MOTOROLA SOLUTIONS

ACCREDITED
TESTING CERT # 2518.01

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

Motorola Solutions, Inc
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Date of Report: 12/11/2014
Report Revision: A

Responsible Engineer:	Deanna Zakharia (Plantation Lab Director EME Test Lab)
Report Author:	Tan Kai Yan (EME Engineer)
Date/s Tested:	10/01/14 – 10/15/14
Manufacturer/Location:	Motorola Solutions, Inc, Penang
Sector/Group/Div.:	EMS
Date submitted for test:	09/12/14
DUT Description:	RDU4100+ UHF BRUS 10CH Non-Display, Removable Antenna, 4.0 Watts, Black, Li-Ion; & RDU4160+ UHF BRUS 16CH Display, Removable Antenna 4.0 Watts, Black, Li-Ion
Test TX mode(s):	TDMA (PTT)
Max. Power output:	4.2 W
Nominal Power:	4.0 W
Tx Frequency Bands:	438-470 MHz
Signaling type:	FM
Model(s) Tested:	PMUE4599A & PMUE4618A
Model(s) Certified:	PMUE4599A & PMUE4618A
Serial Number(s):	11 & 6
Classification:	Occupational/Controlled
FCC ID:	AZ489FT4923; (438-470 MHz)
IC :	109U-89FT4923 ; (450-470 MHz)

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 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

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Approval Date: 12/12/2014

Certification Date: 10/23/2014

Certification No. L1141010P & L1141011P

Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
10/23/2014	O	Initial release
12/11/2014	A	References updated Pg. 5

1.0 Introduction

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 PMUE4599A and PMUE4618A. These devices are classified as Occupational/Controlled.

2.0 FCC SAR Summary

TABLE 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/Kg)		Max Calc at Face (W/Kg)		Max Calc at Head (W/Kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR	1g-SAR	10g-SAR
TNF	438-470	2.18	1.59	2.34	1.75	NA	NA
*Simultaneous Results		NA	NA	NA	NA	NA	NA

3.0 Abbreviations / Definitions

CNR: Calibration Not Required
EME: Electromagnetic Energy
DUT: Device Under Test
NA: Not Applicable
PTT: Push to Talk
SAR: Specific Absorption Rate
RSM: Remote Speaker Microphone
FM: Frequency Modulation
IF: Intermediate Frequency
TNF: Licensed Non-Broadcast Transmitter Held to Face

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.

4.0 Referenced Standards and Guidelines

These products are 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)

- Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C.:1997.

- 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.

- FCC KDB – 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r02 (12/04/2013)

- FCC KDB – 643646 D01 SAR Test for PTT Radios v01r01 (04/04/2011)

- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03 (02/07/2014)
  D02 RF Exposure Reporting v01r01 (05/28/2013)

- FCC KDB – 447498 D01 General RF Exposure Guidance v05r02 (02/07/2014)

5.0 SAR Limits

TABLE 2

EXPOSURE LIMITS	SAR (W/Kg) (General Population / Uncontrolled Exposure Environment)	SAR (W/Kg) (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

6.0 Description of Device Under Test (DUT)

These portable devices operate using Zero Intermediate Frequency (IF) with analog Frequency Modulation (FM) signaling incorporating traditional simplex two-way radio transmission protocol. These models intended use are to be 5-5-90 (5% TX, 5% RX and 90% standby), with a maximum duty cycle of 50%.

The models represented under this filing utilize removable antennas capable of transmitting in the 438-470 MHz band respectively. The nominal output powers are 4.0 W with maximum output powers of 4.2 W as defined by upper limit of the production line final test station. The intended operating positions are “at the face” with the DUT at least 2.5cm 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.

Models PMUE4599A and PMUE4618A are being offered with the accessories listed in section 7.0.

7.0 Optional Accessories and Test Criteria

These devices is offered with optional accessories. All accessories were individually evaluated during the test plan creation to determine if testing was required per the guidelines outlined in section 4.0 to assess compliance of these devices. The following sections identify the test criteria and details for each accessory category.

7.1 Antenna

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

TABLE 3

Antenna Models	Description	Selected for test	Tested
8575099C01	Helical antenna, 403-470MHz, ¼ wave, 3 dBi gain	Yes	Yes

7.2 Battery

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

TABLE 4

Battery Models	Description	Selected for test	Tested	Comments
60012000001	Ultra high cap Li-Ion 2400mAh	Yes	Yes	

7.3 Body worn Accessory

There is one body worn accessory offered for this product. The table below lists the body worn accessory, and body worn accessory description.

TABLE 5

Body worn Models	Description	Selected for test	Tested	Comments
4280383X62	Spring Action Belt Clip	Yes	Yes	

7.4 Audio Cable Accessories

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

TABLE 6

Audio Acc. Models	Description	Selected for test	Tested	Comments
HKLN4604A	Swivel Earpiece W/PTT (RLN6423F)	Yes	Yes	
HKLN4606A	Remote Speaker Mic (53862F)	Yes	No	Intended for test. Per KDB provisions test not required.
HKLN4601A	Dual Pin Surveillance W/PTT (HKLN4477F)	Yes	No	Intended for test. Per KDB provisions test not required.
HKLN4605A	EarBud W clip PTT Mic (53866F)	Yes	No	Intended for test. Per KDB provisions test not required.
HKLN4599A	Earpiece with in-line PTT Mic (56517F)	No	No	By similarity to HKLN4604A

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

TABLE 7

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.8.8.1222	DAE4	ES3DV3 (E-Field)

The DASY5™ system is operated per the instructions in the 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 8

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	OVAL1019 OVAL1020					

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 9. 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 9

Ingredients	450 MHz	
	Head	Body
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
Bacteria	0.1	0.1

9.0 Additional Test Equipment

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

TABLE 10

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Power Meter (Agilent)	E4419B	MY45103725	3/3/2014	3/3/2015
E-Series Avg. Power Sensor (Agilent)	E9301B	MY41495730	4/10/2014	4/10/2015
E-Series Avg. Power Sensor	E9301B	MY41495733	4/10/2014	4/10/2015
Power Meter (HP)	E4418B	US39251267	1/27/2014	1/27/2015
Power Sensor (HP)	8481B	3318A10982	4/9/2014	4/9/2015
Signal Generator (Agilent)	E4428C	MY47381119	6/7/2013	6/7/2015
Bi-Dir. Coupler (NARDA)	40296	40296	1/31/2014	1/31/2016
AMP (Amplifier Research)	1W1000	16625	CNR	CNR
AMP (Amplifier Research)	10W1000	5924	CNR	CNR
Dickson Temperature Recorder	TM320	7081356	9/16/2014	9/16/2015
Dickson Temperature Recorder	TM325	12121144	5/16/2014	5/16/2015
Omega Digital Thermometer with J Type TC Probe	HH200A	20857	10/23/2013	10/23/2014
Omega Digital Thermometer with J Type TC Probe	HH200A	48870	6/9/2014	6/9/2015
Omega Digital Thermometer with J Type TC Probe	HH202A	18800	3/3/2014	3/3/2015
Omega Digital Thermometer with J Type TC Probe	HH202A	18801	6/9/2014	6/9/2015
Agilent PNA-L Network Analyzer	N5230C	MY49002155	8/4/2014	8/4/2015
Dielectric Probe Kit (DAK)	DAK-3.5	1059	5/15/2014	5/15/2015
Dielectric Probe Kit (DAK)	DAK-12	1013	5/15/2014	5/15/2015
Speag Dipole	D450V3	1077	11/18/2013	11/18/2015
Speag Probe	ES3DV3	3163	5/15/2014	5/15/2015
Speag DAE	DAE4	1231	2/12/2014	2/12/2015

10.0 SAR Measurement System Validation and Verification

DASY output files of the probe/dipole calibration certificates and system performance test results are included in appendices B, C and D respectively.

10.1 System Validation

The SAR measurement system was validated according to the procedures in KDB 865664. The validation status summary table is below.

TABLE 11

Dates	Probe Calibration Point		Probe SN	Measured Tissue Parameters		Validation for CW		
				σ	ϵ_r	Sensitivity	Linearity	Isotropy
06/12/2014	Body	450	3163	0.97	57.2	Pass	Pass	Pass
06/11/2014	Head	450	3163	0.86	42.6	Pass	Pass	Pass

10.2 System Verification

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 12

Probe Serial #	Tissue Type	Dipole Kit / Serial #	Ref SAR @ 1W (W/kg)	System Check Results Measured (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date
3163	FCC Body	SPEAG D450V3/ 1077	*4.50 +/- 10%	1.10	4.40	10/15/14
	IEEE/IEC Head	SPEAG D450V3/ 1077	*4.64 +/- 10%	1.20	4.80	10/01/14
				1.20	4.80	10/15/14

*Dipole manufacture's reference target

10.3 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 13

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
450	FCC Body	0.94 (0.89 – 0.99)	56.7 (53.9 – 59.5)	0.98	55.3	10/15/2014
	IEEE/ IEC Head	0.87 (0.83 – 0.91)	43.5 (41.3 – 45.7)	0.90	45.6	10/01/2014
				0.88	43.5	10/15/2014
458	FCC Body	0.94 (0.89 – 0.99)	56.7 (53.8 – 59.5)	0.98	55.2	10/15/2014
	IEEE/ IEC Head	0.87 (0.83 – 0.91)	43.5 (41.3 – 45.6)	0.91	45.4	10/01/2014
				0.88	43.3	10/15/2014

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^{o}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 14

	Target	Measured
Ambient Temperature	18 – 25 ˚C	Range: 21.1-23.1˚C Avg. 22.3 ˚C
Relative Humidity	30 – 70 %	Range: 56.0-63.0 % Avg. 58.8 %
Tissue Temperature	NA	Range: 21.7-22.8˚C Avg. 22.1˚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 Setup and Methodology

12.1 Measurements

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

The table below includes the step sizes and resolution of area and zoom scans per KDB 865664 requirements.

TABLE 15

<table>
<tr><th colspan="2">Description</th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="2">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ mm</td></tr>
<tr><td colspan="2">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="2" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="2">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td>Maximum zoom scan spatial resolution, normal to phantom surface</td><td>uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td colspan="4">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

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.

12.3 DUT Positioning Procedures

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

12.3.1 Body

The DUT was positioned in normal use configuration against the phantom with the offered body worn accessory 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 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 F. For these devices the "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" are scaled using the following formula:

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

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 drif

Additional SAR scaling was applied using the methodologies outlined in FCC KDB 865664 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. Negative or reduced SAR scaling is not permitted.

12.6 DUT Test Plan

The guidelines and requirements outlined from section 4.0 were used to assess compliance of these devices. All modes of operation identified in section 6.0 were considered during the development of the test plan. All tests were performed in TDMA mode and then 50% duty cycle was applied respectively to the final results.

13.0 DUT Test Data

13.1 Assessments at the Body

The battery 60012000001 was used for assessments at the Body because it is the only offered battery (refer to Exhibit 7B for the illustration of the battery). The conducted power measurement for all test channels within Part 90 frequency range (438-470 MHz) which is listed in Table 16. SAR plots of the highest result per Table (bolded) is presented in Appendix E.

TABLE 16

Test Freq (MHz)	Power (W)
438	3.94
451.1875	4.12
457.8625	4.20
470	4.10

Assessments at the Body with Body-worn 4280383X62

Assessment of the offered antennas with the default battery and body worn per KDB 643646. Testing of additional channels was not required per KDB 447498. All results are below 4.0 W/kg. SAR plots of the highest results per Table (bolded) is presented in Appendix E.

TABLE 17

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (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#
8575099C01	60012000001	4280383X62	HKLN4604A	438.0000							
				451.1875							
				457.8625	4.2	-0.56	3.83	2.80	**2.18**	**1.59**	AvG-Ab-141015-03
				470.000							

Assessment at the Body with other audio accessories

Assessment per “KDB 643646 D01 Body SAR Test Consideration for Audio Accessories without Built-in Antenna; Sec 1, A. when overall < 4.0 W/kg, SAR testing for that audio accessory is not necessary.” This was applicable to all remaining accessories.

13.2 Assessments at the Face

The battery 60012000001 was used for assessments at the Face because it is only offered battery (refer to Exhibit 7B for the illustration of the battery). The conducted power measurement for all test channels within Part 90 frequency range (438-470 MHz) which is listed in Table 18. SAR plot of the highest result per Table (bolded) is presented in Appendix E.

TABLE 18

Test Freq (MHz)	Power (W)
438	3.88
451.1875	4.10
457.8625	4.20
470	4.05

Assessment of the offered antennas with the default battery with front of DUT positioned 2.5cm facing phantom. SAR plot of the highest result per Table (bolded) is presented in Appendix E.

TABLE 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (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#
8575099C01	60012000001	NONE	NONE	438.0000							
				451.1875							
				457.8625	4.20	-0.61	4.07	3.04	**2.34**	**1.75**	ErC-Face-141001-06
				470.000							

13.3 Assessments for Industry Canada

Based on the assessment results for body and face per KDB643646 D01, additional tests were not required for the Industry Canada frequency range (450-470 MHz) as the testing performed is in compliance with Industry Canada frequency range.

13.4 Shortened Scan Assessment

A “shortened” scan using the highest SAR configuration overall from the Part 90 was performed to validate the SAR drift of the full DASY5™ 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 SAR results from the table below is provided in APPENDIX E.

TABLE 20

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											
8575099C01	60012000001	NONE	NONE	457.8625	4.20	-0.69	3.80	2.83	**2.23**	**1.66**	AvG-Face-141015-06

14.0 Simultaneous Transmission Exclusion

Not applicable.

15.0 Results Summary

Based on the test guidelines from KDB 643646 and satisfying frequencies with Part 15 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 21

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	438-470	2.18	1.59	2.34	1.75
FCC	438-470	2.18	1.59	2.34	1.75
Industry Canada	450-470	2.18	1.59	2.34	1.75

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.

16.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is not required because SAR results are below 4.0W/kg (Occupational).

17.0 System Uncertainty

A system uncertainty analysis is not required for this report per KDB 865664 because the highest report SAR value for Occupational exposure is less than 7.5W/kg.

Per the guidelines of ISO 17025 a reported system uncertainty is required and therefore measurement uncertainty budget is included in Appendix A.

Appendix A
Measurement Uncertainty Budget

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

Notes for uncertainty budget Table:

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
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 EME**

Certificate No: **ES3-3163_May14**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3163
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:	May 15, 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-13)	In house check: Oct-14

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

Issued: May 17, 2014

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:3163

Manufactured: October 8, 2007
Calibrated: May 15, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3163

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.31	1.12	1.04	± 10.1 %
DCP (mV)[B]	104.3	102.9	104.6	

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	216.3	±3.5 %
		Y	0.0	0.0	1.0		203.1	
		Z	0.0	0.0	1.0		190.3	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.01	69.5	19.3	1.87	128.2	±0.5 %
		Y	3.15	69.9	19.2		138.1	
		Z	2.99	69.2	18.8		130.7	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.13	70.8	23.5	9.46	123.4	±3.0 %
		Y	10.99	70.3	22.9		135.5	
		Z	10.75	70.0	22.9		124.0	
10059-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	3.57	72.0	20.4	2.12	127.7	±0.5 %
		Y	3.62	71.7	19.9		138.6	
		Z	3.29	70.3	19.3		130.8	
10060-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	14.52	99.5	30.0	2.83	137.9	±0.7 %
		Y	9.55	90.9	26.8		148.9	
		Z	11.15	94.5	28.1		138.7	
10061-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	12.48	92.4	28.1	3.60	140.5	±0.9 %
		Y	8.08	84.0	24.8		127.8	
		Z	9.07	87.0	26.1		142.2	
10071-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	11.42	71.4	24.2	9.83	121.7	±3.0 %
		Y	11.12	70.5	23.3		131.7	
		Z	10.98	70.5	23.5		122.8	
10072-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	11.79	73.3	25.2	9.62	147.0	±3.3 %
		Y	10.74	70.4	23.2		129.7	
		Z	11.22	72.1	24.4		147.1	
10073-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	11.95	73.8	25.7	9.94	143.0	±3.8 %
		Y	10.82	70.7	23.6		126.7	
		Z	11.27	72.4	24.8		141.9	
10074-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	12.20	74.4	26.4	10.30	140.5	±3.0 %
		Y	10.89	70.7	23.8		125.5	
		Z	11.43	72.8	25.3		138.7	
10075-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	12.44	75.1	27.1	10.77	136.0	±3.0 %
		Y	11.06	71.1	24.4		122.5	
		Z	11.63	73.3	26.0		136.0	

10076-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	12.59	75.5	27.5	10.94	135.6	±3.3 %
		Y	11.11	71.2	24.6		121.3	
		Z	11.73	73.7	26.4		134.6	
10077-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	12.60	75.6	27.6	11.00	134.5	±3.3 %
		Y	11.12	71.3	24.7		120.5	
		Z	11.69	73.7	26.4		133.1	
10111-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	7.09	67.8	20.4	6.44	144.0	±1.7 %
		Y	6.91	66.9	19.7		133.8	
		Z	7.02	67.8	20.3		147.3	
10112-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.30	67.3	20.1	6.59	125.3	±1.9 %
		Y	7.38	67.3	19.9		139.7	
		Z	7.22	67.1	19.8		127.8	
10113-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	7.35	68.1	20.7	6.62	145.8	±1.7 %
		Y	7.12	67.0	19.8		134.5	
		Z	7.27	68.0	20.5		148.4	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.29	69.3	21.7	8.10	129.5	±2.5 %
		Y	10.19	68.9	21.2		144.0	
		Z	10.14	69.0	21.3		131.5	
10115-CAA	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	X	10.84	69.9	22.2	8.46	133.8	±2.7 %
		Y	10.75	69.5	21.7		148.7	
		Z	10.70	69.6	21.9		135.5	
10116-CAA	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	X	10.33	69.4	21.7	8.15	131.0	±2.5 %
		Y	10.23	69.0	21.3		144.3	
		Z	10.21	69.2	21.5		132.1	
10142-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.92	67.1	19.9	5.73	135.8	±1.4 %
		Y	5.91	66.7	19.4		146.3	
		Z	5.79	66.7	19.5		136.2	
10143-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.91	68.0	20.5	6.35	142.5	±1.4 %
		Y	6.64	66.8	19.6		128.9	
		Z	6.73	67.6	20.1		142.1	
10145-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.66	66.8	19.8	5.76	131.2	±1.4 %
		Y	5.64	66.4	19.3		140.0	
		Z	5.49	66.4	19.3		131.2	
10146-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.59	67.8	20.5	6.41	135.3	±1.7 %
		Y	6.60	67.7	20.1		144.9	
		Z	6.38	67.5	20.0		134.6	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.02	67.0	19.8	5.75	136.2	±1.4 %
		Y	6.09	67.0	19.5		146.1	
		Z	5.95	66.8	19.5		137.9	
10155-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	7.09	67.8	20.5	6.43	143.8	±1.7 %
		Y	6.88	66.9	19.7		130.7	
		Z	6.99	67.7	20.2		145.9	

10156-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.83	66.8	19.8	5.79	132.8	±1.4 %
		Y	5.86	66.6	19.4		142.3	
		Z	5.73	66.6	19.4		134.5	
10157-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.85	67.8	20.5	6.49	138.3	±1.9 %
		Y	6.88	67.7	20.2		149.6	
		Z	6.73	67.6	20.2		140.6	
10158-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	7.35	68.1	20.7	6.62	145.2	±1.7 %
		Y	7.10	67.0	19.8		132.0	
		Z	7.23	67.8	20.3		147.6	
10159-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.98	67.9	20.6	6.56	139.4	±1.4 %
		Y	6.73	66.8	19.7		127.1	
		Z	6.83	67.7	20.3		140.9	
10166-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	5.23	67.2	20.0	5.46	146.3	±1.2 %
		Y	5.05	66.1	19.1		133.7	
		Z	5.12	67.1	19.7		148.6	
10167-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	5.99	67.5	20.3	6.21	126.9	±1.4 %
		Y	5.98	67.4	19.9		137.9	
		Z	6.05	68.3	20.5		149.6	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.05	67.3	20.2	5.72	139.4	±1.2 %
		Y	4.84	66.1	19.3		128.3	
		Z	4.94	67.1	19.9		140.9	
10176-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.86	68.5	21.2	6.52	139.1	±1.7 %
		Y	5.57	67.1	20.1		127.6	
		Z	5.66	68.1	20.8		138.6	
10177-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	5.07	67.4	20.3	5.73	139.4	±1.2 %
		Y	4.87	66.3	19.4		127.2	
		Z	4.96	67.3	20.0		139.7	
10178-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.92	68.7	21.3	6.52	140.7	±1.7 %
		Y	5.58	67.2	20.1		127.3	
		Z	5.63	68.0	20.7		138.4	
10179-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.88	68.6	21.2	6.50	140.3	±1.7 %
		Y	5.59	67.3	20.2		127.6	
		Z	5.63	68.1	20.7		137.3	
10180-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.91	68.7	21.3	6.50	141.3	±1.7 %
		Y	5.80	68.2	20.7		145.8	
		Z	5.62	68.0	20.7		136.9	
10184-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	5.09	67.4	20.3	5.73	140.2	±1.4 %
		Y	5.03	67.0	19.8		146.0	
		Z	4.92	67.0	19.9		139.3	
10185-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.92	68.7	21.3	6.51	141.5	±1.7 %
		Y	5.77	68.0	20.6		145.2	
		Z	5.63	68.0	20.7		138.1	

10187-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	5.10	67.5	20.4	5.73	140.4	±1.4 %
		Y	5.04	67.0	19.8		144.6	
		Z	4.95	67.2	20.0		139.5	
10188-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.93	68.7	21.2	6.52	143.8	±1.9 %
		Y	5.79	68.1	20.6		145.0	
		Z	5.67	68.2	20.8		139.6	
10298-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.74	66.9	19.8	5.72	135.2	±1.4 %
		Y	5.67	66.4	19.3		134.7	
		Z	5.54	66.3	19.3		131.0	
10299-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.73	67.9	20.5	6.39	141.9	±1.4 %
		Y	6.65	67.4	20.0		141.4	
		Z	6.56	67.7	20.2		136.9	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.01	70.5	20.1	1.71	131.6	±0.5 %
		Y	3.00	69.6	19.1		133.8	
		Z	2.89	69.2	18.9		131.3	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.21	69.5	22.1	8.36	127.7	±2.5 %
		Y	9.98	68.6	21.3		129.8	
		Z	9.93	68.9	21.6		124.4	

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 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:3163

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	0.05	1.20	± 13.3 %
220	49.0	0.81	7.09	7.09	7.09	0.05	1.20	± 13.3 %
300	45.3	0.87	7.34	7.34	7.34	0.25	1.25	± 13.3 %
450	43.5	0.87	6.51	6.51	6.51	0.22	1.80	± 13.3 %
750	41.9	0.89	6.41	6.41	6.41	0.44	1.50	± 12.0 %
900	41.5	0.97	6.06	6.06	6.06	0.35	1.72	± 12.0 %
1810	40.0	1.40	5.18	5.18	5.18	0.77	1.27	± 12.0 %
1950	40.0	1.40	4.87	4.87	4.87	0.66	1.29	± 12.0 %
2300	39.5	1.67	4.67	4.67	4.67	0.80	1.23	± 12.0 %
2450	39.2	1.80	4.35	4.35	4.35	0.53	1.64	± 12.0 %
2600	39.0	1.96	4.26	4.26	4.26	0.71	1.42	± 12.0 %
3500	37.9	2.91	4.27	4.27	4.27	0.80	1.20	± 13.1 %
3700	37.7	3.12	4.15	4.15	4.15	0.90	1.20	± 13.1 %

[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.
[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.

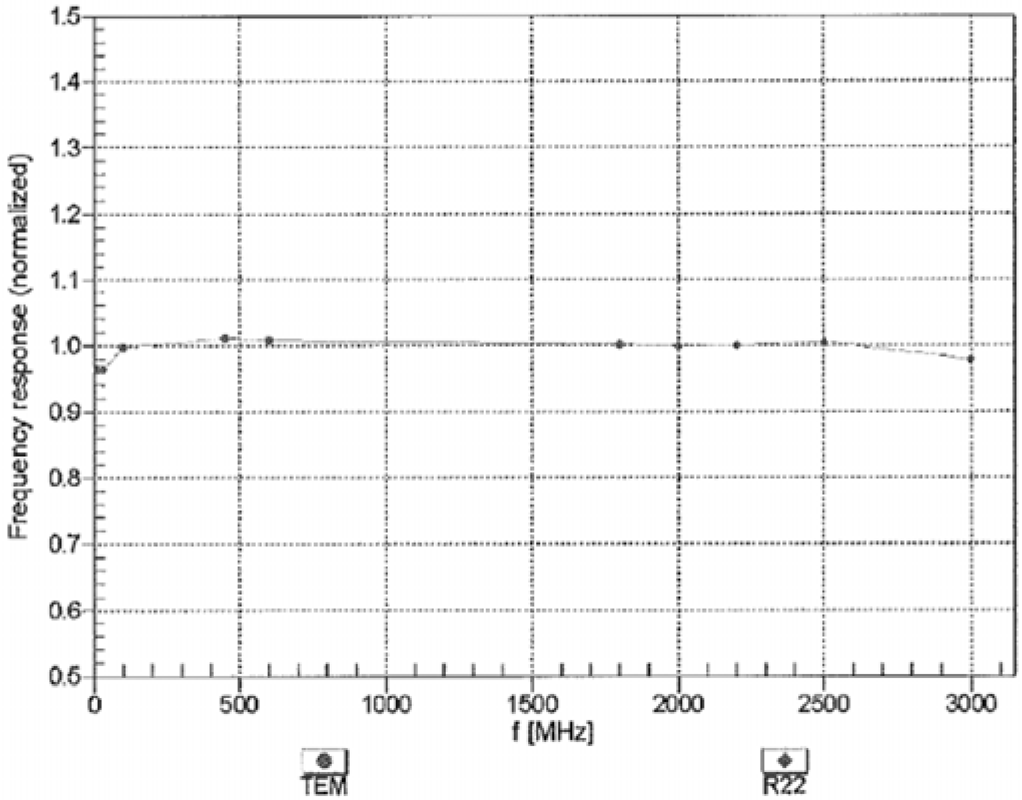
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3163

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	6.87	6.87	6.87	0.08	1.35	± 13.3 %
220	60.2	0.86	6.65	6.65	6.65	0.05	1.35	± 13.3 %
300	58.2	0.92	6.94	6.94	6.94	0.13	1.80	± 13.3 %
450	56.7	0.94	7.19	7.19	7.19	0.15	1.82	± 13.3 %
750	55.5	0.96	6.14	6.14	6.14	0.65	1.28	± 12.0 %
900	55.0	1.05	5.94	5.94	5.94	0.50	1.43	± 12.0 %
1810	53.3	1.52	4.82	4.82	4.82	0.62	1.45	± 12.0 %
1950	53.3	1.52	4.82	4.82	4.82	0.53	1.55	± 12.0 %
2300	52.9	1.81	4.43	4.43	4.43	0.76	1.28	± 12.0 %
2450	52.7	1.95	4.22	4.22	4.22	0.70	1.18	± 12.0 %
2600	52.5	2.16	4.07	4.07	4.07	0.80	1.03	± 12.0 %
3500	51.3	3.31	3.72	3.72	3.72	0.85	1.30	± 13.1 %
3700	51.0	3.55	3.53	3.53	3.53	0.80	1.50	± 13.1 %

[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.
[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.

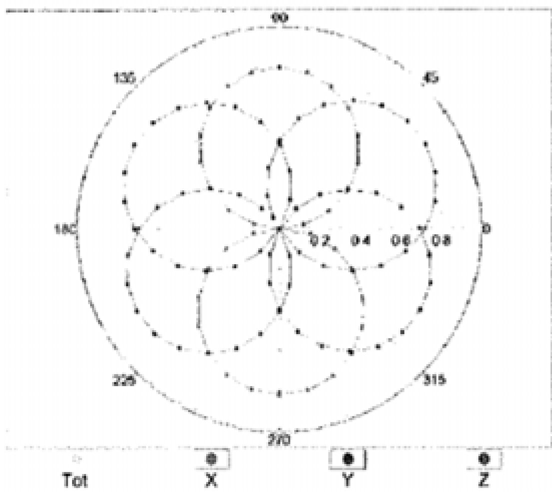
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



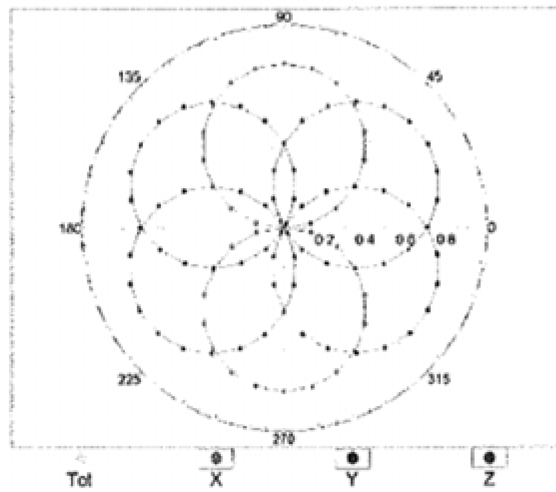
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

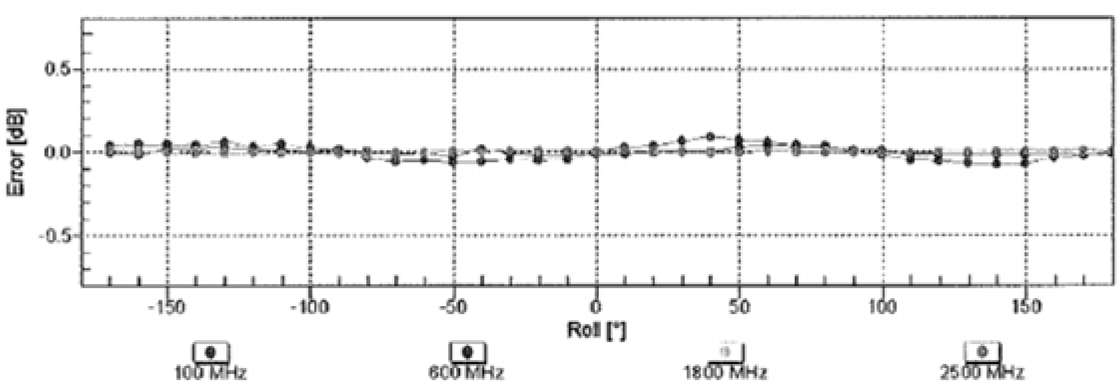
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



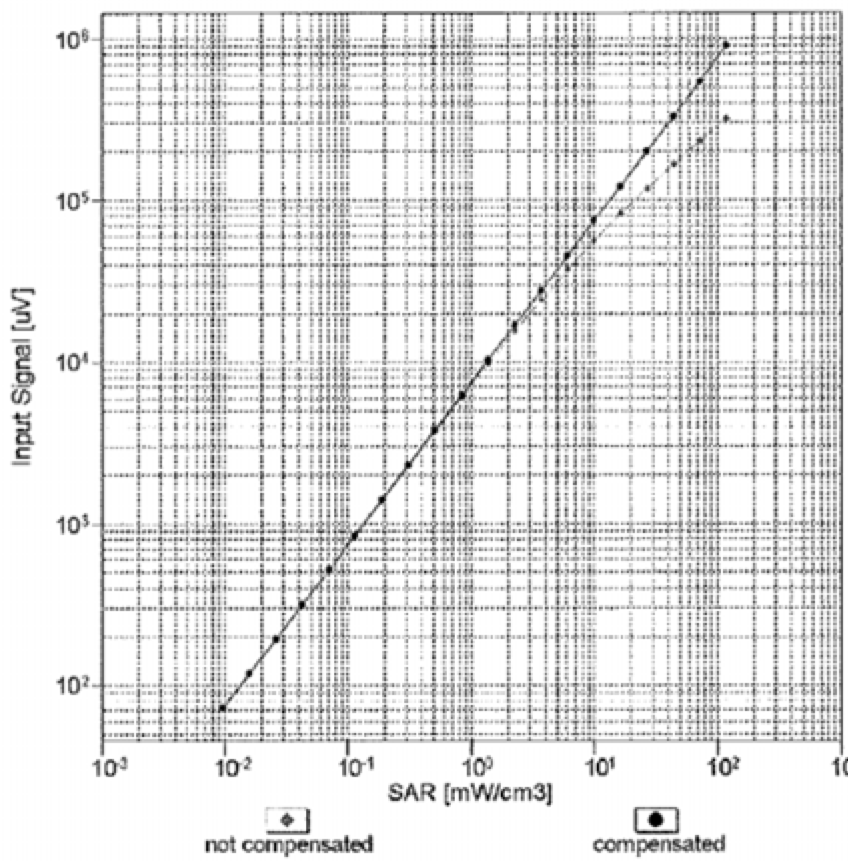
f=1800 MHz,R22

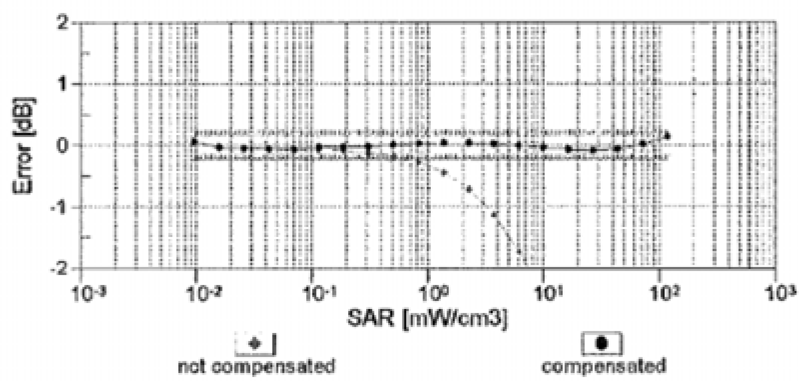




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

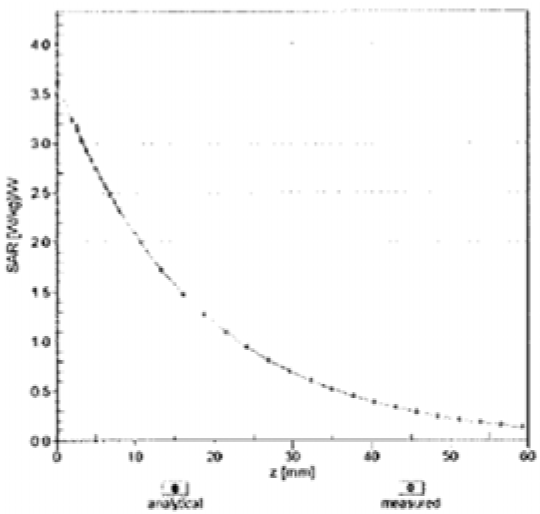
Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

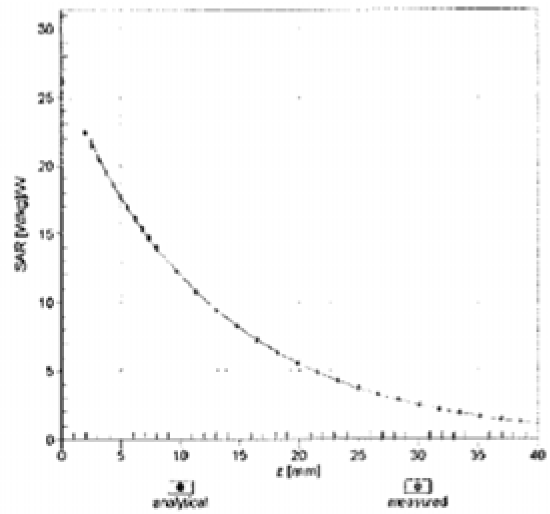




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

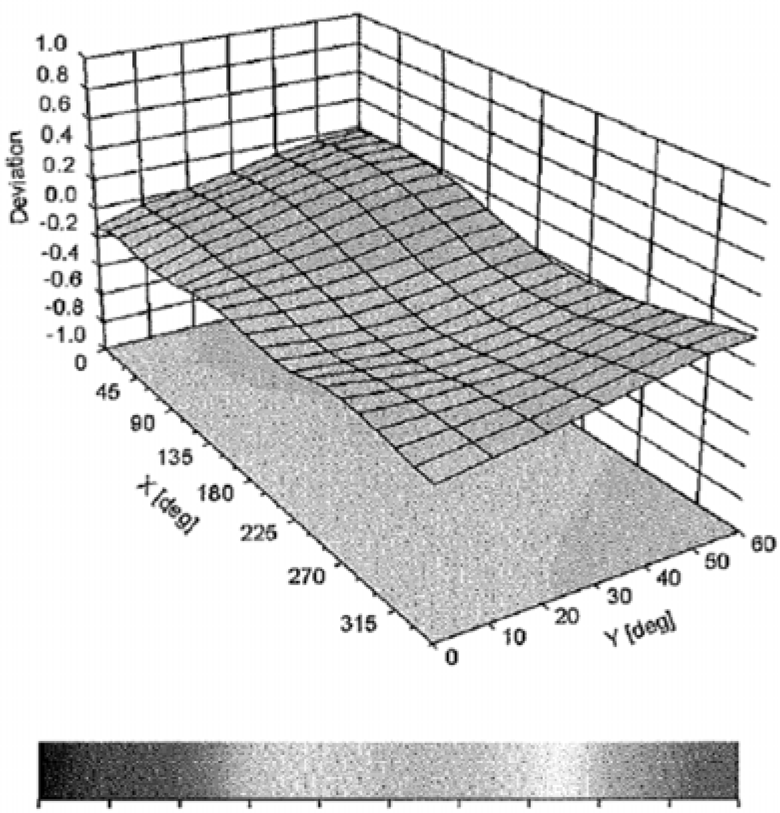
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3163

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	9.7
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
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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

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

Accreditation No.: **SCS 108**

Client **Motorola EME**

Certificate No: **D450V3-1077_Nov13**

CALIBRATION CERTIFICATE

Object	D450V3 - SN: 1077
Calibration procedure(s)	QA CAL-15.v7 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	November 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: November 18, 2013

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

Certificate No: D450V3-1077_Nov13 Page 1 of 8

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 1528-2013, "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	43.3 ± 6 %	0.87 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	1.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.64 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.764 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.05 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	55.8 ± 6 %	0.93 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	1.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.50 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.742 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.98 W/kg ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	58.1 Ω - 3.2 jΩ
Return Loss	- 21.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	54.9 Ω - 6.1 jΩ
Return Loss	- 22.6 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	June 24, 2010

DASY5 Validation Report for Head TSL

Date: 18.11.2013

Test Laboratory: The name of your organization

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1077

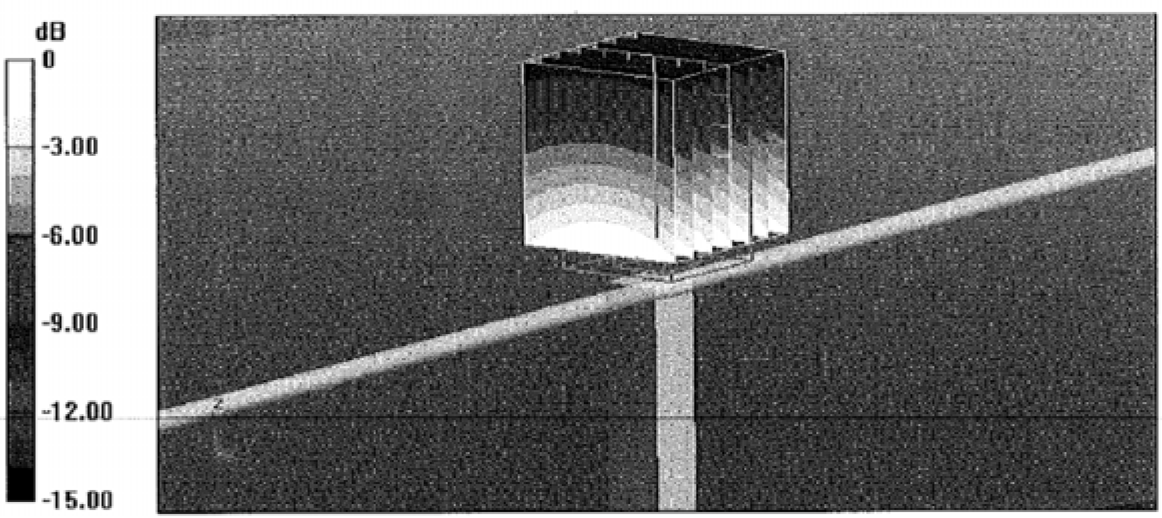
Communication System: UID 0 - CW ; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.87 S/m; ε_r = 43.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.59, 6.59, 6.59); Calibrated: 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:

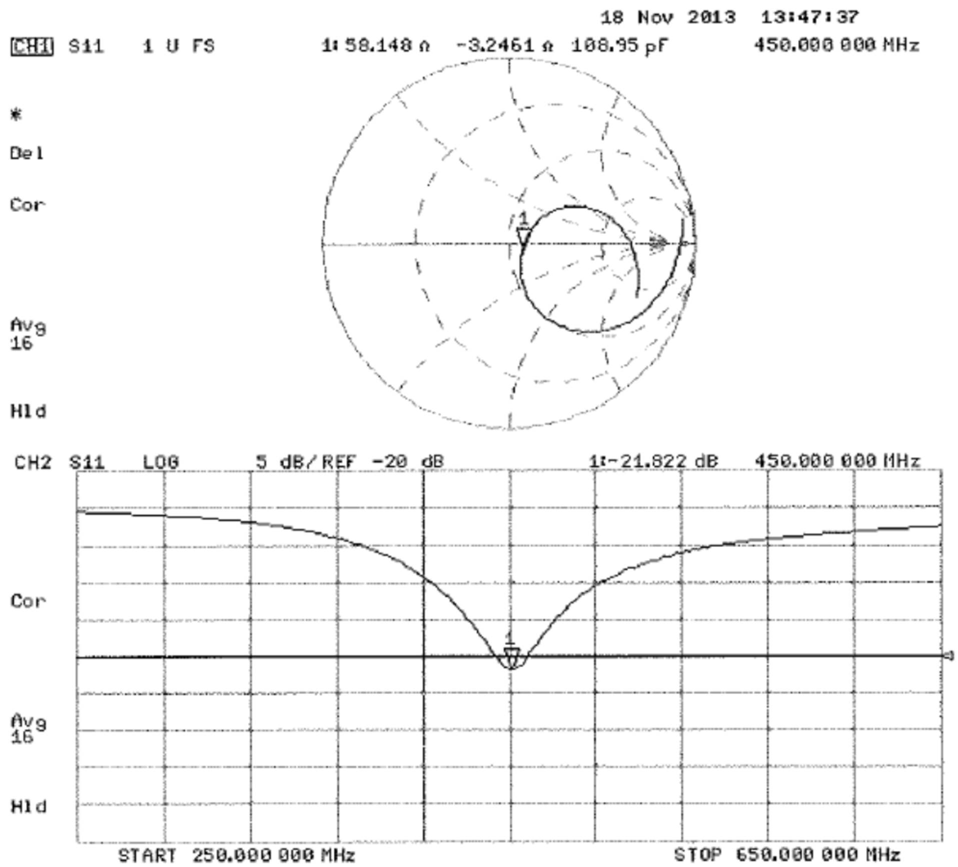
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.227 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.79 W/kg
SAR(1 g) = 1.16 W/kg; SAR(10 g) = 0.764 W/kg
Maximum value of SAR (measured) = 1.24 W/kg



0 dB = 1.24 W/kg = 0.93 dBW/kg

Certificate No: D450V3-1077_Nov13 Page 5 of 8

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 18.11.2013

Test Laboratory: The name of your organization

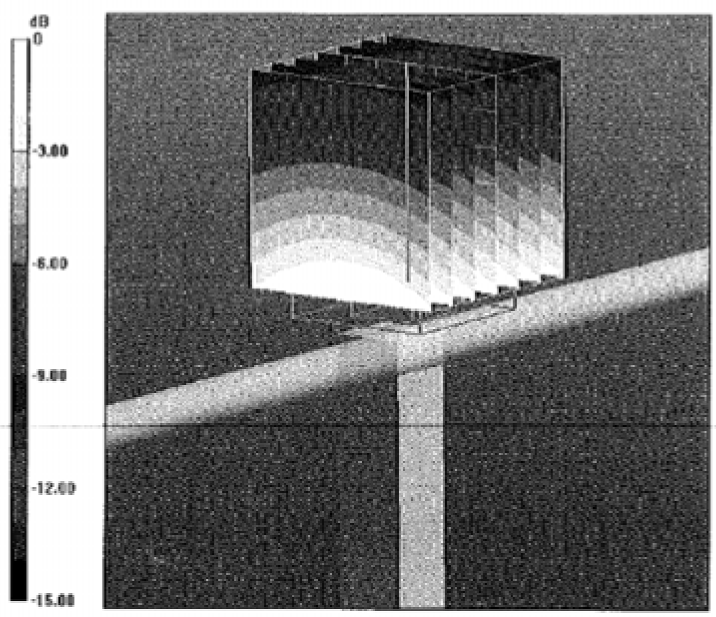
DUT: Dipole 450 MHz D450V3; Type: D450V3; Serial: D450V3 - SN:1077

Communication System: UID 0 - CW ; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; $\sigma = 0.93$ S/m; $\varepsilon_r = 55.8$; $\rho = 1000$ 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 = 36.878 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.75 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.742 W/kg
Maximum value of SAR (measured) = 1.20 W/kg



0 dB = 1.20 W/kg = 0.79 dBW/kg

Certificate No: D450V3-1077_Nov13 Page 7 of 8

Impedance Measurement Plot for Body TSL