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D-PL-12139-01-00

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-12139-01-00.

Appendix for the SAR Test Report

Dosimetric Assessment of the Portable Device Datalogic Joya X2

(FCC ID: U4GJX2W / IC: 3862E-JX2W)

According to the FCC Requirements Calibration Data

October 21, 2014

IMST GmbH

Carl-Friedrich-Gauß-Str. 2 - 4

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
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client IMST

Certificate No: EX3-3860_Jul13

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3860

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

Calibration date: July 29, 2013

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 29, 2013

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ 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 *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3860

Manufactured: January 23, 2012
Calibrated: July 29, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3860

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.15	0.12	0.38	± 10.1 %
DCP (mV)[B]	100.8	108.9	101.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	137.4	±3.3 %
		Y	0.0	0.0	1.0		158.9	
		Z	0.0	0.0	1.0		133.0	

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:3860

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2450	39.2	1.80	7.38	7.38	7.38	0.50	0.68	± 12.0 %
5200	36.0	4.66	5.29	5.29	5.29	0.33	1.80	± 13.1 %
5300	35.9	4.76	4.95	4.95	4.95	0.36	1.80	± 13.1 %
5500	35.6	4.96	4.86	4.86	4.86	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.28	4.28	4.28	0.56	1.80	± 13.1 %
5800	35.3	5.27	4.80	4.80	4.80	0.42	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:3860

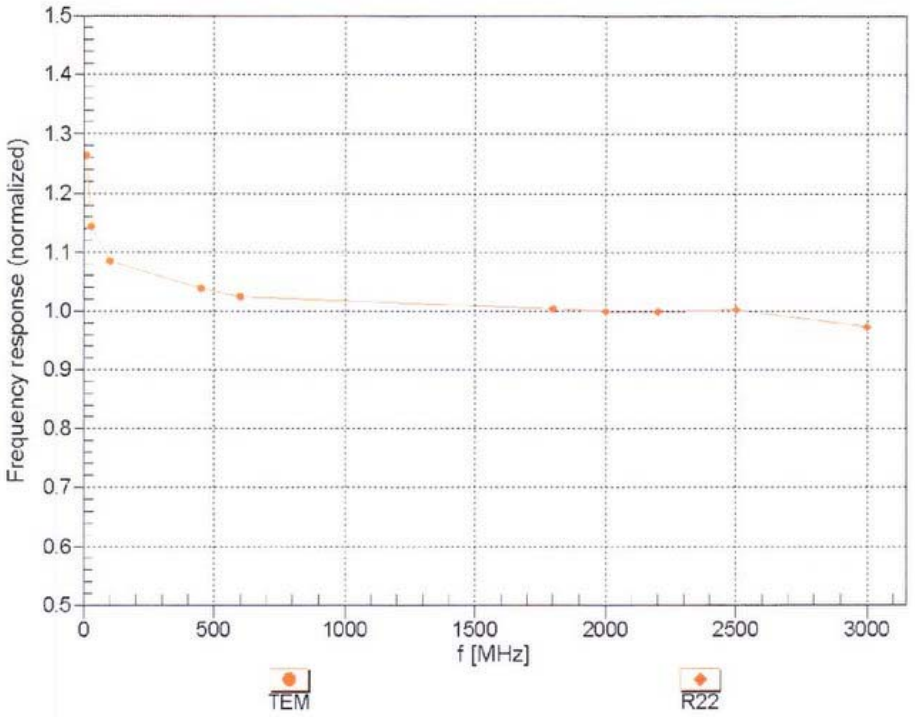
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2450	52.7	1.95	7.47	7.47	7.47	0.46	0.72	± 12.0 %
5200	49.0	5.30	4.50	4.50	4.50	0.43	1.90	± 13.1 %
5300	48.9	5.42	4.18	4.18	4.18	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.78	3.78	3.78	0.56	1.90	± 13.1 %
5600	48.5	5.77	4.01	4.01	4.01	0.40	1.90	± 13.1 %
5800	48.2	6.00	3.76	3.76	3.76	0.64	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

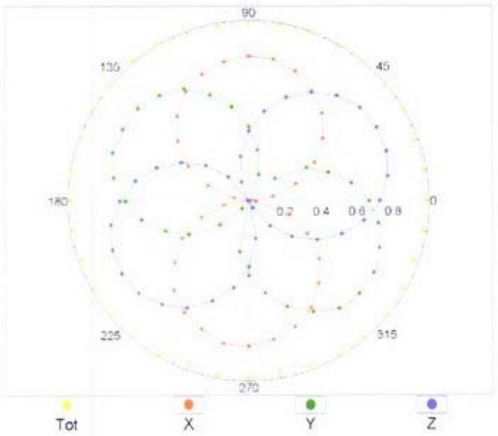
(TEM-Cell:ifi110 EXX, Waveguide: R22)



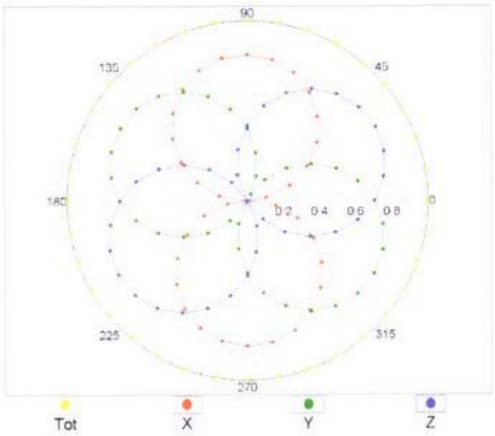
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

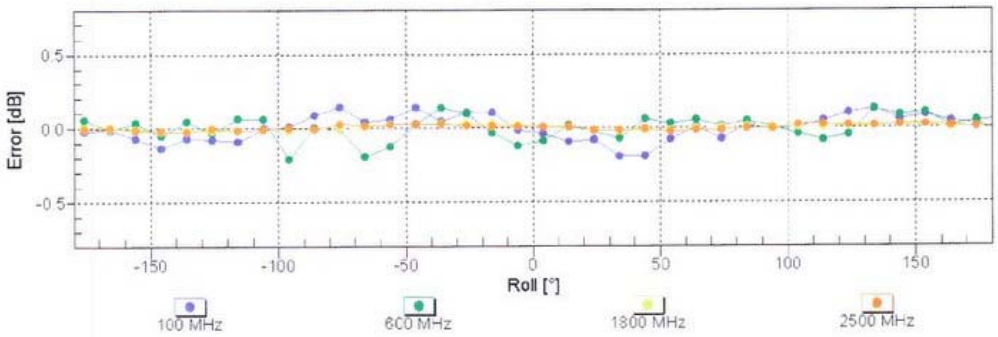
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



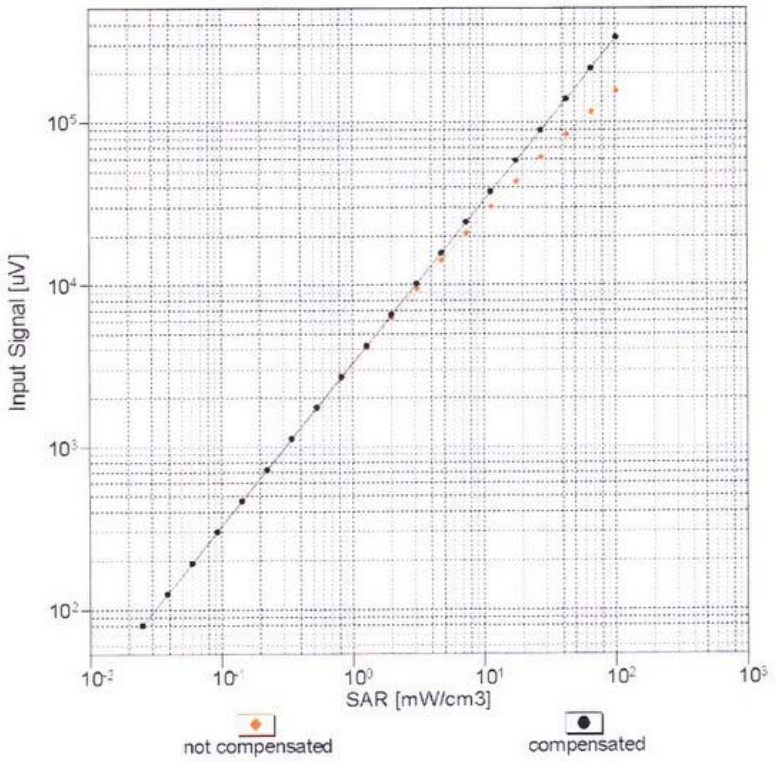
f=1800 MHz,R22

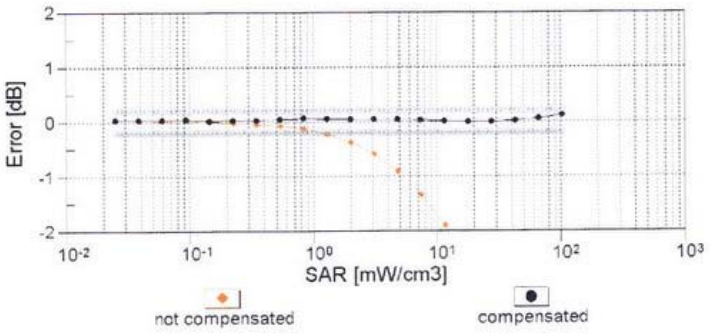




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

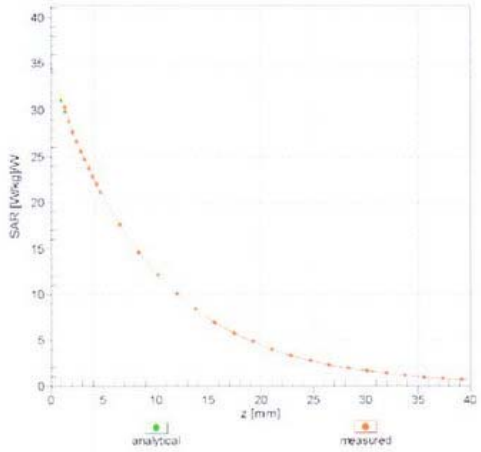




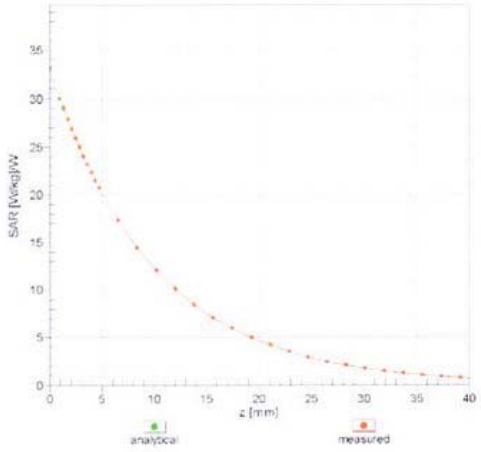
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 2450 MHz,WGLS R22 (H_convF)

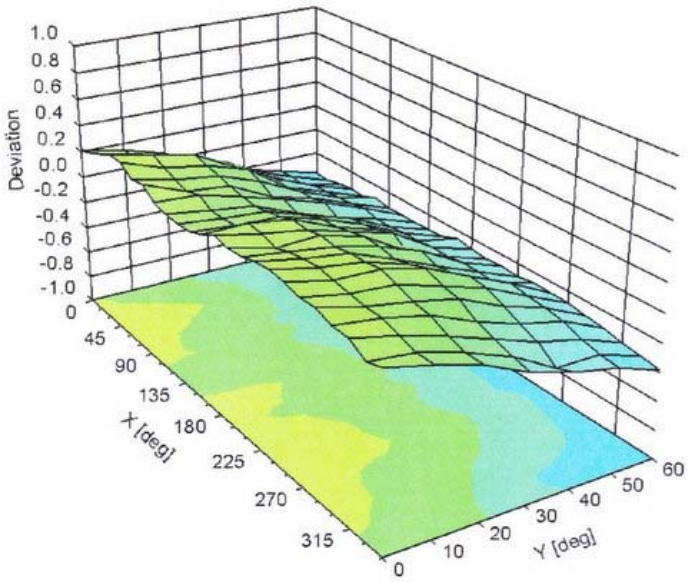


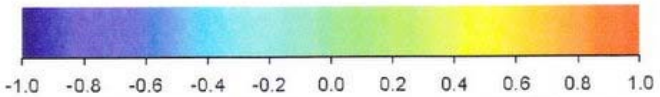
f = 2450 MHz,WGLS R22 (M_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3860

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	14
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_Sep2013

Object: D2450V2 SN: 709

Date of Calibration: September 26, 2013

Next Calibration: September 2015

Object Condition: In Tolerance

Calibration Equipment used:

Test Equipment	Serial Number	Last calibration	Calibrated by	Next calibration
Powermeter E4416A	GB41050414	Nov 12	Rohde&Schwarz (262487-D-K-15012-01-00-2012-11)	Nov 14
Power Sensor E9301H	US40010212	Nov 12	Rohde&Schwarz (262492-D-K-15012-01-00-2012-11)	Nov 14
Powermeter E4417A	GB41050441	Nov 12	Rohde&Schwarz (262488-D-K-15012-01-00-2012-11)	Nov 14
Power Sensor E9301A	MY41495584	Nov 12	Rohde&Schwarz (262489-D-K-15012-01-00-2012-11)	Nov 14
Network Analyzer E5071C	MY46103220	Jul 13	Rohde&Schwarz (11-300285997)	Jul 15
Reference Probe EX3DV4	SN 3536	Sep 12	SPEAG (EX3-3536_Sep12)	Sep 13
DAE3	SN 335	Feb 13	SPEAG (DAE3-335_Feb13)	Feb 14

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
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 = 10mm	
Zoom Scan resolution	dx, dy, dz = 5mm	
Frequency:	2450 MHz ± 1MHz	

Head TSL Parameters			
	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL Parameters	22.0	39.20	1.80
Measured Head TSL Parameters	22.0	39.7 ± 6%	1.81 S/m ± 6%

SAR Result with Head TSL			
Averaged over 1g	SAR measured	250 mW input power	13.80 mW/g
	SAR normalized	normalized to 1W	55.20 mW/g
	SAR for nominal Head TSL parameters	normalized to 1W	**55.21 mW/g ± 16.5 % (k=2)**
Averaged over 10g	SAR measured	250 mW input power	6.21 mW/g
	SAR normalized	normalized to 1W	24.84 mW/g
	SAR for nominal Head TSL parameters	normalized to 1W	**24.85 mW/g ± 16.5 % (k=2)**

Body TSL Parameters			
	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL Parameters	22.0	52.70	1.95
Measured Body TSL Parameters	21.6	50.90 ± 6%	1.96 S/m ± 6%

SAR Result with Body TSL			
Averaged over 1g	SAR measured	250 mW input power	13.90 mW/g
	SAR normalized	normalized to 1W	55.60 mW/g
	SAR for nominal Body TSL parameters	normalized to 1W	**55.04 mW/g ± 16.5 % (k=2)**
Averaged over 10g	SAR measured	250 mW input power	6.28 mW/g
	SAR normalized	normalized to 1W	25.12 mW/g
	SAR for nominal Body TSL parameters	normalized to 1W	**24.95 mW/g ± 16.5 % (k=2)**

General Antenna Parameters		
Antenna Parameters with Head TSL	Impedance, transformed to feed point	48.6 Ω + 0.25 jΩ
	Return Loss	-30.90 dB
Antenna Parameter with Body TSL	Impedance, transformed to feed point	49.1 Ω – 0.99 jΩ
	Return Loss	-37.40 dB
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 semigrid 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.		

Additional EUT Data	
Manufactured by:	SPEAG
Manufactured on:	January 15, 1998

SAR Result with Head TSL

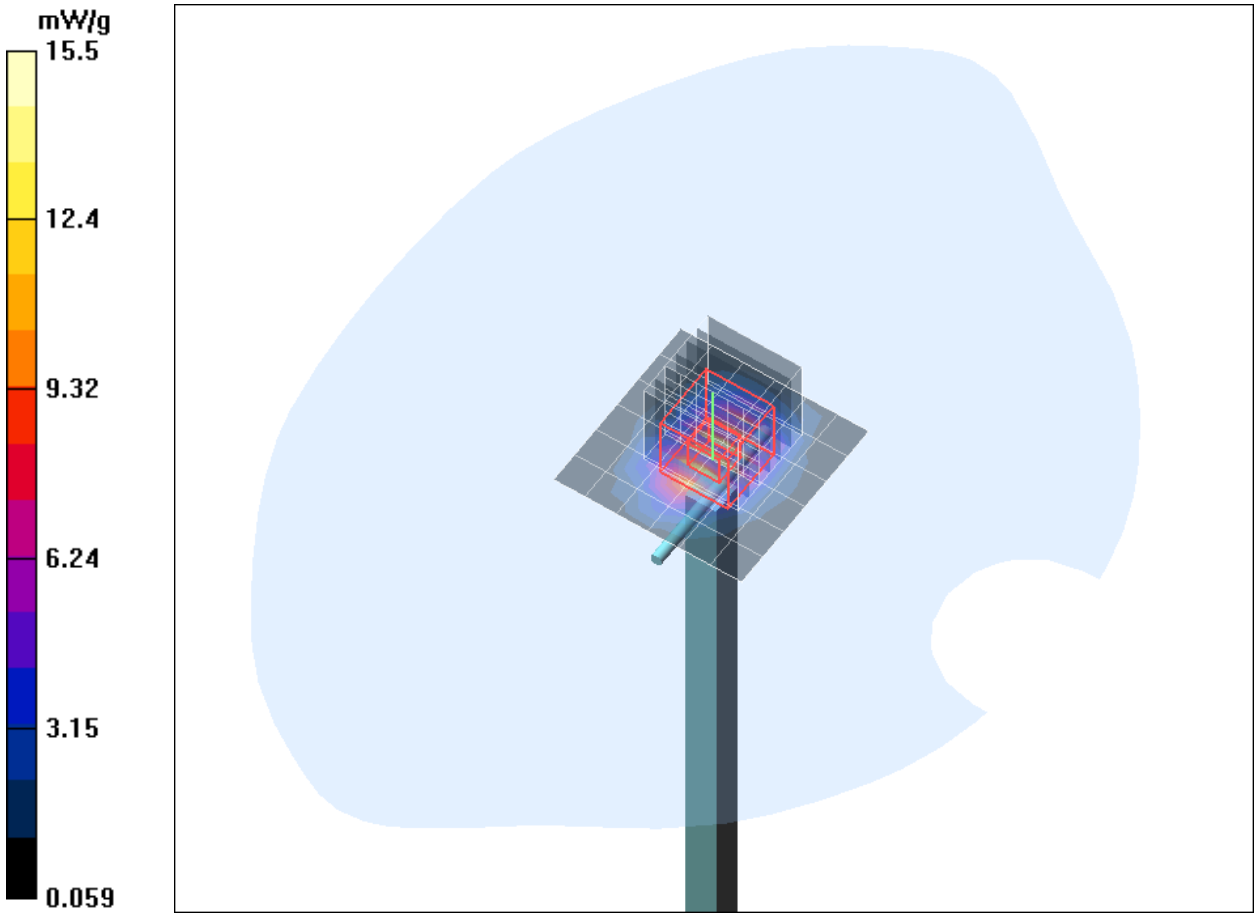
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 260913_b_3536.da4

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; σ = 1.81 mho/m; ε_r = 39.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.76, 7.76, 7.76); Calibrated: 24.09.2012
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 18.02.2013
- 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 (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 15.6 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.2 V/m; Power Drift = -0.016 dB
Peak SAR (extrapolated) = 30.7 W/kg
SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.21 mW/g
Maximum value of SAR (measured) = 15.5 mW/g



SAR Result with Body TSL

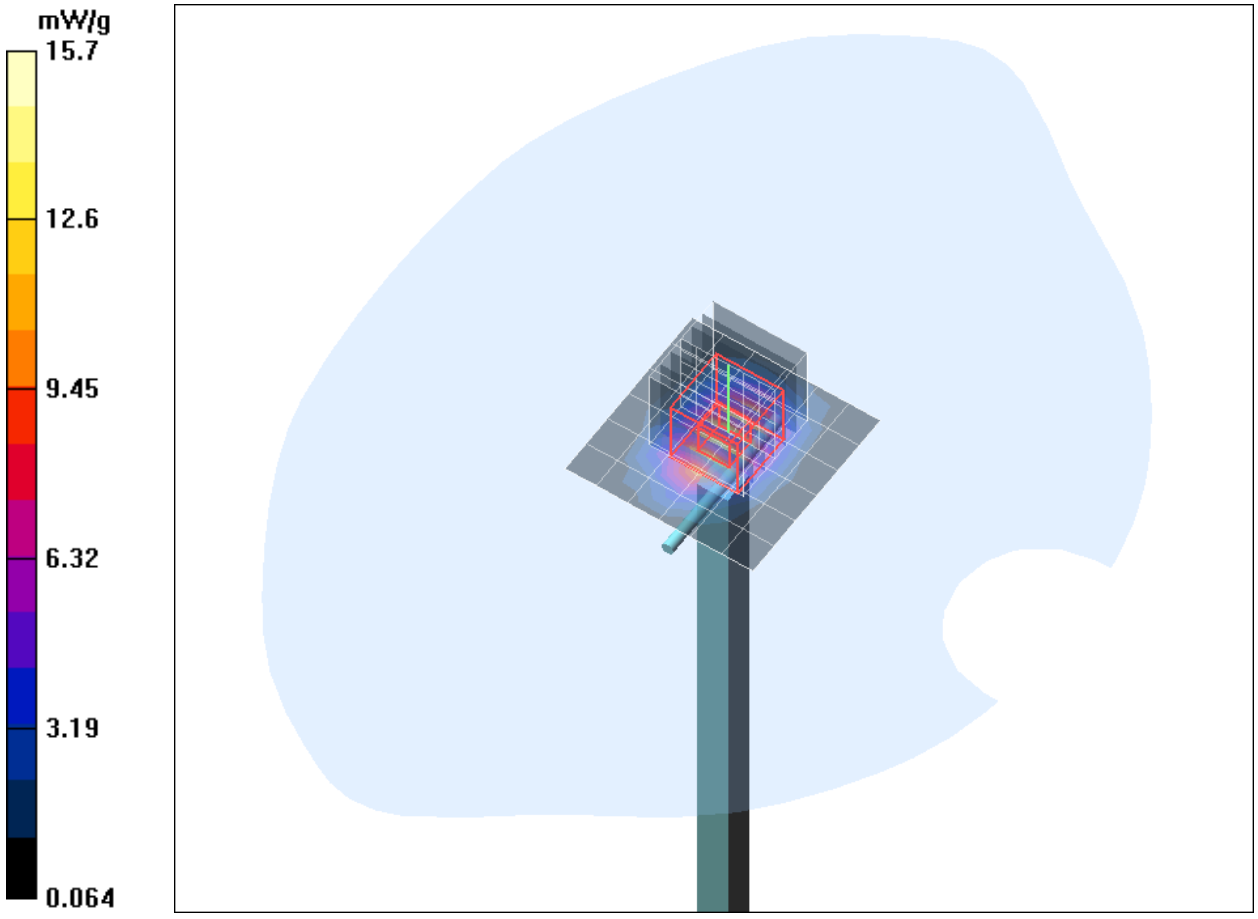
Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 260913_b_3536.da4

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

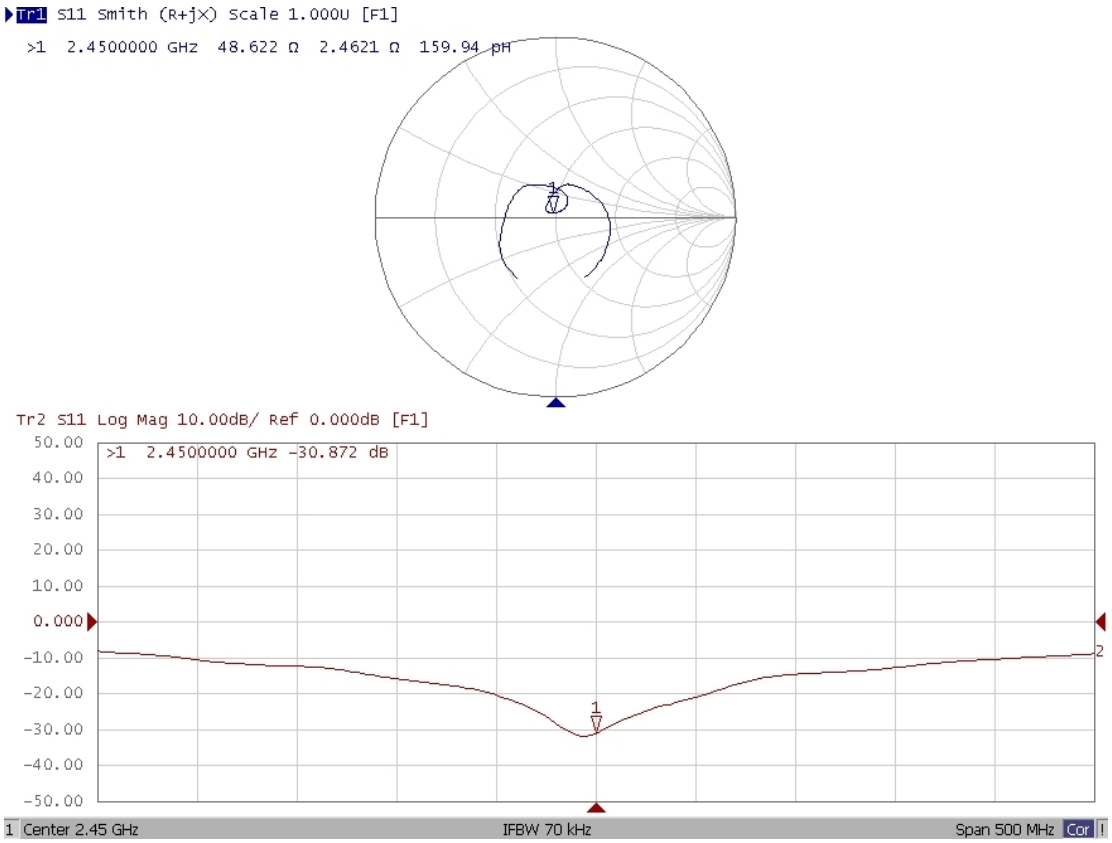
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.96 mho/m; ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: EX3DV4 - SN3536; ConvF(7.55, 7.55, 7.55); Calibrated: 24.09.2012
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 18.02.2013
- 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 (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 15.9 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.8 V/m; Power Drift = 0.043 dB
Peak SAR (extrapolated) = 30.3 W/kg
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.28 mW/g
Maximum value of SAR (measured) = 15.7 mW/g



Impedance Measurement Plot for Head TSL



Impedance Measurement Plot for Body TSL