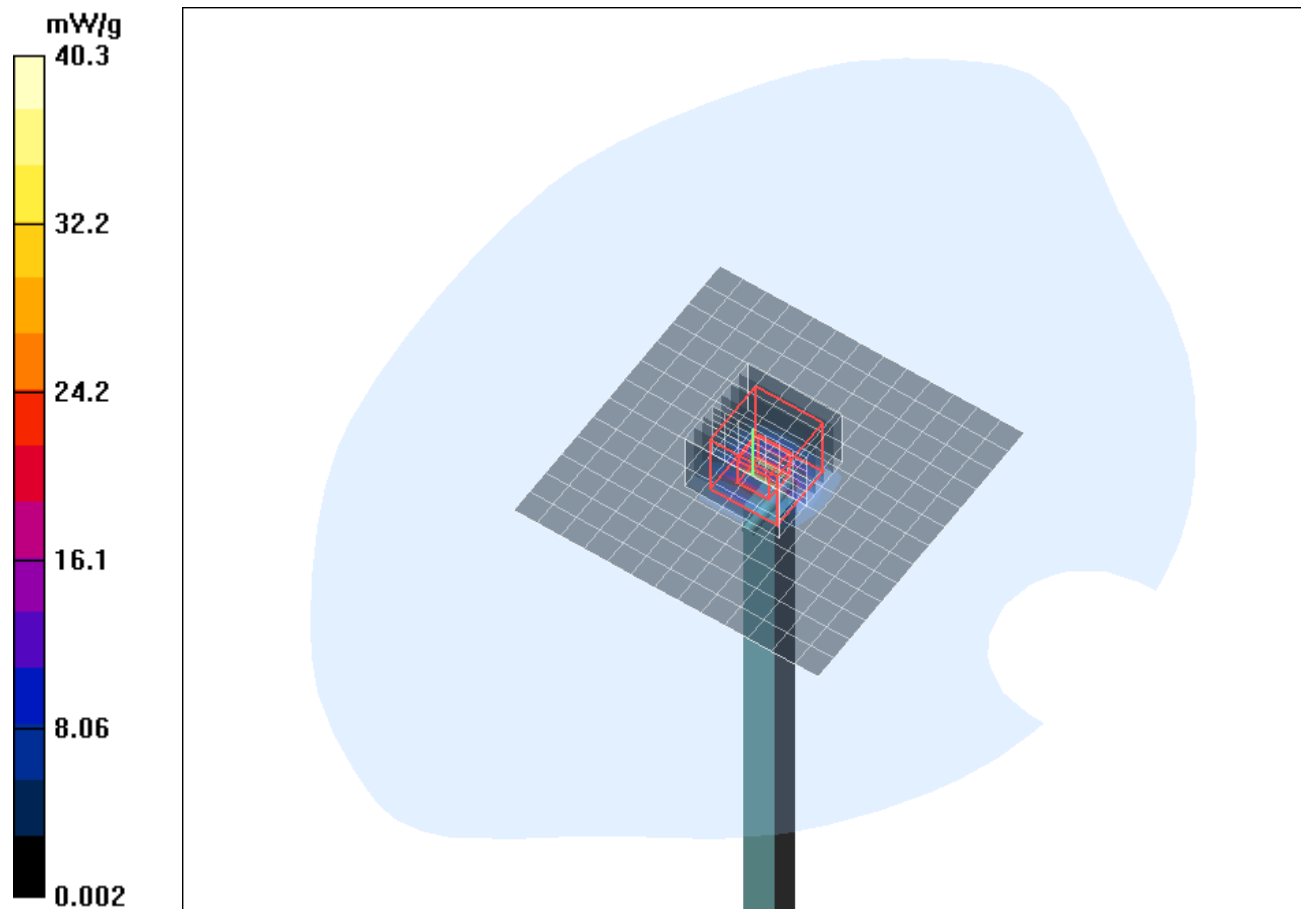
d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: $dx=4.3\text{mm}$, $dy=4.3\text{mm}$, $dz=3\text{mm}$

Reference Value = 91.9 V/m; Power Drift = -0.142 dB

Peak SAR (extrapolated) = 75.2 W/kg

SAR(1 g) = 21 mW/g; SAR(10 g) = 5.91 mW/g

Maximum value of SAR (measured) = 40.3 mW/g



SAR Result with Body TSL at 5800 MHz**Test Laboratory:** IMST GmbH, DASY Blue (I); **File Name:** [300412_b_3536_5800.da4](#)**DUT:** Dipole 5GHz SN: 1028; **Type:** D5GHzV2; **Serial:** D5GHzV2 - SN:1028
Program Name: System Performance Check at 5800 MHzCommunication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5800$ MHz; $\sigma = 6.19$ mho/m; $\epsilon_r = 47.9$; $\rho = 1000$ kg/m³
Phantom section: Flat Section**DASY4 Configuration:**

- Probe: EX3DV4 - SN3536; ConvF(4.03, 4.03, 4.03); Calibrated: 26.09.2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 21.09.2011
- Phantom: SAM Glycol 1176; Type: Speag; Serial: 1176
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (14x14x1): Measurement grid: dx=7.5mm, dy=7.5mm

Maximum value of SAR (measured) = 35.9 mW/g

d=10mm, Pin=250mW/Zoom Scan (8x8x8)/Cube 0: Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

Reference Value = 83.5 V/m; Power Drift = 0.016 dB

Peak SAR (extrapolated) = 75.3 W/kg

SAR(1 g) = 19.6 mW/g; SAR(10 g) = 5.49 mW/g

Maximum value of SAR (measured) = 38.2 mW/g

