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DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

Motorola Solutions Inc.
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Date of Report: 3/10/2016
Report Revision: B

Responsible Engineer:	Tiong Nguk Ing
Report Author:	Tiong Nguk Ing
Date/s Tested:	09/26/2015, 09/29/2015, 10/12/2015, 10/16/2015, 1/28/2016
Manufacturer:	Motorola Solutions Inc.
DUT Description:	450-520 MHz 1-5W, 136-174 MHz 1-6W, 6.25K/12.5K/25 Basic Top Display Model W/GPS. Capable of digital and analog FM transmission. Also capable of TDMA transmission
Test TX mode(s):	CW (PTT)
Max. Power output:	5.6 W (UHF R2), 6.6 W (VHF)
Nominal Power:	5.0 W (UHF R2), 6.0 W (VHF)
Tx Frequency Bands:	450-520 MHz (UHF R2), 136-174 MHz (VHF)
Signaling type:	FM, TDMA
Model(s) Tested:	H97TGD9PW1AN (MNUT1015A)
Model(s) Certified:	H97TGD9PW1AN (MNUT1015A)
Serial Number(s):	CAI1004W9P
Classification:	Occupational/Controlled
FCC ID:	AZ489FT4893 ; UHF R2 450-512 MHz, VHF 150.8-173.4 MHz This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
IC:	109U-89FT4893; This report contains results that are immaterial for IC equipment approval, which are identified.

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

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

Tiong

Tiong Nguk Ing
Deputy Technical Manager
Approval Date: 3/10/2016

Tiong Nguk Ing
Digitally signed by Tiong Nguk Ing
DN: cn=Tiong Nguk Ing, o=Motorola Solutions, ou=Regulatory Compliance Lab, email=n.i.tiong@motorolasolutions.com, c=MY
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Certification Date: 2/16/2016

Certification No.: 160104AD

Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
2/16/2016	A	PCII Report for new battery PMNN4485A
3/10/2016	B	Update version number for reference standard KDB

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 H97TGD9PW1AN (MNUT1015A). This device is classified as Occupational/Controlled. The information herein is to show evidence of Class II Permissive Change compliance base on SAR evaluation of a new introduced battery PMNN4485A.

2.0 FCC SAR Summary

Table 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
TNF	150.8-173.4 MHz	2.09	0.93	1.05	0.80
	450-512 MHz	3.58	2.66	2.24	1.65

3.0 Abbreviations / Definitions

CNR: Calibration Not Required
CW: Continuous Wave
DSP: Digital Signal Processor
DUT: Device Under Test
EME: Electromagnetic Energy
FM: Frequency Modulation
LMR: Land Mobile Radio
NA: Not Applicable
PSM: Public Safety Microphone
PTT: Push to Talk
SAR: Specific Absorption Rate
TDMA: Time Division Multiple Access
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

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)
- 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 (2013), 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 (2015), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- RSS-102 (Issue 5) – Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
- Australian Communications Authority Radio communications (Electromagnetic Radiation - Human Exposure) Standard (2014)
- 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).
- FCC KDB – 643646 D01 SAR Test for PTT Radios v01r03
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB – 865664 D02 RF Exposure Reporting v01r02
- FCC KDB – 447498 D01 General RF Exposure Guidance v06

5.0 SAR Limits

Table 2

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

6.0 Description of Device Under Test (DUT)

This portable transmits using FM (frequency modulation) and incorporates traditional simplex two-way radio transmission protocol. Its normal use is to be 5-5-90 (5% TX, 5% RX and 90% standby). It is also capable of TDMA transmission.

The TDMA technique requires sophisticated algorithms and a digital signal processor (DSP) to perform voice compressions/decompressions and RF modulation/demodulation. Duty cycle is 2:1, 2 slots TDMA with transmit taking 1 slot.

The LMR bands in this device operate 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.

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. 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. The following sections identify the test criteria and details for each accessory category applicable for this PCII filling only. Please refer to previous filling for a detailed listing of all approved offered accessories.

7.1 Antennas

There are two antennas applicable for this PCII filling. This antenna was approved offered antennas in previous filling. The table below lists their descriptions.

Table 3

Antenna Models	Description	Selected for test	Tested
PMAT4001A	VHF/UHF/GPS 136-174 MHz, 380-520 MHz, 1575 MHz, ¼ Wave, -8dBd	Yes	Yes
PMAE4065A	UHF/GPS 380-520 MHz, 1575 MHz, ¼ Wave, -2dBd	Yes	Yes

7.2 Battery

This is new offered battery for this PCII filling. The table below lists it description.

Table 4

Battery Models	Description	Selected for test	Tested
PMNN4485A	Battery Impress 2 Li-ion R IP68 2550 mAh	Yes	Yes

7.3 Body worn Accessories

The table below lists the body worn accessories considered in order to demonstrate PCII compliance.

Table 5

Body worn Models	Description	Selected for test	Tested
HLN6875A	3.0” Belt Clip	Yes	Yes
AY000222A01	Boston leather carry case with D-ring	Yes	Yes
RLN4570A	Break-A-Way Chest Pack	Yes	Yes

7.4 Audio Accessories

The table below lists the audio accessories considered in order to demonstrate PCII compliance.

Table 6

Audio Acc. Models	Description	Selected for test	Tested
RMN5058A	Lightweight Headset	Yes	Yes
PMMN4059B	Wind porting Public Safety Microphone	Yes	Yes

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 EX3DV4 (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 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(s) Used	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (wood)
Triple Flat	NA	200MHz -6GHz; Er = 3-5, Loss Tangent = ≤0.05	280x175x175	2mm +/- 0.2mm	Wood	< 0.05
SAM	NA	300MHz -6GHz; Er = < 5, Loss Tangent = ≤0.05	Human Model			
Oval Flat	√	300MHz -6GHz; Er = 4+/- 1, Loss Tangent = ≤0.05	600x400x190			

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 (percent by mass)

Table 9

Ingredients	150 MHz		450 MHz	
	Head	Body	Head	Body
Sugar	55.4	49.7	56.00	46.50
Diacetin	0	0	0	0
De ionized – Water	38.35	46.2	39.10	50.53
Salt	5.15	3.00	3.80	1.87
HEC	1	1	1.00	1.00
Bact.	0.10	0.10	0.10	0.10

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
Speag Probe	ES3DV3	3147	5/27/2015	5/27/2016
Speag Probe	EX3DV4	3638	1/26/2015	1/26/2016*
Speag DAE	DAE4	729	4/27/2015	4/27/2016
Power Meter	E4419B	MY50000505	9/2/2015	9/2/2017
E-Series Avg. Power Sensor	E9301B	MY41495594	4/14/2015	4/14/2016
E-Series Avg. Power Sensor	E9301B	MY50280001	8/5/2015	8/5/2016
Power Meter	E4418B	MY4107917	5/7/2015	5/7/2016
E-Series Avg. Power Sensor	E9301B	MY50290001	9/18/2015	9/18/2016
Power Meter	E4418B	US39251150	2/5/2015	2/5/2016
Power Sensor	8481B	3318A10982	4/13/2015	4/13/2016
Signal Generator	E4438C	MY42081753	1/17/2014	1/17/2016*
Bi-Directional Coupler	3020A	40295	9/22/2015	9/22/2017
Power Amplifier	10WD1000	28782	CNR	CNR
Dickson Temperature Recorder	TM325	12121144	6/17/2015	6/17/2016
Omega Digital Thermometer with J Type TC Probe	HH200A	20857	10/21/2014	10/21/2015*
Omega Digital Thermometer with J Type TC Probe	HH200A	48870	6/16/2015	6/16/2016
Omega Digital Thermometer with J Type TC Probe	HH202A	18800	4/6/2015	4/6/2016
Omega Digital Thermometer with J Type TC Probe	HH202A	18801	6/16/2015	6/16/2016
Omega Digital Thermometer with J Type TC Probe	HH202A	18812	6/24/2015	6/24/2016
Temperature Probe	DTM3000	2959	4/24/2015	4/24/2016
Network Analyzer	N5230C	MY49002155	8/3/2015	8/3/2016
Dielectric Probe Kit (DAK)	DAK-3.5	1059	4/21/2015	4/21/2016
Dielectric Probe Kit (DAK)	DAK-12	1013	4/21/2015	4/21/2016
Speag Dipole	D450V3	1075	7/7/2015	7/7/2017
Speag Dipole	CLA150	4005	7/8/2015	7/8/2017

* Equipment used for test dates prior to equipment calibration due date.

10.0 SAR Measurement System Validation and Verification

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

<table>
<tr><th rowspan="2">Dates</th><th rowspan="2" colspan="2">Probe Calibration Point</th><th rowspan="2">Probe SN</th><th colspan="2">Measured Tissue Parameters</th><th colspan="3">Validation</th></tr>
<tr><th>σ</th><th>ϵ_r</th><th>Sensitivity</th><th>Linearity</th><th>Isotropy</th></tr>
<tr><td colspan="9">CW</td></tr>
<tr><td>2/10/2015</td><td rowspan="2">Body</td><td rowspan="2">150</td><td rowspan="3">3638</td><td>0.80</td><td>63.7</td><td rowspan="2">Pass</td><td rowspan="2">Pass</td><td rowspan="2">Pass</td></tr>
<tr><td>2/11/2015</td><td>0.80</td><td>62.8</td></tr>
<tr><td>2/10/2015</td><td>Head</td><td>150</td><td>0.79</td><td>52.7</td><td>Pass</td><td>Pass</td><td>Pass</td></tr>
<tr><td>6/18/2015</td><td>Body</td><td>450</td><td rowspan="2">3147</td><td>0.93</td><td>55.5</td><td>Pass</td><td>Pass</td><td>Pass</td></tr>
<tr><td>6/18/2015</td><td>Head</td><td>450</td><td>0.85</td><td>43.2</td><td>Pass</td><td>Pass</td><td>Pass</td></tr>
</table>

10.2 System Verification

System verification 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

<table>
<tr><th>Probe Serial #</th><th>Tissue Type</th><th>Dipole Kit / Serial #</th><th>Ref SAR @ 1W (W/kg)</th><th>System Check Results Measured (W/kg)</th><th>System Check Test Results when normalized to 1W (W/kg)</th><th>Tested Date</th></tr>
<tr><td rowspan="2">3638</td><td>FCC Body</td><td rowspan="2">SPEAG CLA150 / 4005</td><td>3.88 +/- 10%</td><td>3.84</td><td>3.84</td><td>10/12/2015</td></tr>
<tr><td>IEEE/IEC Head</td><td>3.83+/-10%</td><td>3.47</td><td>3.57</td><td>10/16/2015</td></tr>
<tr><td rowspan="3">3147</td><td rowspan="2">FCC Body</td><td rowspan="3">SPEAG D450V3 / 1075</td><td rowspan="2">4.41 +/- 10%</td><td>1.13</td><td>4.52</td><td>9/26/2015</td></tr>
<tr><td>1.13</td><td>4.52</td><td>1/28/2016</td></tr>
<tr><td>IEEE/IEC Head</td><td>4.46 +/- 10%</td><td>1.10</td><td>4.40</td><td>9/29/2015</td></tr>
</table>

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
136	FCC Body	0.79 (0.75-0.83)	62.3 (59.1-65.4)	0.80	60.3	10/12/2015
142	IEEE/ IEC Head	0.75 (0.72-0.79)	52.7 (50.0-55.3)	0.76	53.9	10/16/2015
150	FCC Body	0.80 (0.76-0.84)	61.9 (58.8-65.0)	0.81	59.8	10/12/2015
	IEEE/ IEC Head	0.76 (0.72-0.80)	52.3 (49.7-54.9)	0.77	53.4	10/16/2015
173	FCC Body	0.82 (0.78-0.86)	61.3 (58.3-64.4)	0.82	59.0	10/12/2015
	IEEE/ IEC Head	0.78 (0.74-0.82)	51.2 (48.7-53.8)	0.79	52.1	10/16/2015
450	FCC Body	0.94 (0.89-0.99)	56.7 (53.9-59.5)	0.89	54.5	9/26/2015
				0.95	54.8	1/28/2016
	IEEE/ IEC Head	0.87 (0.83-0.91)	43.5 (41.3-45.7)	0.88	44.5	9/29/2015
466	IEEE/ IEC Head	0.87 (0.83-0.91)	43.4 (41.2-45.6)	0.90	44.2	9/29/2015
520	FCC Body	0.95 (0.90-0.99)	56.4 (53.6-59.2)	0.95	53.6	9/26/2015
	IEEE/ IEC Head	0.87 (0.83-0.92)	43.1 (41.0-45.3)	0.92	42.8	9/29/2015

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: 21.4 – 22.0˚C Avg. 21.7 ˚C
Tissue Temperature	NA	Range: 21.4 – 22.0˚C Avg. 21.7 ˚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. Oval 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

Description		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: ΔxArea, ΔyArea		≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
		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.	
Maximum zoom scan spatial resolution: ΔxZoom, ΔyZoom		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: ΔzZoom(n)	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
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.			

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.

12.3.2 Head

Not applicable.

12.3.3 Face

The DUT was positioned with its' front and back sides 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 drift. Appendix F includes a shortened scan to justify SAR scaling for drift. 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 section 4.0 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 CW and 50% duty cycle was applied to PTT configurations in the final results.

13.0 DUT Test Data

13.1 Assessment at the Body and Face for VHF (150.8-173.4 MHz)

The new battery PMNN4485A was assessed using the accessories indicated in section 7.0 which represent the highest applicable configuration at the body and face found during previous compliance assessment on file with the FCC. SAR plots of the highest results are presented in Appendix E.

Table 16

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#
Assessment at the Body											
PMAT4001A	PMNN4485A	HLN6875A	RMN5058A	150.800							
				158.300							
				165.900							
				173.400	6.35	-0.28	3.77	1.67	**2.09**	**0.93**	HvH-Ab-151012-07
Assessment at the Face											
PMAT4001A	PMNN4485A	None; Front DUT facing phantom	None	150.800							
				158.300							
				165.900							
				173.400	6.34	-0.54	1.78	1.35	**1.05**	**0.80**	HvH-Face-151016-05

13.2 Assessment at the Body and Face for UHF R2 (450-512 MHz)

The new battery PMNN4485A was assessed using the accessories indicated in section 7.0 which represent the highest applicable configuration at the body and face found during previous compliance assessment on file with the FCC. SAR plots of the highest results 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 (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessment at the Body											
PMAE4065A	PMNN4485A	AY000222A01	None	450.000	5.29	-0.03	6.72	4.99	**3.58**	**2.66**	PS-AB-160128-06
				465.500							
				481.000							
				496.500							
				512.000							
Assessment at the Face											
PMAE4065A	PMNN4485A	None; PSM's front facing phantom	PMMN4059B	450.000							
				465.500	5.52	-0.10	4.31	3.17	**2.24**	**1.65**	HvH-Face-150929-04
				481.000							
				496.500							
				512.000							

13.3 Assessment outside FCC Part 90

Assessment of outside FCC Part 90 with new battery PMNN4485A. SAR plots of the highest results 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 (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
Assessment at the Body											
PMAT4001A	PMNN4485A	HLN6875A	RMN5058A	136.000	6.28	-0.10	7.68	3.44	4.13	1.85	HvH-Ab-151012-09
PMAE4065A	PMNN4485A	RLN4570A	None	520.000	5.59	-0.02	13.20	9.64	**6.64**	**4.85**	HvH-Ab-150926-07
Assessment at the Face											
PMAT4001A	PMNN4485A	None, Back facing phantom	None	142.300	6.39	-0.55	2.02	1.55	1.18	0.91	HvH-Face-151016-07
PMAE4065A	PMNN4485A	None, Back facing phantom	None	520.000	5.59	0.04	4.20	3.11	**2.10**	**1.56**	HvH-Face-150929-06

13.4 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 F.

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#
PMAE4065A	PMNN4485A	AY000222A01	None	450.000	5.30	-0.02	6.60	4.91	**3.50**	2.61	PS-AB-160128-07

14.0 Results Summary

The highest Operational Maximum Calculated 1-gram and 10-gram average SAR values found for this filing:

Table 20

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
VHF					
FCC	150.8-173.4	2.09	0.93	*1.05	0.80
IC	138-174	2.09	0.93	1.18	0.91
Overall	136-174	4.13	1.85	1.18	0.91
UHF R2					
FCC	450-512	3.58	2.66	2.24	1.65
IC	450-470	3.58	2.66	2.24	1.65
Overall	450-520	6.64	4.85	2.24	1.65

All results are scaled to the maximum output power.

*** The FCC "Max Calc at the Face" for VHF reflects the new SAR compliance value at the head for this FCC ID. (Previous filled SAR value for VHF head is 0.8 W/kg).**

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of 8 W/kg averaged over 1 gram per the requirements of OET Bulletin 65. The 10 grams result is not applicable to FCC filing.

15.0 Variability Assessment

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

16.0 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

Table A.1: Uncertainty Budget for Device Under Test, for 150 MHz and 450 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				11	11	477
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				23	22	

Notes for uncertainty budget Tables:
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

Table A.2: Uncertainty Budget for System Validation (dipole & flat phantom) for 150MHz and 450 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g U_i (±%)**	**10 g U_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.7	N	1.00	1	1	6.7	6.7	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
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	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				19	18	

Notes for uncertainty budget Tables:
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 0108**

Client **Motorola EME**

Certificate No: **ES3-3147_May15**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3147
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 27, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: May 28, 2015

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 0108**

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).

Certificate No: ES3-3147_May15 Page 2 of 14

Probe ES3DV3

SN:3147

Manufactured: July 12, 2007
Calibrated: May 27, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3147

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.25	1.19	1.18	± 10.1 %
DCP (mV)[B]	100.8	103.2	101.5	

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	208.2	±3.5 %
		Y	0.0	0.0	1.0		201.7	
		Z	0.0	0.0	1.0		204.1	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.19	66.3	18.6	5.67	133.9	±1.7 %
		Y	6.32	67.2	19.5		131.5	
		Z	6.30	66.9	19.2		132.6	
10101-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	7.36	67.1	19.4	6.42	145.2	±2.2 %
		Y	7.49	67.8	20.2		142.9	
		Z	7.46	67.5	19.8		143.4	
10102-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	7.64	67.3	19.6	6.60	147.4	±2.2 %
		Y	7.81	68.2	20.5		145.3	
		Z	7.76	67.7	20.0		145.4	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.10	66.0	18.6	5.80	132.0	±1.4 %
		Y	6.25	67.0	19.6		131.0	
		Z	6.26	66.7	19.3		130.9	
10109-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.13	66.8	19.3	6.43	140.5	±1.9 %
		Y	7.23	67.5	20.1		139.4	
		Z	7.24	67.2	19.7		139.5	
10110-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.80	65.5	18.4	5.75	128.7	±1.4 %
		Y	5.94	66.4	19.3		128.1	
		Z	5.95	66.1	19.0		127.7	
10111-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	6.87	66.5	19.2	6.44	136.7	±1.9 %
		Y	7.00	67.3	20.0		135.6	
		Z	6.97	66.8	19.6		134.7	
10112-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.40	67.1	19.5	6.59	141.9	±2.2 %
		Y	7.54	67.9	20.4		141.5	
		Z	7.48	67.4	19.9		141.2	
10113-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	7.11	66.7	19.3	6.62	137.6	±1.9 %
		Y	7.26	67.6	20.3		137.2	
		Z	7.22	67.1	19.8		136.8	
10140-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	7.57	67.3	19.5	6.49	145.4	±1.9 %
		Y	7.72	68.1	20.4		146.0	
		Z	7.67	67.6	19.9		144.9	
10141-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	X	7.71	67.4	19.6	6.53	147.4	±2.2 %
		Y	7.89	68.3	20.5		147.8	
		Z	7.83	67.8	20.0		146.6	

10142-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.90	66.3	18.8	5.73	148.9	±1.9 %
		Y	5.81	66.4	19.4		126.7	
		Z	6.03	66.9	19.4		148.3	
10143-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.61	66.2	19.0	6.35	132.3	±1.7 %
		Y	6.75	67.1	19.9		132.8	
		Z	6.76	66.8	19.5		131.7	
10144-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	X	6.95	66.6	19.3	6.65	134.5	±1.9 %
		Y	7.09	67.4	20.2		134.1	
		Z	7.11	67.1	19.8		133.6	
10145-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.65	66.0	18.7	5.76	144.5	±1.7 %
		Y	5.73	66.9	19.7		145.0	
		Z	5.73	66.4	19.2		143.2	
10146-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.33	66.1	19.0	6.41	127.1	±1.7 %
		Y	6.48	67.3	20.1		126.3	
		Z	6.47	66.6	19.4		126.5	
10147-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	X	6.60	66.3	19.2	6.72	127.6	±1.9 %
		Y	6.75	67.4	20.3		126.0	
		Z	6.77	66.9	19.8		126.9	
10149-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.11	66.7	19.3	6.42	139.8	±1.9 %
		Y	7.25	67.6	20.1		138.6	
		Z	7.20	67.1	19.7		137.9	
10150-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	X	7.37	67.0	19.4	6.60	142.2	±2.2 %
		Y	7.52	67.8	20.3		141.2	
		Z	7.48	67.4	19.9		140.6	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.81	65.5	18.4	5.75	128.5	±1.7 %
		Y	5.98	66.6	19.4		127.9	
		Z	6.19	67.1	19.5		149.9	
10155-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	6.87	66.4	19.1	6.43	136.3	±1.9 %
		Y	7.00	67.3	20.1		135.0	
		Z	6.97	66.8	19.6		134.6	
10156-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.84	66.1	18.8	5.79	147.1	±1.7 %
		Y	5.98	67.2	19.9		148.4	
		Z	5.98	66.7	19.4		146.6	
10157-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.60	66.2	19.0	6.49	130.9	±1.9 %
		Y	6.73	67.1	20.0		130.1	
		Z	6.76	66.8	19.6		130.8	
10158-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	7.14	66.8	19.4	6.62	137.8	±1.9 %
		Y	7.28	67.6	20.3		136.5	
		Z	7.24	67.1	19.8		136.8	
10159-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.75	66.4	19.2	6.56	132.2	±1.7 %
		Y	6.87	67.3	20.1		131.5	
		Z	6.88	66.9	19.7		131.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.22	66.0	18.6	5.82	133.1	±1.7 %
		Y	6.41	67.1	19.6		132.8	
		Z	6.37	66.6	19.2		132.5	

10161-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.20	66.9	19.3	6.43	141.3	±1.9 %
		Y	7.36	67.8	20.3		140.2	
		Z	7.31	67.3	19.8		139.9	
10162-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	X	7.41	67.1	19.5	6.58	142.6	±1.9 %
		Y	7.57	67.9	20.4		141.7	
		Z	7.53	67.5	19.9		141.7	
10166-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	5.02	65.5	18.3	5.46	138.0	±1.4 %
		Y	5.15	66.7	19.5		138.1	
		Z	5.16	66.1	19.0		137.4	
10167-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	6.02	66.9	19.3	6.21	142.3	±1.7 %
		Y	6.15	68.1	20.5		141.5	
		Z	6.17	67.4	19.8		142.1	
10168-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	X	6.51	67.2	19.8	6.79	142.8	±2.2 %
		Y	6.59	68.2	20.9		141.2	
		Z	6.65	67.7	20.3		142.6	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.86	65.5	18.5	5.73	132.0	±1.4 %
		Y	4.98	66.8	19.8		131.4	
		Z	5.01	66.2	19.2		130.9	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.66	66.8	19.5	6.52	132.0	±1.9 %
		Y	5.75	67.9	20.7		130.4	
		Z	5.84	67.5	20.2		131.7	
10171-AAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	5.66	66.8	19.5	6.49	132.3	±1.7 %
		Y	5.77	68.0	20.7		131.0	
		Z	5.84	67.6	20.2		132.2	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.86	65.5	18.5	5.72	131.7	±1.4 %
		Y	4.99	66.9	19.9		131.2	
		Z	5.00	66.2	19.1		130.6	
10176-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.66	66.8	19.5	6.52	132.1	±1.7 %
		Y	5.75	67.9	20.7		130.7	
		Z	5.81	67.3	20.1		130.8	
10177-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.87	65.5	18.5	5.73	131.8	±1.4 %
		Y	4.97	66.8	19.8		130.8	
		Z	5.00	66.2	19.1		130.8	
10178-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.66	66.8	19.5	6.52	132.3	±1.9 %
		Y	5.77	68.0	20.7		130.1	
		Z	5.83	67.4	20.2		130.9	
10179-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.67	66.9	19.5	6.50	132.7	±1.9 %
		Y	5.74	67.9	20.6		130.6	
		Z	5.83	67.5	20.1		131.3	
10180-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.68	67.0	19.6	6.50	133.2	±1.9 %
		Y	5.74	67.9	20.6		130.8	
		Z	5.81	67.4	20.1		130.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.87	65.6	18.5	5.72	132.4	±1.4 %
		Y	4.97	66.8	19.8		131.0	
		Z	5.01	66.2	19.2		130.1	

10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.66	66.8	19.5	6.52	132.7	±1.9 %
		Y	5.79	68.0	20.8		130.4	
		Z	5.82	67.4	20.1		130.9	
10183-AAA	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	X	5.65	66.8	19.5	6.50	132.7	±1.9 %
		Y	5.76	68.0	20.7		130.6	
		Z	5.83	67.5	20.1		131.5	
10184-CAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	4.86	65.5	18.5	5.73	132.2	±1.4 %
		Y	4.98	66.8	19.8		130.8	
		Z	5.02	66.3	19.2		130.6	
10185-CAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.64	66.7	19.4	6.51	132.0	±1.7 %
		Y	5.78	68.0	20.7		130.2	
		Z	5.83	67.4	20.2		131.0	
10186-AAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	X	5.68	66.9	19.6	6.50	132.5	±1.9 %
		Y	5.79	68.1	20.7		130.7	
		Z	5.82	67.5	20.1		131.4	
10187-CAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	4.86	65.5	18.5	5.73	131.7	±1.4 %
		Y	5.00	66.9	19.8		130.9	
		Z	5.02	66.3	19.2		131.1	
10188-CAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.67	66.8	19.5	6.52	131.9	±1.9 %
		Y	5.77	67.9	20.8		130.6	
		Z	5.83	67.4	20.1		131.2	
10189-AAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	X	5.67	66.9	19.6	6.50	132.2	±1.7 %
		Y	5.77	68.0	20.7		131.5	
		Z	5.83	67.5	20.2		132.1	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.12	66.1	18.7	5.81	130.9	±1.7 %
		Y	6.27	67.0	19.7		130.1	
		Z	6.23	66.6	19.2		129.2	
10298-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.71	66.1	18.7	5.72	146.5	±1.7 %
		Y	5.85	67.2	19.8		146.0	
		Z	5.84	66.6	19.3		144.8	
10299-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.46	66.3	19.0	6.39	129.6	±1.7 %
		Y	6.59	67.2	20.0		128.5	
		Z	6.58	66.7	19.5		128.4	
10300-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	X	6.64	66.4	19.2	6.60	129.3	±1.7 %
		Y	6.81	67.5	20.3		129.1	
		Z	6.81	67.0	19.7		128.8	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.67	66.7	19.0	6.06	136.4	±1.9 %
		Y	6.89	67.8	20.1		135.8	
		Z	6.78	67.1	19.5		134.8	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 8 and 9).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3147

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	7.08	7.08	7.08	0.04	1.50	± 13.3 %
220	49.0	0.81	7.13	7.13	7.13	0.05	1.10	± 13.3 %
300	45.3	0.87	7.37	7.37	7.37	0.15	1.90	± 13.3 %
450	43.5	0.87	6.72	6.72	6.72	0.24	2.50	± 13.3 %
750	41.9	0.89	6.31	6.31	6.31	0.26	2.20	± 12.0 %
900	41.5	0.97	5.84	5.84	5.84	0.57	1.41	± 12.0 %
1810	40.0	1.40	5.06	5.06	5.06	0.51	1.48	± 12.0 %
1950	40.0	1.40	4.85	4.85	4.85	0.53	1.42	± 12.0 %
2300	39.5	1.67	4.67	4.67	4.67	0.80	1.20	± 12.0 %
2450	39.2	1.80	4.36	4.36	4.36	0.80	1.25	± 12.0 %
2600	39.0	1.96	4.25	4.25	4.25	0.80	1.26	± 12.0 %
3500	37.9	2.91	4.17	4.17	4.17	0.80	1.20	± 13.1 %
3700	37.7	3.12	3.97	3.97	3.97	0.80	1.30	± 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. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

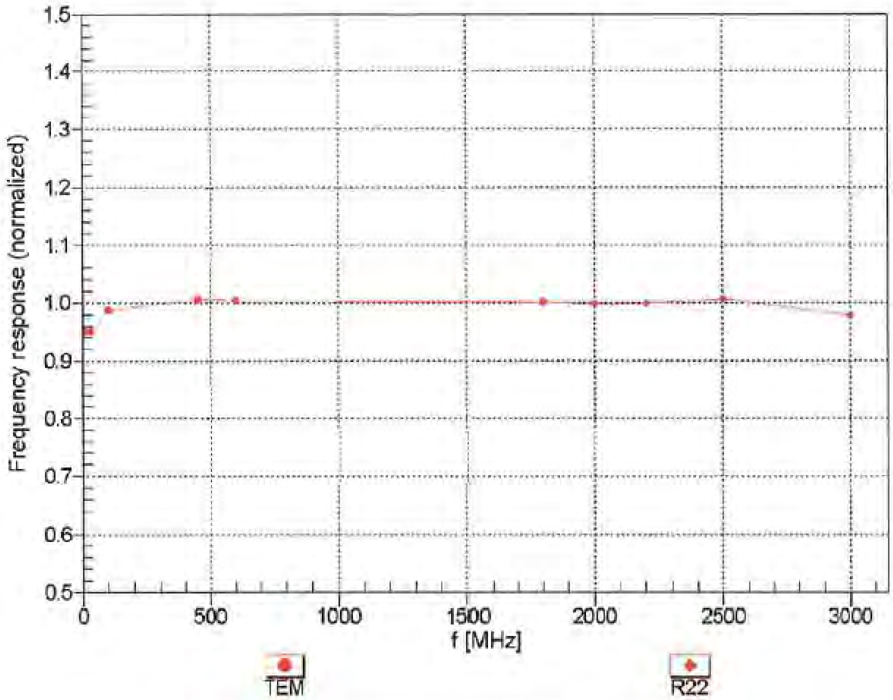
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3147

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	6.71	6.71	6.71	0.04	1.50	± 13.3 %
220	60.2	0.86	6.62	6.62	6.62	0.04	1.50	± 13.3 %
300	58.2	0.92	7.08	7.08	7.08	0.12	1.20	± 13.3 %
450	56.7	0.94	6.96	6.96	6.96	0.12	2.20	± 13.3 %
750	55.5	0.96	6.03	6.03	6.03	0.55	1.45	± 12.0 %
900	55.0	1.05	5.85	5.85	5.85	0.41	1.66	± 12.0 %
1810	53.3	1.52	4.76	4.76	4.76	0.37	1.90	± 12.0 %
1950	53.3	1.52	4.81	4.81	4.81	0.56	1.53	± 12.0 %
2300	52.9	1.81	4.43	4.43	4.43	0.79	1.25	± 12.0 %
2450	52.7	1.95	4.28	4.28	4.28	0.72	1.16	± 12.0 %
2600	52.5	2.16	4.14	4.14	4.14	0.80	1.00	± 12.0 %
3500	51.3	3.31	3.66	3.66	3.66	0.80	1.35	± 13.1 %
3700	51.0	3.55	3.47	3.47	3.47	0.84	1.55	± 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. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

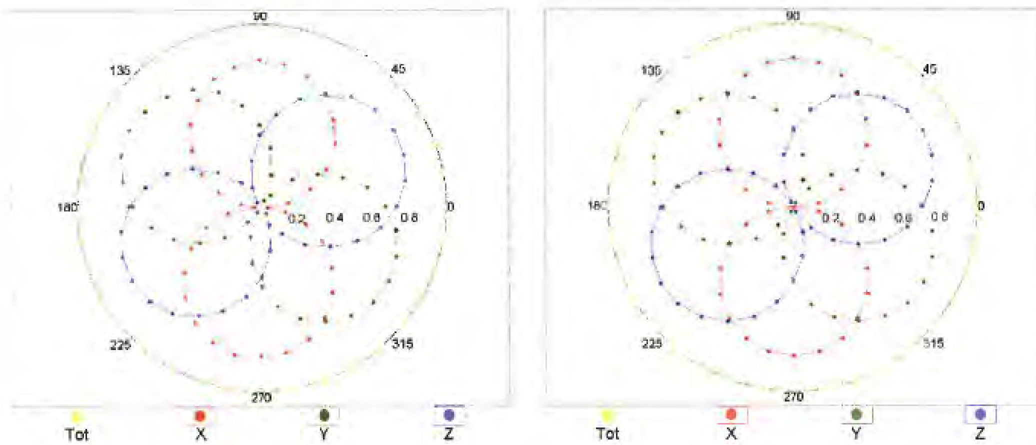
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

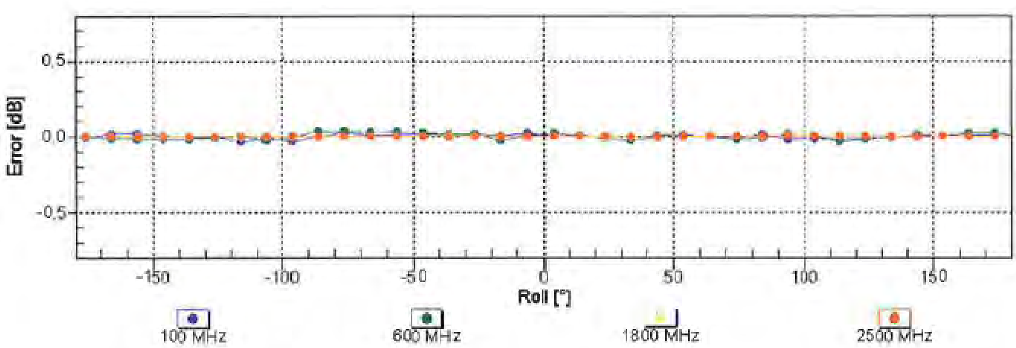


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

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

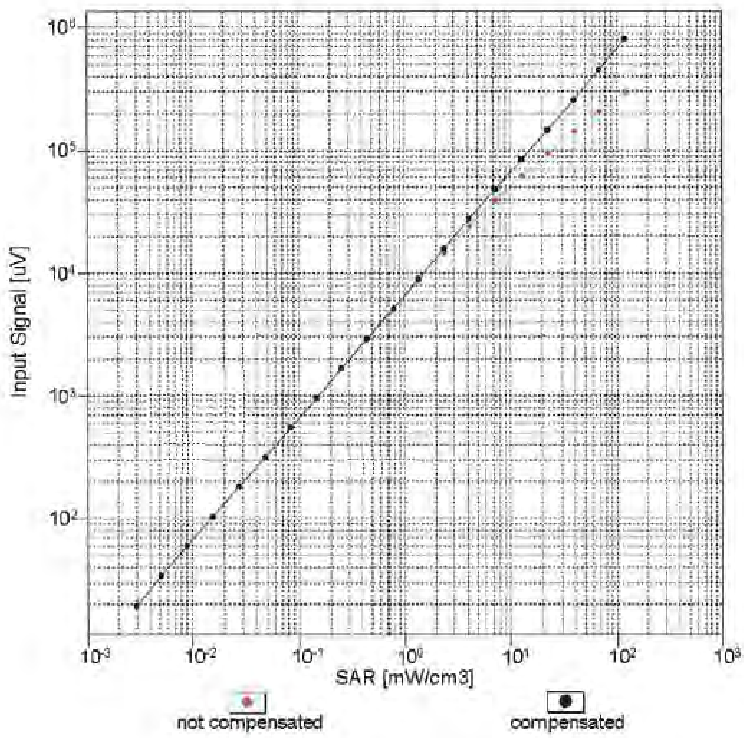


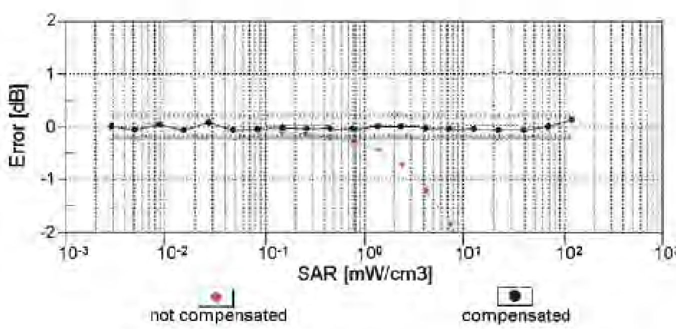


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

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

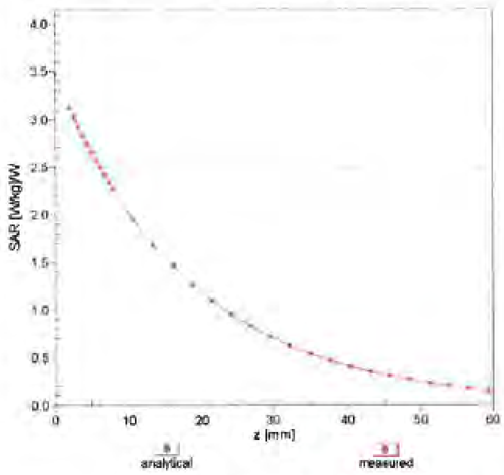




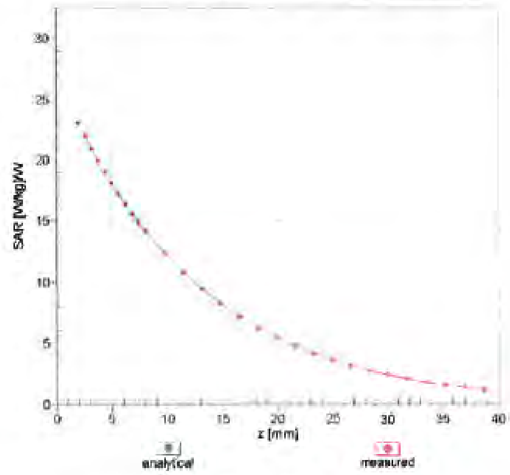
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

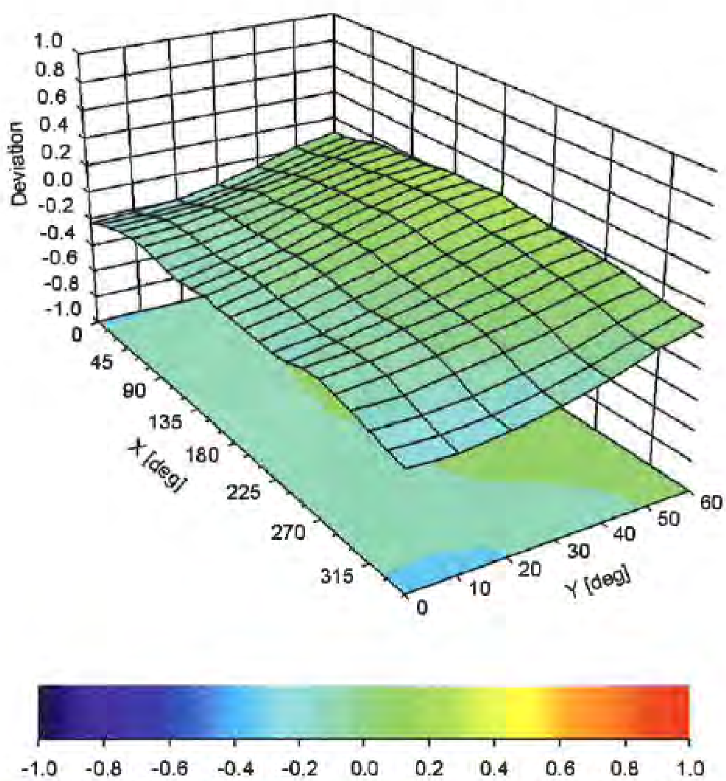


f = 1810 MHz,WGLS R22 (H_convF)



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:3147

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	13.8
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

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

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

Accreditation No.: **SCS 0108**

Client **Motorola EME**

Certificate No: **EX3-3638_Jan15**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3638

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: January 26, 2015

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-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: January 27, 2015

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 0108**

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 EX3DV4

SN:3638

Manufactured: November 1, 2007
Calibrated: January 26, 2015

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3638

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	0.45	0.21	0.39	± 10.1 %
DCP (mV)[B]	100.6	100.6	96.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	141.6	±3.0 %
		Y	0.0	0.0	1.0		148.3	
		Z	0.0	0.0	1.0		145.0	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.80	67.4	17.9	1.87	145.3	±0.9 %
		Y	2.78	68.4	19.0		133.4	
		Z	2.24	61.9	14.2		129.1	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.63	68.8	21.9	9.46	137.9	±3.3 %
		Y	10.44	68.3	21.7		127.8	
		Z	10.29	68.2	21.4		138.1	
10059-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	2.84	67.4	18.0	2.12	145.6	±0.9 %
		Y	3.02	69.8	19.8		133.4	
		Z	2.30	62.3	14.5		128.0	
10060-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	3.60	75.6	21.9	2.83	127.7	±0.7 %
		Y	3.43	77.0	23.2		138.1	
		Z	2.17	64.6	15.8		132.2	
10061-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	3.93	72.8	20.8	3.60	127.3	±0.9 %
		Y	3.49	72.4	21.4		137.6	
		Z	2.68	64.7	16.2		129.4	
10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.37	68.7	21.3	8.68	142.8	±3.3 %
		Y	10.21	68.2	21.2		131.7	
		Z	10.05	68.1	20.8		145.6	
10063-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	X	10.26	68.7	21.4	8.63	142.1	±3.0 %
		Y	10.08	68.2	21.2		130.9	
		Z	9.97	68.1	20.9		147.4	
10064-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	X	10.75	69.2	21.9	9.09	145.8	±3.3 %
		Y	10.60	68.7	21.7		136.1	
		Z	10.40	68.5	21.3		147.6	
10065-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	X	10.37	68.8	21.6	9.00	137.6	±3.3 %
		Y	10.20	68.3	21.5		131.3	
		Z	10.05	68.2	21.1		145.1	
10066-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	X	10.59	69.0	22.0	9.38	138.2	±3.3 %
		Y	10.41	68.6	21.8		129.9	
		Z	10.21	68.3	21.4		141.0	
10067-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	X	11.10	69.4	22.7	10.12	137.9	±3.5 %
		Y	10.83	68.7	22.4		128.0	
		Z	10.67	68.7	22.1		139.7	

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10068-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	X	10.92	69.3	22.7	10.24	131.5	±3.3 %
		Y	10.84	69.2	22.7		147.6	
		Z	10.47	68.5	22.1		135.2	
10069-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	X	11.14	69.3	22.9	10.56	130.0	±3.5 %
		Y	11.08	69.2	23.0		147.0	
		Z	10.73	68.6	22.4		135.7	
10071-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	10.69	68.9	22.2	9.83	134.8	±3.3 %
		Y	10.52	68.4	22.0		128.8	
		Z	10.42	68.5	21.8		142.5	
10072-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	10.15	68.4	21.8	9.62	126.2	±3.0 %
		Y	10.19	68.5	22.0		145.1	
		Z	9.88	67.9	21.4		136.2	
10073-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	10.31	69.0	22.4	9.94	145.2	±3.0 %
		Y	10.06	68.3	22.1		138.8	
		Z	9.76	67.7	21.5		129.2	
10074-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	10.34	69.0	22.7	10.30	140.6	±3.3 %
		Y	10.08	68.3	22.4		134.4	
		Z	9.93	68.2	22.1		146.5	
10075-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	10.37	69.0	23.0	10.77	134.8	±3.5 %
		Y	10.16	68.5	22.9		149.4	
		Z	9.94	68.1	22.4		140.7	
10076-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	10.29	68.8	23.0	10.94	132.0	±3.3 %
		Y	10.03	68.2	22.8		145.6	
		Z	9.84	67.9	22.4		136.6	
10077-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	10.25	68.8	23.0	11.00	130.7	±3.3 %
		Y	9.99	68.2	22.8		144.5	
		Z	9.79	67.8	22.4		134.4	
10114-CAB	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.38	68.7	20.9	8.10	149.3	±2.7 %
		Y	10.43	68.7	21.0		147.1	
		Z	9.96	67.7	20.2		135.5	
10115-CAB	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	X	10.51	68.3	20.9	8.46	125.0	±3.0 %
		Y	10.60	68.3	21.0		123.8	
		Z	10.41	68.0	20.6		136.2	
10116-CAB	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	X	10.39	68.8	21.0	8.15	149.1	±2.7 %
		Y	10.43	68.7	21.0		145.2	
		Z	9.93	67.6	20.2		133.1	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.32	68.6	20.9	8.07	147.2	±2.7 %
		Y	10.38	68.6	20.9		145.7	
		Z	9.88	67.5	20.1		129.8	
10118-CAB	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	X	10.55	68.2	20.9	8.59	122.3	±3.3 %
		Y	11.03	69.2	21.5		149.5	
		Z	10.43	67.9	20.6		132.4	
10119-CAB	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	X	10.36	68.7	20.9	8.13	146.6	±2.7 %
		Y	10.43	68.7	21.1		144.1	
		Z	9.88	67.5	20.1		128.9	

10193-CAB	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	10.03	68.5	20.9	8.09	140.6	±2.5 %
		Y	9.97	68.3	20.9		137.2	
		Z	9.48	67.2	20.0		124.1	
10194-CAB	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	X	10.04	68.5	20.9	8.12	141.3	±3.0 %
		Y	10.03	68.3	20.9		138.9	
		Z	9.83	68.0	20.5		147.9	
10195-CAB	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	X	10.16	68.6	21.0	8.21	141.1	±3.0 %
		Y	10.17	68.5	21.1		139.7	
		Z	9.97	68.2	20.6		149.7	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.97	68.4	20.8	8.10	140.4	±3.0 %
		Y	9.95	68.3	20.9		135.9	
		Z	9.81	68.1	20.5		149.4	
10197-CAB	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)	X	10.06	68.5	20.9	8.13	141.6	±2.5 %
		Y	10.07	68.5	21.0		139.0	
		Z	9.54	67.2	20.1		125.5	
10198-CAB	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)	X	10.17	68.5	21.0	8.27	140.6	±2.7 %
		Y	10.23	68.6	21.2		139.6	
		Z	9.67	67.3	20.2		125.3	
10219-CAB	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.83	68.2	20.7	8.03	138.8	±2.5 %
		Y	9.86	68.3	20.9		135.0	
		Z	9.36	67.1	19.9		124.0	
10220-CAB	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	X	10.04	68.4	20.9	8.13	142.4	±2.7 %
		Y	10.05	68.4	21.0		138.3	
		Z	9.54	67.2	20.0		126.0	
10221-CAB	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	X	10.23	68.7	21.1	8.27	141.7	±3.0 %
		Y	10.24	68.6	21.1		139.7	
		Z	9.68	67.3	20.1		125.8	
10222-CAB	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.25	68.5	20.8	8.06	145.7	±2.5 %
		Y	10.34	68.6	21.0		142.1	
		Z	9.85	67.5	20.1		130.7	
10223-CAB	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	X	10.80	69.0	21.2	8.48	149.2	±3.3 %
		Y	10.86	69.0	21.3		145.7	
		Z	10.34	67.9	20.5		134.6	
10224-CAB	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	X	10.28	68.7	20.9	8.08	145.4	±2.7 %
		Y	10.30	68.5	20.9		141.1	
		Z	9.81	67.4	20.1		129.4	
10315-AAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.84	68.1	18.3	1.71	141.5	±0.9 %
		Y	3.08	70.8	20.2		136.4	
		Z	2.21	62.0	14.2		131.9	
10316-AAB	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.09	68.4	21.0	8.36	137.4	±3.0 %
		Y	10.07	68.3	21.1		133.1	
		Z	9.93	68.1	20.7		147.9	
10317-AAB	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	10.09	68.4	21.0	8.36	137.5	±3.3 %
		Y	10.10	68.4	21.1		135.7	
		Z	9.98	68.2	20.8		149.3	

10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.79	68.1	18.3	1.54	141.2	±0.9 %
		Y	3.44	73.2	21.2		135.6	
		Z	2.13	61.6	13.9		131.3	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.00	68.3	20.9	8.23	136.7	±3.3 %
		Y	10.00	68.2	21.0		131.7	
		Z	9.86	68.0	20.5		147.5	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	9.99	68.3	20.9	8.23	137.3	±3.0 %
		Y	9.98	68.2	20.9		133.2	
		Z	9.89	68.1	20.6		149.7	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	9.87	68.2	20.8	8.14	136.4	±3.0 %
		Y	9.86	68.1	20.9		131.8	
		Z	9.74	68.0	20.5		148.1	
10419-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preambule)	X	9.95	68.3	20.9	8.19	137.9	±3.3 %
		Y	9.99	68.3	21.0		135.7	
		Z	9.81	68.0	20.5		147.9	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 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: EX3DV4 - SN:3638

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	12.32	12.32	12.32	0.00	1.00	± 13.3 %
220	49.0	0.81	11.28	11.28	11.28	0.00	1.00	± 13.3 %
2450	39.2	1.80	6.90	6.90	6.90	0.35	0.85	± 12.0 %
4950	36.3	4.40	5.26	5.26	5.26	0.40	1.80	± 13.1 %
5200	36.0	4.66	4.98	4.98	4.98	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.66	4.66	4.66	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.61	4.61	4.61	0.45	1.80	± 13.1 %
5600	35.5	5.07	4.35	4.35	4.35	0.45	1.80	± 13.1 %
5800	35.3	5.27	4.43	4.43	4.43	0.45	1.80	± 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. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

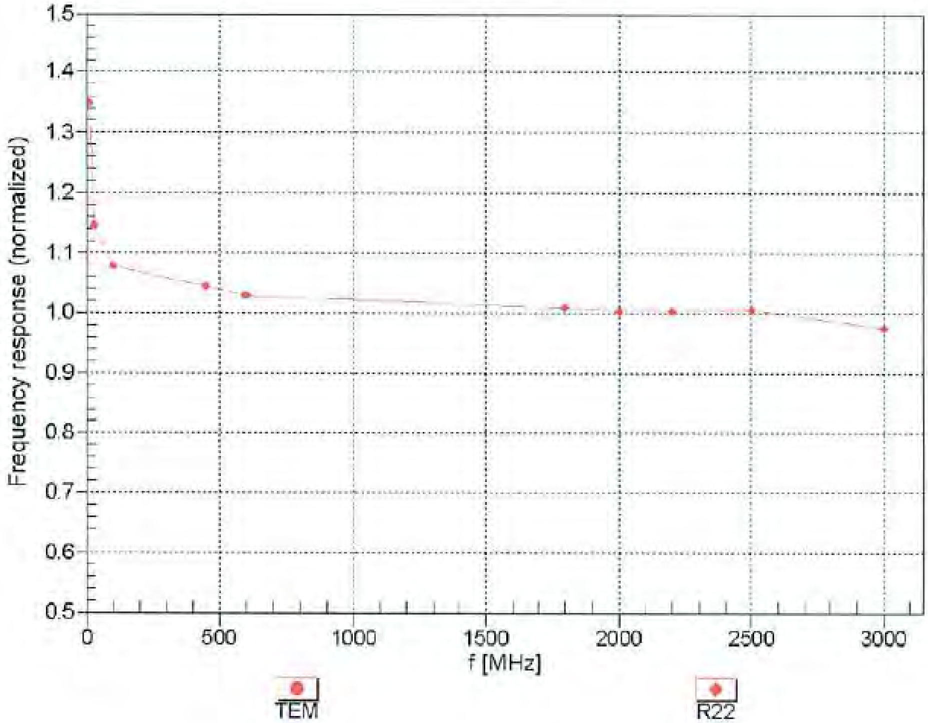
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3638

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	11.55	11.55	11.55	0.00	1.00	± 13.3 %
220	60.2	0.86	10.80	10.80	10.80	0.00	1.00	± 13.3 %
2450	52.7	1.95	7.12	7.12	7.12	0.80	0.50	± 12.0 %
4950	49.4	5.01	4.49	4.49	4.49	0.50	1.90	± 13.1 %
5200	49.0	5.30	4.36	4.36	4.36	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.16	4.16	4.16	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.79	3.79	3.79	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.66	3.66	3.66	0.55	1.90	± 13.1 %
5800	48.2	6.00	4.00	4.00	4.00	0.55	1.90	± 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. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

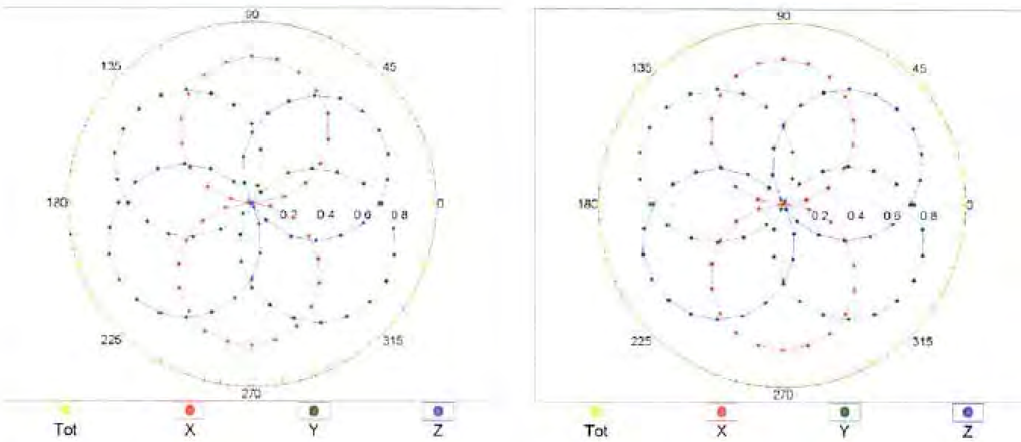
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

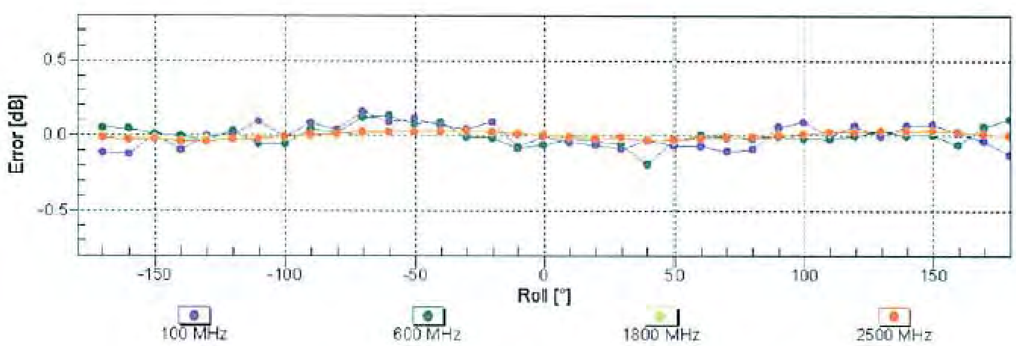


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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

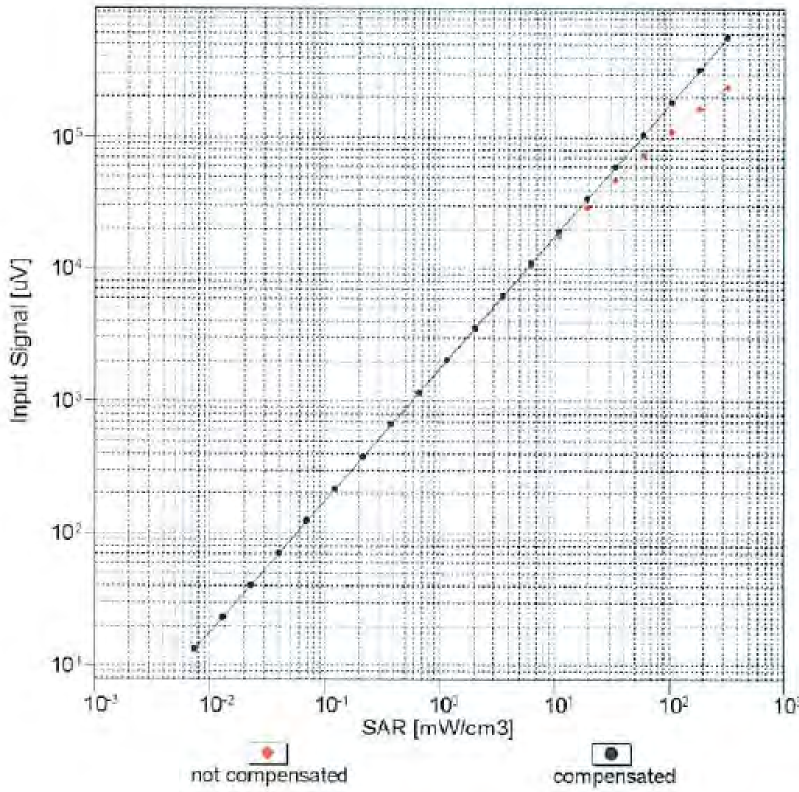
f=600 MHz,TEM f=1800 MHz,R22

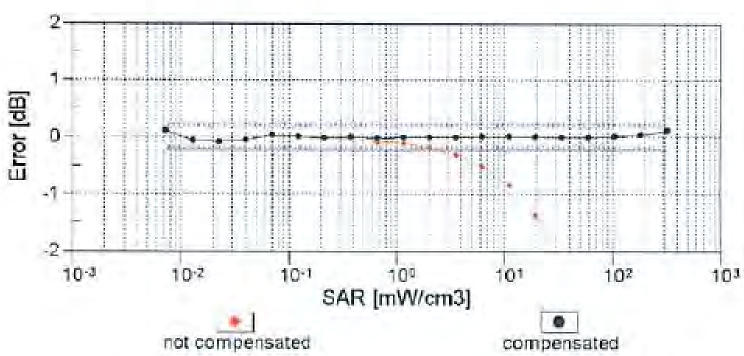




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

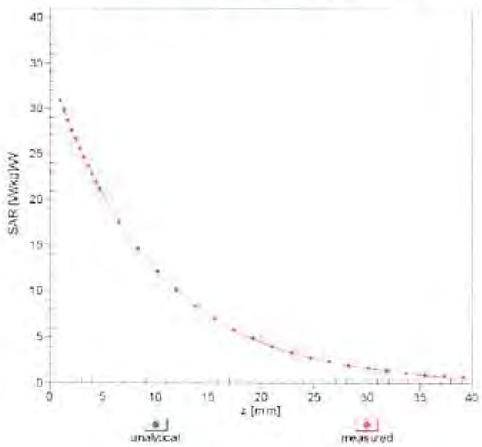




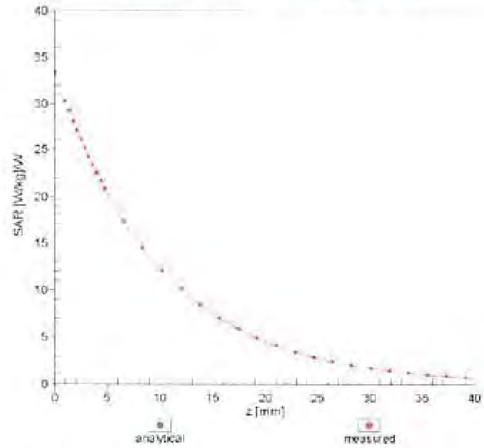
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 2450 MHz,WGLS R22 (H_convF)

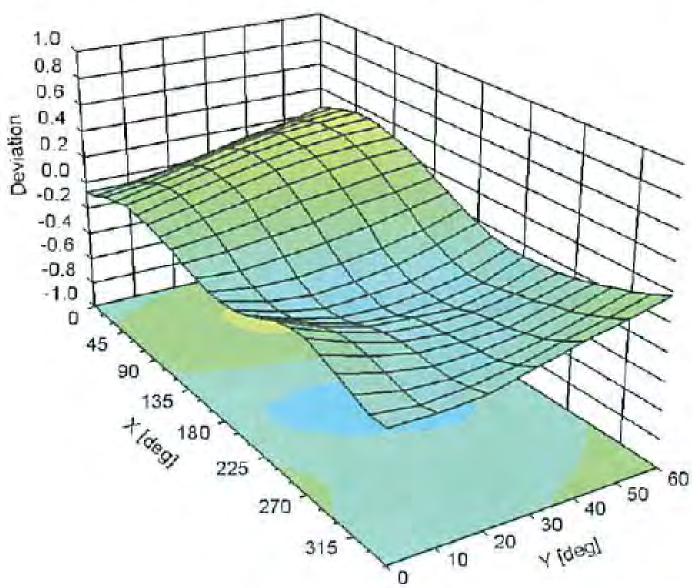


f = 2450 MHz,WGLS R22 (M_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3638

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-30.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 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
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 0108**

Client **Motorola EME**

Certificate No: **CLA150-4005_Jul15**

CALIBRATION CERTIFICATE

Object	CLA150 - SN: 4005
Calibration procedure(s)	QA CAL-15.v8 Calibration procedure for system validation sources below 700 MHz
Calibration date:	July 08, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 3877	09-Jan-15 (No. EX3-3877_Jan15)	Jan-16
DAE4	SN: 654	22-Jun-15 (No. DAE4-654_Jun15)	Jun-16
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
RF generator HP 8648C	US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: July 15, 2015

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

Certificate No: CLA150-4005_Jul15 Page 1 of 8

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

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) IEC 62209-2, "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)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	150 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	52.3	0.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	50.2 ± 6 %	0.77 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	1 W input power	3.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.83 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**2.53 W/kg ± 18.0 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	61.9	0.80 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	60.1 ± 6 %	0.84 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	1 W input power	4.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.88 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	1 W input power	2.68 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.57 W/kg ± 18.0 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 149.5 MHz

Impedance, transformed to feed point	35.3 Ω - 5.4 jΩ
Return Loss	- 14.8 dB

Antenna Parameters with Head TSL at 150.0 MHz

Impedance, transformed to feed point	41.6 Ω - 2.1 jΩ
Return Loss	- 20.5 dB

Antenna Parameters with Head TSL at 150.5 MHz

Impedance, transformed to feed point	49.8 Ω + 0.8 jΩ
Return Loss	- 33.7 dB

Antenna Parameters with Body TSL at 149.5 MHz

Impedance, transformed to feed point	36.8 Ω - 7.0 jΩ
Return Loss	- 15.3 dB

Antenna Parameters with Body TSL at 150.0 MHz

Impedance, transformed to feed point	43.3 Ω - 4.2 jΩ
Return Loss	- 21.4 dB

Antenna Parameters with Body TSL at 150.5 MHz

Impedance, transformed to feed point	51.3 Ω - 2.0 jΩ
Return Loss	- 32.5 dB

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 23, 2013

DASY5 Validation Report for Head TSL

Date: 08.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4005

Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; $\sigma = 0.768$ S/m; $\varepsilon_r = 50.203$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

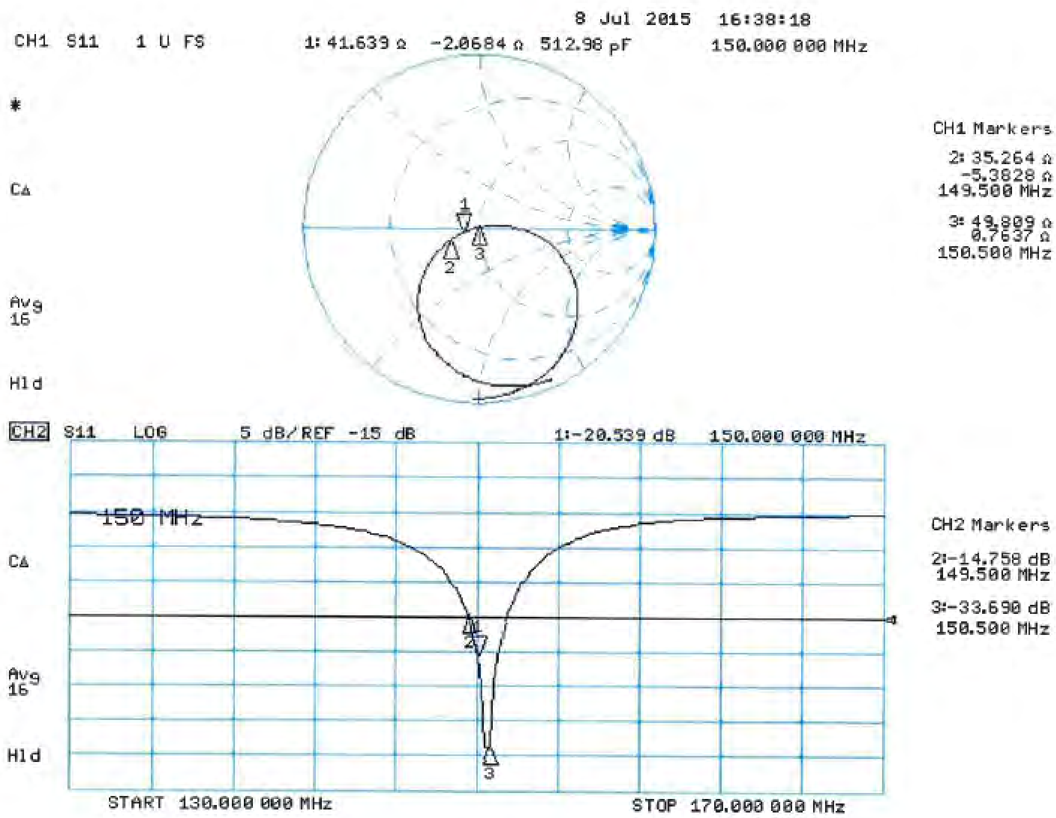
- Probe: EX3DV4 - SN3877; ConvF(12, 12, 12); Calibrated: 09.01.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 22.06.2015
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.53 W/kg

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 77.52 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 7.54 W/kg
SAR(1 g) = 3.9 W/kg; SAR(10 g) = 2.57 W/kg
Maximum value of SAR (measured) = 5.48 W/kg

0 dB = 5.53 W/kg = 7.43 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: CLA150-4005_Jul15 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 08.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4005

Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; $\sigma = 0.84$ S/m; $\varepsilon_r = 60.08$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.42, 11.42, 11.42); Calibrated: 09.01.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 22.06.2015
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

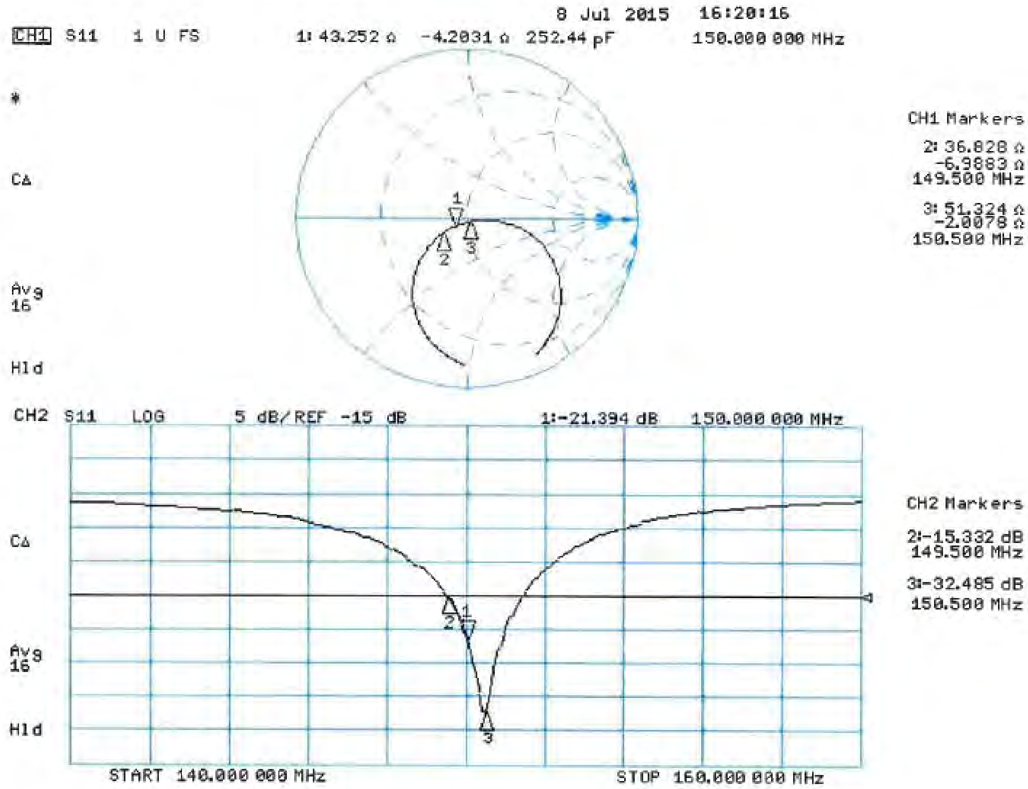
CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.10 W/kg

CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 77.99 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 7.76 W/kg
SAR(1 g) = 4.06 W/kg; SAR(10 g) = 2.68 W/kg
Maximum value of SAR (measured) = 5.73 W/kg

0 dB = 5.10 W/kg = 7.08 dBW/kg

Certificate No: CLA150-4005_Jul15 Page 7 of 8

Impedance Measurement Plot for Body TSL



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

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S Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **Motorola EME** **Certificate No: D450V3-1075_Jul15**

CALIBRATION CERTIFICATE

Object	D450V3 - SN:1075
Calibration procedure(s)	QA CAL-15.v8 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	July 07, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ET3DV6	SN: 1507	30-Dec-14 (No. ET3-1507_Dec14)	Dec-15
DAE4	SN: 789	16-Mar-15 (No. DAE4-789_Mar15)	Mar-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: July 8, 2015

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

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Accreditation No.: **SCS 0108**

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) IEC 62209-2, "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)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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	V52.8.8
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	42.7 ± 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	1.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.46 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.745 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**2.97 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	55.0 ± 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	1.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.41 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.733 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.90 W/kg ± 17.6 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.6 Ω - 1.6 jΩ
Return Loss	- 22.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	54.4 Ω - 7.6 jΩ
Return Loss	- 21.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.355 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: 06.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

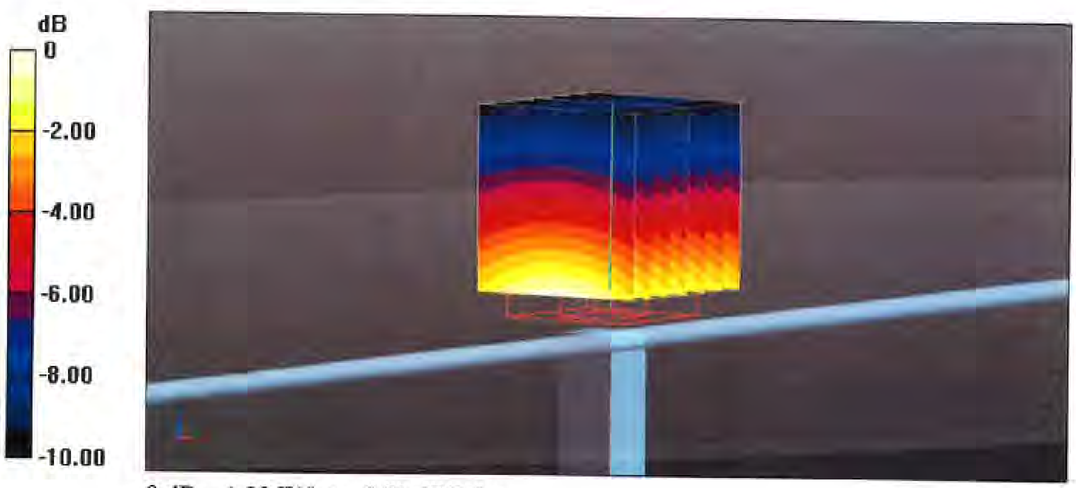
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1075

Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; $\sigma = 0.87$ S/m; $\varepsilon_r = 42.7$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

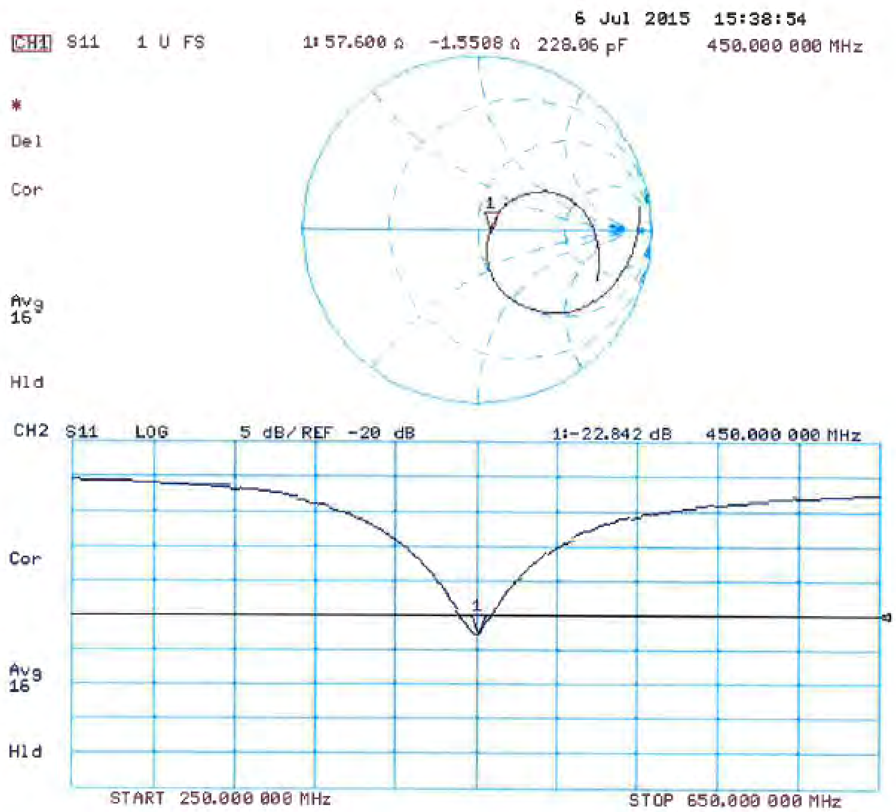
- Probe: ET3DV6 - SN1507; ConvF(6.58, 6.58, 6.58); Calibrated: 30.12.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn789; Calibrated: 16.03.2015
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.21 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.61 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.745 W/kg
Maximum value of SAR (measured) = 1.20 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

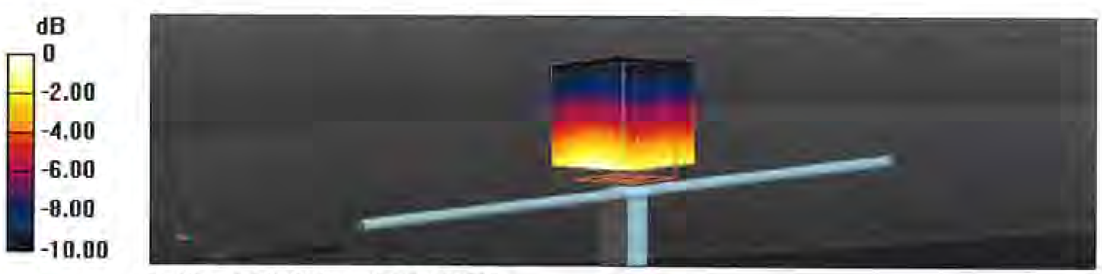
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1075

Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.95 S/m; ε_r = 55; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(7.05, 7.05, 7.05); Calibrated: 30.12.2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn789; Calibrated: 16.03.2015
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

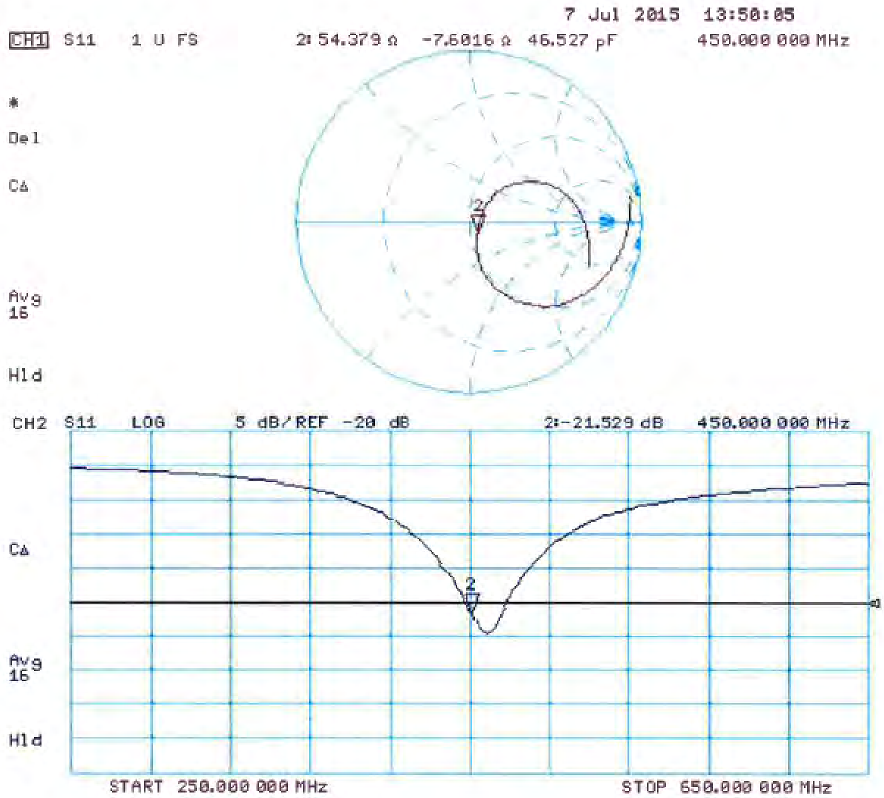
Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 36.52 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.82 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.733 W/kg
Maximum value of SAR (measured) = 1.20 W/kg



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

Certificate No: D450V3-1075_Jul15 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D450V3-1075_Jul15 Page 8 of 8

Dipole Data

As stated in KDB 865664, only dipoles used for longer calibration intervals required to provide supporting information and measurement to qualify for extended calibration interval.

Both dipoles CLA 150 and D450V3 do not exceed the annual calibration data, therefore validation for impedance and return loss is not required.