MOTOROLA SOLUTIONS

ACCREDITED
TESTING CERT # 2518.05

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 2 of 4

Motorola Solutions, Inc.
EME Test Laboratory
Motorola Solutions Malaysia Sdn Bhd (455657-H)
Plot 2, Bayan Lepas Technoplex Industrial Park,
Mukim 12 SWD 11900 Bayan Lepas Penang, Malaysia.

Date of Report: 06/03/2015
Report Revision: B

Responsible Engineer:	Tan Kai Yan (EME Engineer) / Veeramani Veerapan (Sr. EME Engineer)
Report Author:	Tan Kai Yan (EME Engineer)
Date/s Tested:	12/16/2014 –2/10/2015, 4/8/2015 – 4/9/2015, 5/6/2015
Manufacturer/Location:	Motorola Solutions, Inc, Penang
Sector/Group/Div.:	ASTRO
Date submitted for test:	12/09/14
DUT Description:	Handheld Portable - Frequency bands; LMR 136-174 MHz, 380-520 MHz, 764-776 MHz, 794-824 MHz & 851-869 MHz; Bluetooth 2.402-2.480 GHz; WLAN 2.400-2.483.5 GHz
Test TX mode(s):	CW (PTT), Bluetooth, and WLAN 802.11b/g/n
Max. Power output:	6.6 W (VHF), 5.7 W (UHF), 2.99 W (700 MHz band), 3.6 W (800 MHz band), 10 mW (Bluetooth), 63.1 mW (802.11b), 25.1 mW (802.11g/n)
Nominal Power:	6.0 W (VHF), 5.0 W (UHF), 2.5 W (700 MHz band), 3.0 W (800 MHz band), 10 mW (Bluetooth), 47.1 mW (802.11b), 19.95 mW (802.11g), 19.63 mW (802.11n)
Tx Frequency Bands:	LMR 136-174 MHz, 380-520 MHz, 764-805 MHz, 806-870 MHz; Bluetooth 2402-2480 MHz; WLAN 2400-2483.5 MHz
Signaling type:	FM, TDMA, FHSS (Bluetooth), 802.11b/g/n (WLAN)
Model(s) Tested:	H91TGD9PW5AN (NUW1006A); H91TGD9PW7AN (NUW1008A)
Model(s) Certified:	H91TGD9PW5AN (NUW1006A); H91TGD9PW7AN (NUW1008A)
Serial Number(s):	AT3A086, AT3A087, AT3A089, AT3A091, AT3A084, AT3A138, AT3A088, AT3A139, AT3A085, AT3A382
Classification:	Occupational/Controlled
FCC ID:	AZ489FT7061; 150.8-173.4 MHz, 406.1-512 MHz, 764-775 MHz,794-824 MHz, 851-869 MHz This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
IC:	109U-89FT7061; This report contains results that are immaterial for IC equipment approval, which are clearly identified.

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of OET Bulletin 65. The 10 grams result is not applicable to FCC filing. The test results clearly demonstrate compliance with ICNIRP (1998) Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz), Health Physics 74, 494-522 RF Exposure limits of 10 W/kg averaged over 10grams of contiguous tissue.

Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 4.0 of this report. This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc EME Laboratory.
I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements. This reporting format is consistent with the suggested guidelines of the TIA TSB-150 December 2004. The results and statements contained in this report pertain only to the device(s) evaluated.

Deanna M Zakharia

Deanna Zakharia
Digitally signed by Deanna Zakharia
DN: cn=Deanna Zakharia, o=Motorola Solutions, ou=Regulatory Compliance Lab, email=edc015@motorolasolutions.com, c=US
Date: 2015.06.03 14:10:48 -04'00'

Deanna Zakharia
EME Lab Senior Resource Manager,
Laboratory Director
Approval Date: 6/03/2015

Appendix B
Probe Calibration Certificates

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 **Motorola MY**

Certificate No: **ES3-3196_Mar14/3**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3196_Mar14/2)

Object	ES3DV3 - SN:3196
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	March 26, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: April 18, 2014

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

Certificate No: ES3-3196_Mar14/3 Page 1 of 14

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

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

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

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
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., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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 ϑ = 0 (f ≤ 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 ≤ 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.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3196

Manufactured: June 16, 2008
Calibrated: March 26, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.29	1.30	1.34	± 10.1 %
DCP (mV)[B]	102.2	103.1	102.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	186.6	±3.0 %
		Y	0.0	0.0	1.0		211.2	
		Z	0.0	0.0	1.0		199.2	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.14	69.7	19.0	1.87	148.2	±0.7 %
		Y	2.97	69.0	18.8		148.8	
		Z	3.57	72.8	20.8		137.7	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.36	71.1	23.5	9.46	148.9	±3.0 %
		Y	11.60	72.1	24.3		148.9	
		Z	11.15	70.5	23.2		136.9	
10059-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	3.50	71.0	19.6	2.12	147.9	±0.7 %
		Y	3.60	72.0	20.2		148.2	
		Z	3.84	73.3	21.0		137.2	
10060-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	8.72	89.3	26.4	2.83	133.0	±0.7 %
		Y	10.20	92.7	27.7		134.4	
		Z	14.93	99.6	29.9		148.1	
10061-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	8.65	85.0	25.2	3.60	136.6	±0.7 %
		Y	8.87	86.1	25.8		136.3	
		Z	9.80	87.8	26.5		126.3	
10071-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	11.51	71.4	23.9	9.83	143.3	±3.0 %
		Y	11.85	72.6	24.9		145.3	
		Z	11.44	71.2	23.9		132.9	
10072-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	11.08	71.1	23.7	9.62	139.8	±3.0 %
		Y	11.53	72.7	24.8		143.9	
		Z	10.96	70.7	23.5		131.0	
10073-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	11.24	71.7	24.2	9.94	138.0	±3.5 %
		Y	11.69	73.2	25.4		140.4	
		Z	11.03	70.9	23.8		126.7	
10074-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	11.39	72.0	24.7	10.30	134.3	±3.3 %
		Y	11.92	73.8	26.0		138.1	
		Z	11.20	71.4	24.5		120.2	
10075-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	11.62	72.6	25.4	10.77	132.4	±3.5 %
		Y	12.10	74.1	26.5		138.8	
		Z	12.40	74.7	26.7		147.2	
10076-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	11.63	72.7	25.6	10.94	130.3	±3.5 %
		Y	12.17	74.3	26.7		136.5	
		Z	12.50	75.0	27.0		145.8	

10077-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	11.68	72.9	25.8	11.00	130.3	±3.8 %
		Y	12.21	74.5	26.9		136.6	
		Z	12.50	75.0	27.1		144.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.27	66.9	19.5	5.80	137.0	±1.2 %
		Y	6.32	67.4	19.8		143.2	
		Z	6.42	67.6	20.0		146.0	
10109-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.27	67.5	20.0	6.43	146.0	±1.4 %
		Y	7.03	66.9	19.8		127.1	
		Z	7.09	67.0	19.8		130.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.93	66.3	19.1	5.75	133.4	±1.2 %
		Y	6.00	66.8	19.6		139.8	
		Z	6.07	67.0	19.7		143.0	
10111-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	6.97	67.1	19.8	6.44	141.5	±1.4 %
		Y	7.03	67.6	20.2		147.4	
		Z	6.86	66.8	19.8		126.9	
10112-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.49	67.6	20.1	6.59	147.2	±1.4 %
		Y	7.23	67.0	19.9		128.1	
		Z	7.37	67.3	20.1		132.9	
10113-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	7.23	67.4	20.0	6.62	142.5	±1.4 %
		Y	7.30	67.9	20.4		149.2	
		Z	7.12	67.1	20.0		129.0	
10142-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.76	66.1	19.1	5.73	130.8	±1.2 %
		Y	5.83	66.7	19.6		136.1	
		Z	5.93	66.9	19.7		141.7	
10143-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.73	67.1	19.8	6.35	137.6	±1.4 %
		Y	6.79	67.5	20.1		143.1	
		Z	6.89	67.7	20.3		148.8	
10145-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.71	66.7	19.4	5.76	148.3	±1.2 %
		Y	5.58	66.5	19.5		131.5	
		Z	5.64	66.5	19.5		136.1	
10146-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.42	67.0	19.8	6.41	130.6	±1.2 %
		Y	6.52	67.6	20.3		135.8	
		Z	6.57	67.5	20.2		140.6	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.93	66.3	19.2	5.75	133.1	±1.2 %
		Y	6.02	67.0	19.7		138.2	
		Z	6.06	67.0	19.7		142.7	
10155-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	6.97	67.1	19.8	6.43	141.5	±1.4 %
		Y	7.03	67.6	20.2		146.5	
		Z	6.83	66.7	19.7		126.8	
10156-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.69	65.9	19.0	5.79	129.8	±1.2 %
		Y	5.79	66.6	19.6		134.9	
		Z	5.86	66.7	19.6		138.6	
10157-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.71	67.0	19.8	6.49	135.5	±1.4 %
		Y	6.76	67.4	20.2		141.0	
		Z	6.86	67.6	20.3		145.5	

10158-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	7.23	67.4	20.0	6.62	143.1	±1.4 %
		Y	7.28	67.8	20.4		148.2	
		Z	7.10	67.0	20.0		127.9	
10159-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.84	67.2	19.9	6.56	136.3	±1.2 %
		Y	6.88	67.5	20.3		142.4	
		Z	7.01	67.9	20.5		147.3	
10166-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	5.09	66.3	19.2	5.46	142.5	±1.2 %
		Y	5.18	67.0	19.7		149.6	
		Z	5.02	66.1	19.2		129.2	
10167-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	6.07	67.7	20.1	6.21	145.8	±1.2 %
		Y	5.92	67.2	20.0		130.1	
		Z	5.98	67.3	20.1		131.8	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.93	66.4	19.4	5.72	134.6	±0.9 %
		Y	5.00	67.0	19.8		142.6	
		Z	5.11	67.4	20.1		149.7	
10176-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.68	67.5	20.3	6.52	134.8	±1.2 %
		Y	5.81	68.2	20.9		142.7	
		Z	5.67	67.4	20.4		127.0	
10177-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.92	66.4	19.4	5.73	134.0	±0.9 %
		Y	5.01	67.0	19.9		142.6	
		Z	5.12	67.5	20.2		149.5	
10178-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.67	67.4	20.3	6.52	133.1	±1.4 %
		Y	5.87	68.5	21.1		142.1	
		Z	5.65	67.4	20.5		126.9	
10179-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.68	67.6	20.4	6.50	133.0	±1.2 %
		Y	5.82	68.3	20.9		142.6	
		Z	5.62	67.3	20.3		127.2	
10180-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.68	67.6	20.3	6.50	133.6	±1.2 %
		Y	5.88	68.6	21.1		142.1	
		Z	5.67	67.5	20.5		126.9	
10184-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	4.92	66.3	19.4	5.73	133.1	±0.9 %
		Y	5.03	67.1	20.0		142.2	
		Z	5.11	67.4	20.1		149.3	
10185-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.66	67.4	20.3	6.51	133.2	±1.4 %
		Y	5.84	68.4	21.0		142.0	
		Z	5.65	67.3	20.4		127.4	
10187-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	4.91	66.3	19.3	5.73	133.7	±1.2 %
		Y	5.05	67.2	20.0		141.7	
		Z	5.10	67.3	20.1		149.6	
10188-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.68	67.5	20.3	6.52	133.6	±1.4 %
		Y	5.88	68.6	21.1		141.9	
		Z	5.70	67.6	20.5		126.9	
10298-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.77	66.8	19.5	5.72	148.7	±0.9 %
		Y	5.64	66.6	19.5		132.4	
		Z	5.75	66.8	19.7		140.5	

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10299-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.52	66.9	19.7	6.39	131.8	±1.2 %
		Y	6.62	67.5	20.2		139.1	
		Z	6.71	67.7	20.3		147.5	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.86	68.7	18.6	1.71	147.4	±0.5 %
		Y	2.78	68.5	18.7		130.6	
		Z	3.02	70.3	19.8		137.6	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.27	69.4	21.8	8.36	145.9	±2.2 %
		Y	10.15	69.3	22.0		127.0	
		Z	10.17	69.2	21.8		134.8	

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 8 and 9).
[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.

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DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

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 [G]	Depth [G] (mm)	Unct. (k=2)
150	52.3	0.76	7.21	7.21	7.21	0.04	1.20	± 13.3 %
220	49.0	0.81	7.20	7.20	7.20	0.05	1.20	± 13.3 %
300	45.3	0.87	7.17	7.17	7.17	0.15	1.50	± 13.3 %
450	43.5	0.87	6.64	6.64	6.64	0.23	1.80	± 13.3 %
750	41.9	0.89	6.66	6.66	6.66	0.80	1.16	± 12.0 %
900	41.5	0.97	6.30	6.30	6.30	0.54	1.42	± 12.0 %
1810	40.0	1.40	5.40	5.40	5.40	0.70	1.27	± 12.0 %
1950	40.0	1.40	5.16	5.16	5.16	0.76	1.22	± 12.0 %
2300	39.5	1.67	4.91	4.91	4.91	0.80	1.24	± 12.0 %
2450	39.2	1.80	4.63	4.63	4.63	0.80	1.28	± 12.0 %
2600	39.0	1.96	4.44	4.44	4.44	0.80	1.26	± 12.0 %
3500	37.9	2.91	4.37	4.37	4.37	0.90	1.21	± 13.1 %
3700	37.7	3.12	4.07	4.07	4.07	0.90	1.21	± 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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

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 [G]	Depth [G] (mm)	Unct. (k=2)
150	61.9	0.80	6.83	6.83	6.83	0.04	1.20	± 13.3 %
220	60.2	0.86	6.65	6.65	6.65	0.05	1.20	± 13.3 %
300	58.2	0.92	6.83	6.83	6.83	0.10	1.60	± 13.3 %
450	56.7	0.94	6.92	6.92	6.92	0.14	1.58	± 13.3 %
750	55.5	0.96	6.24	6.24	6.24	0.31	1.91	± 12.0 %
900	55.0	1.05	6.02	6.02	6.02	0.51	1.47	± 12.0 %
1810	53.3	1.52	4.82	4.82	4.82	0.62	1.42	± 12.0 %
1950	53.3	1.52	4.80	4.80	4.80	0.49	1.78	± 12.0 %
2300	52.9	1.81	4.39	4.39	4.39	0.80	1.25	± 12.0 %
2450	52.7	1.95	4.25	4.25	4.25	0.80	1.39	± 12.0 %
2600	52.5	2.16	4.03	4.03	4.03	0.80	1.01	± 12.0 %
3500	51.3	3.31	3.69	3.69	3.69	0.80	1.26	± 13.1 %
3700	51.0	3.55	3.56	3.56	3.56	0.80	1.61	± 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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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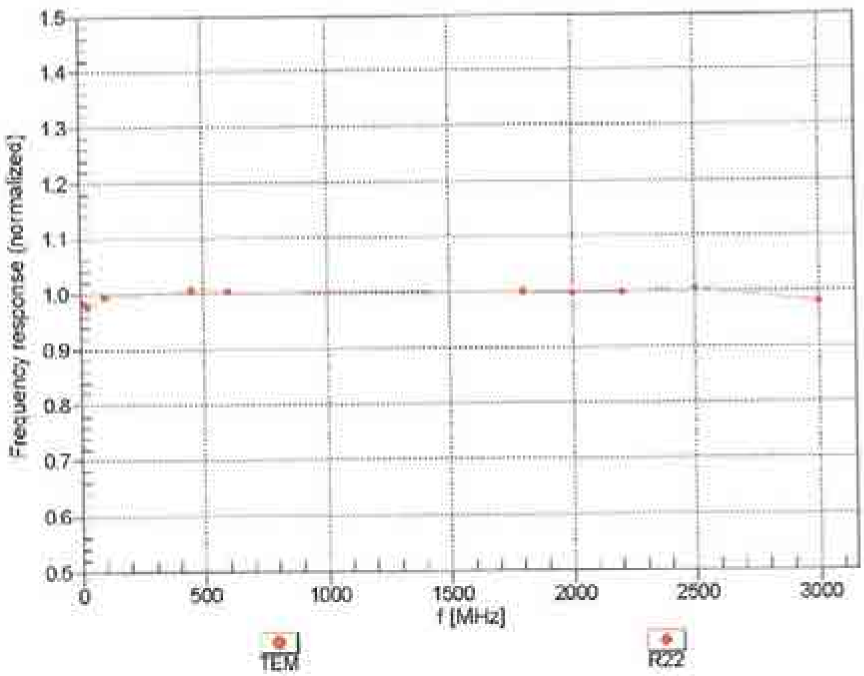
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

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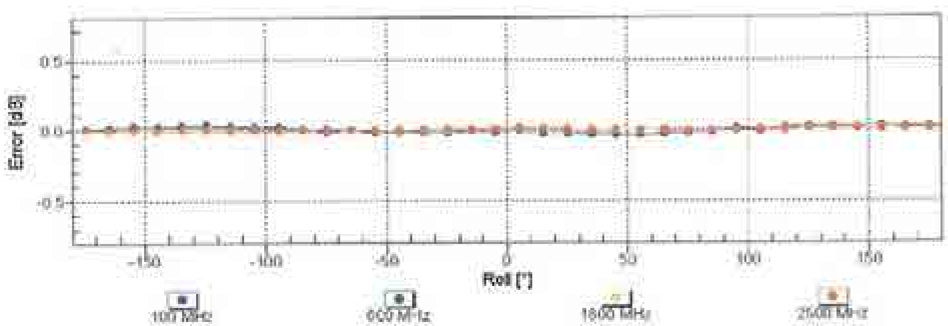
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM

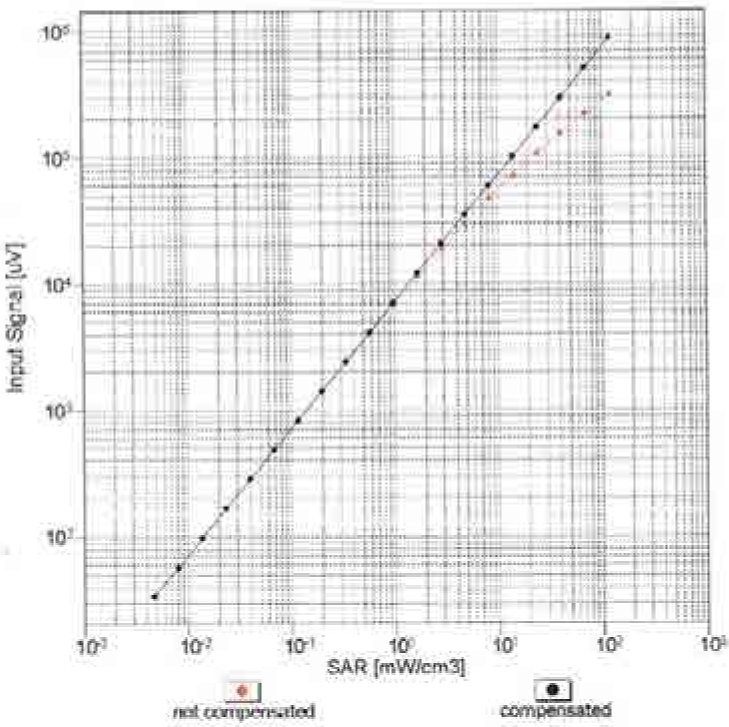
f=1800 MHz,R22

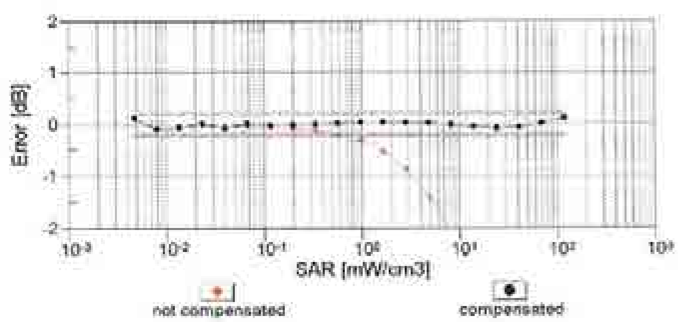


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ES3DV3– SN:3196 March 26, 2014

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)





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

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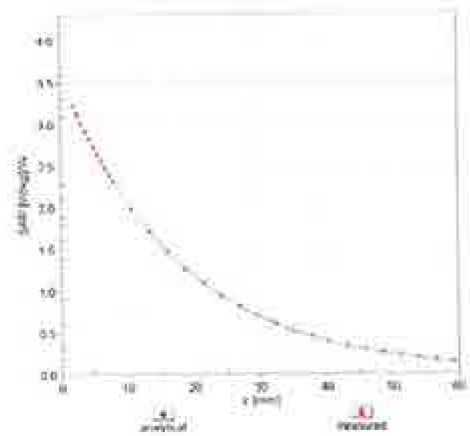
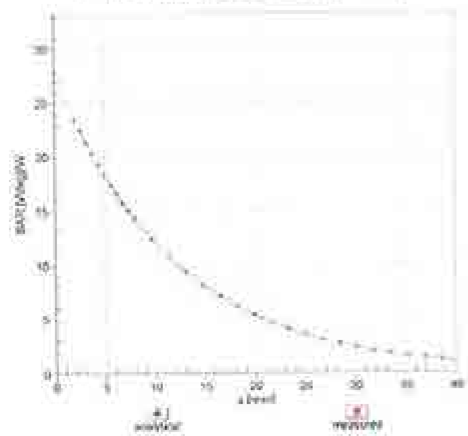
Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

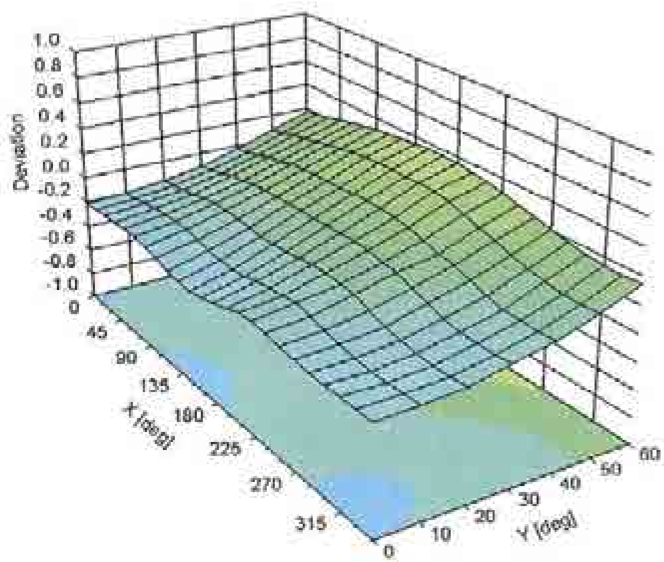


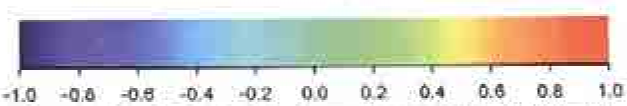
f = 1810 MHz,WGLS R22 (H_convF)



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: ES3DV3 - SN:3196

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	5.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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 **Motorola MY**

Certificate No: **ES3-3122_Mar14/3**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3122_Mar14/2)

Object	ES3DV3 - SN:3122
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	March 26, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: April 18, 2014

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

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

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

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

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
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., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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 ϑ = 0 (f ≤ 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 ≤ 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.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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Probe ES3DV3

SN:3122

Manufactured: July 11, 2006
Calibrated: March 26, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3122

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.35	1.23	1.42	± 10.1 %
DCP (mV)[B]	102.4	103.8	102.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	190.7	±3.3 %
		Y	0.0	0.0	1.0		212.5	
		Z	0.0	0.0	1.0		196.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.20	69.8	19.3	1.87	133.2	±0.7 %
		Y	3.28	70.2	19.1		147.0	
		Z	3.16	69.7	19.3		138.5	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	12.02	72.4	24.4	9.46	137.3	±3.0 %
		Y	11.33	70.5	22.9		126.5	
		Z	12.18	73.0	24.8		141.8	
10059-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	3.82	72.1	20.2	2.12	134.2	±0.5 %
		Y	4.07	73.0	20.2		149.7	
		Z	3.96	72.9	20.6		139.1	
10060-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	17.48	99.7	29.5	2.83	146.8	±0.5 %
		Y	16.02	96.7	27.9		136.1	
		Z	16.50	99.1	29.4		128.5	
10061-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	12.14	89.3	26.6	3.60	128.0	±0.7 %
		Y	13.97	90.3	28.2		144.5	
		Z	11.90	88.8	26.4		133.8	
10071-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	12.44	73.3	25.2	9.83	135.5	±3.3 %
		Y	11.66	71.1	23.5		125.3	
		Z	12.62	73.9	25.6		141.4	
10072-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	12.17	73.4	25.1	9.62	133.7	±3.3 %
		Y	11.40	71.1	23.4		123.9	
		Z	12.40	74.1	25.5		139.2	
10073-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	12.54	74.3	25.8	9.94	132.2	±3.3 %
		Y	11.58	71.6	23.9		120.7	
		Z	12.85	75.2	26.4		138.0	
10074-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	12.91	75.1	26.6	10.30	130.3	±3.5 %
		Y	11.84	72.1	24.5		119.3	
		Z	13.22	76.1	27.2		137.0	
10075-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	13.35	76.1	27.5	10.77	128.5	±4.1 %
		Y	12.30	73.1	25.4		119.4	
		Z	13.88	77.6	28.5		135.2	
10076-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	13.55	76.6	28.0	10.94	127.0	±4.1 %
		Y	12.43	73.5	25.7		118.7	
		Z	14.14	78.2	28.9		134.8	

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10077-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	13.62	76.9	28.1	11.00	126.8	±4.1 %
		Y	12.47	73.6	25.8		118.2	
		Z	14.26	78.6	29.2		134.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.58	68.1	20.3	5.80	146.7	±1.4 %
		Y	6.35	67.2	19.5		139.0	
		Z	6.31	67.2	19.8		128.5	
10109-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.28	67.4	20.1	6.43	130.5	±1.9 %
		Y	7.32	67.6	20.0		147.6	
		Z	7.33	67.8	20.4		136.8	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.28	67.6	20.1	5.75	142.4	±1.4 %
		Y	6.02	66.6	19.3		135.1	
		Z	6.25	67.6	20.2		148.9	
10111-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	7.04	67.1	20.0	6.44	126.2	±1.7 %
		Y	7.07	67.3	19.8		143.8	
		Z	7.08	67.5	20.3		132.1	
10112-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.51	67.6	20.3	6.59	131.1	±1.7 %
		Y	7.21	66.6	19.4		125.1	
		Z	7.60	68.0	20.6		137.9	
10113-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	7.29	67.3	20.2	6.62	127.7	±1.9 %
		Y	7.34	67.6	20.1		146.5	
		Z	7.31	67.7	20.4		133.6	
10142-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	6.10	67.2	19.9	5.73	139.4	±1.4 %
		Y	5.85	66.4	19.1		133.9	
		Z	6.06	67.4	20.0		145.5	
10143-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	7.10	68.0	20.5	6.35	147.4	±1.7 %
		Y	6.86	67.3	19.8		141.3	
		Z	6.82	67.3	20.1		129.1	
10145-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.86	66.9	19.8	5.76	135.5	±1.2 %
		Y	5.61	66.0	19.0		129.7	
		Z	5.79	67.0	19.9		141.2	
10146-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.85	67.9	20.5	6.41	141.6	±1.4 %
		Y	6.58	67.1	19.8		134.8	
		Z	6.81	68.2	20.7		147.4	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.26	67.5	20.0	5.75	141.0	±1.4 %
		Y	6.01	66.6	19.2		135.2	
		Z	6.26	67.7	20.2		147.8	
10155-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	7.07	67.3	20.1	6.43	126.3	±1.7 %
		Y	7.07	67.3	19.9		143.7	
		Z	7.05	67.4	20.2		131.8	
10156-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	6.04	67.0	19.8	5.79	138.2	±1.4 %
		Y	5.81	66.2	19.1		132.1	
		Z	6.02	67.3	20.0		144.3	
10157-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	7.10	67.9	20.6	6.49	146.3	±1.7 %
		Y	6.85	67.2	19.9		138.8	
		Z	6.81	67.3	20.2		127.8	

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10158-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	7.33	67.5	20.3	6.62	128.0	±1.9 %
		Y	7.32	67.5	20.0		144.3	
		Z	7.31	67.6	20.4		134.2	
10159-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	7.23	68.1	20.7	6.56	148.1	±1.7 %
		Y	6.97	67.3	19.9		139.2	
		Z	6.96	67.5	20.3		129.2	
10166-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	5.24	66.4	19.5	5.46	130.4	±1.2 %
		Y	5.21	66.5	19.2		144.2	
		Z	5.22	66.7	19.6		137.4	
10167-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	6.23	67.5	20.2	6.21	134.8	±1.2 %
		Y	5.95	66.6	19.4		125.9	
		Z	6.25	68.1	20.6		141.7	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.30	67.6	20.3	5.72	146.4	±1.2 %
		Y	5.06	66.6	19.5		138.0	
		Z	5.11	67.0	20.0		131.0	
10176-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	6.23	69.0	21.3	6.52	147.4	±1.7 %
		Y	5.96	68.0	20.5		140.0	
		Z	6.02	68.4	21.0		131.4	
10177-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	5.30	67.5	20.3	5.73	145.3	±1.2 %
		Y	5.05	66.6	19.4		137.8	
		Z	5.10	66.9	19.9		130.0	
10178-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	6.24	69.0	21.4	6.52	147.1	±1.7 %
		Y	5.94	67.9	20.4		139.9	
		Z	6.00	68.4	21.0		131.0	
10179-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	6.20	68.9	21.2	6.50	147.0	±1.7 %
		Y	5.94	68.0	20.4		140.4	
		Z	6.02	68.5	21.1		131.6	
10180-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	6.24	69.1	21.3	6.50	147.0	±1.7 %
		Y	5.98	68.2	20.5		140.3	
		Z	5.96	68.2	20.9		130.9	
10184-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	5.29	67.5	20.2	5.73	146.0	±1.2 %
		Y	5.06	66.6	19.4		138.7	
		Z	5.10	66.8	19.9		130.0	
10185-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	6.23	69.0	21.4	6.51	147.1	±1.7 %
		Y	5.98	68.1	20.5		141.1	
		Z	5.99	68.3	21.0		130.8	
10187-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	5.29	67.5	20.2	5.73	145.9	±1.4 %
		Y	5.06	66.6	19.4		139.1	
		Z	5.13	67.0	20.0		129.7	
10188-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	6.22	68.9	21.3	6.52	147.5	±1.7 %
		Y	5.99	68.1	20.5		141.3	
		Z	6.01	68.3	21.0		130.7	
10298-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.92	66.9	19.8	5.72	137.0	±1.2 %
		Y	5.67	66.1	19.0		130.7	
		Z	5.87	67.1	18.9		142.9	

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10299-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.95	67.9	20.5	6.39	143.9	±1.4 %
		Y	6.69	67.2	19.8		137.9	
		Z	6.70	67.4	20.2		126.5	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.88	68.9	19.1	1.71	132.3	±0.5 %
		Y	2.85	68.6	18.5		127.3	
		Z	2.92	69.1	19.1		138.8	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.45	69.7	22.2	8.36	130.6	±2.2 %
		Y	10.03	68.5	21.2		124.7	
		Z	10.58	70.2	22.5		138.8	

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 8 and 9).
[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: ES3DV3 - SN:3122

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 [G]	Depth [G] (mm)	Unct. (k=2)
150	52.3	0.76	7.15	7.15	7.15	0.03	1.20	± 13.3 %
220	49.0	0.81	7.08	7.08	7.08	0.05	1.20	± 13.3 %
300	45.3	0.87	6.92	6.92	6.92	0.10	1.30	± 13.3 %
450	43.5	0.87	6.62	6.62	6.62	0.20	1.60	± 13.3 %
750	41.9	0.89	6.55	6.55	6.55	0.63	1.26	± 12.0 %
900	41.5	0.97	6.17	6.17	6.17	0.41	1.53	± 12.0 %
1810	40.0	1.40	5.27	5.27	5.27	0.49	1.52	± 12.0 %
1950	40.0	1.40	5.04	5.04	5.04	0.80	1.15	± 12.0 %
2300	39.5	1.67	4.87	4.87	4.87	0.80	1.15	± 12.0 %
2450	39.2	1.80	4.56	4.56	4.56	0.80	1.23	± 12.0 %
2600	39.0	1.96	4.38	4.38	4.38	0.60	1.45	± 12.0 %
3500	37.9	2.91	4.32	4.32	4.32	0.90	1.12	± 13.1 %
3700	37.7	3.12	3.91	3.91	3.91	0.90	1.16	± 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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3122

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 [G]	Depth [G] (mm)	Unct. (k=2)
150	61.9	0.80	6.70	6.70	6.70	0.08	1.20	± 13.3 %
220	60.2	0.86	6.50	6.50	6.50	0.05	1.20	± 13.3 %
300	58.2	0.92	6.74	6.74	6.74	0.10	1.30	± 13.3 %
450	56.7	0.94	6.90	6.90	6.90	0.10	1.30	± 13.3 %
750	55.5	0.96	6.10	6.10	6.10	0.65	1.26	± 12.0 %
900	55.0	1.05	5.92	5.92	5.92	0.58	1.34	± 12.0 %
1810	53.3	1.52	4.76	4.76	4.76	0.45	1.73	± 12.0 %
1950	53.3	1.52	4.71	4.71	4.71	0.44	1.77	± 12.0 %
2300	52.9	1.81	4.35	4.35	4.35	0.80	1.21	± 12.0 %
2450	52.7	1.95	4.17	4.17	4.17	0.42	2.15	± 12.0 %
2600	52.5	2.16	3.97	3.97	3.97	0.80	1.00	± 12.0 %
3500	51.3	3.31	3.65	3.65	3.65	0.80	1.35	± 13.1 %
3700	51.0	3.55	3.60	3.60	3.60	0.80	1.42	± 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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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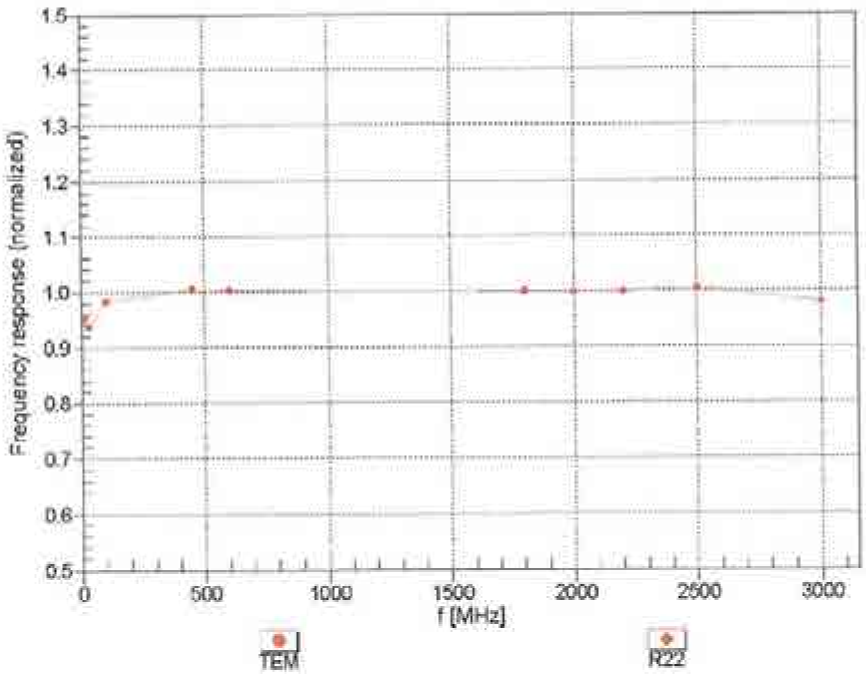
Frequency Response of E-Field

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



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

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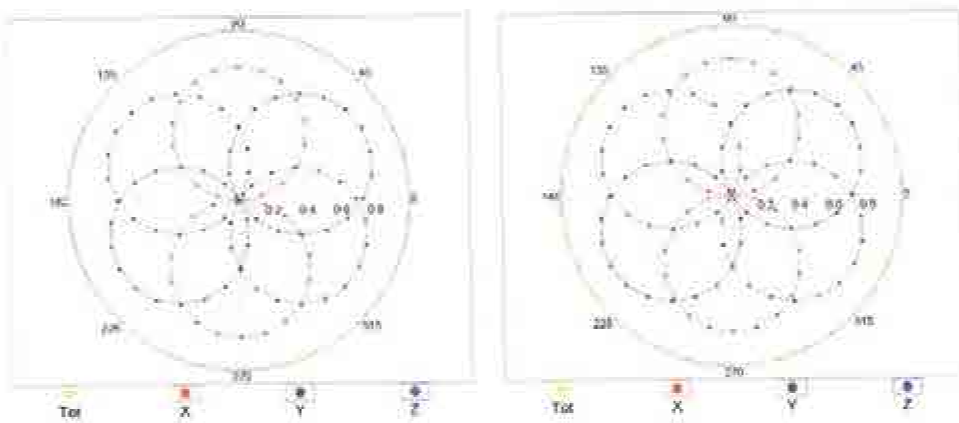
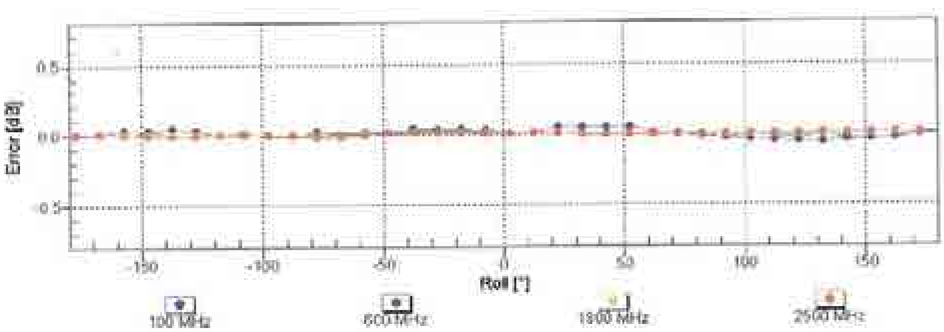
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM f=1800 MHz,R22

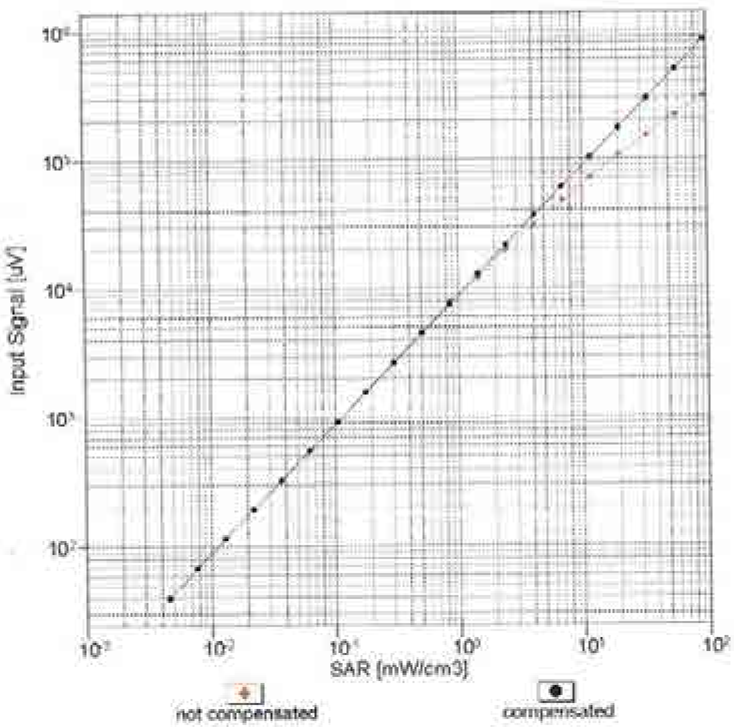


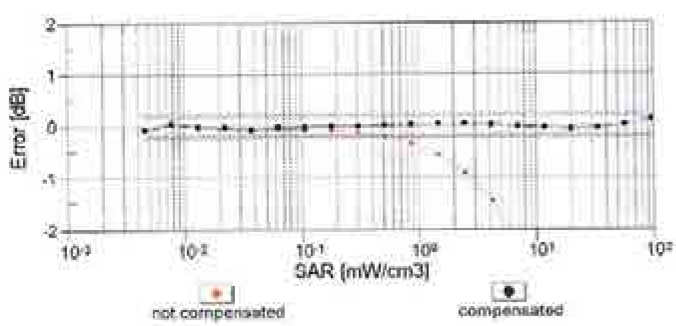


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

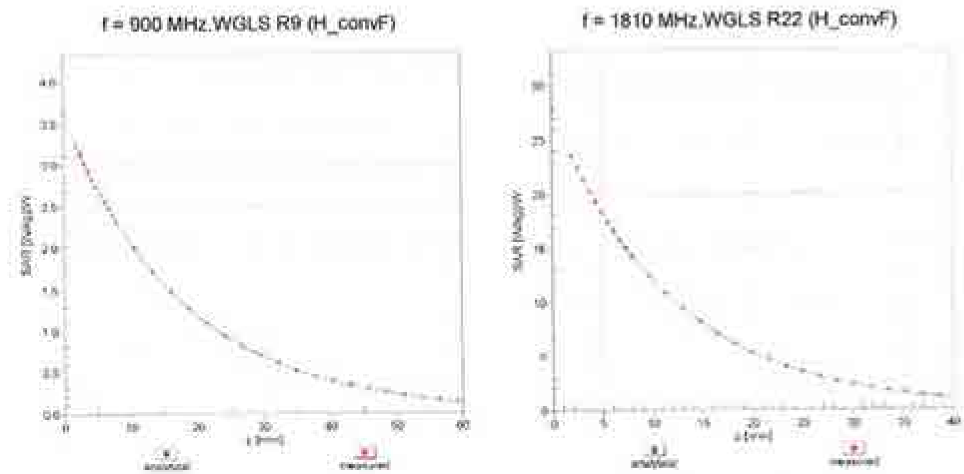
(TEM cell , f_{eval}= 1900 MHz)





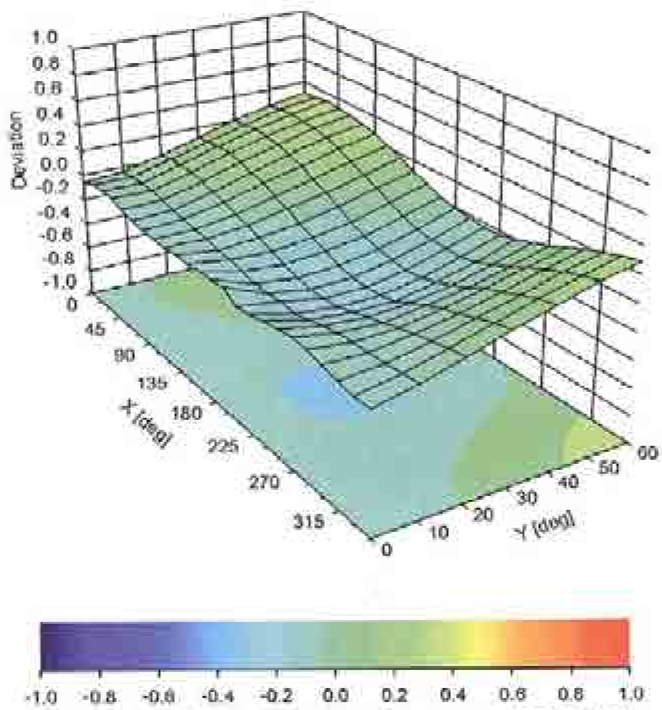
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



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: ES3DV3 - SN:3122

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	22.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

S Schweizerischer Kalibrierdienst
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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 **Motorola Solutions MY**

Certificate No: **ES3-3274_Nov14**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3274

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: November 12, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: November 12, 2014

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

Certificate No: ES3-3274_Nov14 Page 1 of 11

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

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

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

Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
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., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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 ϑ = 0 (f ≤ 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 ≤ 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.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3274

Manufactured: February 25, 2010
Calibrated: November 12, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3274

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.21	1.14	1.18	± 10.1 %
DCP (mV)[B]	103.5	102.8	101.3	

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	205.2	±3.5 %
		Y	0.0	0.0	1.0		199.1	
		Z	0.0	0.0	1.0		205.4	

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: ES3DV3 - SN:3274

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 [G]	Depth [G] (mm)	Unct. (k=2)
150	52.3	0.76	7.12	7.12	7.12	0.06	1.20	± 13.3 %
300	45.3	0.87	7.17	7.17	7.17	0.15	2.60	± 13.3 %
450	43.5	0.87	6.76	6.76	6.76	0.22	1.70	± 13.3 %
750	41.9	0.89	6.47	6.47	6.47	0.25	2.13	± 12.0 %
900	41.5	0.97	6.11	6.11	6.11	0.39	1.65	± 12.0 %
2450	39.2	1.80	4.48	4.48	4.48	0.79	1.24	± 12.0 %

[C] Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3274

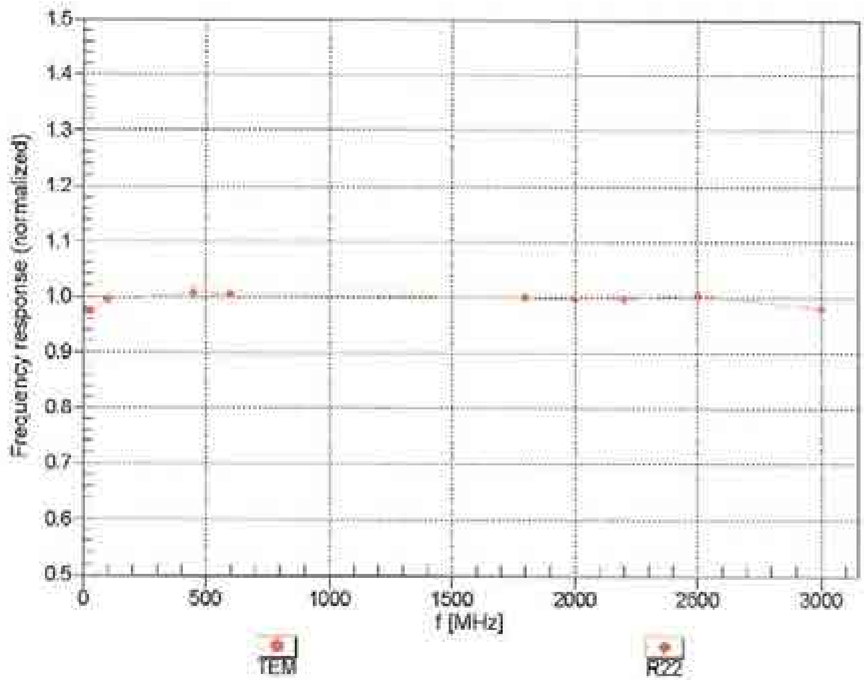
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
150	61.9	0.80	7.13	7.13	7.13	0.05	1.20	± 13.3 %
300	58.2	0.92	6.87	6.87	6.87	0.10	1.25	± 13.3 %
450	56.7	0.94	7.06	7.06	7.06	0.13	1.70	± 13.3 %
750	55.5	0.96	6.23	6.23	6.23	0.59	1.34	± 12.0 %
900	55.0	1.05	6.07	6.07	6.07	0.79	1.15	± 12.0 %
2450	52.7	1.95	4.46	4.46	4.46	0.80	1.15	± 12.0 %

[C] Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[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.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

ES3DV3– SN:3274 November 12, 2014

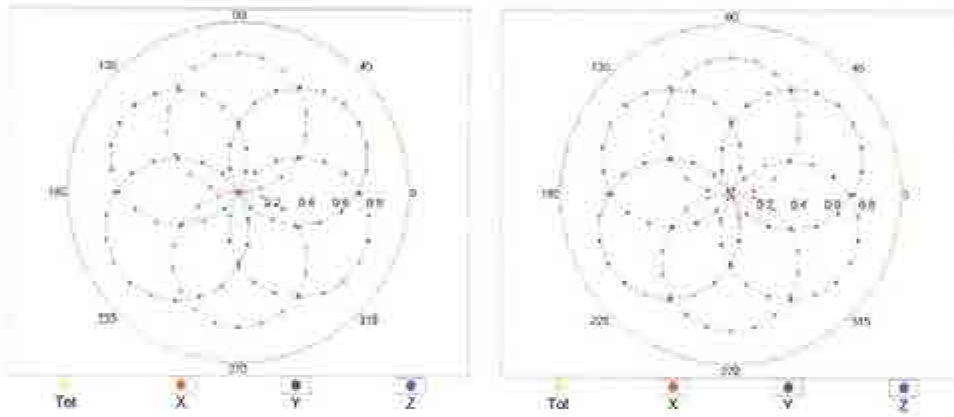
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

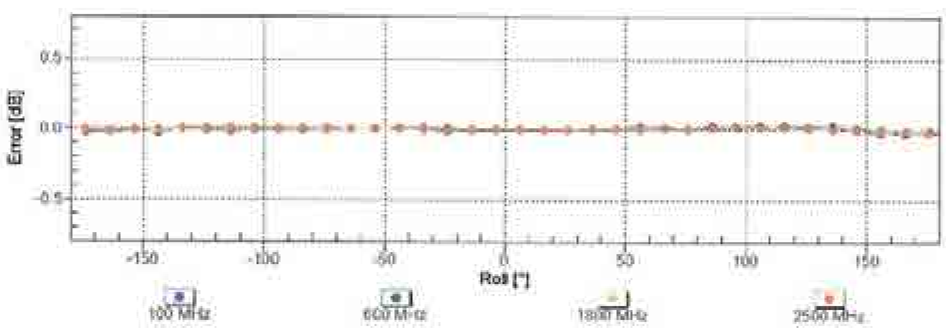


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM f=1800 MHz,R22

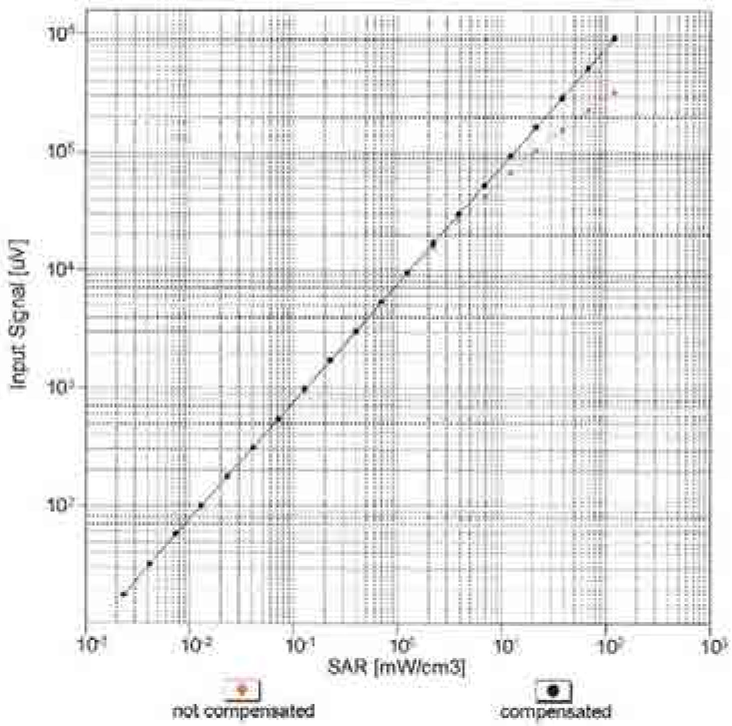


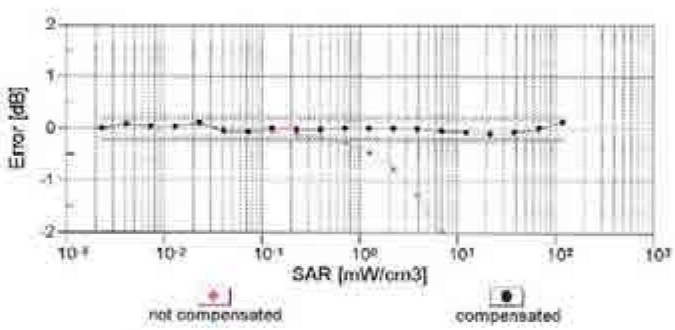


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

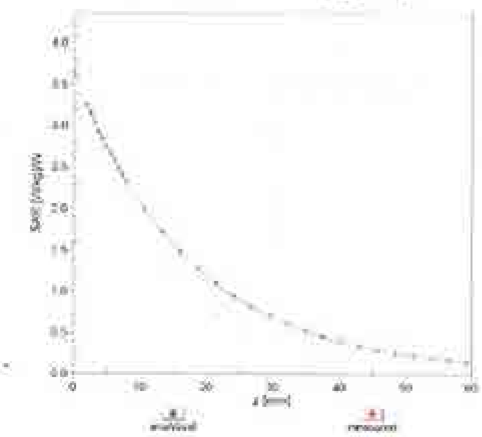
(TEM cell , f_{eval}= 1900 MHz)

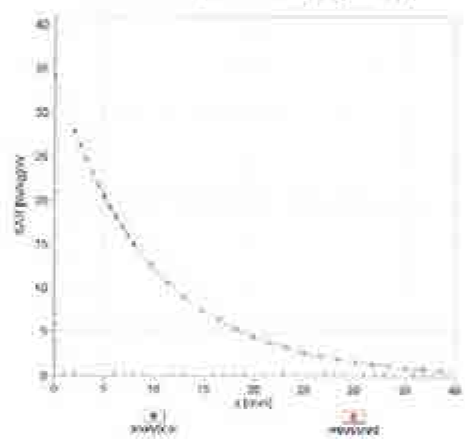




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

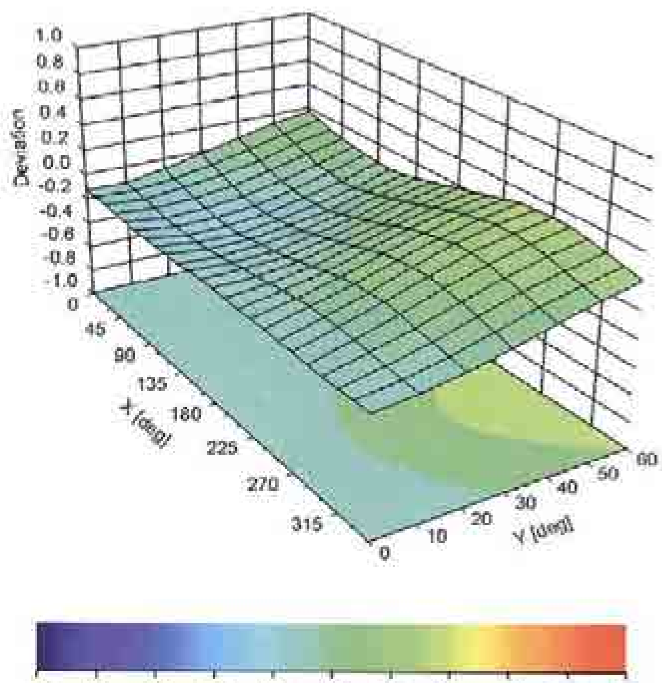
Conversion Factor Assessment





Deviation from Isotropy in Liquid

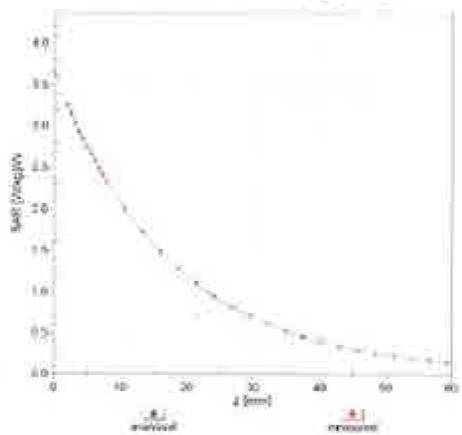
Error (ϕ, ϑ), f = 900 MHz



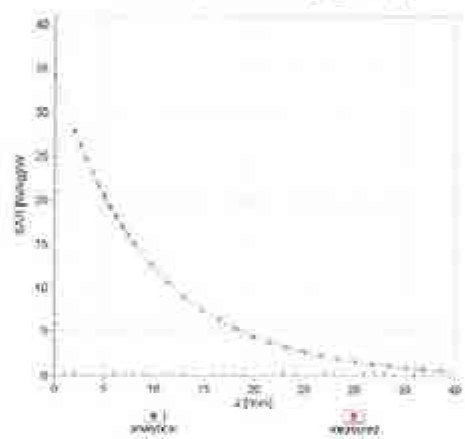
Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

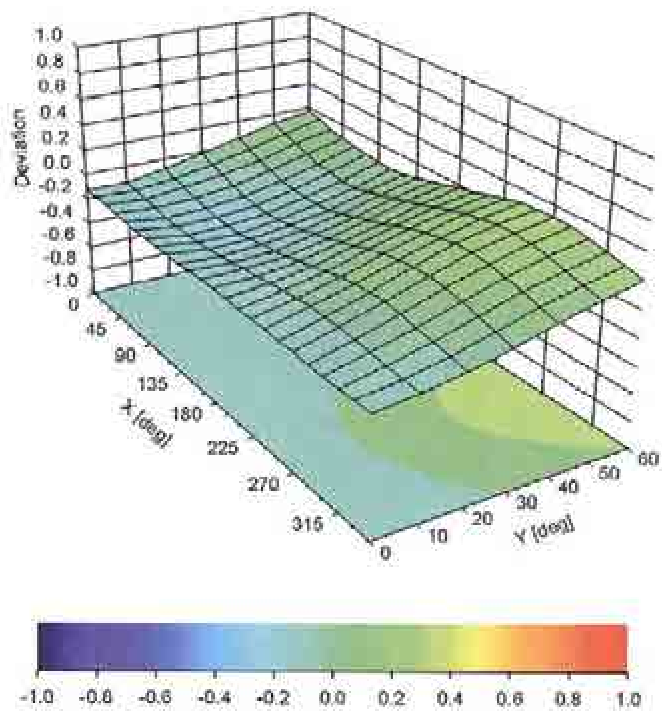


f = 2450 MHz,WGLS R22 (H_convF)



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: ES3DV3 - SN:3274

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-124
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

S Schweizerischer Kalibrierdienst
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Motorola Solutions MY**

Certificate No: **ES3-3096_Nov14**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3096

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: November 12, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: November 12, 2014

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

Certificate No: ES3-3096_Nov14 Page 1 of 13

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

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., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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 ϑ = 0 (f ≤ 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 ≤ 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.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3096

Manufactured: July 12, 2005
Calibrated: November 12, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3096

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.27	1.02	1.19	± 10.1 %
DCP (mV)[B]	102.9	103.8	102.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	213.0	±3.3 %
		Y	0.0	0.0	1.0		216.6	
		Z	0.0	0.0	1.0		205.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.95	68.5	18.5	1.87	149.6	±0.7 %
		Y	3.44	71.3	19.8		147.0	
		Z	2.99	68.9	18.7		144.4	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.41	71.1	23.6	9.46	125.3	±3.3 %
		Y	11.06	69.9	22.6		124.5	
		Z	11.75	72.2	24.2		145.8	
10059-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	3.69	71.8	20.0	2.12	149.3	±0.5 %
		Y	4.13	73.7	20.8		149.8	
		Z	3.71	72.1	20.1		144.1	
10060-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	13.67	96.2	28.4	2.83	136.2	±0.5 %
		Y	17.13	99.6	29.2		135.5	
		Z	13.31	96.5	28.7		130.3	
10061-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	10.55	87.5	25.9	3.60	139.8	±0.7 %
		Y	16.59	94.9	28.1		141.7	
		Z	10.32	87.8	26.1		133.2	
10071-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	11.69	71.6	24.2	9.83	123.2	±3.3 %
		Y	11.23	70.1	23.0		121.8	
		Z	12.03	72.7	24.8		142.4	
10072-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	11.35	71.6	24.0	9.62	121.1	±4.9 %
		Y	11.83	72.5	24.2		149.6	
		Z	11.77	72.9	24.8		139.9	
10073-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	12.56	74.8	26.1	9.94	148.3	±5.2 %
		Y	12.18	73.4	25.0		149.9	
		Z	11.99	73.6	25.5		137.5	
10074-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	12.92	75.6	26.9	10.30	147.1	±5.7 %
		Y	12.40	73.9	25.5		146.6	
		Z	12.27	74.3	26.1		135.2	
10075-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	13.32	76.6	27.8	10.77	143.7	±6.0 %
		Y	12.83	74.9	26.4		145.7	
		Z	12.52	74.9	26.9		131.6	
10076-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	13.55	77.2	28.3	10.94	143.3	±6.3 %
		Y	12.99	75.3	26.8		144.4	
		Z	12.67	75.3	27.2		130.5	

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10077-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	13.59	77.4	28.5	11.00	142.7	±6.3 %
		Y	13.01	75.4	26.9		143.4	
		Z	12.65	75.3	27.3		129.6	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.34	69.2	21.6	8.10	129.8	±2.2 %
		Y	10.11	68.6	21.0		129.9	
		Z	10.21	69.0	21.4		123.3	
10115-CAA	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	X	10.92	69.9	22.1	8.46	132.8	±2.5 %
		Y	10.64	69.0	21.4		134.1	
		Z	10.77	69.6	21.9		127.1	
10116-CAA	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	X	10.38	69.3	21.6	8.15	129.4	±2.2 %
		Y	10.16	68.7	21.1		130.3	
		Z	10.27	69.1	21.5		124.1	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.31	69.2	21.5	8.07	129.8	±2.2 %
		Y	10.10	68.5	21.0		131.1	
		Z	10.18	68.9	21.4		124.4	
10118-CAA	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	X	11.06	70.0	22.3	8.59	133.3	±2.5 %
		Y	10.80	69.3	21.6		135.2	
		Z	10.94	69.8	22.2		128.5	
10119-CAA	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	X	10.33	69.2	21.6	8.13	128.2	±2.2 %
		Y	10.15	68.6	21.1		130.4	
		Z	10.25	69.1	21.5		123.2	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.97	68.8	21.4	8.09	124.1	±2.2 %
		Y	9.81	68.2	20.9		126.0	
		Z	10.23	69.7	22.0		145.2	
10194-CAA	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	X	9.99	68.9	21.5	8.12	123.7	±2.2 %
		Y	9.87	68.4	21.0		126.6	
		Z	10.30	69.8	22.0		146.0	
10195-CAA	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	X	10.16	69.1	21.6	8.21	125.4	±2.2 %
		Y	10.00	68.5	21.1		126.2	
		Z	10.44	70.0	22.2		146.0	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.99	68.9	21.5	8.10	124.0	±2.2 %
		Y	9.75	68.1	20.9		124.6	
		Z	10.23	69.7	22.0		144.4	
10197-CAA	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)	X	10.05	69.0	21.5	8.13	125.1	±2.2 %
		Y	9.84	68.3	20.9		124.9	
		Z	10.30	69.8	22.0		145.0	
10198-CAA	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)	X	10.19	69.1	21.7	8.27	125.0	±2.2 %
		Y	10.00	68.4	21.1		125.2	
		Z	10.48	70.0	22.2		145.3	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.86	68.8	21.4	8.03	123.8	±1.9 %
		Y	9.63	68.0	20.8		122.4	
		Z	10.11	69.6	21.9		143.2	
10220-CAA	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	X	10.05	69.0	21.5	8.13	125.5	±2.2 %
		Y	9.83	68.2	20.9		124.2	
		Z	10.30	69.8	22.0		145.2	

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10221-CAA	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	X	10.20	69.1	21.6	8.27	126.0	±2.2 %
		Y	10.02	68.4	21.1		125.1	
		Z	10.49	70.0	22.2		146.6	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.29	69.2	21.5	8.06	129.4	±2.2 %
		Y	10.03	68.4	20.9		128.2	
		Z	10.17	68.9	21.4		123.3	
10223-CAA	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	X	10.96	70.0	22.2	8.46	134.3	±2.7 %
		Y	10.64	69.0	21.5		132.8	
		Z	10.80	69.6	22.0		127.6	
10224-CAA	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	X	10.31	69.3	21.6	8.08	129.7	±2.2 %
		Y	10.07	68.5	21.0		129.5	
		Z	10.18	69.0	21.4		123.4	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.76	68.2	18.5	1.71	127.5	±0.5 %
		Y	3.24	71.1	19.9		129.0	
		Z	2.87	69.0	19.0		144.9	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.22	69.2	21.8	8.36	124.8	±2.2 %
		Y	10.01	68.5	21.2		124.4	
		Z	10.49	70.0	22.3		144.7	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.55	67.7	18.4	1.54	128.2	±0.7 %
		Y	2.89	69.8	19.4		129.0	
		Z	2.64	68.4	18.8		145.3	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.04	68.9	21.6	8.23	123.9	±2.2 %
		Y	9.83	68.2	21.0		124.4	
		Z	10.30	69.7	22.1		144.1	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	9.94	68.9	21.6	8.14	124.2	±2.2 %
		Y	9.73	68.2	20.9		124.5	
		Z	10.17	69.7	22.0		143.2	
10419-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preambule)	X	10.01	68.9	21.6	8.19	124.8	±2.2 %
		Y	9.84	68.3	21.0		125.6	
		Z	10.30	69.8	22.1		143.9	

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 7 and 8).
[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: ES3DV3 - SN:3096

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 [G]	Depth [G] (mm)	Unct. (k=2)
150	52.3	0.76	6.87	6.87	6.87	0.05	1.20	± 13.3 %
300	45.3	0.87	6.98	6.98	6.98	0.12	2.80	± 13.3 %
450	43.5	0.87	6.61	6.61	6.61	0.22	2.00	± 13.3 %
750	41.9	0.89	6.40	6.40	6.40	0.38	1.62	± 12.0 %
900	41.5	0.97	6.05	6.05	6.05	0.42	1.48	± 12.0 %
2450	39.2	1.80	4.48	4.48	4.48	0.79	1.41	± 12.0 %

[C] Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[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.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3096

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 [G]	Depth [G] (mm)	Unct. (k=2)
150	61.9	0.80	6.80	6.80	6.80	0.05	1.20	± 13.3 %
300	58.2	0.92	6.77	6.77	6.77	0.10	1.25	± 13.3 %
450	56.7	0.94	6.73	6.73	6.73	0.12	1.25	± 13.3 %
750	55.5	0.96	5.99	5.99	5.99	0.70	1.21	± 12.0 %
900	55.0	1.05	5.82	5.82	5.82	0.35	1.71	± 12.0 %
2450	52.7	1.95	4.38	4.38	4.38	0.82	1.25	± 12.0 %

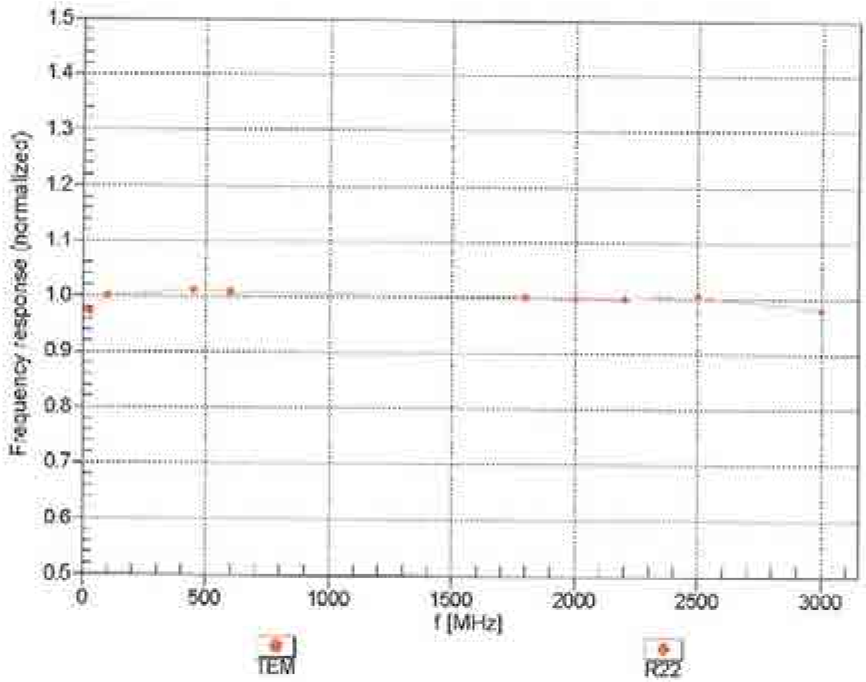
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[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.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

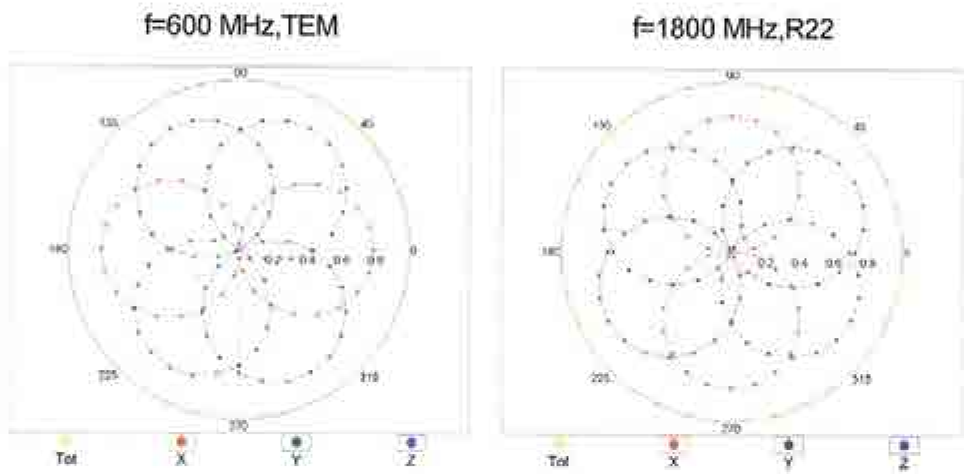
ES3DV3– SN:3096 November 12, 2014

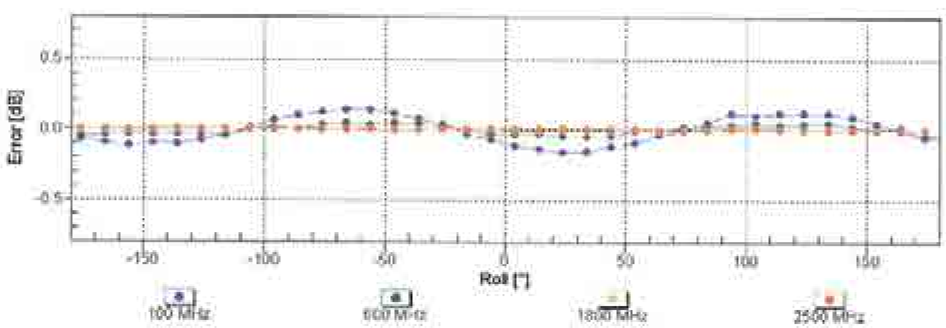
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

Receiving Pattern (ϕ), ϑ = 0°



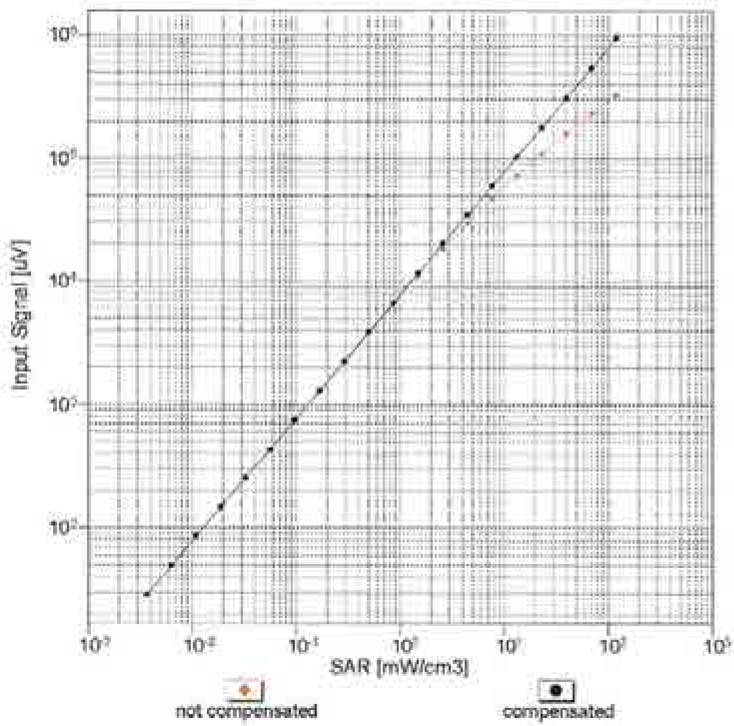


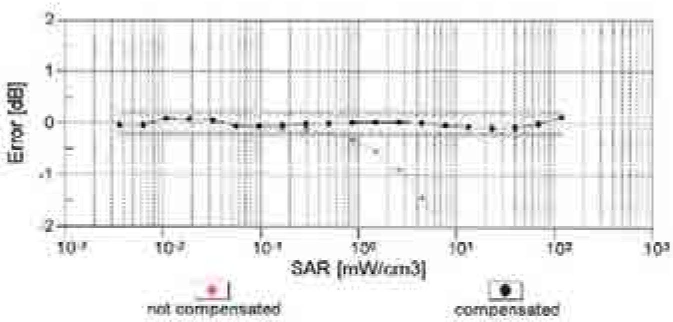
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ES3DV3– SN:3096 November 12, 2014

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)



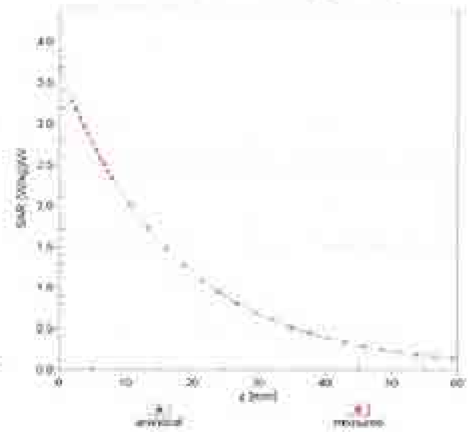


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

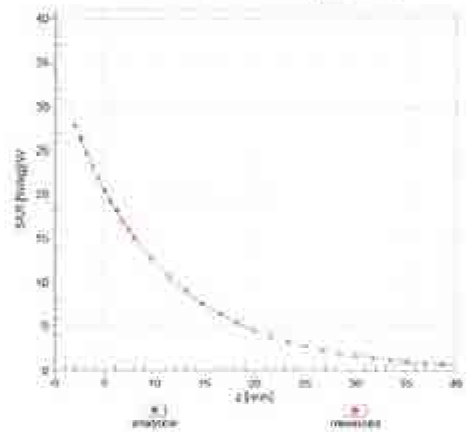
Certificate No: ES3-3096_Nov14 Page 11 of 13

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

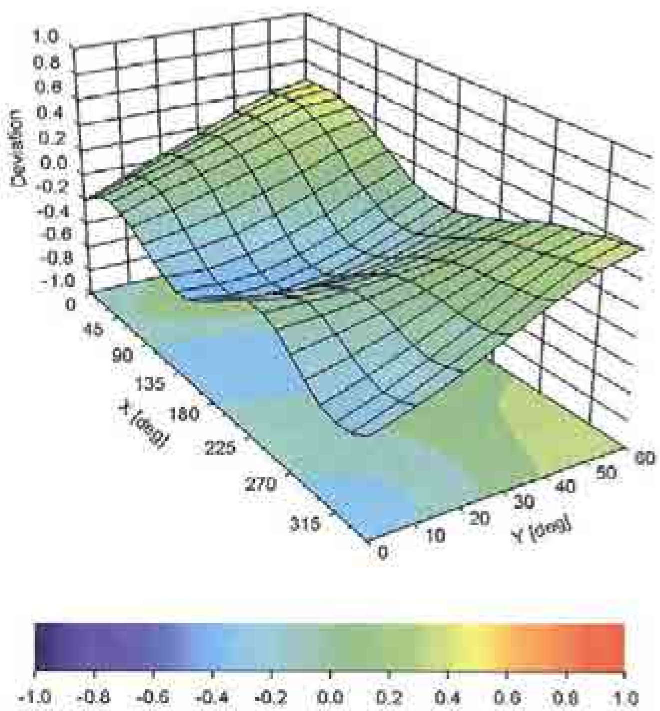


f = 2450 MHz,WGLS R22 (H_convF)



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: ES3DV3 - SN:3096

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-136.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Appendix C
Dipole Calibration Certificates

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

Client **Motorola MY**

Certificate No: **CLA150-4010_May14**

CALIBRATION CERTIFICATE

Object: CLA150 - SN: 4010

Calibration procedure(s): QA CAL-15.v8
Calibration procedure for system validation sources below 700 MHz

Calibration date: May 08, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe EX3DV4	SN: 3877	06-Jan-14 (No. EX3-3877_Jan14)	Jan-15
DAE4	SN: 654	16-Jul-13 (No. DAE4-654_Jul13)	Jul-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: May 8, 2014

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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) IEC 62209-2, "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 2013
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	dx, dy, dz = 5.0 mm	
Frequency	150 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	52.3	0.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	49.9 ± 6 %	0.76 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	1 W input power	3.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.55 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**2.37 W/kg ± 18.0 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	61.9	0.80 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	62.5 ± 6 %	0.80 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	1 W input power	3.68 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.69 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	1 W input power	2.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.46 W/kg ± 18.0 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.2 Ω - 3.5 jΩ
Return Loss	- 28.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 7.7 jΩ
Return Loss	- 22.3 dB

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	April 15, 2014

DASY5 Validation Report for Head TSL

Date: 08.05.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4010

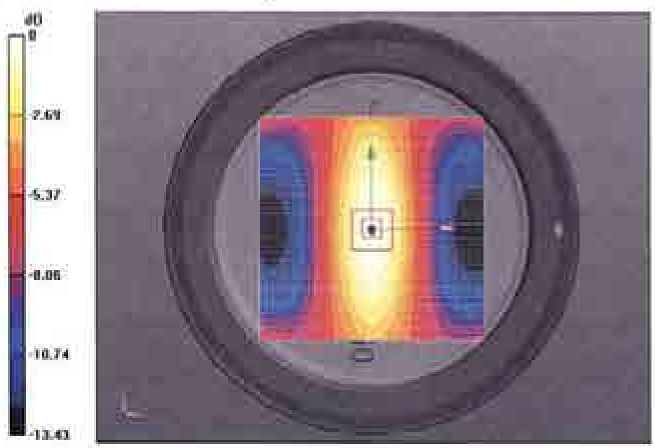
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; $\sigma = 0.76$ S/m; $\varepsilon_r = 49.9$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.76, 11.76, 11.76); Calibrated: 06.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.07.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

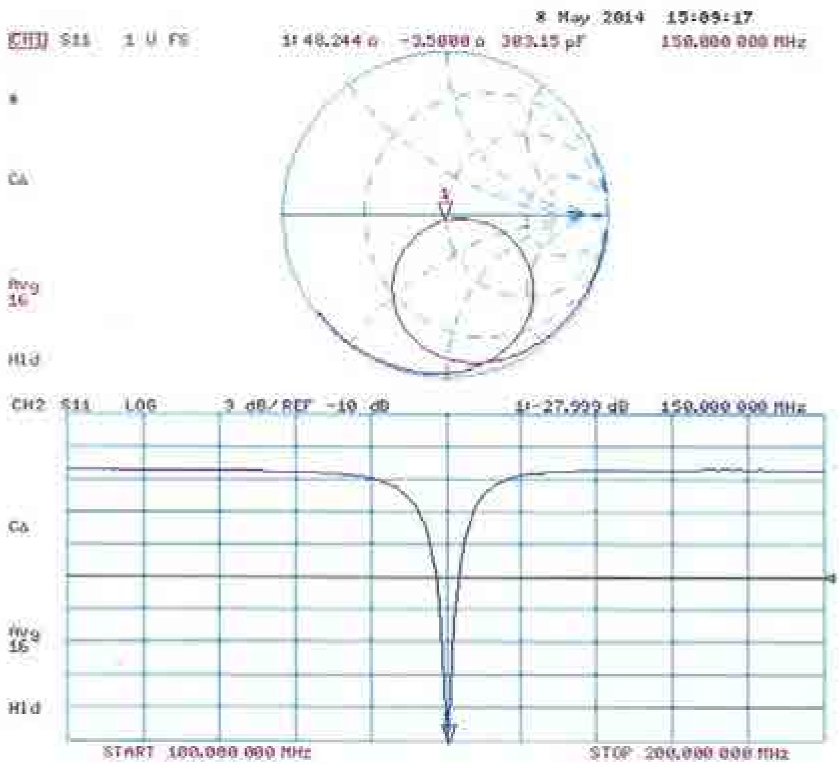
CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 4.65 W/kg

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 78.11 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 5.77 W/kg
SAR(1 g) = 3.59 W/kg; SAR(10 g) = 2.39 W/kg
Maximum value of SAR (measured) = 4.64 W/kg



0 dB = 4.65 W/kg = 6.67 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: CLA150-4010_May14 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 08.05.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4010

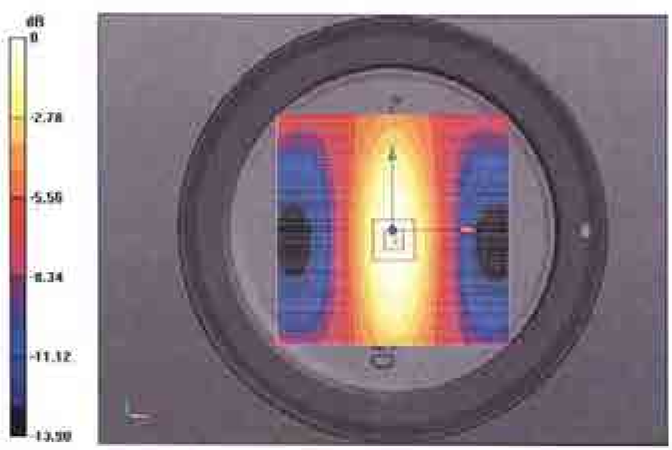
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; σ = 0.8 S/m; ϵ_r = 62.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.45, 11.45, 11.45); Calibrated: 06.01.2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.07.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 4.77 W/kg

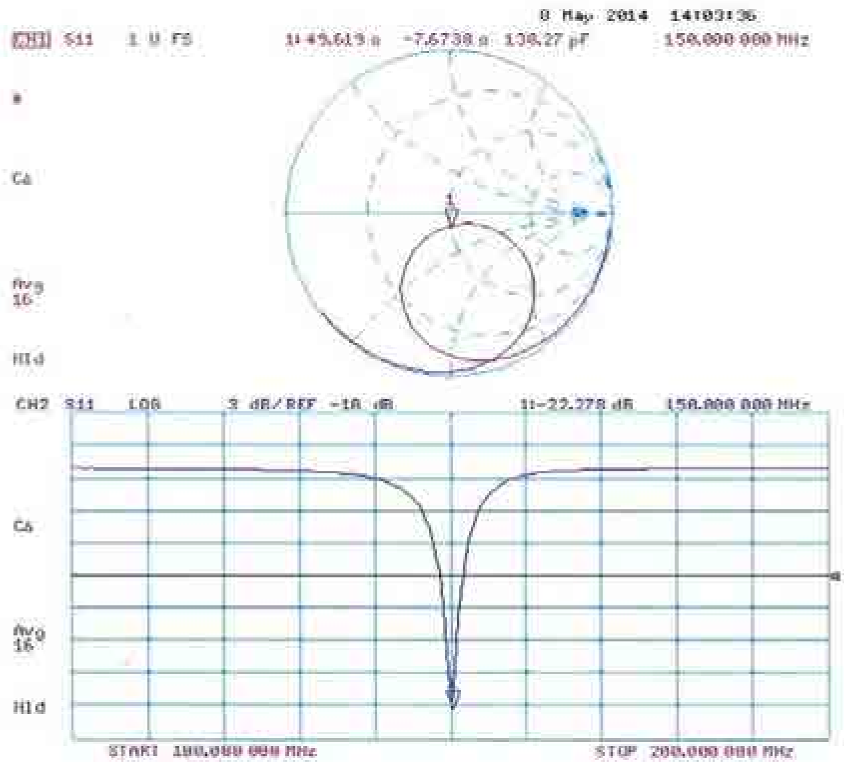
CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 76.42 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 5.84 W/kg
SAR(1 g) = 3.68 W/kg; SAR(10 g) = 2.46 W/kg
Maximum value of SAR (measured) = 4.73 W/kg



0 dB = 4.77 W/kg = 6.79 dBW/kg

Certificate No: CLA150-4010_May14 Page 7 of 8

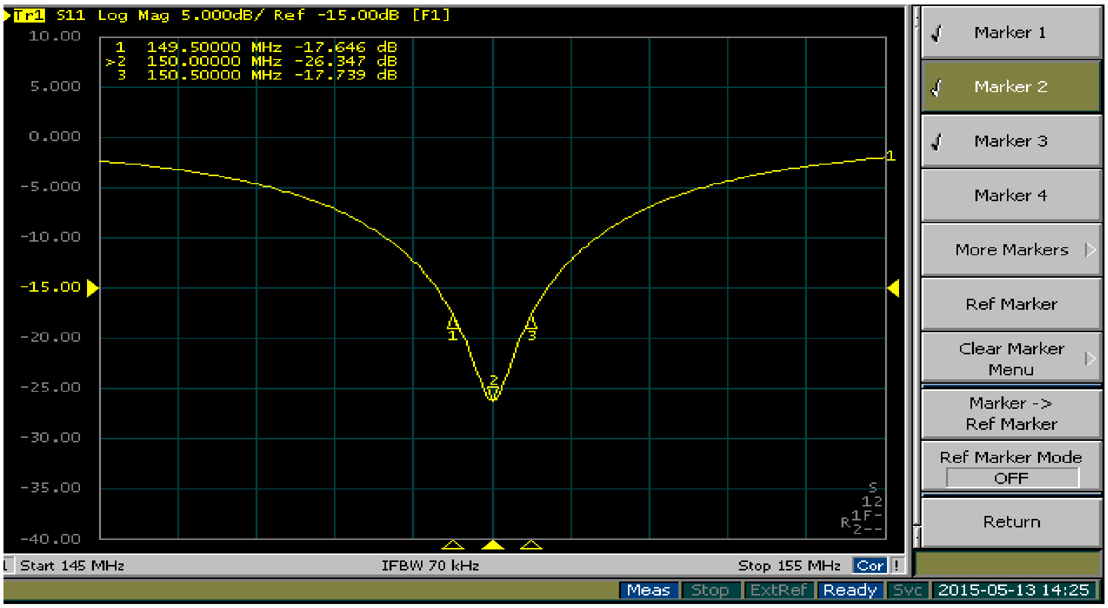
Impedance Measurement Plot for Body TSL



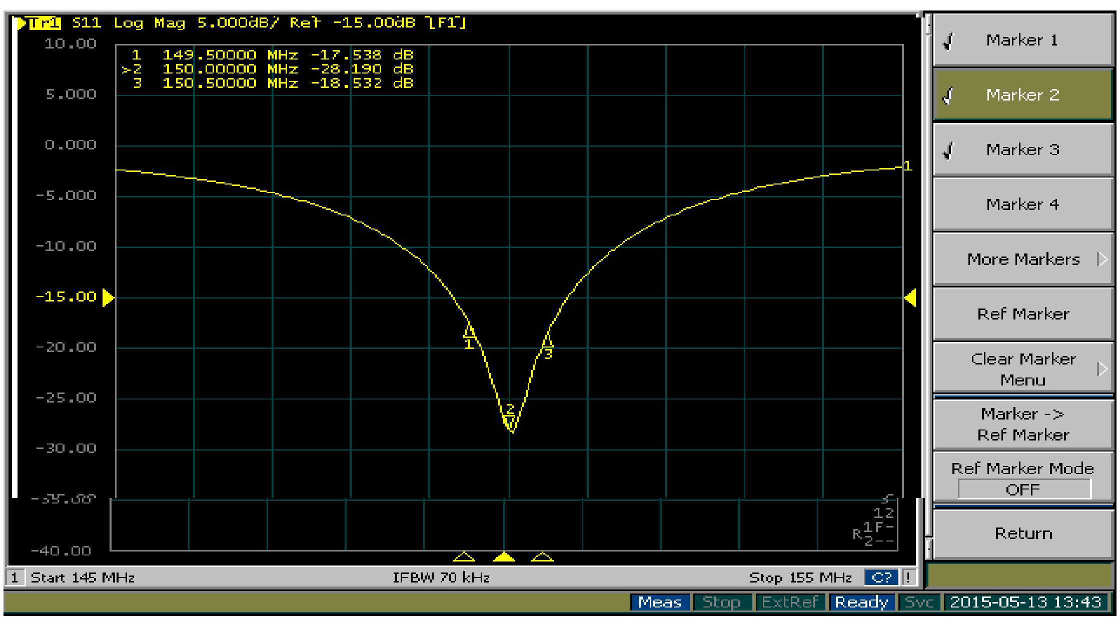
Return Loss Plot for Dipole CLA 4010

Per FCC response to the KDB inquiry 427840, dated 05/08/2015, the CLA-150 with serial # 4010 has been verified that it is tuned to 150 MHz +/- 0.5 MHz or better as indicated in the plots below:

Body return loss



Head return loss



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Accreditation No.: **SCS 108**

Client **Motorola MY**

Certificate No: **D450V3-1053_Mar13**

CALIBRATION CERTIFICATE

Object: D450V3 - SN: 1053

Calibration procedure(s): QA CAL-15.v7
Calibration procedure for dipole validation kits below 700 MHz

Calibration date: March 12, 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	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ET3DV6	SN: 1507	28-Dec-12 (No. ET3-1507_Dec12)	Dec-13
DAE4	SN: 654	18-Apr-12 (No. DAE4-654_Apr12)	Apr-13

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-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 13, 2013

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

Certificate No: D450V3-1053_Mar13 Page 1 of 8

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.5 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.71 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.802 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.14 W/kg ± 17.6 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	58.4 ± 6 %	0.94 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.55 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.753 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.01 W/kg ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.5 Ω - 2.8 jΩ
Return Loss	- 22.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	54.7 Ω - 7.3 jΩ
Return Loss	- 21.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.350 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 16, 2005

DASY5 Validation Report for Head TSL

Date: 12.Mar.13

Test Laboratory: SPEAG, Zürich, Switzerland

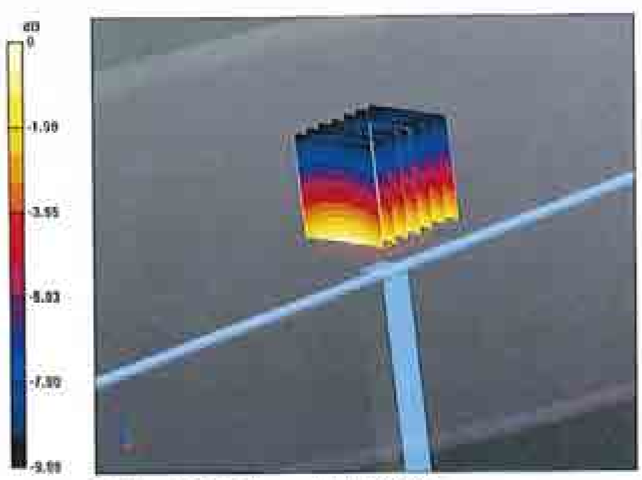
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1053

Communication System: CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; $\sigma = 0.9$ S/m; $\varepsilon_r = 43.5$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

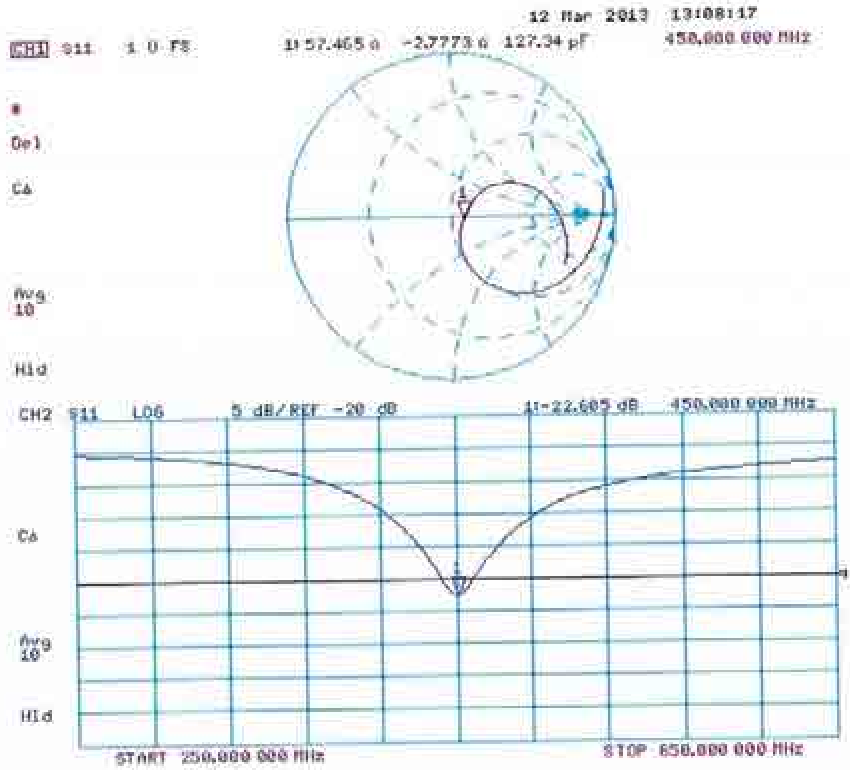
- Probe: ET3DV6 - SN1507; ConvF(6.59, 6.59, 6.59); Calibrated: 28.Dec.12;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.Apr.12
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.316 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.87 W/kg
SAR(1 g) = 1.21 W/kg; SAR(10 g) = 0.802 W/kg
Maximum value of SAR (measured) = 1.30 W/kg



0 dB = 1.30 W/kg = 1.14 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.Mar.13

Test Laboratory: SPEAG, Zürich, Switzerland

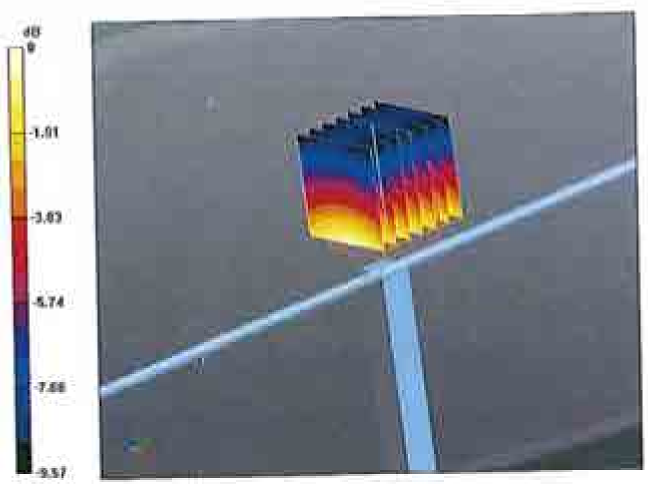
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1053

Communication System: CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.94 S/m; ε_r = 56.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(7.03, 7.03, 7.03); Calibrated: 28.Dec.12;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.Apr.12
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

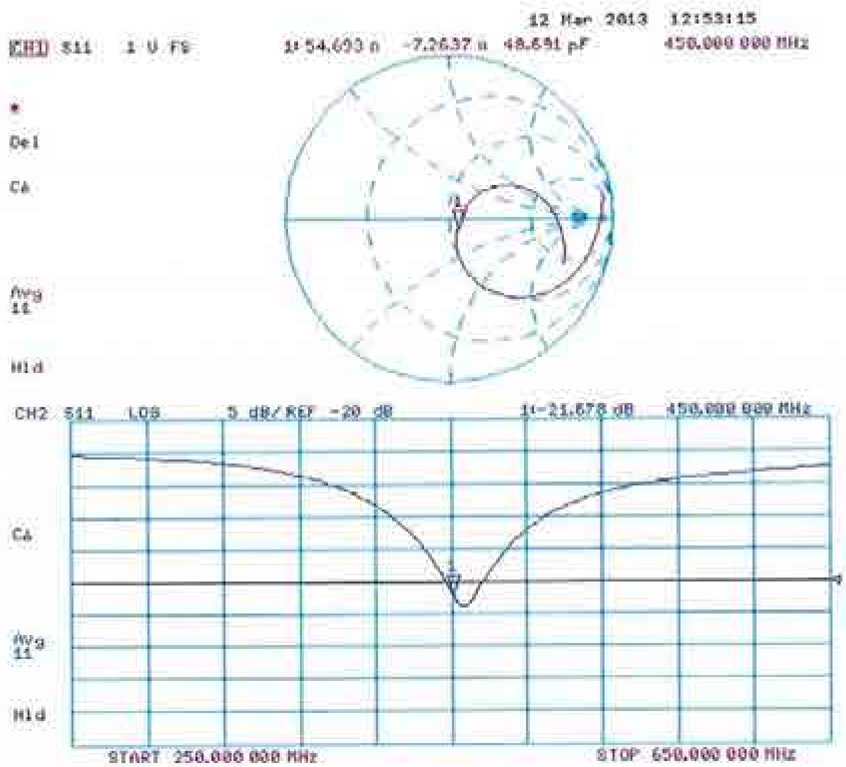
Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 37.010 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.77 W/kg
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.753 W/kg
Maximum value of SAR (measured) = 1.21 W/kg



0 dB = 1.21 W/kg = 0.83 dBW/kg

Certificate No: D450V3-1053_Mar13 Page 7 of 8

Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **Motorola MY**

Certificate No: **D450V3-1054_Oct13**

CALIBRATION CERTIFICATE

Object	D450V3 - SN: 1054
Calibration procedure(s)	QA CAL-15.v7 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	October 18, 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: S5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ET3DV6	SN: 1507	28-Dec-12 (No. ET3-1507_Dec12)	Dec-13
DAE4	SN: 654	18-Jul-13 (No. DAE4-654_Jul13)	Jul-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: October 18, 2013

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

Certificate No: D450V3-1054_Oct13 Page 1 of 8

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.5 ± 6 %	0.88 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	1.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.72 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.782 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.10 W/kg ± 17.6 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.4 ± 6 %	0.96 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	1.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.60 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.771 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.04 W/kg ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.6 Ω - 3.0 jΩ
Return Loss	- 22.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	53.2 Ω - 7.8 jΩ
Return Loss	- 21.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.346 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 16, 2005

DASY5 Validation Report for Head TSL

Date: 18.10.2013

Test Laboratory: The name of your organization

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1054

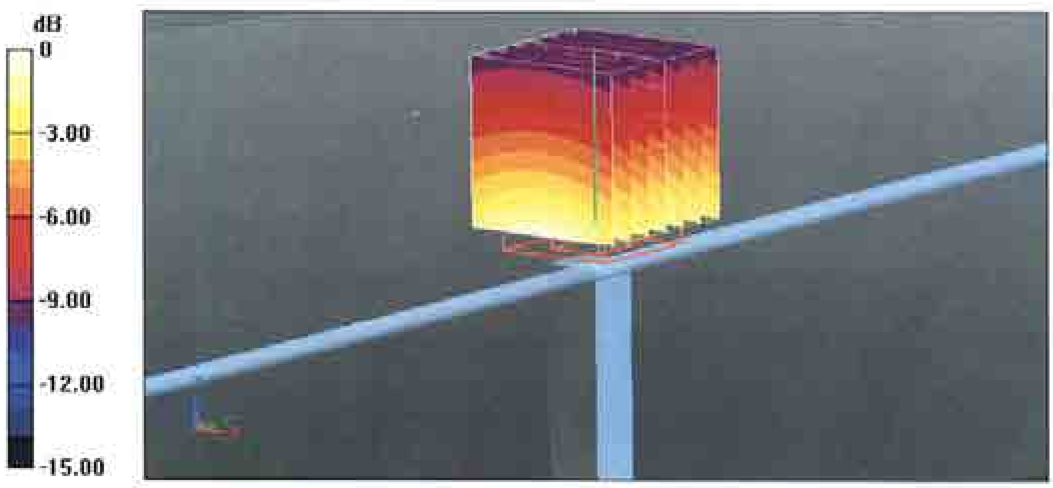
Communication System: UID 0 - CW ; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; $\sigma = 0.88$ S/m; $\varepsilon_r = 43.5$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.59, 6.59, 6.59); Calibrated: 28.12.2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.07.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

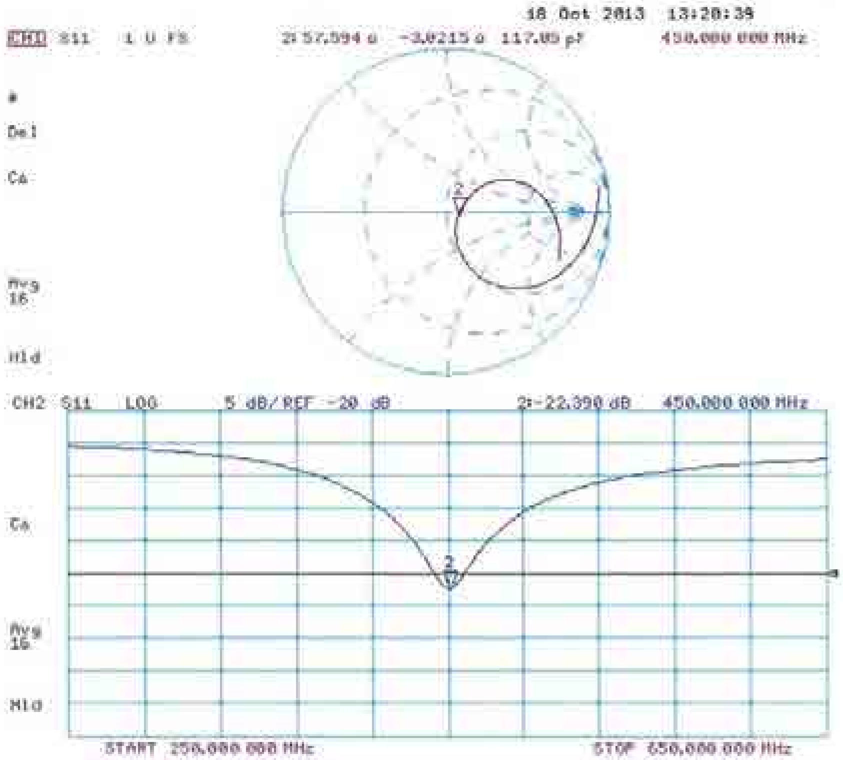
Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 37.179 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.82 W/kg
SAR(1 g) = 1.19 W/kg; SAR(10 g) = 0.782 W/kg
Maximum value of SAR (measured) = 1.27 W/kg



0 dB = 1.27 W/kg = 1.04 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D450V3-1054_Oct13 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 18.10.2013

Test Laboratory: The name of your organization

DUT: Dipole 450 MHz D450V3; Type: D450V3; Serial: D450V3 - SN:1054

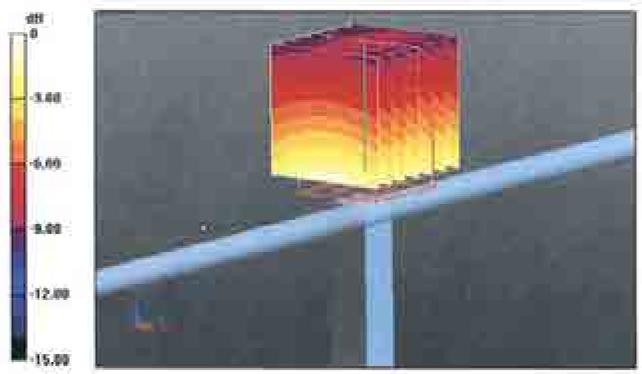
Communication System: UID 0 - CW ; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; $\sigma = 0.96$ S/m; $\varepsilon_r = 56.4$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(7.03, 7.03, 7.03); Calibrated: 28.12.2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.07.2013
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

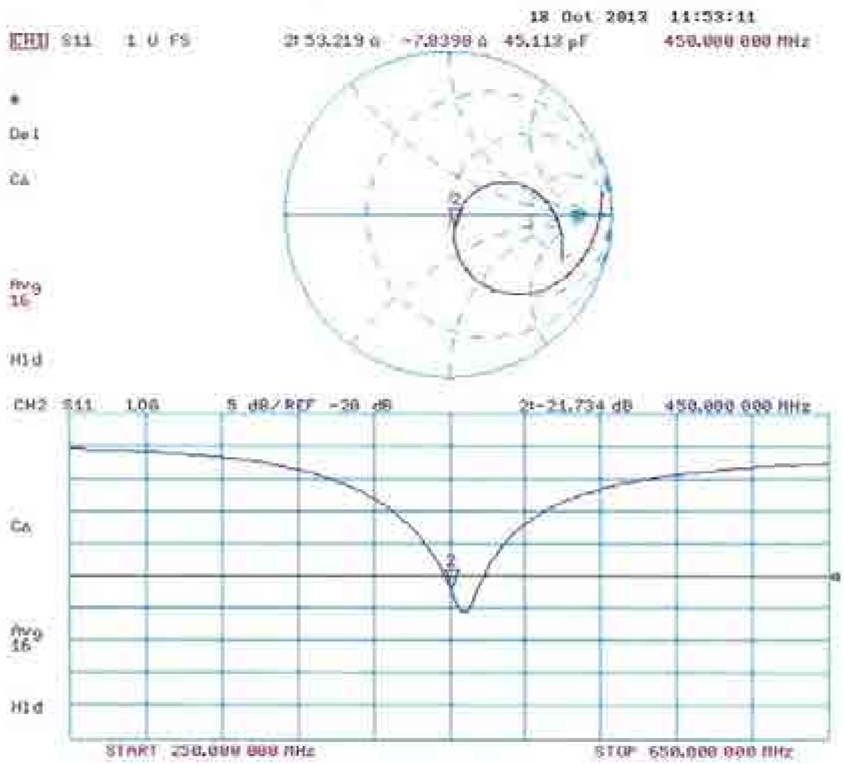
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 37.179 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.81 W/kg
SAR(1 g) = 1.17 W/kg; SAR(10 g) = 0.771 W/kg
Maximum value of SAR (measured) = 1.25 W/kg



0 dB = 1.25 W/kg = 0.97 dBW/kg

Certificate No: D450V3-1054_Oct13 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D450V3-1054_Oct13 Page 8 of 8

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Accreditation No.: **SCS 108**

Client **Motorola MY**

Certificate No: **D835V2-4d029_Mar13**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d029
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	March 05, 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 EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

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-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: March 5, 2013

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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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9 ± 6 %	0.94 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	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.46 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.18 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.1 ± 6 %	1.02 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	2.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.66 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.39 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1 Ω - 4.4 jΩ
Return Loss	- 27.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6 Ω - 6.7 jΩ
Return Loss	- 22.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.388 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 17, 2004

DASY5 Validation Report for Head TSL

Date: 05.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

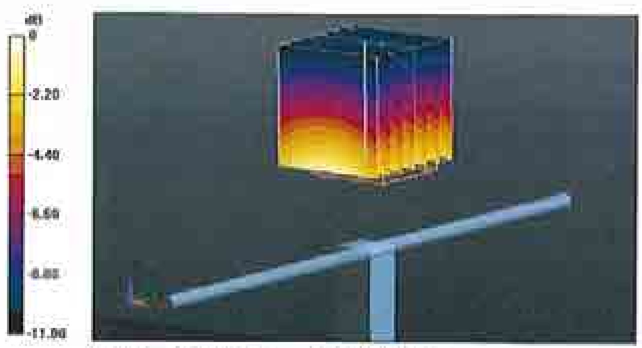
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d029

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

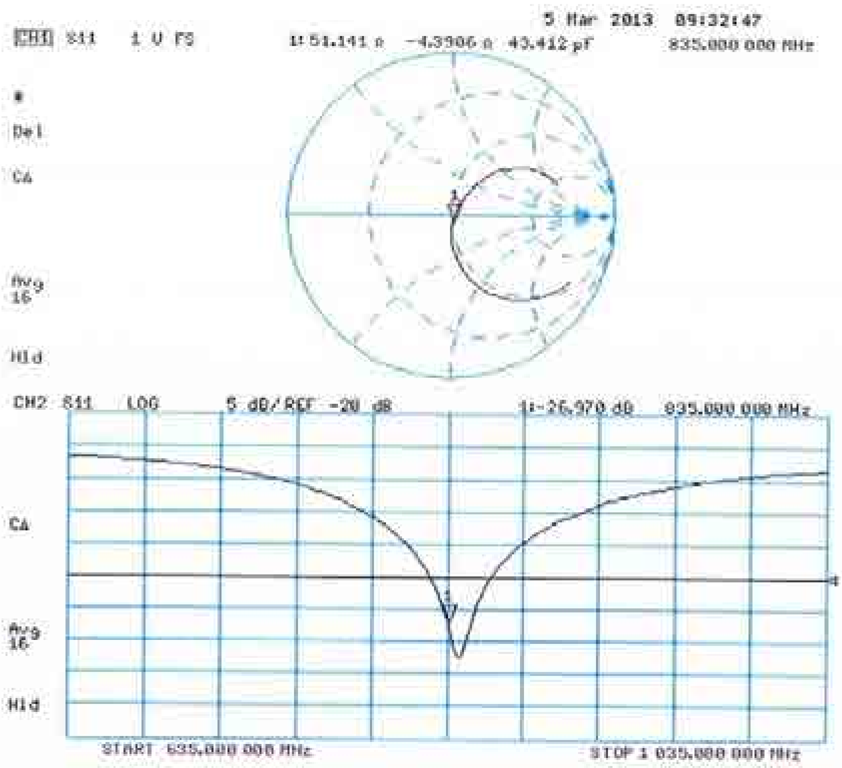
- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.876 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.71 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 2.88 W/kg



0 dB = 2.88 W/kg = 4.59 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 04.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d029

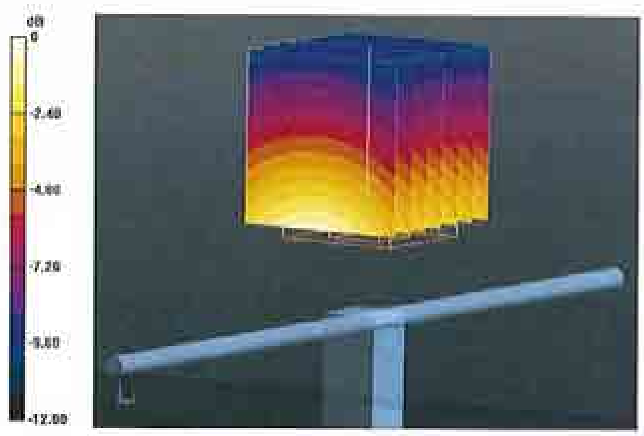
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma = 1.02$ S/m; $\varepsilon_r = 54.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

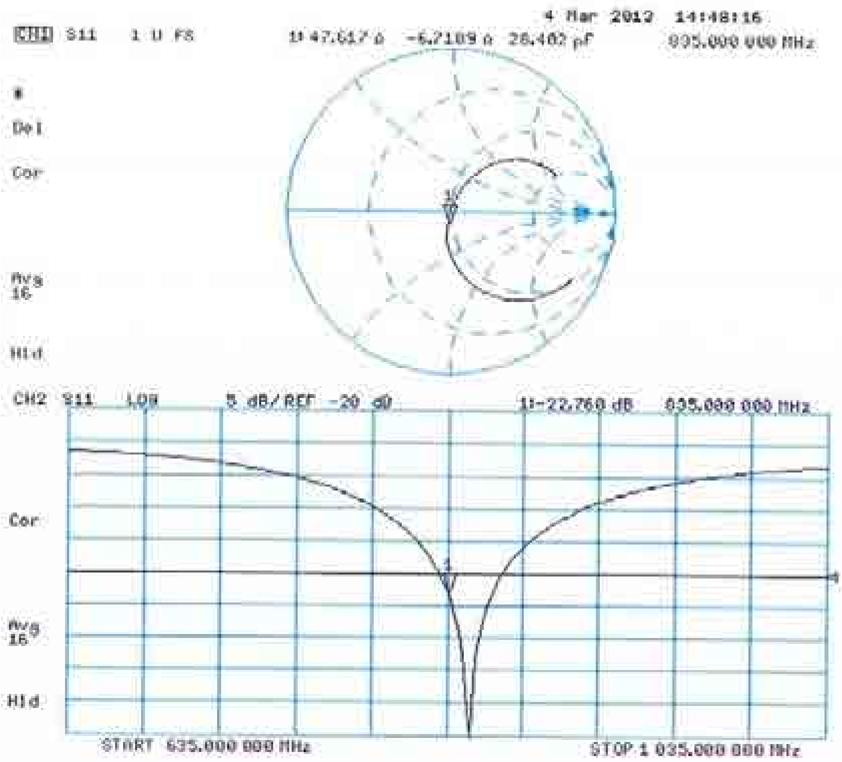
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.578 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.69 W/kg
SAR(1 g) = 2.52 W/kg; SAR(10 g) = 1.65 W/kg
Maximum value of SAR (measured) = 2.92 W/kg



0 dB = 2.92 W/kg = 4.65 dBW/kg

Impedance Measurement Plot for Body TSL



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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Motorola MY**

Certificate No: **D2450V2-781_Mar13**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 781
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	March 06, 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 EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
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-12)	In house check: Oct-13

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

Issued: March 6, 2013

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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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
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	37.8 ± 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	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.0 W/kg ± 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	50.7 ± 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	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.96 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.5 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.3 Ω + 2.3 jΩ
Return Loss	- 26.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.5 Ω + 3.4 jΩ
Return Loss	- 29.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 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	May 06, 2005

DASY5 Validation Report for Head TSL

Date: 06.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 781

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 S/m; ε_r = 37.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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 = 94.879 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 28.9 W/kg
SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.34 W/kg
Maximum value of SAR (measured) = 17.6 W/kg

0 dB = 17.6 W/kg = 12.46 dBW/kg

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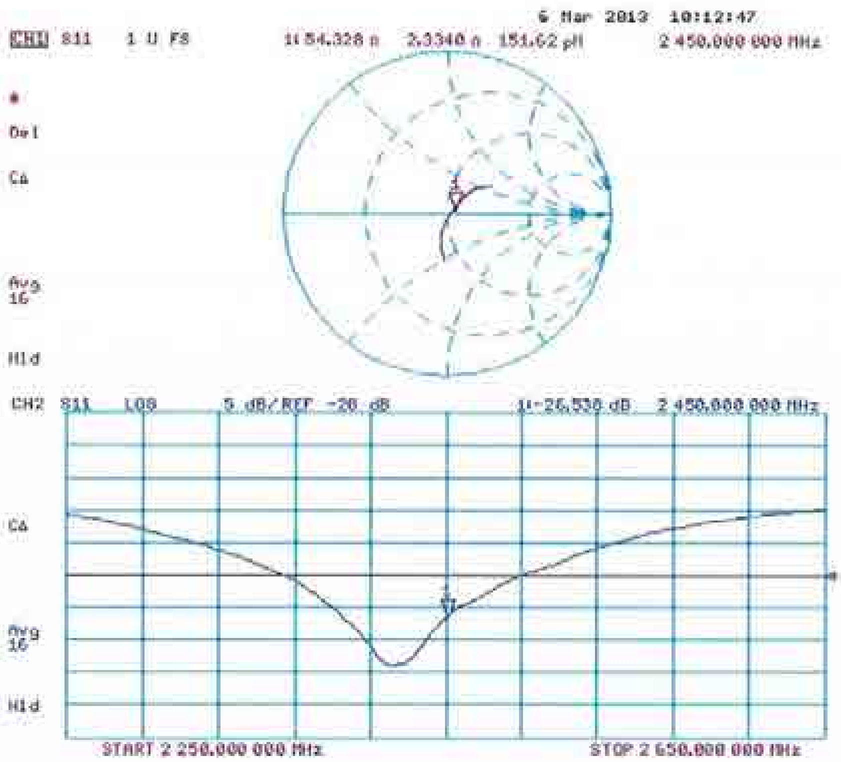
Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 06.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

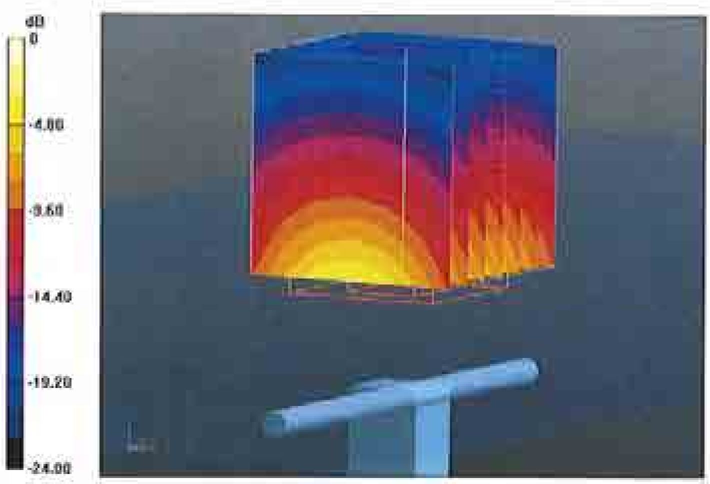
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 781

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.01 S/m; ε_r = 50.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.879 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 27.2 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.96 W/kg
Maximum value of SAR (measured) = 17.1 W/kg



0 dB = 17.1 W/kg = 12.33 dBW/kg

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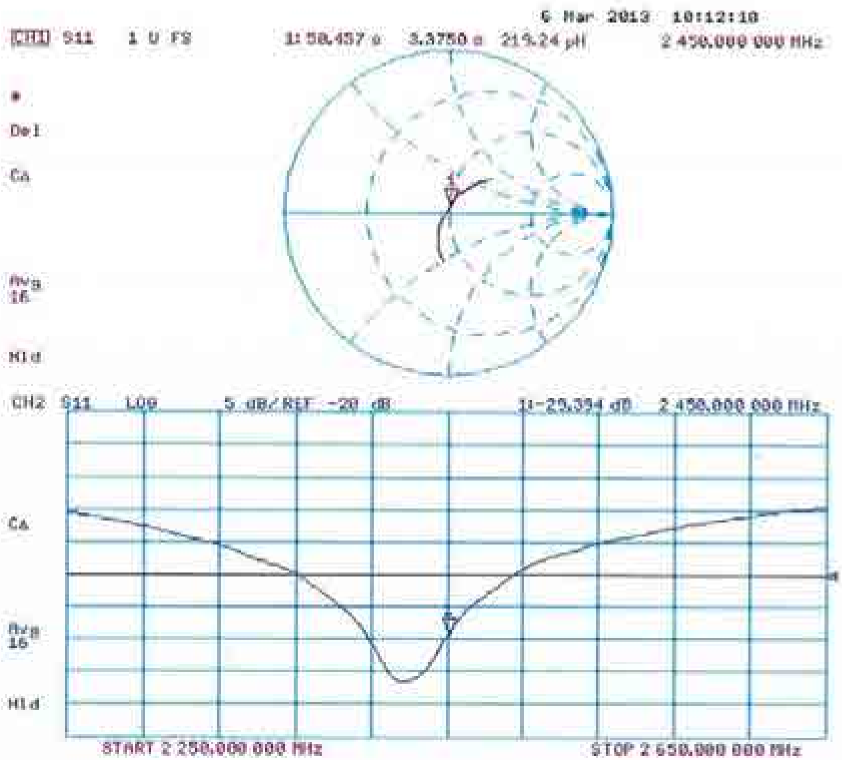
Impedance Measurement Plot for Body TSL



Dipole Data

The table below includes dipole impedance and return loss measurement data measured by Motorola Solutions' EME lab. The results meet the requirements stated in KDB 865664.

Dipole D450V3-1053	Head			Body		
	Impedance		Return Loss	Impedance		Return Loss
Date Measured	real Ω	imag jΩ	dB	real Ω	imag jΩ	dB
03/22/2013	52.8	-7.2	-22.6	49.7	-7.4	-22.3
04/14/2014	53.4	4.94	-24.9	51.8	-6.6	-23.3

Dipole D450V3-1054	Head			Body		
	Impedance		Return Loss	Impedance		Return Loss
Date Measured	real Ω	imag jΩ	dB	real Ω	imag jΩ	dB
11/19/2013	57.5	-4.85	-21.6	50.6	-6.97	-23.3
02/06/2015	53.4	-2.70	-25.4	48.8	-5.58	-25.1

Dipole D835V2-4d029	Head			Body		
	Impedance		Return Loss	Impedance		Return Loss
Date Measured	real Ω	imag jΩ	dB	real Ω	imag jΩ	dB
03/21/2013	50.5	-4.5	-26.8	48.7	-6.2	-23.7
04/14/2014	52.2	-3.9	-27.2	46.0	-3.44	-25.2

Dipole D2450V2-781	Head			Body		
	Impedance		Return Loss	Impedance		Return Loss
Date Measured	real Ω	imag jΩ	dB	real Ω	imag jΩ	dB
03/27/2013	57.0	5.6	-21.4	51.4	4.9	-26.3
10/18/2014	54.5	5.89	-26.5	49.5	5.7	-29.4