MOTOROLA SOLUTIONS

ACCREDITED
TESTING CERT # 2518.05

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

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

Date of Report:	**01/30/13**
Report Revision:	**O**
Report ID:	**SAR rpt_ PMUE4174A _Rev.O 130130_SR11111**

Responsible Engineer:	Tan CheeChin (EME Section Manager)
Report Author:	Tan CheeChin (EME Section Manager)
Date/s Tested:	12/28/12 – 01/29/13
Manufacturer/Location:	Motorola, Penang
Sector/Group/Div.:	PCR
Date submitted for test:	12/20/12
DUT Description:	Full keypad with GPS & GOB 403 - 470MHz, 4W
Test TX mode(s):	CW (PTT)
Max. Power output:	4.8 W
Nominal Power:	4.0 W
Tx Frequency Bands:	403-470 MHz
Signaling type:	FM
Model(s) Tested:	PMUE4174A
Model(s) Certified:	PMUE4174A
Serial Number(s):	627TNX0276, 627TNX0279
Classification:	Occupational/Controlled
FCC ID:	ABZ99FT4095; Rule Part 90 (406.1-470 MHz)
IC:	109AB-99FT4095; (406.1-430 and 450-470 MHz)

* Refer to section 15 of part 1 for highest SAR summary results.

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 47 CFR 2.1093(d). 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 3.0 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 Zakharia

EMS EME Lab Senior Resource Manager,
Laboratory Director
Approval Date: 2/1/2013

Certification Date: 2/1/2013

Certification No.: L1130114

Part 1 of 2

APPENDICES

Part 2 of 2

Report Revision History

Date	Revision	Comments
01/30/13	O	Initial release

1.0 Introduction example

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for model number PMUE4174A.

2.0 Abbreviations / Definitions

CNR: Calibration Not Required
EME: Electromagnetic Energy
FKP: Full Keypad
CW: Continuous Wave
DUT: Device Under Test
DC: Duty Cycle
FM: Frequency Modulation/Factory Mutual
NA: Not Applicable
PTT: Push to Talk
RSM: Remote Speaker Microphone
SAR: Specific Absorption Rate

Audio accessories: These accessories allow communication while the DUT is worn on the body.
Body worn accessories: These accessories allow the DUT to be worn on the body of the user.
Maximum Power: Defined as the upper limit of the production line final test station.

3.0 Referenced Standards and Guidelines

This product is designed to comply with the following applicable national and international standards and guidelines.

- IEC62209-1*(2005) Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
- United States Federal Communications Commission, Code of Federal Regulations; Rule Part 47CFR § 2.1093 sub-part J:1999
- Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.
- IEEE 1528*(2003), Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1992

- Institute of Electrical and Electronics Engineers (IEEE) C95.1-2005
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6 (2009), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- Australian Communications Authority Radio communications (Electromagnetic Radiation - Human Exposure) Standard (2003)
- ANATEL, Brazil Regulatory Authority, Resolution No. 303 of July 2, 2002 "Regulation of the limitation of exposure to electrical, magnetic, and electromagnetic fields in the radio frequency range between 9 kHz and 300 GHz." and “Attachment to resolution # 303 from July 2, 2002”
- IEC62209-2 Edition 1.0 2010-03, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz).

* The IEC62209-1 and IEEE 1528 are applicable for hand-held devices used in close proximity to the ear only.

4.0 SAR Limits

TABLE 1

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average - ANSI - (averaged over the whole body)	0.08	0.4
Spatial Peak - ANSI - (averaged over any 1-g of tissue)	1.6	8.0
Spatial Peak – ICNIRP/ANSI - (hands/wrists/feet/ankles averaged over 10-g)	4.0	20.0
Spatial Peak - ICNIRP - (Head and Trunk 10-g)	2.0	10.0

5.0 SAR Result Scaling Methodology:

The calculated 1-gram and 10-gram averaged SAR results indicated as "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" in the data tables is determined by scaling the measured SAR to account for power leveling variations and power slump. A table and graph of output power versus time is provided in APPENDIX H. For this device the "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" are scaled using the following formula:

$$Max\_Calc = SAR\_meas \cdot 10^{\frac{-Drift}{10}} \cdot \frac{P\_\max}{P\_\mathrm{int}} \cdot DC$$

P_max = Maximum Power (W)
P_int = Initial Power (W)
Drift = DASY drift results (dB)
SAR_meas = Measured 1-g or 10-g Avg. SAR (W/kg)
DC = Transmission mode duty cycle in % where applicable
50% duty cycle is applied for PTT operation

Note: for conservative results, the following are applied:
If P_int > P_max, then P_max/P_int = 1.
Drift = 1 for positive drift

Additional SAR scaling was applied using the methodologies outlined in FCC KDB450824 using tissue sensitivity values. SAR was scaled for conditions where the tissue permittivity was measured above the nominal target and for tissue conductivity that was measured below the nominal target.

6.0 Description of Device Under Test (DUT):

This device operates using analog frequency modulation (FM) signaling incorporating traditional simplex two-way radio transmission protocol.

The model represented under this filing utilizes removable antennas (UHF) and capable of transmitting in the 403-470 MHz band respectively. The nominal UHF output power is 4.0 watts with maximum output power of 4.8 watts defined by upper limit of the production line final test station. The intended operating positions are "at the face" with the DUT at least 1 inch from the mouth, and "at the body" by means of the offered body worn accessories. Body worn audio and PTT operation is accomplished by means of optional remote accessories that are connected to the radio.

7.0 Optional Accessories and Test Criteria:

This device is offered with optional accessories. All accessories were individually evaluated during the test plan creation to determine if testing was required. The following sections identify the test criteria and details for each accessory category. Refer to Exhibit 7B for antenna separation distances.

7.1 Antennas:

There are three UHF antennas offered for this product. The table below lists their descriptions.

TABLE 2

Antenna Models	Description	Tested
PMAE4018B	403-433 MHz, Folded Monopole; ¼ wave; 2.2dBi gain	Yes
PMAE4024B	430-470 MHz, Folded Monopole; ¼ wave; 2.2dBi gain	Yes
PMAE4023B	430-470 MHz, GPS Stubby; ¼ wave; 1.8dBi gain	Yes

7.2 Battery:

There is one battery offered for this product. The table below lists its description.

TABLE 3

Battery Models	Description	Tested	Comments
NNTN8386A	MOTOTRBO CSA IMPRES Li-Ion	Yes	Height = 135 mm

7.3 Body worn Accessories:

All body worn accessories were considered. The table below lists the body worn accessories, and body worn accessory descriptions.

TABLE 4

Body worn Models	Description	Tested	Comments
PMLN6086A	Belt Clip For 2.5-Inch Belt Width	Yes	
PMLN6097A	Hard Leather Carry Case 2.5-Inch SWL FKP	Yes	
PMLN6099A	Soft Leather Carry Case 2.5-Inch□ SWL FKP	Yes	
PMLN5610A	2.5-Inch Replacement Swivel Belt Loop	No	Replacement part

7.4 Audio Accessories:

All audio accessories were considered. The table below lists the offered audio accessories and their descriptions. Exhibit 7B illustrates photos of the tested audio accessories.

TABLE 5

Audio Acc. Models	Description	Selected for Test	Tested	Comments
PMMN4067B	ATEX CSA Remote Speaker Microphone, IMPRES	Yes	Yes	Default audio accessory applicable for offered battery, body worn and antenna.
PMLN5275C	Behind the Head Heavy Duty Headset	Yes	Yes	
NNTN8380A	Standard Hardhat Mount Headset, 26 NRR	Yes	Yes	
NNTN8379A	Standard Hardhat Mount Headset, 24 NRR	No	No	Similar to NNTN8380A
PMMN4050A	IMPRES Noise Canceling RSM with audio jack	Yes	Yes	
RMN4054B	Rx Only Headset	Yes	Yes	Attached with PMMN4050A for testing.
RLN4941A	Rx Only Earpiece	Yes	Yes	Attached with PMMN4050A for testing.
NNTN8378A	CSA PTT Adapter	Yes	Yes	Attached with NNTN8380A for testing.

8.0 Description of Test System:

8.1 Descriptions of Robotics/Probes/Readout Electronics:

TABLE 6

Disometric System Type	System Version	DAE Type	Probe Type
Schmid & Partner Engineering AG SPEAG™ DASY4™	4.7 build 80	DAE4	ES3DV3 (E-field)
Schmid & Partner Engineering AG SPEAG™ DASY5™	52.8.2.969	DAE4	ES3DV3 (E-field)

The DASY4™ and DASY5™ system is operated per the instructions in the respective DASY4™ and DASY5™ Users Manual. The complete manual is available directly from SPEAG™. All measurement equipment used to assess EME SAR compliance was calibrated according to ISO/IEC 17025 A2LA guidelines. Section 9.0 presents additional test equipment information. Appendices B and C present the applicable calibration certificates. The E-field probe first scans a coarse grid over a large area inside the phantom in order to locate the interpolated maximum SAR distribution. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The subsequent scan can directly use this position as reference for the cube evaluations.

8.2 Description of Phantom(s)

TABLE 7

Phantom Type	Phantom ID(s)	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (wood)
Dual Flat	NA	300MHz -6GHz; Er = 4+/- 1, Loss Tangent = ≤0.05	600x400x190	2mm +/- 0.2mm	Wood	< 0.05
SAM	NA					
Elliptical	ELI4 1037 ELI4 1028 ELI5 1147 ELI5 1150					

8.3 Description of Simulated Tissue:

The sugar based simulate tissue is produced by placing the correct measured amount of De-ionized water into a large container. Each of the dried ingredients are weighed and added to the water carefully to avoid clumping. If the solution has a high sugar concentration the water is pre-heated to aid in dissolving the ingredients. For Diacetin and similar type simulates, sugar and HEC ingredients are not needed. The solution is mixed thoroughly, covered, and allowed to sit overnight prior to use.

The simulated tissue mixture was mixed based on the Simulated Tissue Composition indicated in Table 8 below for 450 MHz. During the daily testing of this product, the applicable mixture was used to measure the Di-electric parameters at each of the tested frequencies to verify that the Di-electric parameters were within the tolerance of the tissue specifications.

Simulated Tissue Composition (by mass)
TABLE 8

Reference Standards	% of Listed Ingredients	450 MHz	
		Head	Body
FCC Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01); IEEE 1528 – 2003; IEC62209-1 (2005); CENELEC EN62209-1 (2006)	Sugar	56.0	46.5
	Diacetin	0	0
	De ionized -Water	39.1	50.53
	Salt	3.8	1.87
	HEC	1.0	1.0
	Bact.	0.1	0.1

Reference section 10.1 for target parameters

9.0 Additional Test Equipment:

The table below lists additional test equipment used during the SAR assessment.

TABLE 9

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Power Meter	E4418B	MY45100911	6/25/2012	6/25/2013
Power Sensor	8481B	MY41091243	6/26/2012	6/26/2013
Power Meter	E4418B	MY45101014	10/31/2012	10/31/2013
Power Sensor	8481B	SG41090248	11/6/2012	11/6/2013
Power Meter	E4418B	MY45100532	11/14/2012	11/14/2013
Power Sensor	8481B	MY41091170	11/6/2012	11/6/2013
Signal Generator	E4438C	MY45091014	11/2/2012	11/2/2014
Amplifier	10W1000C	312858	CNR*	CNR*
NARDA Bi-Directional Coupler	3020A	41935	8/24/2012	8/24/2013
Thermometer	HH202A	35882	7/24/2012	7/24/2013
Therm. Probe	80PK-22	9135	7/24/2012	7/24/2013
Dickson Temp & RH Data Logger	TM320	06153216	7/6/2012	7/6/2013
Network Analyzer	E5071B	MY42403147	11/1/2012	11/1/2013
Dielectric Probe Kit (HP)	85070E	MY44300183	CNR*	CNR*
SPEAG™ Dipole	D450V3	1054	(Head- 11/21/2011) (Body -5/21/2012)	(Head -11/21/2013) (Body -5/21/2014)
SPEAG™ Probe	ES3DV3	3196	4/27/2012	4/27/2013
SPEAG™ Probe	ES3DV3	3122	4/26/2012	4/26/2013

***Calibration is not required by the OEM. The dielectric probe kit is used in conjunction with a calibrated network analyzer. The dielectric probe kit is calibrated for short, open, and load using the calibrated network analyzer. A saline solution is routinely measured as an additional check point.**

10.0 SAR Measurement System Verification:

The system performance check was conducted daily and within 24 hours prior to testing. DASY output files of the probe/dipole calibration certificates and system performance test results are included in appendices B, C, D respectively.

10.1 Equivalent Tissue Test Results:

Simulated tissue prepared for SAR measurements is measured daily and within 24 hours prior to actual SAR testing to verify that the tissue is within +/- 5% of target parameters at the center of the transmit band. This measurement is done using the applicable equipment indicated in section 9.0. The table below summarizes the measured tissue parameters used for the SAR assessment.

TABLE 10

Frequency (MHz)	Tissue Type	Conductivity Target & Range (S/m)	Dielectric Constant Target & Range	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
403	FCC Body	0.93 (0.88-0.98)	57.17 (54.31-60.03)	0.91	55.30	01/29/13
	IEEE / IEC Head	0.87 (0.83-0.91)	44.06 (41.86-46.26)	0.83	44.50	01/10/13
406	FCC Body	0.93 (0.88-0.98)	57.14 (54.28-60.00)	0.91	56.70	12/28/12
				0.91	55.10	01/21/13
	IEEE / IEC Head	0.87 (0.83-0.91)	44.03 (41.83-46.23)	0.83	44.60	01/21/13
420	FCC Body	0.94 (0.89-0.99)	57.00 (54.15-59.85)	0.93	56.50	12/28/12
				0.92	54.80	01/21/13
	IEEE / IEC Head	0.87 (0.83-0.91)	43.86 (41.67-46.05)	0.84	44.30	01/21/13
430	FCC Body	0.94 (0.89-0.99)	56.90 (54.06-59.74)	0.93	56.30	12/28/12
				0.93	56.30	01/09/13
				0.93	54.70	01/21/13
	IEEE / IEC Head	0.87 (0.83-0.91)	43.74 (41.55-45.93)	0.85	43.60	01/09/13
				0.85	43.90	01/10/13
433	FCC Body	0.94 (0.89-0.99)	56.87 (54.03-59.71)	0.94	56.30	12/28/12
				0.93	56.30	01/09/13
	IEEE / IEC Head	0.87 (0.83-0.91)	43.70 (41.52-45.89)	0.85	43.60	01/09/13
443	FCC Body	0.94 (0.89-0.99)	56.77 (53.93-59.61)	0.95	56.10	12/28/12
				0.94	56.20	01/09/13
				0.93	55.60	01/11/13
450	FCC Body	0.94 (0.89-0.99)	56.70 (53.86-59.54)	0.95	56.00	12/28/12
				0.95	56.10	01/09/13
				0.93	55.40	01/11/13
				0.94	54.30	01/21/13
				0.94	54.70	01/22/13
				0.95	54.9	01/29/13
	IEEE / IEC Head	0.87 (0.83-0.91)	43.50 (41.32-45.68)	0.87	43.20	01/09/13
				0.87	43.40	01/10/13
				0.87	43.60	01/21/13
457	FCC Body	0.94 (0.89-0.99)	56.67 (53.84-59.50)	0.96	55.90	12/28/12
				0.95	54.20	01/21/13
				0.95	54.60	01/22/13
	IEEE / IEC Head	0.87 (0.83-0.91)	43.46 (41.29-45.63)	0.87	43.40	01/21/13
470	FCC Body	0.94 (0.89-0.99)	56.62 (53.79-59.45)	0.96	54.00	01/21/13
				0.96	54.40	01/22/13
	IEEE / IEC Head	0.87 (0.83-0.91)	43.40 (41.23-45.57)	0.88	43.10	01/21/13

10.2 System Check Test Results:

System performance checks were conducted each day during the SAR assessment. The results are normalized to 1W. APPENDIX D includes DASY plots for each day during the SAR assessment. The table below summarizes the daily system check results used for the SAR assessment.

TABLE 11

Probe Serial #	Tissue Type	Dipole Kit / Serial #	Reference SAR @ 1W (W/kg)	System Check Results Measured (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date
3122	FCC Body	SPEAG D450V3 / 1054	4.49 +/- 10%	1.14	4.56	01/09/13
				1.13	4.50	01/11/13
	IEEE /IEC Head	SPEAG D450V3 / 1054	4.75 +/- 10%	1.17	4.68	01/09/13
				1.19	4.76	01/10/13
3196	FCC Body	SPEAG D450V3 / 1054	4.49 +/- 10%	1.11	4.44	12/28/12
				1.11	4.44	01/21/13
				1.13	4.52	01/22/13
				1.12	4.48	01/29/13
	IEEE /IEC Head	SPEAG D450V3 / 1054	4.75 +/- 10%	1.17	4.48	01/21/13

11.0 Environmental Test Conditions:

The EME Laboratory's ambient environment is well controlled resulting in very stable simulated tissue temperature and therefore stable dielectric properties. Simulated tissue temperature is measured prior to each scan to insure it is within +/ - 2°C of the temperature at which the dielectric properties were determined. The liquid depth within the phantom used for measurements was at least 15cm. Additional precautions are routinely taken to ensure the stability of the simulated tissue such as covering the phantoms when scans are not actively in process in order to minimize evaporation. The lab environment is continuously monitored. The table below presents the range and average environmental conditions during the SAR tests reported herein:

TABLE 12

	Target	Measured
Ambient Temperature	18 - 25 ˚C	Range: 21.1-23.6˚C Avg. 22.9˚C
Relative Humidity	30 - 70 %	Range: 43.0-58.3% Avg. 48.3%
Tissue Temperature	NA	Range: 19.8-21.7˚C Avg. 20.8˚C

Relative humidity target range is a recommended target

The EME Lab RF environment uses a Spectrum Analyzer to monitor for extraneous large signal RF contaminants that could possibly affect the test results. If such unwanted signals are discovered the SAR scans are repeated.

12.0 DUT Test Methodology

12.1 Measurements

SAR measurements were performed using the DASY system described in section 8.0 using zoom scan. Elliptical flat phantoms filled with applicable simulated tissue were used for body and face testing.

12.2 DUT Configuration(s)

The DUT is a portable device operational at the body and face as described in section 6.0 while using the applicable accessories listed in section 7.0. All accessories listed in section 7.0 of this report were considered when implementing the guidelines specified in KDB 643646 D01.

12.3 DUT Positioning Procedures

The positioning of the device for each body location is described below and illustrated in APPENDIX I.

12.3.1 Body

The DUT was positioned in normal use configuration against the phantom with the offered body worn accessories as well as with the offered audio accessories as applicable.

12.3.2 Head

Not applicable.

12.3.3 Face

The DUT was positioned with its' front side separated 2.5cm from the phantom.

12.4 DUT Test Channels:

The number of test channels was determined by using the following IEEE 1528 equation. The use of this equation produces the same or more test channels compared to the FCC KDB 447498 number of test channels formula.

$$N_c = 2 * roundup[10 * (f_{high} - f_{low}) / f_c] + 1$$

Where
N_c = Number of channels
F_{high} = Upper channel
F_{low} = Lower channel
F_c = Center channel

12.5 DUT Test Plan:

The guidelines and requirements outlined in "SAR Test Reduction Considerations for Occupational PTT Radios" FCC KDB 643646 D01 dated 4/4/11 for head (face) and body were used to assess compliance of this device. All modes of operation identified in section 6.0 were considered during the development of the test plan.
All tests were performed in 100% CW mode and then 50% duty cycle was applied to the final results. The initial powers measured are within the range of 95%-100% maximum power.

13.0 DUT Test Data

13.1 Assessment at the Body:

The battery NNTN8386A was selected as the default battery to assess at the Body since only one battery is offered (refer to Exhibit 7B for the dimension of the battery). The conducted power measurement for all test channels within Part 90 frequency range (406.1-470 MHz) using the battery NNTN8386A is indicated in Table 13. The channel with the highest conducted power will be identified as the default channel per KDB 643646 D01 SAR Test for PTT Radios v01r01. Highest SAR results from each table are bolded. SAR plots of the highest results are presented in Appendix E-G.

TABLE 13

Test Freq (MHz)	Power (W)
406.125	4.72
419.6	4.73
430	4.75
433	4.74
443.3	4.73
456.7	4.75
470	4.70

13.2 Assessment at the Body with Body worn PMLN6086A:

Assessment of offered antennas with the default battery and body worn accessory PMLN6086A per KDB 643646 D01 SAR Test for PTT Radios v01r01 – Body SAR Test Considerations for Body worn Accessories. Refer to Table 13 for the highest output power channel.

TABLE 14

Assessments at the Body (CW mode)												
Antenna	**Battery**	**Carry Accessory**	**Cable Accessory**	**Test Freq. (MHz)**	**Initial Power (W)**	**SAR Drift (dB)**	**Meas. 1g-SAR (W/kg)**	**Meas. 10g-SAR (W/kg)**	**Max Calc.1g-SAR (W/kg)**	**Max Calc. 10g-SAR (W/kg)**	**Run#**
PMAE4018B	NNTN8386A	PMLN6086A	PMMN4067B RSM	406.125	4.75	-0.45	7.470	5.050	4.19	2.83	CcC-AB-121228-04
				419.600	4.77	-0.33	5.930	4.050	3.22	2.20	CcC-AB-121228-03
				433.000	4.76	-0.38	7.390	4.950	4.07	2.72	CcC-AB-121228-02
PMAE4024B	NNTN8386A	PMLN6086A	PMMN4067B RSM	430.000	4.78	-0.25	7.620	5.080	4.05	2.70	CcC-AB-121228-05
				443.300	4.75	-0.49	7.550	4.980	**4.27**	**2.82**	Lee-AB-121228-06
				456.700	4.77	-0.57	6.260	4.010	3.59	2.30	Lee-AB-121228-07
				470.000							
PMAE4023B	NNTN8386A	PMLN6086A	PMMN4067B RSM	430.000	4.76	-0.31	6.490	4.400	3.51	2.38	Lee-AB-121228-08
				443.300							
				456.700	4.79	-0.9	5.030	3.220	3.10	1.98	Lee-AB-121228-09
				470.000							

13.3 Assessment at the Body with Body worn PMLN6097A:

Assessment of offered antennas with the default battery and body worn accessory PMLN6097A per KDB 643646 D01 SAR Test for PTT Radios v01r01 – Body SAR Test Considerations for Body worn Accessories. Refer to Table 13 for highest output power channel.

TABLE 15

Assessments at the Body (CW mode)											
Antenna	**Battery**	**Carry Accessory**	**Cable Accessory**	**Test Freq. (MHz)**	**Initial Power (W)**	**SAR Drift (dB)**	**Meas. 1g-SAR (W/kg)**	**Meas. 10g-SAR (W/kg)**	**Max Calc.1g-SAR (W/kg)**	**Max Calc. 10g-SAR (W/kg)**	**Run#**
PMAE4018B	NNTN8386A	PMLN6097A	PMMN4067B RSM	406.125							
				419.600							
				433.000	4.80	-0.371	1.958	1.493	1.07	0.81	Lee-AB-130109-02
PMAE4024B	NNTN8386A	PMLN6097A	PMMN4067B RSM	430.000	4.79	-0.353	2.369	1.804	**1.29**	**0.98**	Lee-AB-130109-03
				443.300							
				456.700							
				470.000							
PMAE4023B	NNTN8386A	PMLN6097A	PMMN4067B RSM	430.000	4.78	-0.291	2.299	1.764	1.23	0.95	Lee-AB-130109-04
				443.300							
				456.700							
				470.000							

13.4 Assessment at the Body with Body worn PMLN6099A:

Assessment of offered antennas with the default battery and body worn accessory PMLN6099A per KDB 643646 D01 SAR Test for PTT Radios v01r01 – Body SAR Test Considerations for Body worn Accessories. Refer to Table 13 for highest output power channel.

TABLE 16

Assessments at the Body (CW mode)											
Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Initial Power (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc.1g -SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4018B	NNTN8386A	PMLN6099A	PMMN4067B RSM	406.125							
				419.600							
				433.000	4.79	-0.382	2.078	1.594	1.14	0.87	Lee-AB-130109-05
PMAE4024B	NNTN8386A	PMLN6099A	PMMN4067B RSM	430.000	4.80	-0.371	2.489	1.914	**1.36**	**1.04**	Lee-AB-130109-06
				443.300							
				456.700							
				470.000							
PMAE4023B	NNTN8386A	PMLN6099A	PMMN4067B RSM	430.000	4.78	-0.293	2.198	1.684	1.18	0.90	Lee-AB-130109-07
				443.300							
				456.700							
				470.000							

13.5 Assessment of other audio accessories at the body:

Assessment per KDB 643646 D01 Body SAR Test Considerations for Audio Accessories without Built-in Antenna.

TABLE 17

Assessments at the Body (CW mode)											
Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Initial Power (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc.1g -SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4024B	NNTN8386A	PMLN6086A	PMLN5275C	430.000							
				443.300	4.80	-0.394	8.330	5.485	**4.75**	**3.13**	CcC-AB-130111-06
				456.700							
				470.000							
PMAE4024B	NNTN8386A	PMLN6086A	NNTN8380A/ NNTN8378A	430.000							
				443.300	4.80	-0.446	7.860	5.170	4.36	2.86	Lee-AB-130109-09
				456.700							
				470.000							
PMAE4024B	NNTN8386A	PMLN6086A	PMMN4050A/ RMN4054B	430.000							
				443.300	4.79	-0.42	7.720	5.140	4.26	2.84	Lee-AB-130109-10
				456.700							
				470.000							
PMAE4024B	NNTN8386A	PMLN6086A	PMMN4050A/ RLN4941A	430.000							
				443.300	4.78	-0.434	7.840	5.180	4.35	2.87	PS-AB-130109-11
				456.700							
				470.000							

13.6 Assessment outside FCC Part 90 at the body:

Assessment using highest SAR configuration from Part 90 assessment above (Run# CcC-AB-130111-06, Table 17). Only one offered antenna PMAE4018B applicable for the assessment outside FCC Part 90.

TABLE 18

Assessments at the Body (CW mode)											
Antenna	**Battery**	**Carry Accessory**	**Cable Accessory**	**Test Freq (MHz)**	**Init Pwr (W)**	**SAR Drift (dB)**	**Meas. 1g-SAR (mW/g)**	**Meas. 10g-SAR (mW/g)**	**Max Calc. 1g-SAR (mW/g)**	**Max Calc. 10g-SAR (mW/g)**	**Run#**
PMAE4018B	NNTN8386A	PMLN6086A	PMLN5275C	403.00	4.40	-0.380	6.410	4.380	3.82	2.61	CcC-AB-130129-02

13.7 Assessment at the Face:

The battery NNTN8386A was selected as the default battery. The conducted power measurement for all test channels within Part 90 frequency range (406.1-470 MHz) using battery NNTN8386A is listed in Table 19. The channel with the highest conducted power was used as the default channel per KDB 643646 D01 SAR Test for PTT Radios v01r01. SAR plots of the highest results per table (bolded) are presented in Appendix E-G.

TABLE 19

Test Freq (MHz)	Power (W)
406.125	4.72
419.6	4.73
430	4.75
433	4.74
443.3	4.73
456.7	4.75
470	4.70

Assessment of each of the offered antennas with the default battery per KDB 643646

D01 SAR Test for PTT Radios v01r01 – Head SAR Test Considerations. Refer to Table 19 for highest output power channel.

TABLE 20

Assessments at the Face (CW mode)											
Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Initial Power (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc.1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4018B	NNTN8386A	NONE	NONE	406.125							
				419.600							
				433.000	4.79	-0.463	5.926	4.431	**3.30**	**2.47**	PS-FACE-130109-13
PMAE4024B	NNTN8386A	NONE	NONE	430.000	4.79	-0.343	5.956	4.451	3.23	2.41	PS-FACE-130109-14
				443.300							
				456.700							
				470.000							
PMAE4023B	NNTN8386A	NONE	NONE	430.000	4.76	-0.212	5.096	3.803	2.70	2.01	CcC-FACE-130110-02
				443.300							
				456.700							
				470.000							

13.8 Assessment of outside FCC Part 90 at the Face:

Assessment using highest SAR configuration from Part 90 assessment above Run# PS-FACE-130109-13, Table 20). Only one offered antenna PMAE4018B applicable for the assessment outside FCC Part 90.

TABLE 21

Assessments at the Face (CW mode)											
Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (mW/g)	Meas. 10g-SAR (mW/g)	Max Calc. 1g-SAR (mW/g)	Max Calc. 10g-SAR (mW/g)	Run#
PMAE4018B	NNTN8386A	NONE	NONE	403.000	4.38	-0.313	4.516	3.369	2.70	2.01	PS-FACE-130110-04

13.9 Assessment for Industry Canada frequency range:

Based on the assessment results for body and face per KDB643646 D01, testing was limited at 406.1- 430 MHz & 450 - 470 MHz, due to the overall SAR is < 4.00 W/kg. Therefore, additional tests were performed at 406.1- 430 MHz & 450 - 470 MHz, to be in compliance with Industry Canada frequency range. Assessment is using the overall highest SAR configuration from both body and face assessments. Highest SAR results from both body and face assessments are bolded.

TABLE 22

Assessments at the Body (CW mode)											
Antenna	**Battery**	**Carry Accessory**	**Cable Accessory**	**Test Freq (MHz)**	**Init Pwr (W)**	**SAR Drift (dB)**	**Meas. 1g-SAR (mW/g)**	**Meas. 10g-SAR (mW/g)**	**Max Calc. 1g-SAR (mW/g)**	**Max Calc. 10g-SAR (mW/g)**	**Run#**
406.1- 430 MHz											
PMAE4018B	NNTN8386A	PMLN6086A	PMLN5275C	406.125	4.57	-0.440	6.980	4.740	**4.06**	**2.75**	PS-AB-130121-13
				419.600	4.63	-0.290	5.910	4.030	3.28	2.23	PS-AB-130121-14
PMAE4024B	NNTN8386A	PMLN6086A	PMLN5275C	430.000	4.74	-0.280	6.940	4.670	3.75	2.52	PS-AB-130121-15
PMAE4023B	NNTN8386A	PMLN6086A	PMLN5275C	430.000	4.78	-0.250	6.720	4.500	3.57	2.39	PS-AB-130121-16
450-470 MHz											
PMAE4024B	NNTN8386A	PMLN6086A	PMLN5275C	456.700	4.80	-0.560	6.310	4.070	3.59	2.32	PS-AB-130121-17
				470.000	4.80	-0.600	5.680	3.590	3.26	2.06	PS-AB-130121-18
PMAE4023B	NNTN8386A	PMLN6086A	PMLN5275C	456.700	4.79	-0.750	4.930	3.190	2.94	1.90	CcC-AB-130122-02
				470.000	4.78	-0.900	4.220	2.670	2.61	1.65	CcC-AB-130122-03

TABLE 23

Assessments at the Face (CW mode)											
Antenna	**Battery**	**Carry Accessory**	**Cable Accessory**	**Test Freq (MHz)**	**Init Pwr (W)**	**SAR Drift (dB)**	**Meas. 1g-SAR (mW/g)**	**Meas. 10g-SAR (mW/g)**	**Max Calc. 1g-SAR (mW/g)**	**Max Calc. 10g-SAR (mW/g)**	**Run#**
406.1- 430 MHz											
PMAE4018B	NNTN8386A	NONE	NONE	406.125	4.64	-0.320	5.310	4.000	2.96	2.23	CcC-FACE-130121-06
				419.600	4.78	-0.300	5.210	3.920	2.80	2.11	CcC-FACE-130121-07
PMAE4024B	NNTN8386A	NONE	NONE	430.000	4.79	-0.343	5.956	4.451	**3.23**	**2.41**	PS-FACE-130109-14
PMAE4023B	NNTN8386A	NONE	NONE	430.000	4.76	-0.212	5.096	3.803	2.70	2.01	CcC-FACE-130110-02
450 - 470 MHz											
PMAE4024B	NNTN8386A	NONE	NONE	456.700	4.78	-0.480	4.310	3.230	2.42	1.81	CcC-FACE-130121-08
				470.000	4.78	-0.590	3.580	2.690	2.06	1.55	CcC-FACE-130121-09
PMAE4023B	NNTN8386A	NONE	NONE	456.700	4.80	-0.750	3.880	2.910	2.31	1.73	PS-FACE-130121-10
				470.000	4.79	-0.890	3.090	2.320	1.90	1.43	PS-FACE-130121-11

13.10 Shorten Scan Assessment:

A “shortened” scan using the highest SAR configuration overall from above was performed to validate the SAR drift of the full DASY4™ coarse and zoom scans. Note that the shortened scan represents the zoom scan performance result; this is obtained by first running a coarse scan to find the peak area and then, using a newly charged battery, a zoom scan only was performed. The results of the shortened cube scan presented in APPENDIX E demonstrate that the scaling methodology used to determine the calculated SAR results presented herein are valid. The both SAR results from the table below are provided in APPENDIX E.

TABLE 24

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (mW/g)	Meas. 10g-SAR (mW/g)	Max Calc. 1g-SAR (mW/g)	Max Calc. 10g-SAR (mW/g)	Run#
Shorten scan											
PMAE4024B	NNTN8386A	PMLN6086A	PMLN5275C	443.300	4.60	-0.269	8.651	5.686	4.80	3.16	PS-AB-130111-07

14.0 Simultaneous Transmission Exclusion:

NA

15.0 Conclusion:

Based on the test guidelines from KDB 643646 and satisfying the testing of additional frequencies within the FCC band to be in compliance with Industry Canada frequency range, the highest Operational Maximum Calculated 1-gram and 10-gram average SAR values found for this filing:

TABLE 25

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
Overall	403-470	4.80	3.16	3.30	2.47
FCC	406.1-470	4.80	3.16	3.30	2.47
Industry Canada	406.1-430	4.06	2.75	3.23	2.41
	450-470	3.59	2.32	2.42	1.81

All results are scaled to the maximum output power

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 47 CFR 2.1093(d). The 10 grams result is not applicable to FCC filing.

APPENDIX A
Measurement Uncertainty

The Measurement Uncertainty tables indicated in this APPENDIX are applicable to the DUT test frequencies ranging from 300MHz to 550MHz and for Dipole test frequencies ranging from 300MHz to 550MHz. Therefore, the highest tolerance for the probe calibration uncertainty is indicated.

Table 1:

Uncertainty Budget for Device Under Test, for 300 MHz to 550 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	c_i **(1 g)**	c_i **(10 g)**	**1 g** u_i **(±%)**	**10 g** u_i **(±%)**	v_i
Measurement System									
Probe Calibration	E.2.1	6.7	N	1.00	1	1	6.7	6.7	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				12	11	482
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k* =2				23	23	

FCD-0558 Uncertainty Budget Rev.8.1

Table 2:

Uncertainty Budget for System Verification (dipole & flat phantom) for 300 MHz to 550 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	c_i **(1 g)**	c_i **(10 g)**	**1 g** u_i **(±%)**	**10 g** u_i **(±%)**	v_i
Measurement System									
Probe Calibration	E.2.1	6.7	N	1.00	1	1	6.7	6.7	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				19	19	

FCD-0558 Uncertainty Budget Rev.8.1

Notes for Tables 1 and 2

a) Column headings *a*-*k* are given for reference.
b) Tol. - tolerance in influence quantity.
c) Prob. Dist. – Probability distribution
d) N, R - normal, rectangular probability distributions
e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
f) *ci* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
g) *ui* – SAR uncertainty
h) *vi* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

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
Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **Motorola MY**

Certificate No: ES3-3196_Apr12

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3196
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	April 27, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: April 27, 2012

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

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	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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization 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, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3196

Manufactured: June 16, 2008
Calibrated: April 27, 2012

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]	1.27	1.29	1.33	± 10.1 %
DCP (mV)[B]	102.2	100.1	100.1	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	159.3	±3.0 %
			Y	0.00	0.00	1.00	163.8	
			Z	0.00	0.00	1.00	164.9	

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 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: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	Depth (mm)	Unct. (k=2)
300	45.3	0.87	7.20	7.20	7.20	0.25	1.09	± 13.4 %
450	43.5	0.87	6.64	6.64	6.64	0.15	1.63	± 13.4 %
750	41.9	0.89	6.68	6.68	6.68	0.79	1.25	± 12.0 %
900	41.5	0.97	6.31	6.31	6.31	0.79	1.31	± 12.0 %
1810	40.0	1.40	5.16	5.16	5.16	0.79	1.27	± 12.0 %
1950	40.0	1.40	4.95	4.95	4.95	0.79	1.30	± 12.0 %
2300	39.5	1.67	4.75	4.75	4.75	0.79	1.29	± 12.0 %
2450	39.2	1.80	4.49	4.49	4.49	0.79	1.29	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.79	1.32	± 12.0 %

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

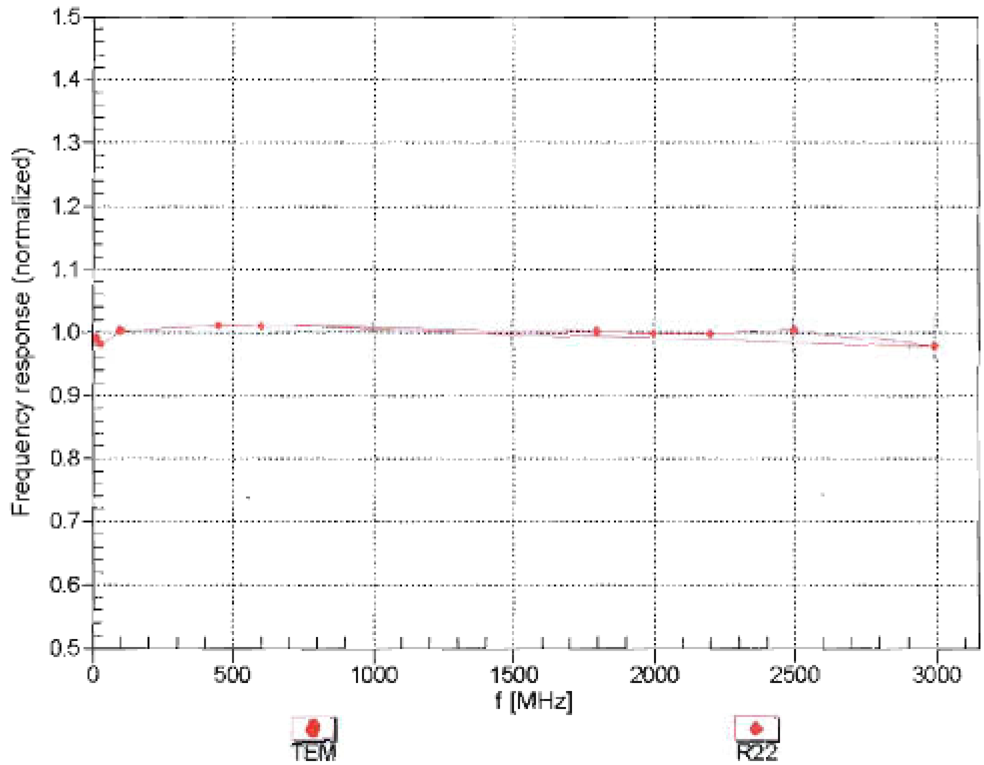
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3196

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	Depth (mm)	Unct. (k=2)
300	58.2	0.92	6.83	6.83	6.83	0.24	1.92	± 13.4 %
450	56.7	0.94	6.99	6.99	6.99	0.09	1.00	± 13.4 %
750	55.5	0.96	6.37	6.37	6.37	0.79	1.40	± 12.0 %
900	55.0	1.05	6.22	6.22	6.22	0.79	1.37	± 12.0 %
1810	53.3	1.52	4.79	4.79	4.79	0.79	1.41	± 12.0 %
1950	53.3	1.52	4.73	4.73	4.73	0.79	1.42	± 12.0 %
2300	52.9	1.81	4.35	4.35	4.35	0.79	1.31	± 12.0 %
2450	52.7	1.95	4.20	4.20	4.20	0.79	1.21	± 12.0 %
2600	52.5	2.16	4.00	4.00	4.00	0.79	1.11	± 12.0 %

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

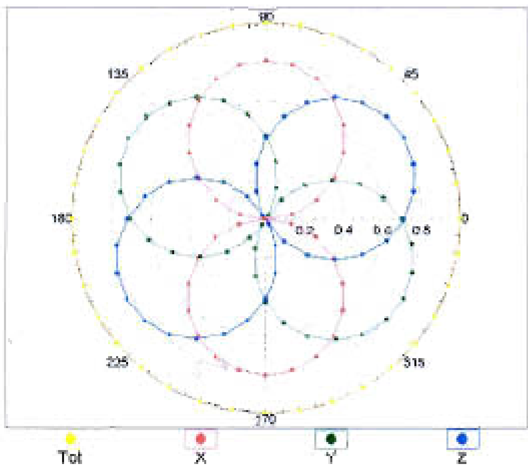
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



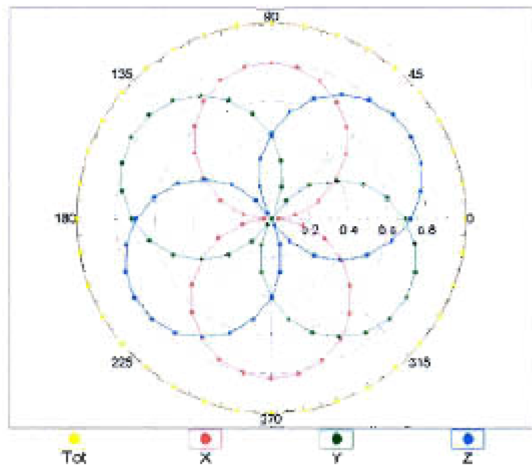
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

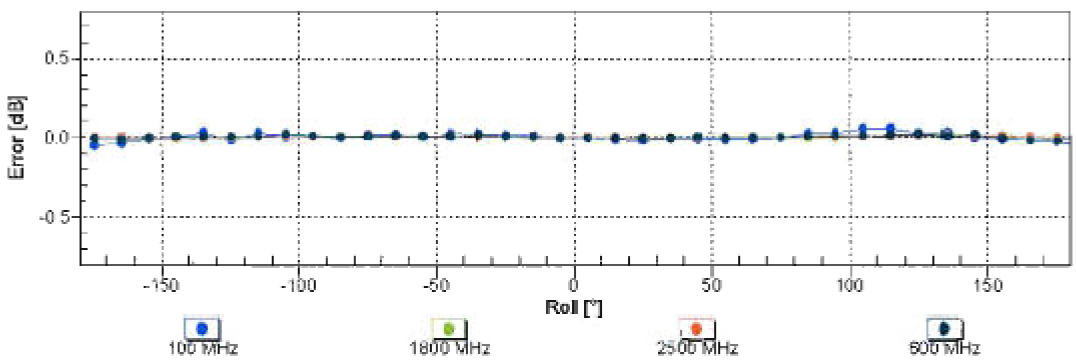
Receiving Pattern (ϕ), $\vartheta = 0°$

f=1800 MHz,R22



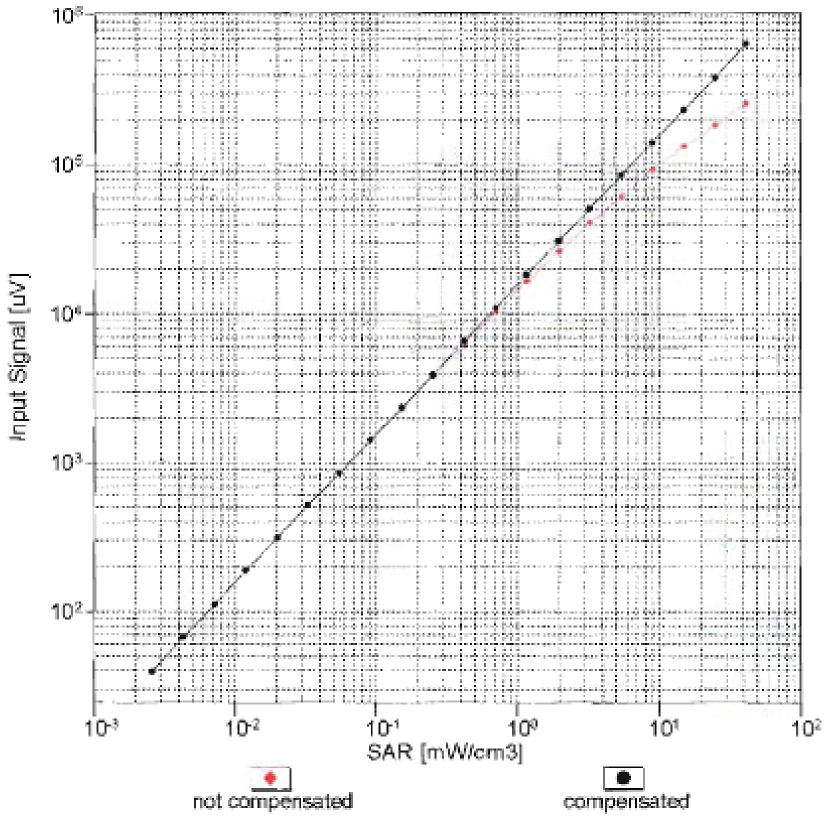
f=600 MHz,TEM

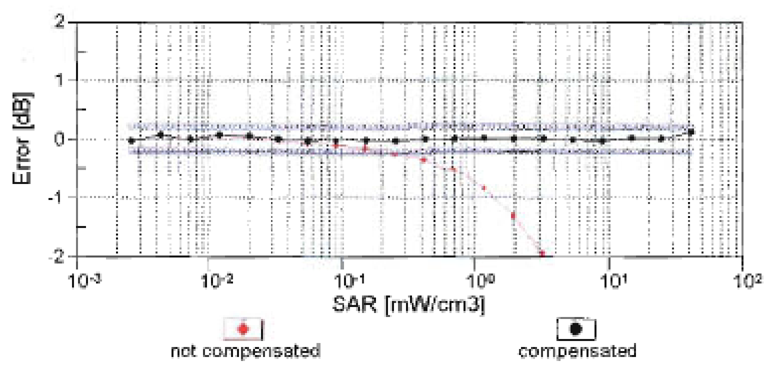




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

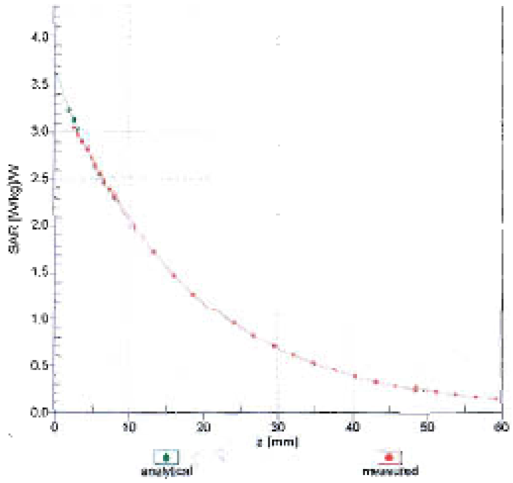




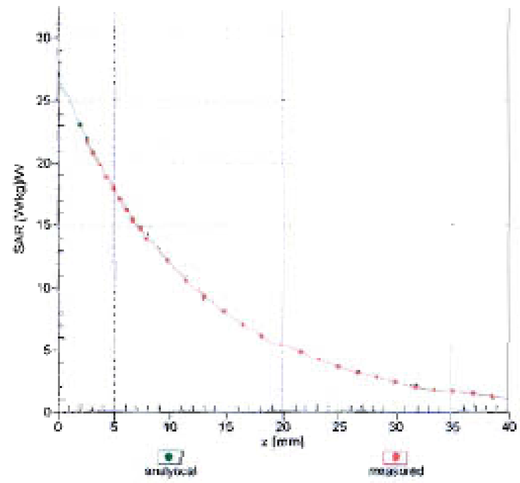
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz, WGLS R9 (H_convF)

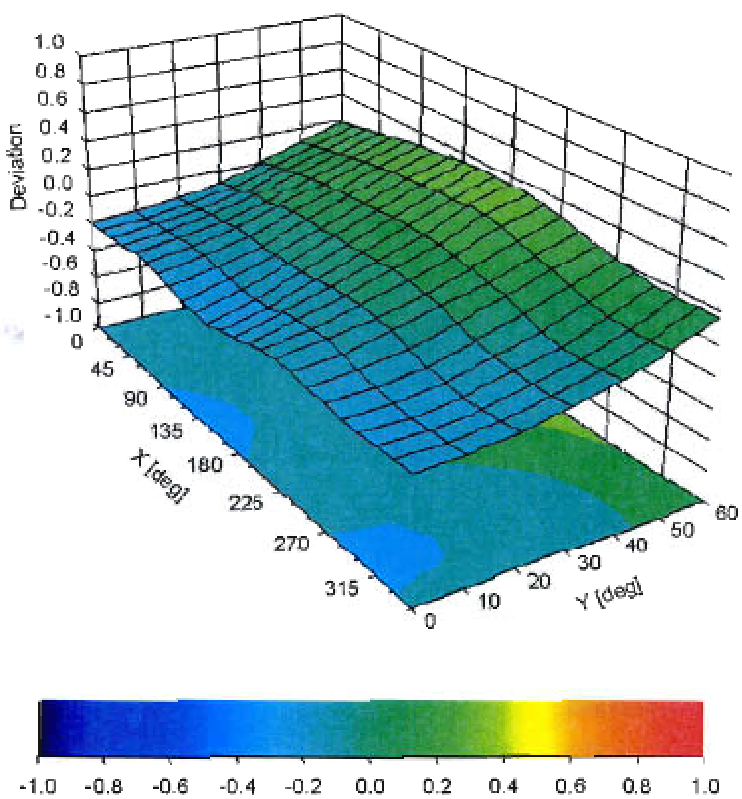


f = 1810 MHz, WGLS R22 (H_convF)



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 (°)	-174.5
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

Schmid & Partner Engineering AG **s p e a g**

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV3**
Serial Number:	**3196**
Place of Assessment:	**Zurich**
Date of Assessment:	**April 28, 2012**
Probe Calibration Date:	**April 27, 2012**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 450, 900 MHz or 1810 MHz.

Assessed by:

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ES3DV3 SN:3196

Conversion factor (± standard deviation)

150 ± 50 MHz	*ConvF*	**8.6 ± 10%**	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
250 ± 50 MHz	*ConvF*	**8.0 ± 10%**	ε_r = 47.6 ± 5% σ = 0.83 ± 5% mho/m (head tissue)
150 ± 50 MHz	*ConvF*	**8.3 ± 10%**	ε_r = 61.9 ± 5% σ = 0.80 ± 5% mho/m (body tissue)
250 ± 50 MHz	*ConvF*	**7.8 ± 10%**	ε_r = 59.4 ± 5% σ = 0.88 ± 5% mho/m (body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also DASY Manual.

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

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

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

Accreditation No.: SCS 108

Client **Motorola MY**

Certificate No: ES3-3122_Apr12

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3122
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	April 26, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: April 27, 2012

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

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	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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization 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, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3122

Manufactured: July 11, 2006
Calibrated: April 26, 2012

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 ($\mu V/(V/m)^2$)[A]	1.34	1.22	1.42	± 10.1 %
DCP (mV)[B]	102.0	100.9	99.8	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	161.7	±3.0 %
			Y	0.00	0.00	1.00	154.6	
			Z	0.00	0.00	1.00	179.0	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: 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	Depth (mm)	Unct. (k=2)
300	45.3	0.87	6.94	6.94	6.94	0.25	1.10	± 13.4 %
450	43.5	0.87	6.41	6.41	6.41	0.14	1.67	± 13.4 %
750	41.9	0.89	6.55	6.55	6.55	0.25	2.02	± 12.0 %
900	41.5	0.97	6.22	6.22	6.22	0.20	2.33	± 12.0 %
1810	40.0	1.40	5.29	5.29	5.29	0.60	1.40	± 12.0 %
1950	40.0	1.40	5.16	5.16	5.16	0.61	1.39	± 12.0 %
2300	39.5	1.67	4.95	4.95	4.95	0.62	1.42	± 12.0 %
2450	39.2	1.80	4.60	4.60	4.60	0.80	1.19	± 12.0 %
2600	39.0	1.96	4.42	4.42	4.42	0.80	1.12	± 12.0 %

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

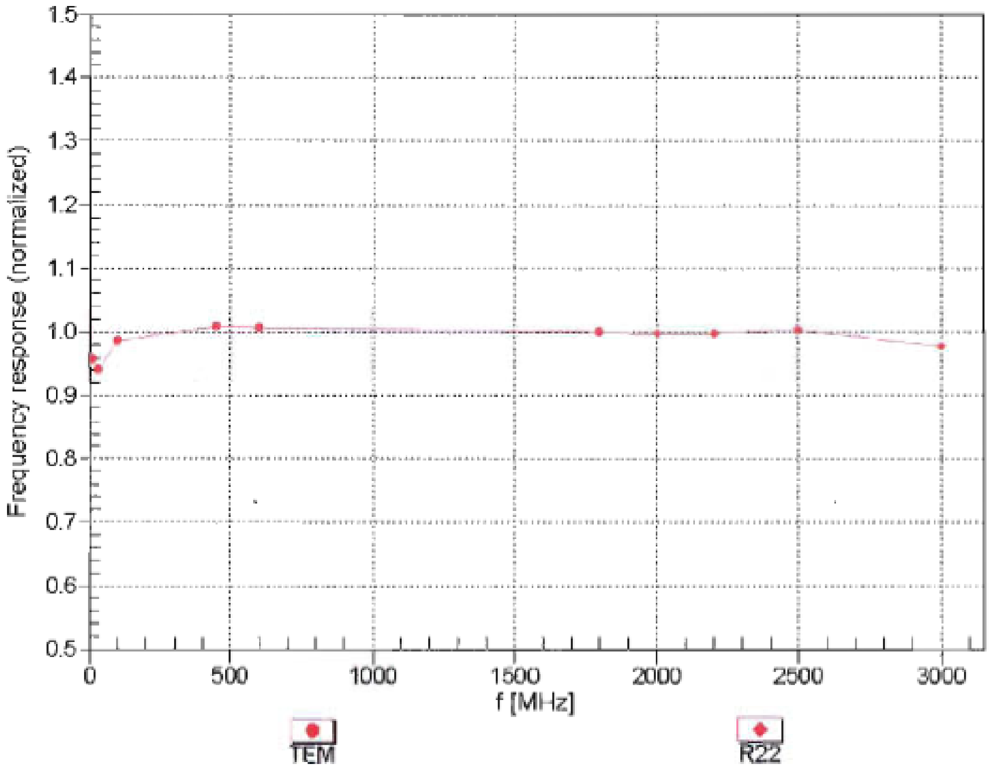
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	58.2	0.92	6.58	6.58	6.58	0.23	1.88	± 13.4 %
450	56.7	0.94	6.82	6.82	6.82	0.09	1.00	± 13.4 %
750	55.5	0.96	6.19	6.19	6.19	0.29	1.92	± 12.0 %
900	55.0	1.05	6.06	6.06	6.06	0.38	1.60	± 12.0 %
1810	53.3	1.52	4.74	4.74	4.74	0.27	2.98	± 12.0 %
1950	53.3	1.52	4.64	4.64	4.64	0.42	1.99	± 12.0 %
2300	52.9	1.81	4.25	4.25	4.25	0.69	1.24	± 12.0 %
2450	52.7	1.95	4.16	4.16	4.16	0.80	0.61	± 12.0 %
2600	52.5	2.16	3.94	3.94	3.94	0.80	0.50	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

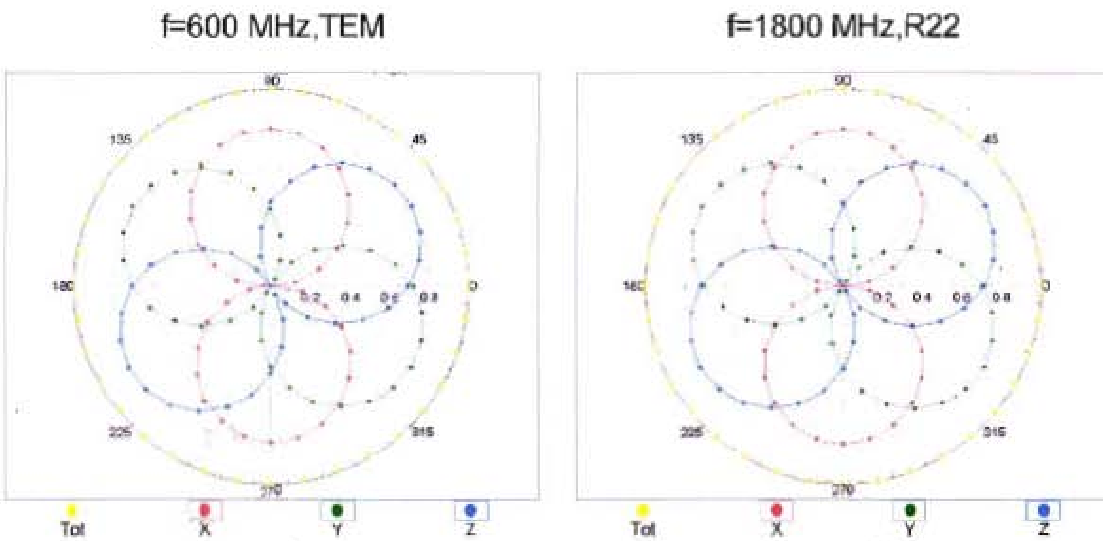
Frequency Response of E-Field

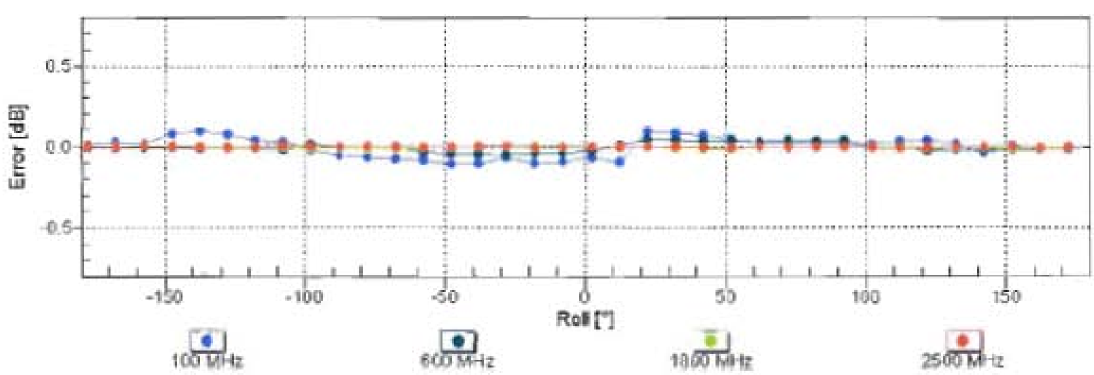
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

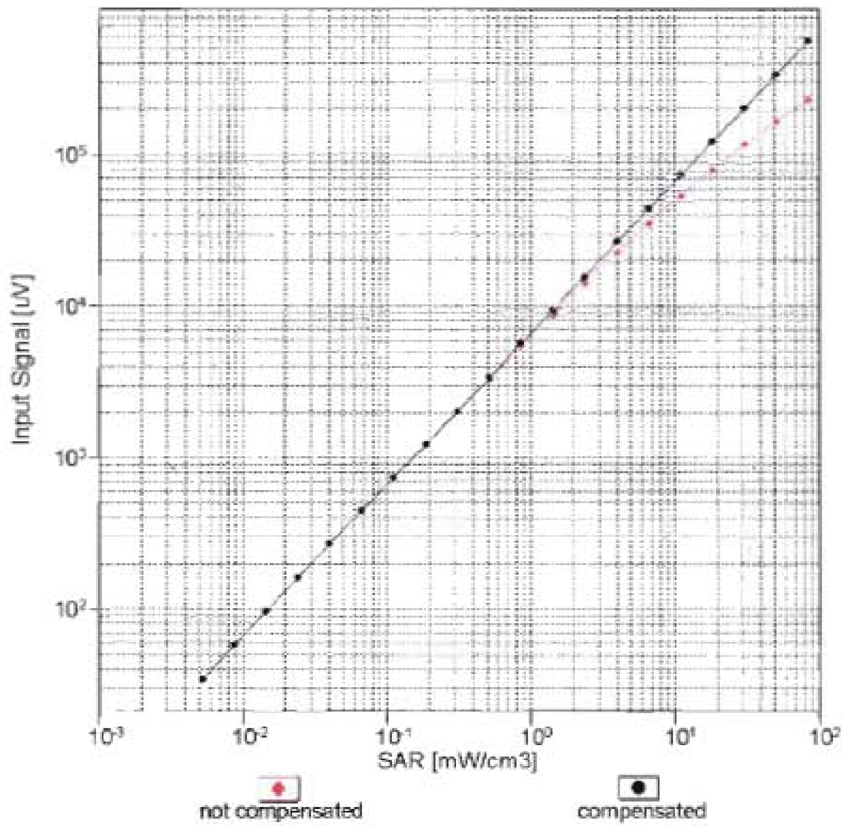
Receiving Pattern (ϕ), $\vartheta = 0°$

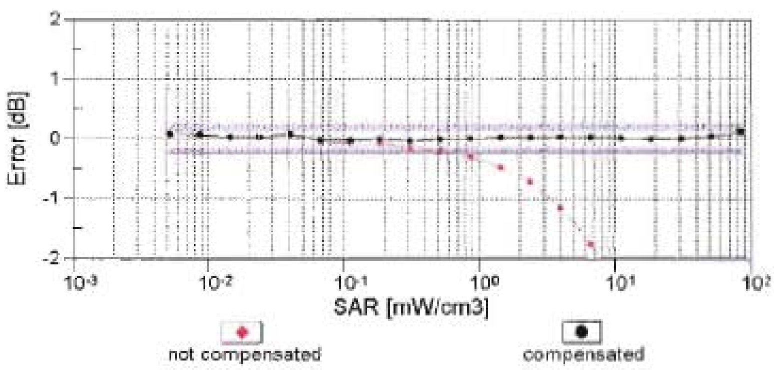




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

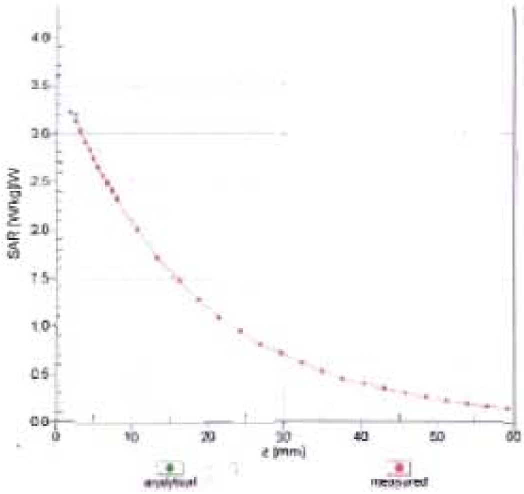
Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

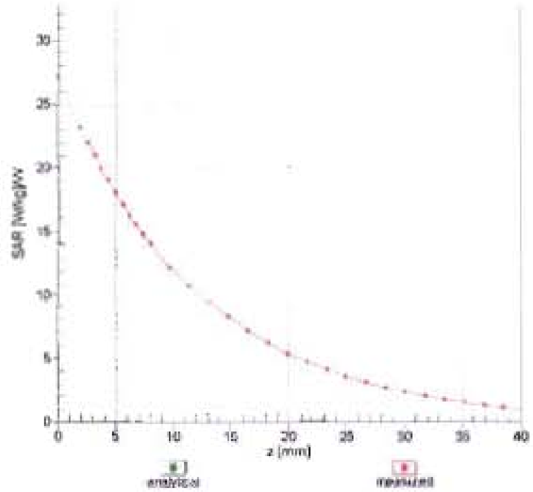




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

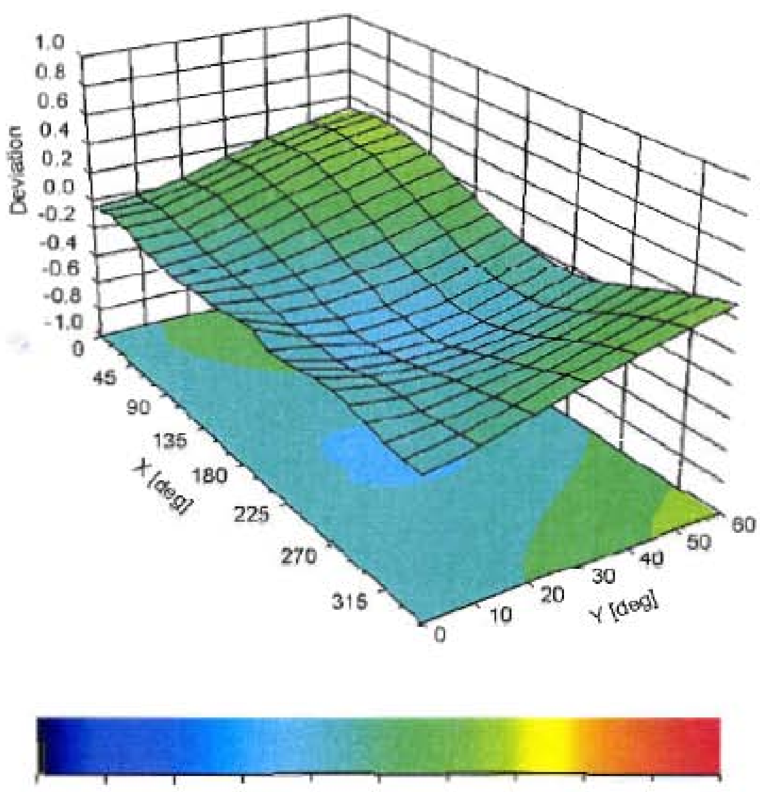
Conversion Factor Assessment





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 (°)	22.4
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

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV3**
Serial Number:	**3122**
Place of Assessment:	**Zurich**
Date of Assessment:	**April 28, 2012**
Probe Calibration Date:	**April 26, 2012**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 450, 900 MHz or 1810 MHz.

Assessed by:

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ES3DV3 SN:3122

Conversion factor (± standard deviation)

150 ± 50 MHz	*ConvF*	**8.5 ± 10%**	**ε_r = 52.3 ± 5%** **σ = 0.76 ± 5% mho/m** (head tissue)
250 ± 50 MHz	*ConvF*	**7.9 ± 10%**	**ε_r = 47.6 ± 5%** **σ = 0.83 ± 5% mho/m** (head tissue)
150 ± 50 MHz	*ConvF*	**8.2 ± 10%**	**ε_r = 61.9 ± 5%** **σ = 0.80 ± 5% mho/m** (body tissue)
250 ± 50 MHz	*ConvF*	**7.7 ± 10%**	**ε_r = 59.4 ± 5%** **σ = 0.88 ± 5% mho/m** (body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also DASY Manual.

APPENDIX C
Dipole Calibration Certificates

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

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

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

Accreditation No.: SCS 108

Client **Motorola MY**

Certificate No: D450V3-1054_Nov11

CALIBRATION CERTIFICATE

Object	D450V3 - SN: 1054
Calibration procedure(s)	QA CAL-15.v6 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	November 21, 2011

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 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	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.3 / 06327	29-Mar-11 (No. 217-01168)	Apr-12
Reference Probe ET3DV6	SN: 1507	29-Apr-11 (No. ET3-1507_Apr11)	May-12
DAE4	SN: 654	03-May-11 (No. DAE4-654_May11)	May-12

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

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

Issued: November 21, 2011

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

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

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

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

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
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	44.1 ± 6 %	0.85 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	398 mW input power	1.85 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**4.75 mW /g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	398 mW input power	1.23 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**3.15 mW /g ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.1 Ω - 5.6 jΩ
Return Loss	- 21.4 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.
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: 21.11.2011

Test Laboratory: SPEAG

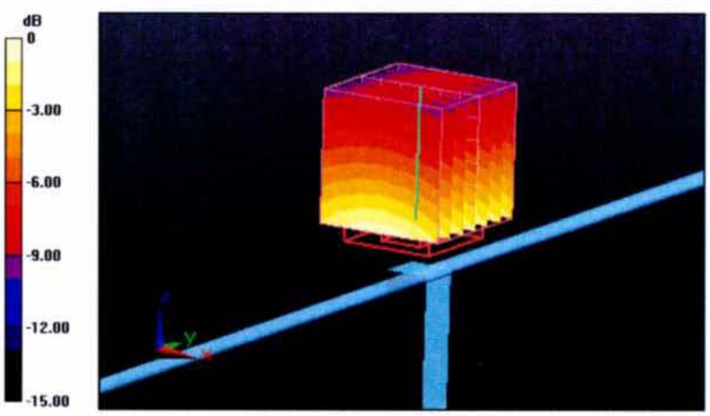
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1054

Communication System: CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.85 mho/m; ε_r = 44.1; ρ = 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: 29.04.2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 03.05.2011
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

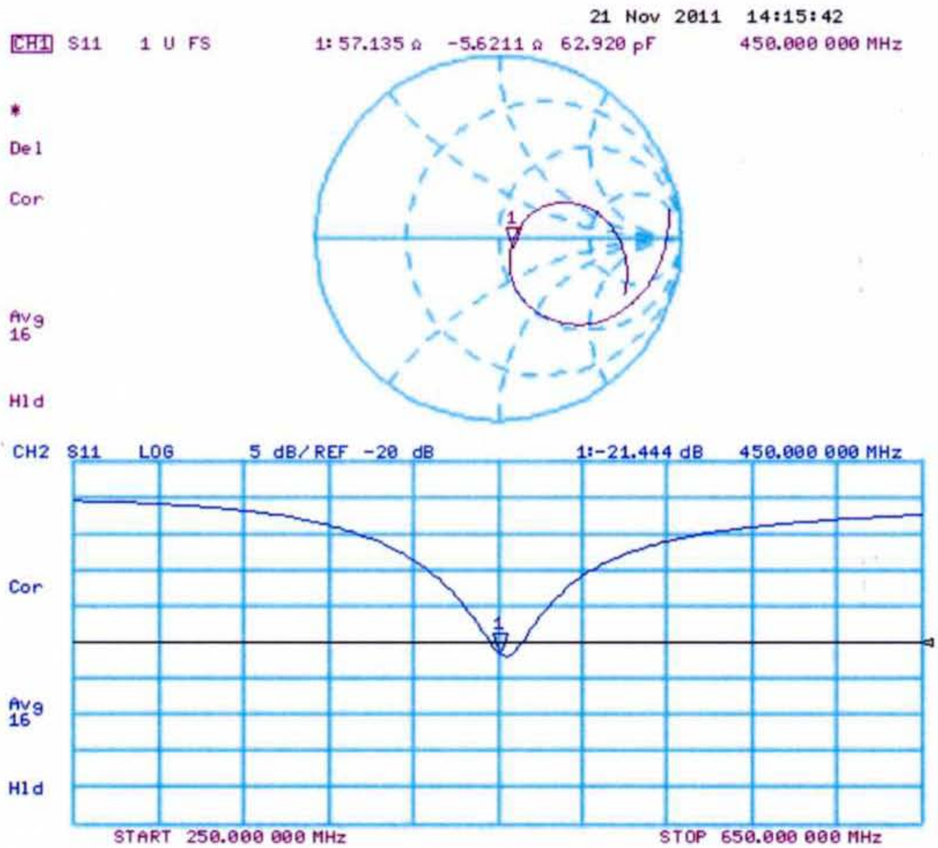
Dipole Calibration for Head Tissue/d=15mm, Pin=398mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 49.817 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 2.818 W/kg
SAR(1 g) = 1.85 mW/g; SAR(10 g) = 1.23 mW/g
Maximum value of SAR (measured) = 1.979 mW/g



0 dB = 1.980mW/g

Certificate No: D450V3-1054_Nov11 Page 5 of 6

Impedance Measurement Plot for Head TSL



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

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

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

Accreditation No.: **SCS 108**

Client **Motorola MY (Precision)**

Certificate No: **D450V3-1054_May12**

CALIBRATION CERTIFICATE

Object	D450V3 - SN: 1054
Calibration procedure(s)	QA CAL-15.v6 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	May 21, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ET3DV6	SN: 1507	30-Dec-11 (No. ET3-1507_Dec11)	Dec-12
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-11)	In house check: Oct-12

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

Issued: May 22, 2012

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

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
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	V52.8.1
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	

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	54.7 ± 6 %	0.92 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	398 mW input power	1.77 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**4.49 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	398 mW input power	1.17 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**2.97 mW / g ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Body TSL

Impedance, transformed to feed point	57.3 Ω - 2.9 jΩ
Return Loss	- 22.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.222 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 Body TSL

Date: 21.05.2012

Test Laboratory: SPEAG

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

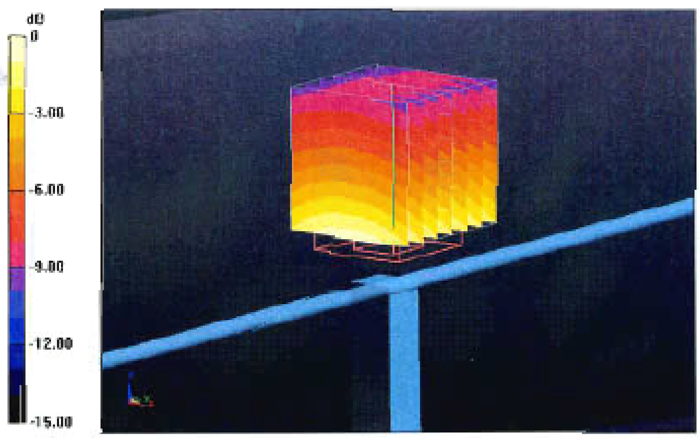
Communication System: CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; $\sigma = 0.92$ mho/m; $\varepsilon_r = 54.7$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(7.05, 7.05, 7.05); Calibrated: 30.12.2011;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.04.2012
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Body Tissue/d=15mm, Pin=398mW/Zoom Scan (7x7x7)/Cube 0:

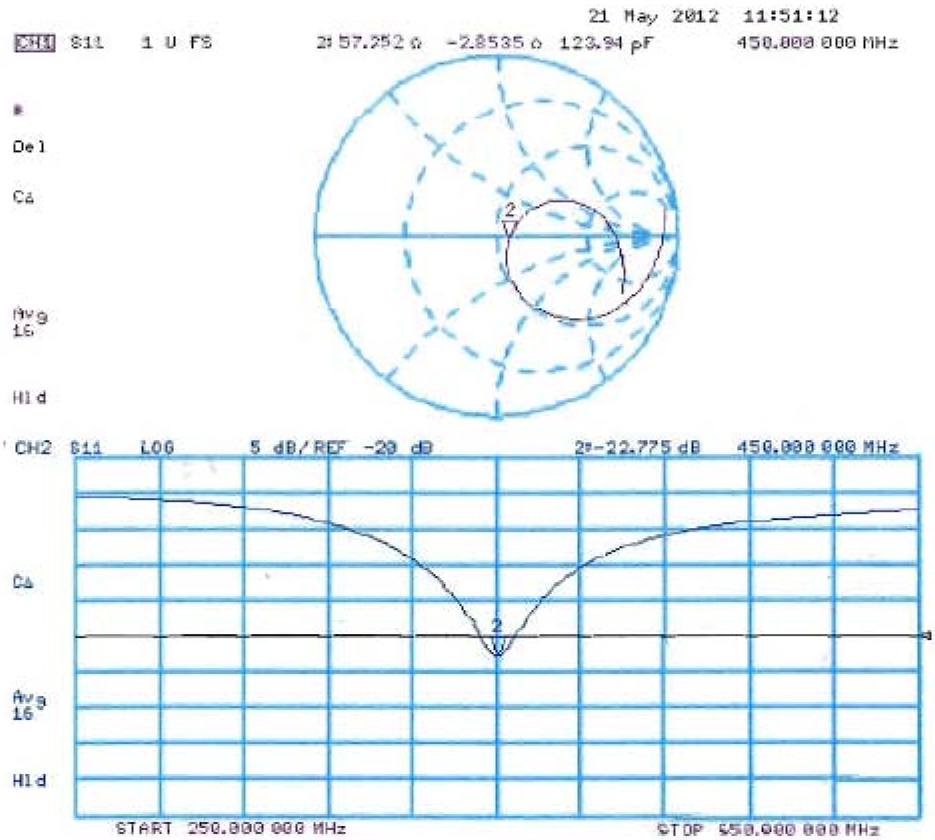
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 46.569 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 2.760 mW/g
SAR(1 g) = 1.77 mW/g; SAR(10 g) = 1.17 mW/g
Maximum value of SAR (measured) = 1.89 mW/g



0 dB = 1.89 mW/g = 5.53 dB mW/g

Certificate No: D450V3-1054_May12 Page 5 of 6

Impedance Measurement Plot for Body TSL



Certificate No: D450V3-1054_May12 Page 6 of 6