TESTING CERT # 2518.01

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

Motorola Solutions Inc.
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Date of Report:	**11/06/2013**
Report Revision:	**A**
Report ID:	**SR11760_PMUE4402A Rev A 131106**

Responsible Engineer:	Tan CheeChin (EME Section Manager)
Report Author:	Tan CheeChin (EME Section Manager)
Date/s Tested:	09/30/13-10/03/13
Manufacturer/Location:	Motorola Solutions, Penang
Sector/Group/Div.:	EMS
Date submitted for test:	09/10/13
DUT Description:	Handheld Portable - Frequency band of 450-527MHz, 2.402-2.480GHz (Bluetooth), GOB
Test TX mode(s):	TDMA (PTT); CW (Bluetooth)
Max. Power output:	2.4W (450-527MHz), 10.0mW (Bluetooth)
Nominal Power:	2.0W(450-527MHz), 2.5mW (Bluetooth)
Tx Frequency Bands:	450-527MHz, 2.402-2.480GHz (Bluetooth)
Signaling type:	TDMA; FHSS (Bluetooth)
Model(s) Tested:	PMUE4402A
Model(s) Certified:	PMUE4402A
Serial Number(s):	682TPT0137, 682TPT0173, 682TPT0182
Classification:	Occupational/Controlled
FCC ID:	AZ489FT4918; Rule Part 90 (450-512 MHz); Rule Part 15 (2402-2480MHz) This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
IC ID:	109U-89FT4918

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.

Zakharia Deanna-EDC015

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Certification Date: 11/7/2013

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Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
10/17/2013	O	Initial release
11/06/2013	A	BT power was updated on front cover pages and in sections 6.0, 13.4 & 14.0. SAR results for BT and simultaneous results were updated in sections 2.0 (Table 1), 13.4, 14.0, 15.0 (Table 25). BT antenna gain was updated in section 7.1 (Table 3).

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 handheld portable model number PMUE4402A. This device is classified as Occupational/Controlled.

2.0 FCC SAR Summary

TABLE 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (mW/g)		Max Calc at Face (mW/g)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
TNF	450-512	0.82	0.59	0.77	0.55
DSS/DTS	2402-2480	NA	NA	NA	NA
Simultaneous Results		1.16	0.93	NA	NA

3.0 Abbreviations / Definitions

CNR: Calibration Not Required
EME: Electromagnetic Energy
CW: Continuous Wave
DUT: Device Under Test
BT: Bluetooth
FHSS: Frequency Hopping Spread Spectrum
FM: Frequency Modulation
NA: Not Applicable
PTT: Push to Talk
4FSK: 4 Level Frequency Shift Keying
TDMA: Time Division Multiple Access
EDR: Enhanced Data Rate
SAR: Specific Absorption Rate
GFSK: Gaussian Frequency-Shift Keying
DQPSK: Differential Quadrature Phase-Shift Keying
DPSK: Differential Phase-Shift Keying
DSP: Digital Signal Processor
GOB: Generic Option Board
TNF: Licensed Non-Broadcast Transmitter Held to Face
DSS: Spread Spectrum Transmitter
DTS: Digital Transmission System

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

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.

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)

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

Time Division Multiple Access (TDMA) is used to allocate portions of the RF signal by dividing time into two slots. Time allocation enables each unit to transmit its voice information without interference from other transmitting units. Transmission from a unit or base station is accommodated during two time-slot lengths of 30 milliseconds with frame length of 60 milliseconds. C4FM CQPSK modulation is used at 12.5 kHz channel spacing. The TDMA technique requires sophisticated algorithms and a digital signal processor (DSP) to perform voice compressions/decompressions and RF modulation/demodulation. The maximum duty cycle for TDMA 1:2 is 50%.

This device operates in a half duplex system. A half duplex system only allows the user to transmit or receive. This device cannot transmit and receive simultaneously. The user must stop transmitting in order to receive a signal or listen for a response, regardless of PTT button or use of voice activated audio accessories. This type of operation, along with the RF safety booklet, which instructs the user to transmit no more than 50% of the time, justifies the use of 50% duty factor for this device.

This device also incorporates a Class 1 Bluetooth device which is a Frequency Hopping Spread Spectrum (FHSS) technology. The Bluetooth radio modem is used to wireless link audio accessories. The maximum actual transmission duty cycle is imposed by the Bluetooth standard. The maximum duty cycle for BT is 77%. Simultaneous transmission can occur between the BT and primary transmitter. Refer to section 14.0 Simultaneous Transmission Exclusion.

The model represented under this filing utilizes fixed antenna and an internal fixed antenna (Bluetooth) capable of transmitting in the 450-527 MHz and 2.402-2.480 GHz (Bluetooth) bands respectively. The nominal output powers are 2.0 W with maximum output powers of 2.4 W (450-527 MHz). The nominal BT output power is 2.5mW and maximum output power is 10.0mW 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 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. Operation at the body without an audio accessory attached is possible by means of BT accessories.

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 per the guidelines outlined in “SAR Test Reduction Considerations for Occupational PTT Radios” FCC KDB 643646 to assess compliance of this device. 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 two non removable antennas and one BT internal antenna offered for this product. The table below lists their descriptions.

TABLE 3

Antenna Models	Description	Selected for test	Tested
PMAE4091A	Stubby Antenna, 450 - 490 MHz, 1/4 wave, -1.5 dBi	Yes	Yes
PMAE4092A	Stubby Antenna, 480 - 527 MHz, 1/4 wave, -1.5 dBi	Yes	Yes
PMLF4122A	Bluetooth Antenna, IFA 2402-2480MHz, 1/4 wave, 0.5 dBi	*No	*No

* Refer to sections 13.4 and 14.0.

7.2 Batteries

There are two batteries offered for this product. The table below lists its description.

TABLE 4

Battery Models	Description	Selected for test	Tested	Comments
HKNN4013A	Battery Pack, 1800 mAh Li-ion	Yes	Yes	
PMNN4425B	Battery Pack, 1370 mAh Li-Ion	Yes	Yes	

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 5

Body worn Models	Description	Selected for test	Tested	Comments
PMLN5956A	Carry Holder	Yes	Yes	
PMLN6074A	Wrist Strap	No	No	Test Not Required

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 6

Audio Acc. Models	Description	Selected for test	Tested	Comments
PMLN5957A	Surveillance Earpiece with in-line microphone and PTT	Yes	Yes	
PMLN5958A	Swivel Earpiece with in-line microphone and PTT	No	No	By similarity to PMLN5957A

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	52.8.2.969	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	OVAL 1016 OVAL 1108					

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 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 9

Reference Standards	% of listed ingredients	450 MHz	
		Head	Body
FCC Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 91-01) 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 10

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Power Meter (Agilent)	E4419B	MY45103725	3/1/2013	3/1/2014
Power Meter (Agilent)	E4418B	GB40206480	11/2/2012	11/2/2013
E-Series Avg. Power Sensor (Agilent)	E9301B	MY41495593	3/7/2013	3/7/2014
E-Series Avg. Power Sensor (Agilent)	E9301B	MY41495594	2/11/2013	2/11/2014
Average Power Sensor (Agilent)	N8482B	MY52080004	2/21/2013	2/21/2014
Bi-Directional Coupler (NARDA)	3020A	40295	6/4/2012	6/4/2014
Signal Generator (Agilent)	E4438C	MY42082269	1/24/2012	1/24/2014
AMP (Amplifier Research)	10WD1000	28782	CNR	CNR
Dickson Temperature Recorder	TM325	12121144	5/8/2013	5/8/2014
Omega Digital Thermometer with J Type TC Probe	HH200A	20857	10/25/2012	10/25/2013
Omega Digital Thermometer with J Type TC Probe	HH200A	48870	5/14/2013	5/14/2014
Omega Digital Thermometer with J Type TC Probe	HH202A	18800	2/21/2013	2/21/2014
Omega Digital Thermometer with J Type TC Probe	HH202A	18801	5/14/2013	5/14/2014
Omega Digital Thermometer with J Type TC Probe	HH202A	18812	6/10/2013	6/10/2014
LKM Electronic Digital Thermometer with Pt100 Sensor Probe	DTM3000	2959	7/24/2013	7/24/2014
Agilent PNA-L Network Analyzer	N5230C	MY49002155	8/1/2013	8/1/2014
Dielectric Assessment Kit (DAK)	DAK-12	1040	10/23/2012	10/23/2013
Dielectric Assessment Kit (DAK)	DAK-12	1013	5/28/2013	5/28/2014
Speag Probe	ESDV3	3291	6/20/2013	6/20/2014
Speag Dipole	D450V3	1075	7/23/2013	7/23/2015
Speag DAE	DAE4	850	7/17/2013	7/17/2014

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 A, B, C respectively.

10.1 System Validation

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

TABLE 11

Dates	Probe Calibration Point		Probe SN	Measured Tissue Parameters		Validation for TDMA		
				σ	ϵ_r	Sensitivity	Linearity	Isotropy
07/17/2013	Body	450	3291	0.93	55.9	Pass	Pass	Pass
07/17/2013	Head	450	3291	0.89	42.4	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 C 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
3291	FCC Body	SPEAG D450V3 / 1075	*4.51 +/- 10%	1.11	4.44	9/30/13
				1.10	4.40	10/01/13
				1.11	4.44	10/03/13
	IEEE/IEC Head	SPEAG D450V3 / 1075	*4.73 +/- 10%	1.10	4.40	10/01/13
				1.10	4.40	10/02/13
				1.09	4.36	10/03/13

*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
463	IEEE/ IEC Head	0.87 (0.83-0.91)	43.4 (41.3-45.6)	0.85	42.3	10/01/13
490	FCC Body	0.94 (0.90-0.99)	56.5 (53.7-59.4)	0.96	56.0	9/30/13
512	FCC Body	0.94 (0.90-0.99)	56.5 (53.6-59.3)	0.97	55.8	9/30/13
				0.95	55.4	10/01/13
				0.96	55.1	10/03/13
	IEEE/ IEC Head	0.87 (0.83-0.92)	43.2 (41.0-45.3)	0.90	41.3	10/02/13
519.5	FCC Body	0.95 (0.90-0.99)	56.4 (53.6-59.3)	0.96	55.0	10/03/13
	IEEE/ IEC Head	0.87 (0.83-0.92)	43.1 (41.0-45.3)	0.91	41.2	10/03/13
527	FCC Body	0.95 (0.90-0.99)	56.4 (53.6-59.2)	0.97	54.9	10/03/13
	IEEE/ IEC Head	0.88 (0.83-0.92)	43.1 (40.9-45.2)	0.92	41.0	10/03/13
450	FCC Body	0.94 (0.89-0.99)	56.7 (53.9-59.5)	0.92	56.5	9/30/13
				0.91	56.1	10/01/13
				0.91	55.9	10/03/13
	IEEE/ IEC Head	0.87 (0.83-0.91)	43.5 (41.3-45.7)	0.84	42.6	10/01/13
				0.85	42.5	10/02/13
				0.85	42.5	10/03/13

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^{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: 21.3 – 22.6˚C Avg. 21.9 ˚C
Relative Humidity	30 – 70 %	Range: 50.5 – 56.8 % Avg. 53.7 %
Tissue Temperature	NA	Range: 21.4-22.3˚C Avg. 21.8˚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 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>½·δ·ln(2) ± 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: ΔxArea, ΔyArea</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: ΔxZoom, ΔyZoom</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: ΔzZoom(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 G.

12.3.1 Body

The DUT was positioned in normal use configuration against the phantom with the offered body worn accessory as well as with and without 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 this device the "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" are scaled using the following formula:

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

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 drift

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 in "SAR Test Reduction Considerations for Occupational PTT Radios" FCC KDB 643646 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 TDMA mode and then 50% duty cycle was applied to the final results.

Standalone and simultaneous BT testing were assessed in sections 13.4 and 14.0 per the guidelines of KDB 447498.

13.0 DUT Test Data

13.1 Assessments at the Body for 450-512 MHz band

The battery PMNN4425B was selected as the default battery for assessments at the Body since it is the thinnest among the batteries (refer to Exhibit 7B for the dimension of the battery). The conducted power measurement for all test channels within Part 90 frequency range (450-512 MHz) using the default battery PMNN4425B is indicated in Table 16. The channel with the highest conducted power will be identified as the default channel per KDB 643646 SAR Test for PTT Radios. SAR plots of the highest results per table (bolded) are presented in APPENDICES D-E.

TABLE 16

Test Freq (MHz)	Power (W)
SN 682TPT0173 for 450-490 MHz	
450	2.35
463	2.37
477	2.38
490	2.39
SN 682TPT0137 for 480-527 MHz	
480	2.31
496	2.31
512	2.32

Assessments at the Body with Body worn PMLN5956A

Assessment of the offered antennas with the default battery and body worn accessory PMLN5956A and additional offered battery per KDB 643646 SAR Test for PTT Radios – Body SAR Test Considerations for Body worn Accessories. Refer to Table 16 for highest output power channel. SAR plots of the highest results per table (bolded) are presented in APPENDIX E.

TABLE 17

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#
PMAE4091A (450-490 MHz)	PMNN4425B	PMLN5956A	PMLN5957A	450							
				463							
				477							
				490	2.30	-0.50	0.85	0.60	0.50	0.35	AvG-Ab-130930-02
PMAE4092A (480-527 MHz)	PMNN4425B	PMLN5956A	PMLN5957A	480							
				496							
				512	2.31	-0.20	1.20	0.88	0.65	0.48	AvG-Ab-130930-03
Assessment of the additional offered battery											
PMAE4092A (480-527 MHz)	HKNN4013A	PMLN5956A	PMLN5957A	480							
				496							
				512	2.30	-0.26	1.22	0.88	**0.68**	**0.49**	AvG-Ab-130930-04

Assessment at the Body with other audio accessories

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

Assessment of wireless BT configuration

Assessment using the overall highest SAR configuration at the body from above without an audio accessory attached. SAR plots of the highest results per table (bolded) are presented in APPENDIX E.

TABLE 18

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#
PMAE4092A (480-527 MHz)	HKNN4013A	PMLN5956A	None	480							
				496							
				512	2.29	-0.33	1.45	1.05	**0.82**	**0.59**	AvG-Ab-131001-03

Assessment outside FCC Part 90 at the Body

Assessment using highest SAR configuration from Part 90 assessment above Run# AvG-Ab-131001-03, Table 18 across the offered antenna (if applicable). SAR plots of the highest results per table (bolded) are presented in APPENDIX F.

TABLE 19

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#
PMAE4092A (480-527 MHz)	HKNN4013A	PMLN5956 A	None	519.5	2.30	-0.23	1.09	0.79	**0.60**	**0.44**	AvG-Ab-131003-03
PMAE4092A (480-527 MHz)	HKNN4013A	PMLN5956 A	None	527.0	2.28	-0.23	0.94	0.68	0.52	0.38	AvG-Ab-131003-04

13.2 Assessments at the Face for 450-512 MHz band

The battery HKNN4013A was selected as the default battery for assessments at the Face since it is highest capacity among the batteries (refer to Exhibit 7B for the dimension of the battery). The conducted power measurement for all test channels within Part 90 frequency range (450-512 MHz) using the default battery HKNN4013A is indicated in Table 20. The channel with the highest conducted power will be identified as the default channel per KDB 643646 SAR Test for PTT Radios. SAR plots of the highest results per table (bolded) are presented in APPENDICES D-E.

TABLE 20

Test Freq (MHz)	Power (W)
SN 682TPT0173 for 450-490 MHz	
450	2.33
463	2.34
477	2.33
490	2.34
SN 682TPT0137 for 480-527 MHz	
480	2.33
496	2.34
512	2.37

Assessment of the offered antennas with the default battery HKNN4013A, front of DUT facing phantom and additional offered battery per KDB 643646 SAR Test for PTT Radios – Head SAR Test Considerations. Refer to Table 22 for highest output power channel. SAR plots of the highest results per table (bolded) are presented in APPENDIX E.

TABLE 21

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#
PMAE4091A (450-490 MHz)	HKNN4013A	None	None	450							
				463	2.31	-0.09	1.17	0.85	0.62	0.45	AvG-Face-131001-06
				477							
				490							
PMAE4092A (480-527 MHz)	HKNN4013A	None	None	480							
				496							
				512	2.33	-0.21	1.42	1.01	**0.77**	**0.55**	AvG-Face-131002-02
Assessment of the additional offered battery											
PMAE4092A (480-527 MHz)	PMNN4425B	None	None	480							
				496							
				512	2.31	-0.22	1.40	1.00	0.77	0.54	AvG-Face-131002-03

Assessment outside FCC Part 90 at the Face

Assessment using highest SAR configuration from Part 90 assessment above Run# AvG-Face-131002-02, Table 21 across the offered antenna (if applicable). SAR plots of the highest results per table (bolded) are presented in APPENDIX F.

TABLE 22

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#
PMAE4092A (480-527 MHz)	HKNN4013A	None	None	519.5	2.33	-0.310	1.17	0.84	**0.65**	**0.47**	AvG-Face-131003-05
PMAE4092A (480-527 MHz)	HKNN4013A	None	None	527.0	2.30	-0.220	0.93	0.67	0.51	0.37	AvG-Face-131003-06

13.3 Assessment for Industry Canada

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

13.4 Assessment at the Bluetooth band

Per guidelines in KDB 447498, the following formula was used to determine the test exclusion for standalone Bluetooth transmitter;

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[$\sqrt{F_{(GHz)}}$] = 2.5, which is ≤ 3 for 1-g SAR

Where:

Max. power = 8mW (10mW*77% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

Per the result from the calculation above, the standalone SAR assessment was not required for Bluetooth band. Therefore, SAR results for Bluetooth are not reported herein.

13.5 Shortened Scan Assessment

A "shortened" scan using the highest SAR configuration overall from above 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 D demonstrate that the scaling methodology used to determine the calculated SAR results presented herein are valid. The SAR result from the table below is provided in APPENDIX D.

TABLE 23

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#
PMAE4092A (480-527 MHz)	HKNN4013A	PMLN5956A	None	512	2.30	0.10	1.47	1.07	**0.77**	**0.56**	AvG-Ab-131003-07

14.0 Simultaneous Transmission Exclusion

Per guidelines in KDB 447498, the following formula was used to determine the test exclusion to an antenna that transmits simultaneously with other antennas for test distances ≤ 50mm:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[√F(GHz)/X] = 0.34 W/kg (1g & 10g)

Where:
X = 7.5 for 1g-SAR; 18.75 for 10g
Max. power = 8mW (10mW*77% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

15.0 Results Summary

Based on the test guidelines from KDB 643646 and satisfying frequencies with Part 90 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 24

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
FCC/ Industry Canada	450-512	0.82	0.59	0.77	0.55
Overall	450-527	0.82	0.59	0.77	0.55

All results are scaled to the maximum output power

The highest combined 1g-SAR results for simultaneous is indicated in the following table:

TABLE 25

Designator	Frequency bands	Combined 1g-SAR (W/kg)	Combined 10g-SAR (W/kg)
FCC/ Industry Canada	450-512 MHz, 2402-2480MHz	1.16	0.93

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.

17.0 System Uncertainty

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

Per the guidelines of ISO 17025 a reported system uncertainty is required and therefore the highest expanded system uncertainty for K=2 is 27% for frequency range of 100MHz to 800MHz.

APPENDIX A
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: ES3-3291_Jun13/2

CALIBRATION CERTIFICATE (Replacement of No: ES3-3291_Jun13)

Object	ES3DV3 - SN:3291
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	June 20, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: July 11, 2013

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

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; 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.

Probe ES3DV3

SN:3291

Manufactured: July 6, 2010
Calibrated: June 20, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3291

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	0.86	1.38	0.83	± 10.1 %
DCP (mV)[B]	102.4	102.0	103.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	132.6	±3.5 %
		Y	0.0	0.0	1.0		166.5	
		Z	0.0	0.0	1.0		163.7	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	5.91	65.7	18.6	5.80	111.7	±1.4 %
		Y	6.42	67.5	19.7		148.8	
		Z	6.36	67.4	19.6		143.7	
10109-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	6.94	66.6	19.4	6.43	118.1	±1.2 %
		Y	6.81	66.0	19.1		110.1	
		Z	6.74	66.0	19.1		106.3	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.59	65.2	18.4	5.75	108.6	±1.4 %
		Y	6.07	66.9	19.4		145.0	
		Z	6.04	67.0	19.5		140.9	
10111-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	6.66	66.4	19.3	6.44	114.1	±1.4 %
		Y	6.54	65.6	18.9		107.8	
		Z	7.08	68.0	20.3		148.2	
10112-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.18	66.9	19.6	6.59	118.7	±1.4 %
		Y	7.11	66.4	19.4		112.5	
		Z	7.01	66.4	19.4		107.7	
10113-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	6.83	66.4	19.3	6.62	114.4	±1.4 %
		Y	6.83	66.0	19.3		109.9	
		Z	7.31	68.2	20.5		149.8	
10142-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.42	65.0	18.3	5.73	106.4	±1.2 %
		Y	5.92	66.8	19.5		143.8	
		Z	5.85	66.9	19.5		136.4	
10143-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.31	66.0	19.0	6.35	109.6	±1.2 %
		Y	6.37	65.8	19.0		106.3	
		Z	6.80	67.9	20.3		142.0	
10145-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.63	66.9	19.4	5.76	143.9	±1.2 %
		Y	5.62	66.4	19.3		138.5	
		Z	5.50	66.5	19.3		130.9	
10146-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.49	67.9	20.1	6.41	141.9	±1.4 %
		Y	6.59	67.7	20.2		144.4	
		Z	6.41	67.8	20.2		134.0	

10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.07	67.0	19.4	5.75	146.2	±1.4 %
		Y	6.16	67.2	19.7		147.2	
		Z	6.04	67.0	19.6		138.4	
10155-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	6.55	66.0	19.0	6.43	108.1	±1.4 %
		Y	6.67	66.1	19.3		110.0	
		Z	7.05	67.9	20.3		145.7	
10156-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.82	66.8	19.4	5.79	143.0	±1.4 %
		Y	5.91	66.8	19.6		144.4	
		Z	5.77	66.7	19.5		134.1	
10157-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.85	68.0	20.3	6.49	148.2	±1.4 %
		Y	6.93	67.8	20.4		149.5	
		Z	6.77	67.9	20.3		139.8	
10158-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	6.77	66.2	19.3	6.62	109.0	±1.4 %
		Y	6.87	66.1	19.4		109.5	
		Z	7.32	68.2	20.5		146.9	
10159-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.37	66.0	19.2	6.56	105.3	±1.7 %
		Y	7.03	67.9	20.4		149.9	
		Z	6.86	67.9	20.4		139.9	
10166-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	4.95	66.2	19.0	5.46	132.2	±1.2 %
		Y	4.97	65.8	18.9		131.6	
		Z	4.98	66.5	19.3		125.1	
10167-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	5.82	67.6	20.0	6.21	132.9	±1.2 %
		Y	5.89	67.1	19.8		133.3	
		Z	5.75	67.4	20.1		125.4	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.67	66.0	19.1	5.72	125.6	±0.9 %
		Y	4.79	66.0	19.2		125.0	
		Z	4.65	65.9	19.3		118.8	
10176-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.27	66.8	19.9	6.52	122.4	±1.2 %
		Y	5.53	67.1	20.1		123.0	
		Z	5.27	66.8	20.1		116.7	
10177-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.71	66.2	19.2	5.73	125.2	±0.9 %
		Y	4.78	65.9	19.2		124.6	
		Z	4.70	66.2	19.4		118.9	
10178-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.30	66.9	20.0	6.52	122.5	±1.2 %
		Y	5.52	67.0	20.1		123.0	
		Z	5.26	66.7	20.1		116.6	
10179-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.26	66.8	19.9	6.50	121.9	±1.2 %
		Y	5.50	67.1	20.2		122.6	
		Z	5.21	66.6	20.0		115.8	
10180-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.27	66.9	19.9	6.50	122.0	±1.2 %
		Y	5.47	66.9	20.0		122.3	
		Z	5.21	66.6	20.0		115.4	

10184-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	4.68	66.1	19.1	5.73	125.6	±0.9 %
		Y	4.83	66.1	19.3		124.3	
		Z	4.69	66.0	19.4		118.4	
10185-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.27	66.8	19.9	6.51	123.4	±1.2 %
		Y	5.52	67.1	20.2		122.5	
		Z	5.22	66.5	19.9		116.0	
10187-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	4.70	66.1	19.2	5.73	125.8	±0.9 %
		Y	4.81	66.0	19.2		124.6	
		Z	4.73	66.3	19.6		118.5	
10188-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.34	67.1	20.1	6.52	123.7	±1.2 %
		Y	5.50	66.9	20.0		122.9	
		Z	5.29	66.9	20.2		116.1	
10298-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.67	66.8	19.4	5.72	140.1	±1.4 %
		Y	5.72	66.6	19.4		138.7	
		Z	5.64	66.8	19.6		131.5	
10299-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.65	68.1	20.3	6.39	144.5	±1.4 %
		Y	6.74	67.9	20.3		145.0	
		Z	6.62	68.2	20.5		136.3	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 7 and 8).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3291

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	7.38	7.38	7.38	0.23	1.10	± 13.4 %
450	43.5	0.87	7.12	7.12	7.12	0.18	2.04	± 13.4 %
750	41.9	0.89	6.69	6.69	6.69	0.24	2.30	± 12.0 %
900	41.5	0.97	6.32	6.32	6.32	0.70	1.22	± 12.0 %
1810	40.0	1.40	5.25	5.25	5.25	0.40	1.71	± 12.0 %
1950	40.0	1.40	5.04	5.04	5.04	0.48	1.55	± 12.0 %
2300	39.5	1.67	4.84	4.84	4.84	0.73	1.28	± 12.0 %
2450	39.2	1.80	4.54	4.54	4.54	0.80	1.23	± 12.0 %
2600	39.0	1.96	4.46	4.46	4.46	0.80	1.30	± 12.0 %
3500	37.9	2.91	4.37	4.37	4.37	1.00	1.00	± 13.1 %
3700	37.7	3.12	3.99	3.99	3.99	1.00	0.93	± 13.1 %

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3291

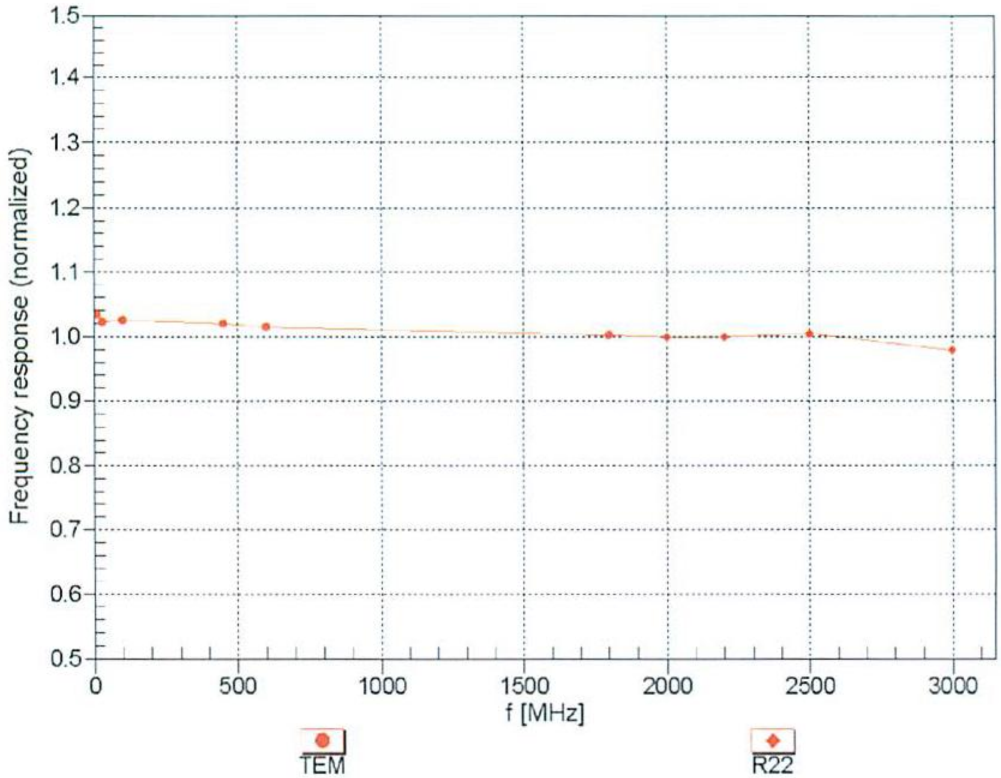
Calibration Parameter Determined in Body Tissue Simulating Media

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	7.42	7.42	7.42	0.22	1.52	± 13.4 %
450	56.7	0.94	7.35	7.35	7.35	0.11	1.00	± 13.4 %
750	55.5	0.96	6.47	6.47	6.47	0.80	1.16	± 12.0 %
900	55.0	1.05	6.34	6.34	6.34	0.80	1.19	± 12.0 %
1810	53.3	1.52	4.98	4.98	4.98	0.60	1.39	± 12.0 %
1950	53.3	1.52	4.93	4.93	4.93	0.72	1.28	± 12.0 %
2300	52.9	1.81	4.58	4.58	4.58	0.67	1.18	± 12.0 %
2450	52.7	1.95	4.36	4.36	4.36	0.66	0.99	± 12.0 %
2600	52.5	2.16	4.17	4.17	4.17	0.60	0.84	± 12.0 %
3500	51.3	3.31	3.65	3.65	3.65	1.00	1.20	± 13.1 %
3700	51.0	3.55	3.54	3.54	3.54	1.00	1.25	± 13.1 %

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

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

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



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

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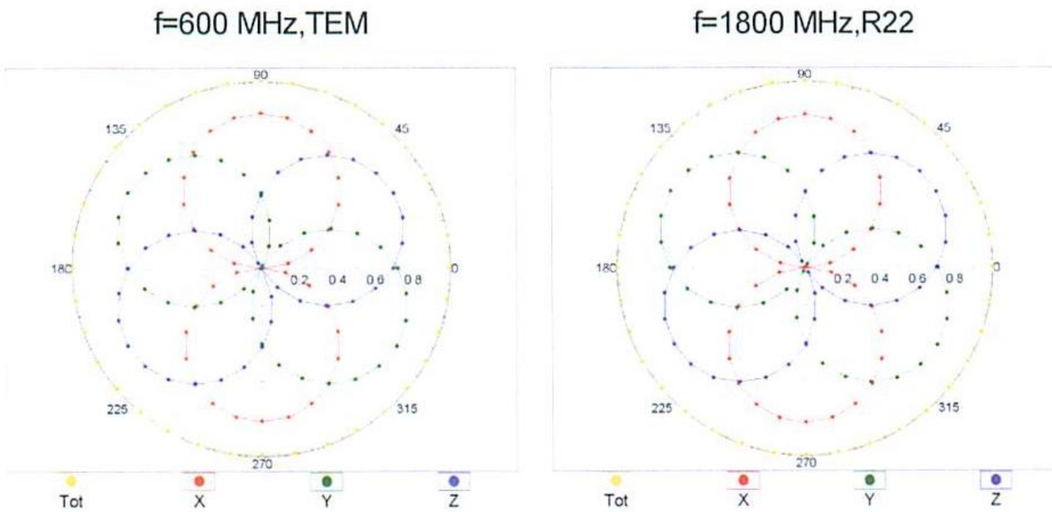
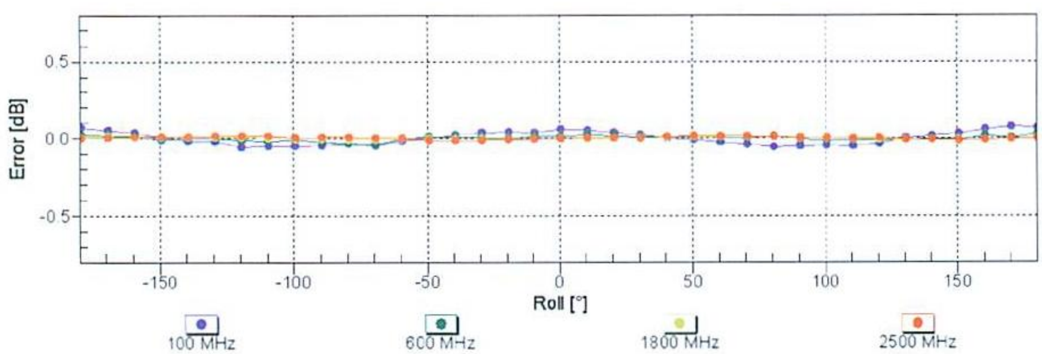
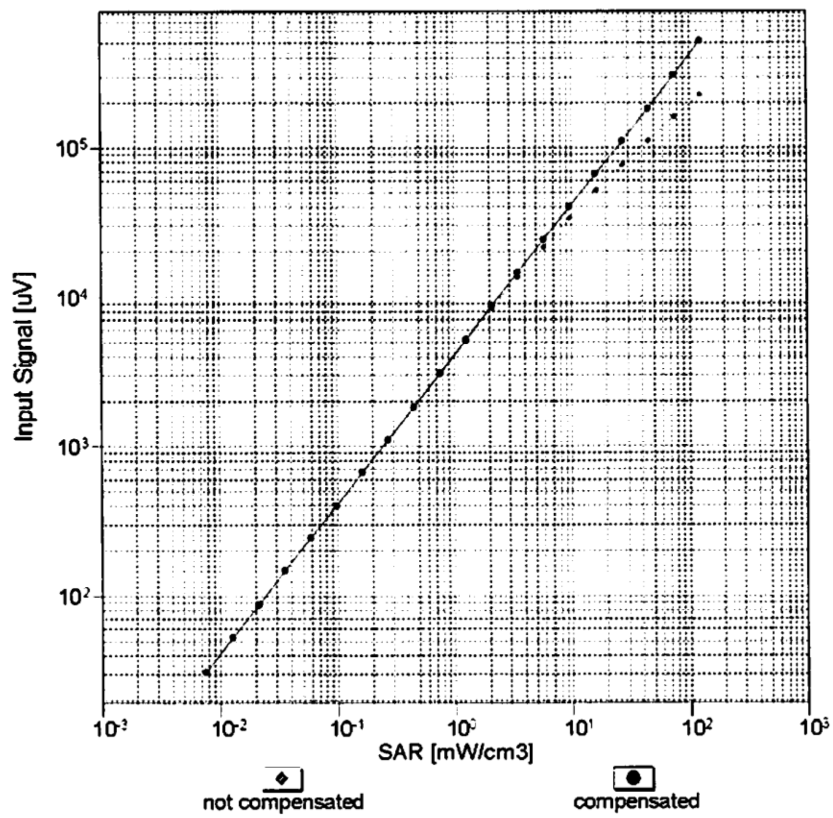
Receiving Pattern (ϕ), ϑ = 0°

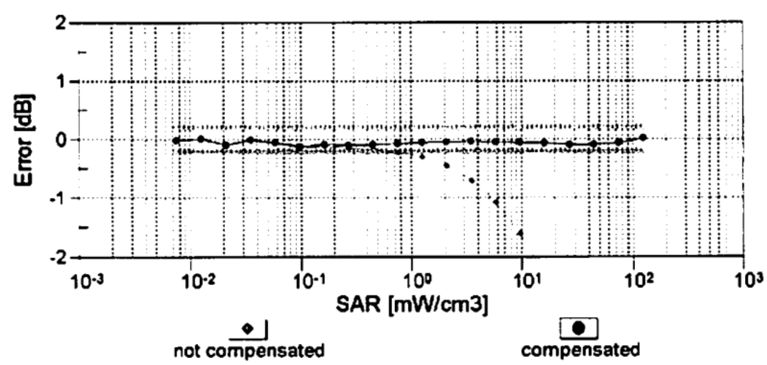




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

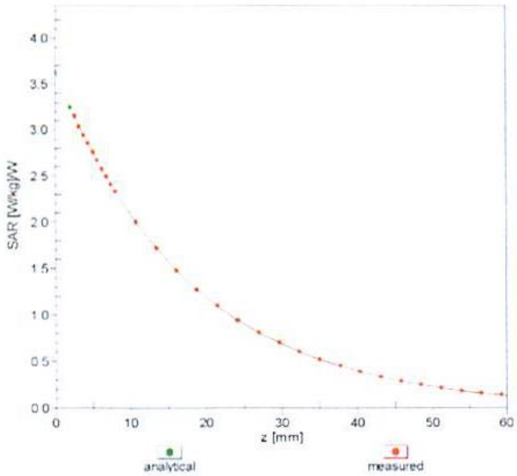




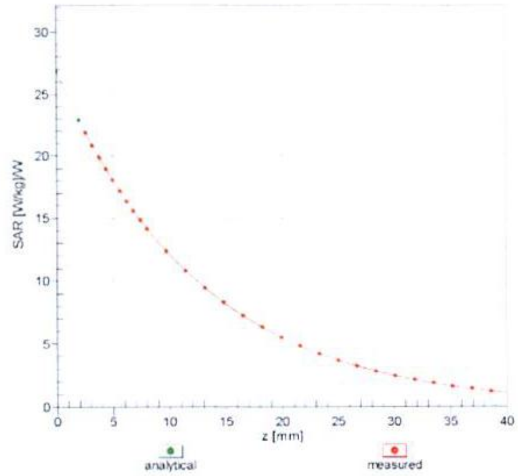
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

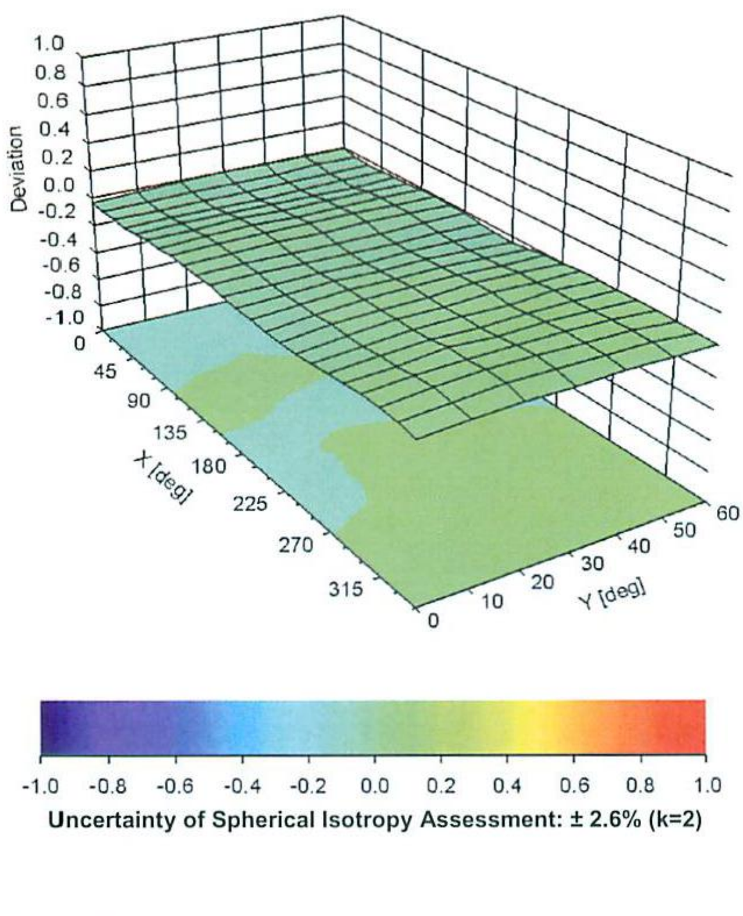


f = 1810 MHz,WGLS R22 (H_convF)



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:3291

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-59.4
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

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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:	**3291**
Place of Assessment:	**Zurich**
Date of Assessment:	**June 22, 2013**
Probe Calibration Date:	**June 20, 2013**

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 or at 1810 MHz.

Assessed by:

Schmid & Partner Engineering AG

s p e a g

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Dosimetric E-Field Probe ES3DV3 SN:3291

Conversion factor (± standard deviation)

150 ± 50 MHz	*ConvF*	**8.59 ± 10%**	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
250 ± 50 MHz	*ConvF*	**8.00 ± 10%**	ε_r = 47.6 ± 5% σ = 0.83 ± 5% mho/m (head tissue)
150 ± 50 MHz	*ConvF*	**8.18 ± 10%**	ε_r = 61.9 ± 5% σ = 0.80 ± 5% mho/m (body tissue)
250 ± 50 MHz	*ConvF*	**7.86 ± 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 B
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
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: **D450V3-1075_Jul13**

CALIBRATION CERTIFICATE

Object	D450V3 - SN: 1075
Calibration procedure(s)	QA CAL-15.v7 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	July 23, 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: 5058 (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
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: July 23, 2013

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.

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	44.0 ± 6 %	0.89 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	1.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.73 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.794 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.13 W/kg ± 17.6 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.1 ± 6 %	0.95 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	1.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.51 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.754 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.99 W/kg ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.8 Ω - 2.2 jΩ
Return Loss	- 22.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	56.5 Ω - 4.4 jΩ
Return Loss	- 22.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 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: 23.07.2013

Test Laboratory: The name of your organization

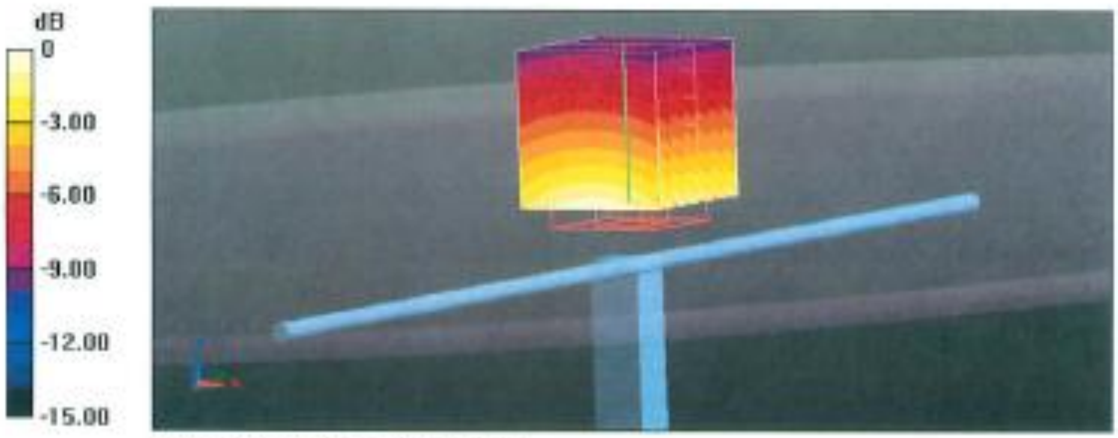
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1075

Communication System: UID 0 - CW ; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.89 S/m; ε_r = 44; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

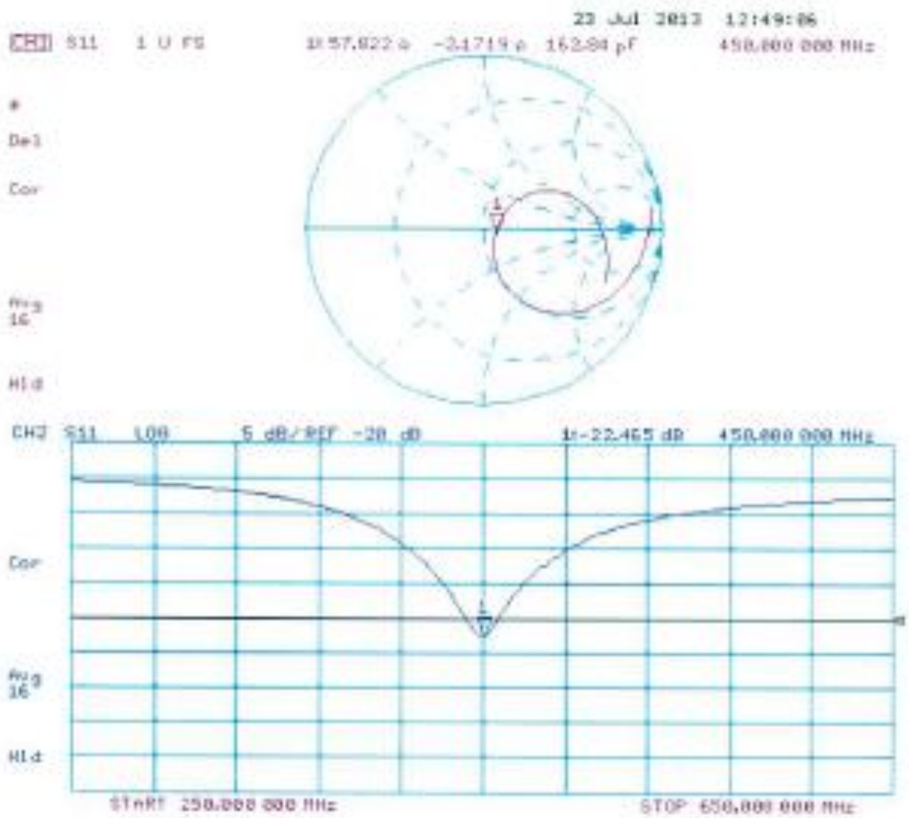
- Probe: ET3DV6 - SN1507; ConvF(6.59, 6.59, 6.59); Calibrated: 28.12.2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.07.2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.426 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.84 W/kg
SAR(1 g) = 1.2 W/kg; SAR(10 g) = 0.794 W/kg
Maximum value of SAR (measured) = 1.28 W/kg



0 dB = 1.28 W/kg = 1.07 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.07.2013

Test Laboratory: The name of your organization

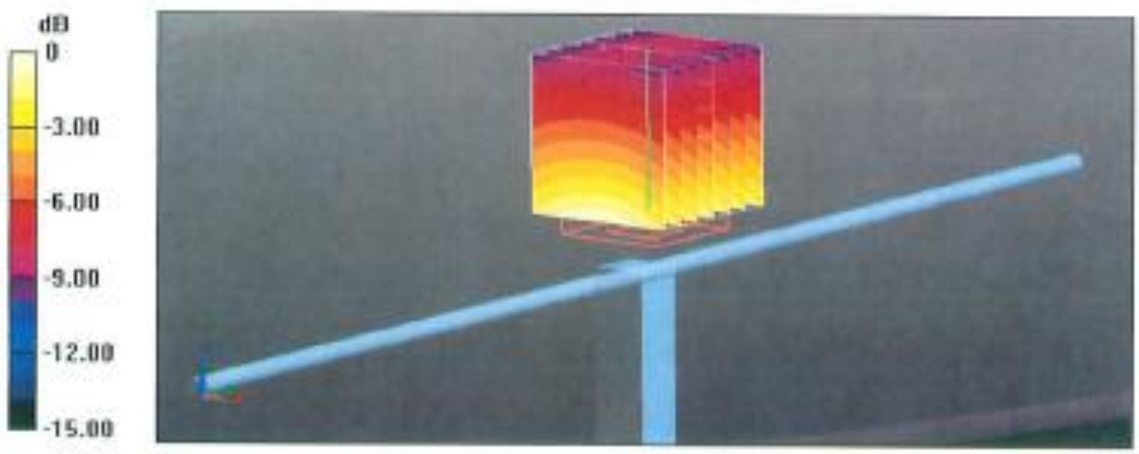
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1075

Communication System: UID 0 - CW ; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; $\sigma = 0.95$ S/m; $\varepsilon_r = 56.1$; $\rho = 1000$ 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 4.0; Type: QDOVA001BA; Serial: 1003
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

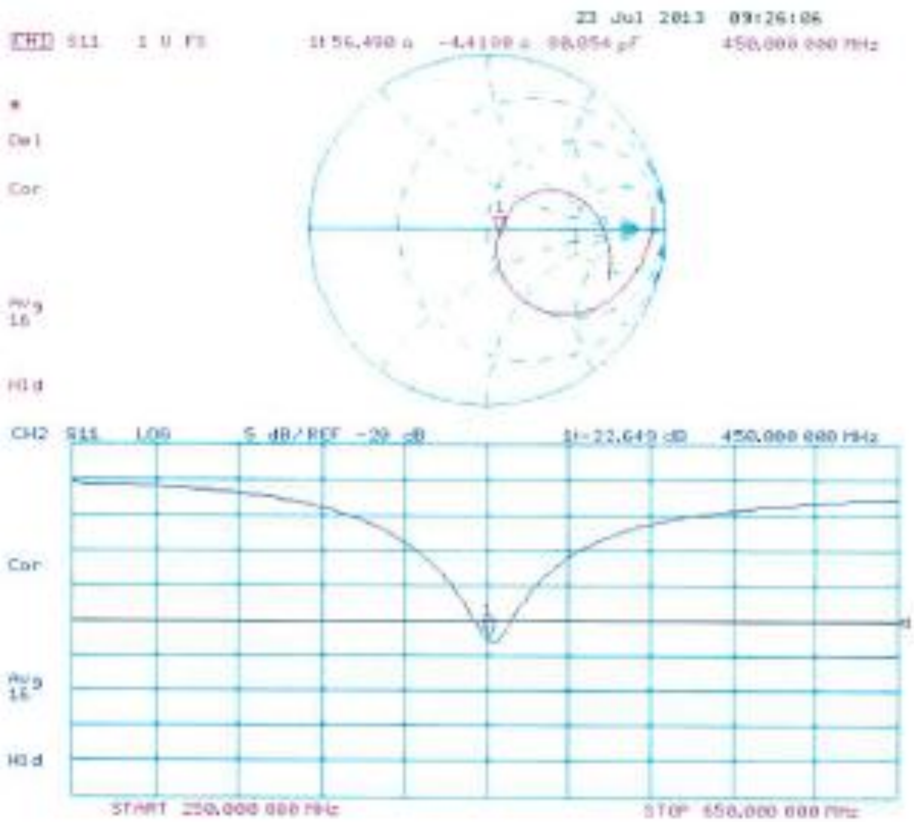
Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.426 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.78 W/kg
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.754 W/kg
Maximum value of SAR (measured) = 1.22 W/kg



0 dB = 1.22 W/kg = 0.86 dBW/kg

Certificate No: D450V3-1075_Jul13 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D450V3-1075_Jul13 Page 8 of 8