MOTOROLA SOLUTIONS

MS ISO/IEC 17025
TESTING
SAMM No.0826

DECLARATION OF COMPLIANCE SAR ASSESSMENT PCII Report

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

Date of Report: 05/18/2018
Report Revision: B

Responsible Engineer:	Veeramani Veerapan
Report Author:	Veeramani Veerapan
Date/s Tested:	03/26/2018- 04/23/2018; 05/18/2018
Manufacturer:	Motorola Solutions Inc.
DUT Description:	Handheld Portable: CP200d, 403-470MHz, 4W, Non-Display
Test TX mode(s):	CW (PTT)
Max. Power output:	4.8 Watts
Nominal Power:	4.0 Watts
Tx Frequency Bands:	403-470 MHz
Signaling type:	FM
Model(s) Tested:	AAH01QDC9JA2AN (PMUE4147B)
Model(s) Certified:	AAH01QDC9JA2AN (PMUE4147B) / PMUE4147BAANAA, AAH01QDC9JC2AN (PMUE4147B) / PMUE4147BAANEA
Serial Number(s):	752TUFQ452
Classification:	Occupational/Controlled
FCC ID:	AZ489FT4948; Rule Part 90 (406.1-470 MHz)
IC	109U-89FT4948; (406.1-430 and 450-470 MHz)
ISED Test Site Registration:	109AK
FCC Test Firm Registration Number:	823256

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 FCC 47 CFR § 2.1093.

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 — Digitally signed by Tiong Nguk Ing Date: 2018.05.21 23:32:20 +08'00'

Tiong Nguk Ing
Deputy Technical Manager (Approved Signatory)
Approval Date: 5/21/2018

APPENDICES

Report Revision History

Date	Revision	Comments
04/25/2018	A	Release of PCII results of some components changes and new offered audio accessories.
05/18/2018	B	Add scans to cover low, mid & high in Sec 13.2, Table 18

1.0 Introduction

This report details the utilization, test setups, test equipments, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model number PMUE4147B. This device is classified as Occupational/Controlled. The information herein is to show evidence of Class II Permissive Change compliance base on the SAR evaluation of components changed and new audio accessories.

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	1g-SAR
TNF	406.1- 470	7.84	2.91

3.0 Abbreviations / Definitions

CNR: Calibration Not Required
EME: Electromagnetic Energy
CW: Continuous Wave
DUT: Device Under Test
DC: Duty Cycle
FM: Frequency Modulation
Li-Ion: Lithium-Ion
LMR: Land Mobile Radio
TNF: Licensed Non-Broadcast Transmitter Head on Face
NA: Not Applicable
PTT: Push to Talk
RF: Radio Frequency
SAR: Specific Absorption Rate

Audio accessories: These accessories allow communication while the DUT is worn on the body.

Body worn accessories: These accessories allow the DUT to be worn on the body of the user.

Maximum Power: Defined as the upper limit of the production line final test station.

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 Radio communication 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
- FCC KDB – 178919 D01 Permissive Change Policy 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 Devices under Test (DUT)

This device is operates in the LMR band using either frequency modulation (FM) with 100% transmit duty cycle or TDMA signals with maximum of 50% transmit duty cycle. For conservative assessment, FM signal was tested.

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

Table 3 below summarizes the bands and maximum output powers. Maximum output powers are defined as upper limit of the production line final test station.

Table 3 below summarizes the bands and maximum output powers. Maximum output powers are defined as upper limit of the production line final test station.

Table 3

Technologies	Band (MHz)	Transmission	Duty Cycle (%)	Max Power (W)
LMR	403-470	FM or TDMA	*50 / *25	4.8

Note - * includes 50% PTT operation

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.

7.0 Optional Accessories and Test Criteria

These devices are offered with optional accessories. All accessories were individually evaluated during the test plan creation to determine if testing was required per the guidelines outlined in section 4.0 to assess compliance of this device. The following sections identify the test criteria and details for each accessory category applicable for this PCII filling. Details listing of all offered accessories are reported in original filling report.

7.1 Antennas

There are two antennas applicable for this PCII filling. The Table below lists their descriptions.

Table 4

Antenna Models	Description	Selected for test	Tested	Comments
PMAE4002A	UHF Stubby, 403-433MHz, ¼ wave, -1dBi	Yes	Yes	
PMAE4003A	UHF Stubby, 430-470MHz, ¼ wave, -1dBi	Yes	Yes	

7.2 Battery

There are two optional batteries applicable for this PCII filling. The Table below lists their descriptions.

Table 5

Battery Models	Description	Selected for test	Tested	Comments
NNTN4970A	Battery Li-Ion 1600mAh	Yes	Yes	
PMNN4098A	Battery Ni-MH 1400mAh Typical	Yes	Yes	

7.3 Body worn Accessory

There is only one body worn applicable for this PCII filling. The Table below lists its description.

Table 6

Body worn Models	Description	Selected for test	Tested	Comments
HLN6602A	Universal Chest pack	Yes	Yes	

7.4 Audio Accessory

Table below lists the new accessories added for this PCII filing.

Table 7

Audio Acc. Models	Description	Selected for test	Tested	Comments
PMLN6854A	Otto Headset ELP connector	Yes	Yes	New audio accessory
PMLN7468A	Otto OTH headset ELP connector	No	No	New audio accessory. By similarity to PMLN6854A

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 8

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

The DASY5™ system is operated per the instructions in the DASY5™ Users Manual. The complete manual is available directly from SPEAG™. All measurement equipment used to assess 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 9

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

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 10. 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 10

Ingredients	450 MHz	
	Head	Body
Sugar	56.0	46.5
Diacetin	0	0
De ionized –Water	39.1	50.53
Salt	3.8	1.87
HEC	1	1
Bact.	0.1	0.1

9.0 Additional Test Equipment

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

Table 11

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
*Speag Probe	ES3DV3	3196	5/17/2017	5/17/2018
†Speag Probe	ES3DV3	3122	4/18/2018	4/18/2019
*Speag DAE	DAE4	684	5/12/2017	5/12/2018
†Speag DAE	DAE4	850	3/7/2018	3/7/2019
Signal Generator	E4438C	MY45091270	7/26/2016	7/26/2018
Power Meter	E4418B	MY45100532	11/1/2017	11/1/2018
Power Meter	E4418B	MY45100911	7/14/2017	7/14/2019
Power Meter	E9301B	MY55210003	9/29/2017	9/29/2018
Power Sensor	E4416A	MY50001037	5/22/2017	5/22/2019
Power Sensor	E9301B	MY41495594	7/20/2017	7/20/2018
Power Sensor	8481B	SG41090258	6/27/2017	6/27/2018
Bi-directional Coupler	3020A	40295	9/4/2017	9/4/2018
Amplifier	10W1000C	312859	CNR	CNR
Dickson Temperature Recorder	TM320	06153216	8/11/2017	8/11/2018
Temperature Probe	JHSS-18U-RSC-6	AGIL700245	10/13/2017	10/13/2018
Temperature Probe	80PK-22	06032017	3/7/2018	3/7/2019
Thermometer	HH806AU	080307	11/30/2017	11/30/2018
Thermometer	HH202A	18812	10/13/2017	10/13/2018
Dielectric Assessment Kit	DAK-3.5	1156	1/9/2018	1/9/2019
Network Analyzer	E5071B	MY42403218	8/24/2017	8/24/2018
Speag Dipole	D450V3	1054	10/25/2017	10/25/2019

Note: * Equipment used for test dates prior to equipment calibration due date.
† Equipment used to replace equipment out for calibration.

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 12

Dates	Probe Calibration Point		Probe SN	Measured Tissue Parameters		Validation		
				σ	ϵ_r	Sensitivity	Linearity	Isotropy
CW								
05/31/2017	Body	450	3196	0.92	54.6	Pass	Pass	Pass
06/01/2017	Head	450		0.89	43.3	Pass	Pass	Pass
04/29/2018	Body	450	3122	0.88	55.5	Pass	Pass	Pass
04/29/2018	Head	450		0.87	42.3	Pass	Pass	Pass

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 13

Probe Serial #	Tissue Type	Dipole Kit / Serial #	Ref SAR @ 1W (W/kg)	System Check Results Measured (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date
3196	FCC Body	SPEAG D450V3 / 1054	4.57 +/- 10%	1.22	4.88	04/18/2018
				1.16	4.64	04/20/2018
	IEEE/IEC Head		4.48 +/- 10%	1.14	4.56	03/28/2018
				1.17	4.68	04/21/2018
3122	FCC Body	SPEAG D450V3 / 1054	4.57 +/- 10%	1.21	4.84	05/18/2018
	IEEE/IEC Head		4.48 +/- 10%	1.18	4.72	*05/17/2018

Note: * System performance check cover next testing day (within 24 hrs)

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 14

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
406	IEEE/IEC Head	0.87 (0.83-0.91)	44.0 (41.8-46.2)	0.83	43.0	*05/17/2018
420		0.87 (0.83-0.91)	43.9 (41.7-46.1)	0.85	43.8	*04/20/2018
430	FCC Body	0.94 (0.89-0.98)	56.9 (54.1-59.7)	0.97	54.6	04/18/2018
				0.96	54.5	04/20/2018
	IEEE/IEC Head	0.87 (0.83-0.91)	43.7 (41.6-45.9)	0.89	42.6	03/28/2018

Note: * This tissue sheet date covered for next test day (within 24 hrs)

Continued Table 15

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
450	FCC Body	0.94 (0.89-0.99)	56.7 (53.9-59.5)	0.98	54.3	04/18/2018
				0.97	54.2	04/20/2018
				0.94	55.0	05/18/2018
	IEEE/IEC Head	0.87 (0.83-0.91)	43.5 (41.3-45.7)	0.90	42.2	03/28/2018
				0.88	43.2	*04/20/2018
				0.87	42.0	*05/17/2018
457	FCC Body	0.94 (0.89-0.99)	56.7 (53.8-59.5)	0.94	54.9	05/18/2018
470		0.94 (0.89-0.99)	56.6 (53.8-59.5)	0.96	54.8	05/18/2018

Note: * This tissue sheet date covered for next test day (within 24 hrs)

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 16

	Target	Measured
Ambient Temperature	18 – 25 ˚C	Range: 19.0 – 24.0˚C Avg. 21.1 ˚C
Tissue Temperature	NA	Range: 19.4 -21.4˚C Avg. 20.4˚C

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 17

<table>
<tr><th colspan="2">Description</th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="2">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="2">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="2" rowspan="2">Maximum area scan spatial resolution: ΔxArea, ΔyArea</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="2">Maximum zoom scan spatial resolution: ΔxZoom, ΔyZoom</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td>Maximum zoom scan spatial resolution, normal to phantom surface</td><td>uniform grid: ΔzZoom(n)</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td colspan="4">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

12.2 DUT Configuration(s)

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

12.3 DUT Positioning Procedures

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

12.3.1 Body

The DUT was positioned in normal use configuration against the phantom with the offered body worn accessory, batteries, and with the offered audio accessory as applicable.

12.3.2 Head

Not applicable.

12.3.3 Face

The DUT was positioned with its' front 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 averaged SAR results indicated as "Max Calc. 1g-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" is 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 LMR assessments at the Body and Face

The new audio accessory PMLN6854A was assessed using the accessories indicated in section 7.0 which represent the highest applicable configurations at the body and face found during the initial compliance assessment on file with the FCC/ ISED.

Table 18

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
Assessment at the Body									
PMAE4003A	PMNN4098A	HLN6602A	PMLN6854A	430.000	4.36	-0.61	12.3	**7.79**	LOH-AB-180418-11
				456.700	4.26	-0.62	3.98	2.59	LOH-AB-180518-04
				470.000	4.22	-0.49	2.68	1.71	ZR(ZZ)-AB-180518-05
Assessment at the Face									
PMAE4002A	NNTN4970A	NONE	NONE	406.1250	4.39	-0.50	1.97	1.21	LOH-FACE-180518-02#
				419.6000	4.20	-0.31	2.57	1.58	LOH-FACE-180421-02#
				430.0000	4.20	-0.05	5.03	**2.91**	ZR(ZZ)-FACE-180328-06

13.2 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 E.

Table 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
PMAE4003A	PMNN4098A	HLN6602A	PMLN6854A	430.000	4.33	-0.50	12.60	**7.84**	LOH-AB-180420-10

14.0 Results Summary

Based on the test guidelines from section 4.0 and satisfying frequencies within FCC band and ISED band, the highest Operational Maximum Calculated 1-gram 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	1g-SAR
FCC	406.1-470	7.84	2.91
ISED	406.1-430 & 450-470	7.84	2.91
Overall	403-470	7.84	2.91

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 FCC 47 CFR § 2.1093.

15.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is required because SAR results are above 4.0W/kg (Occupational).

The Table below includes test results of the original measurement(s), the repeated measurement(s), and the ratio (SAR_{high}/SAR_{low}) for the applicable test configuration(s).

Table 21

Run#	Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Adj Calc. 1g-SAR (W/kg)	Ratio	Comments
LOH-AB-180418-11	PMAE4003A	PMNN4098A	HLN6602A	PMLN6854A	430.000	7.08	1.00	No additional repeated scans is required due to the Ratio (SAR_{high}/SAR_{low}) < 1.20
LOH-AB-180420-10						7.07		

16.0 System Uncertainty

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

FCD-0558 Uncertainty Budget Rev.8

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 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	

FCD-0558 Uncertainty Budget Rev.8
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 Certificate

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

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

Certificate No: **ES3-3196_May17**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3196

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

Calibration date: May 17, 2017

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ES3DV2	SN: 3013	31-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	SN: 660	7-Dec-16 (No. DAE4-660_Dec16)	Dec-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

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

Issued: May 18, 2017

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

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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**

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
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"

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: ES3-3196_May17 Page 2 of 18

Probe ES3DV3

SN:3196

Manufactured: June 16, 2008
Calibrated: May 17, 2017

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.25	1.26	1.30	± 10.1 %
DCP (mV)[B]	101.5	100.5	99.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B $dB\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	191.9	±3.5 %
		Y	0.0	0.0	1.0		203.8	
		Z	0.0	0.0	1.0		204.9	

Note: For details on UID parameters see Appendix.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	7.46	7.46	7.46	0.08	1.25	± 13.3 %
300	45.3	0.87	7.36	7.36	7.36	0.12	1.60	± 13.3 %
450	43.5	0.87	7.11	7.11	7.11	0.20	1.60	± 13.3 %
750	41.9	0.89	6.82	6.82	6.82	0.71	1.27	± 12.0 %
835	41.5	0.90	6.63	6.63	6.63	0.53	1.40	± 12.0 %
900	41.5	0.97	6.45	6.45	6.45	0.74	1.20	± 12.0 %
1450	40.5	1.20	5.78	5.78	5.78	0.74	1.15	± 12.0 %
1810	40.0	1.40	5.58	5.58	5.58	0.42	1.62	± 12.0 %
1900	40.0	1.40	5.42	5.42	5.42	0.71	1.26	± 12.0 %
2100	39.8	1.49	5.44	5.44	5.44	0.78	1.22	± 12.0 %
2300	39.5	1.67	5.00	5.00	5.00	0.74	1.27	± 12.0 %
2450	39.2	1.80	4.74	4.74	4.74	0.65	1.38	± 12.0 %
2600	39.0	1.96	4.60	4.60	4.60	0.75	1.25	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

Calibration Parameter Determined in Body Tissue Simulating Media

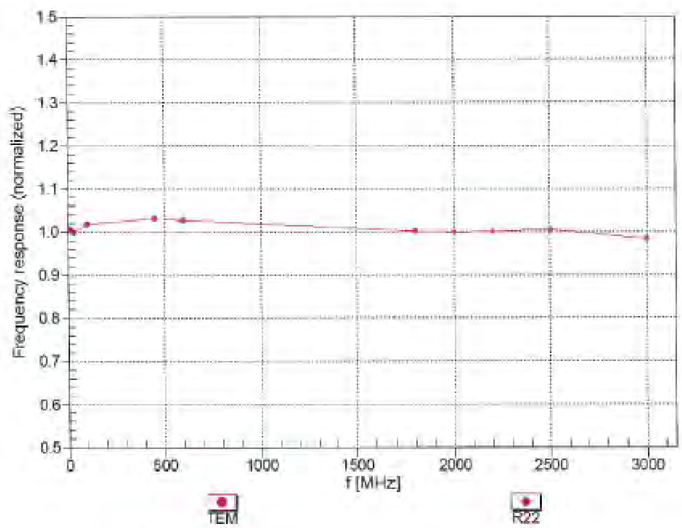
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	7.06	7.06	7.06	0.09	1.25	± 13.3 %
300	58.2	0.92	6.92	6.92	6.92	0.10	1.60	± 13.3 %
450	56.7	0.94	7.00	7.00	7.00	0.13	1.60	± 13.3 %
750	55.5	0.96	6.44	6.44	6.44	0.80	1.13	± 12.0 %
835	55.2	0.97	6.31	6.31	6.31	0.50	1.47	± 12.0 %
900	55.0	1.05	6.27	6.27	6.27	0.52	1.47	± 12.0 %
1450	54.0	1.30	5.40	5.40	5.40	0.71	1.19	± 12.0 %
1810	53.3	1.52	5.11	5.11	5.11	0.40	1.83	± 12.0 %
1900	53.3	1.52	4.91	4.91	4.91	0.60	1.47	± 12.0 %
2100	53.2	1.62	5.24	5.24	5.24	0.60	1.49	± 12.0 %
2300	52.9	1.81	4.72	4.72	4.72	0.80	1.27	± 12.0 %
2450	52.7	1.95	4.58	4.58	4.58	0.80	1.13	± 12.0 %
2600	52.5	2.16	4.40	4.40	4.40	0.80	1.20	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

ES3DV3– SN:3196 May 17, 2017

Frequency Response of E-Field

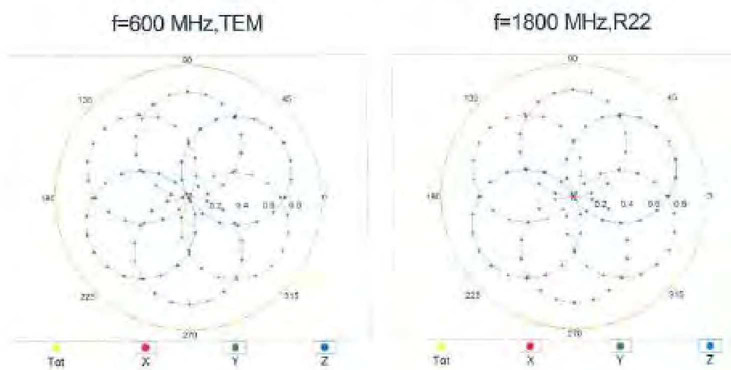
(TEM-Cell:ifi110 EXX, Waveguide: R22)

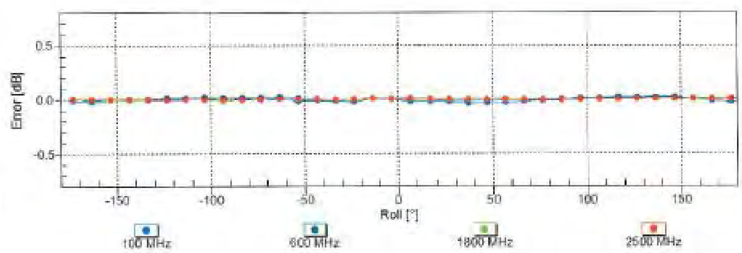


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Certificate No: ES3-3196_May17 Page 7 of 18

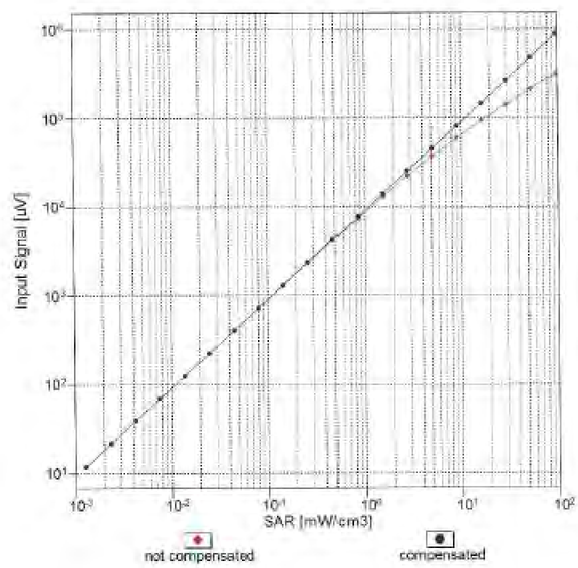
Receiving Pattern (ϕ), ϑ = 0°

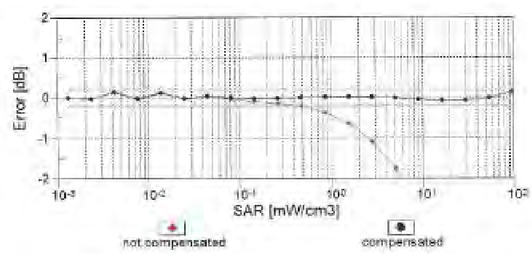




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

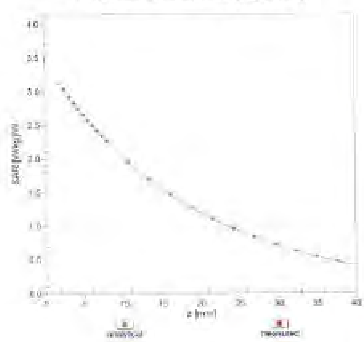
Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

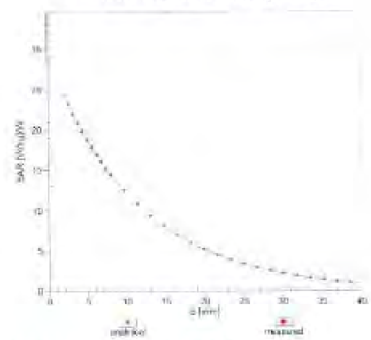




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

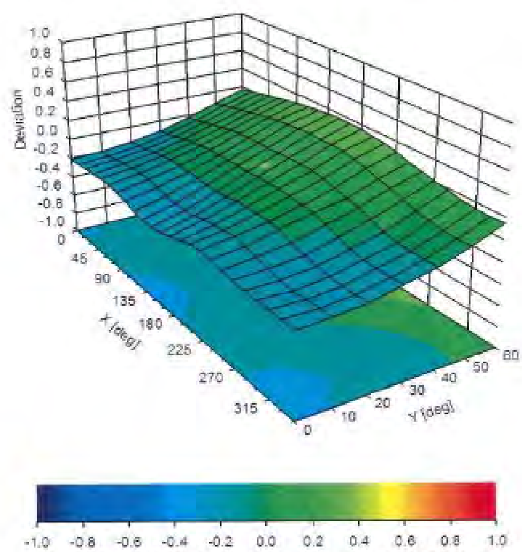
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	6.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Appendix: 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	191.9	±3.5 %
		Y	0.0	0.0	1.0		203.8	
		Z	0.0	0.0	1.0		204.9	
10011-CAB	UMTS-FDD (WCDMA)	X	3.15	66.2	18.1	2.91	131.3	±0.7 %
		Y	3.25	66.4	17.9		143.9	
		Z	3.34	67.3	18.9		144.4	
10097-CAB	UMTS-FDD (HSDPA)	X	4.57	66.5	18.5	3.98	141.0	±0.9 %
		Y	4.44	65.6	17.9		129.2	
		Z	4.57	66.5	18.7		131.2	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.63	66.8	18.7	3.98	141.2	±0.9 %
		Y	4.48	65.8	18.0		129.6	
		Z	4.56	66.4	18.7		130.5	
10100-CAC	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.64	68.4	20.3	5.67	148.8	±1.4 %
		Y	6.31	66.9	19.3		134.7	
		Z	6.47	67.7	20.0		137.4	
10101-CAC	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	7.41	67.5	20.1	6.42	132.2	±1.9 %
		Y	7.45	67.4	19.8		144.4	
		Z	7.62	68.2	20.6		147.4	
10108-CAD	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.50	67.9	20.2	5.80	144.9	±1.4 %
		Y	6.20	66.5	19.1		132.7	
		Z	6.38	67.4	20.0		134.5	
10109-CAD	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.19	67.3	20.0	6.43	128.8	±1.7 %
		Y	7.22	67.1	19.7		141.7	
		Z	7.36	67.8	20.5		143.1	
10110-CAD	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.14	67.1	19.8	5.75	140.8	±1.4 %
		Y	5.93	66.1	19.0		128.6	
		Z	6.05	66.8	19.7		131.2	
10111-CAD	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	7.21	68.0	20.5	6.44	148.8	±1.7 %
		Y	6.96	66.8	19.6		137.4	
		Z	7.09	67.5	20.3		138.9	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.47	69.6	21.8	8.07	135.7	±2.7 %
		Y	10.30	69.0	21.3		145.6	
		Z	10.27	69.1	21.6		124.4	
10140-CAC	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	7.66	67.8	20.3	6.49	133.4	±1.7 %
		Y	7.64	67.6	20.0		145.3	
		Z	7.83	68.4	20.7		148.8	
10142-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.97	67.0	19.8	5.73	137.4	±1.7 %
		Y	5.99	66.8	19.4		149.4	
		Z	5.87	66.5	19.6		128.3	
10143-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.96	67.8	20.4	6.35	145.0	±1.4 %
		Y	6.67	66.5	19.4		130.6	
		Z	6.87	67.4	20.3		135.1	

10145-CAD	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.66	66.4	19.5	5.76	132.2	±1.4 %
		Y	5.72	66.4	19.3		145.5	
		Z	5.83	67.1	20.0		146.9	
10146-CAD	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.59	67.3	20.2	6.41	134.3	±1.7 %
		Y	6.70	67.5	20.1		148.7	
		Z	6.57	67.3	20.2		128.0	
10149-CAC	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.42	68.1	20.5	6.42	148.9	±1.7 %
		Y	7.16	66.9	19.7		137.3	
		Z	7.32	67.6	20.4		139.9	
10154-CAD	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.06	66.9	19.7	5.75	135.0	±1.4 %
		Y	5.91	66.0	19.0		128.3	
		Z	6.02	66.6	19.7		129.1	
10155-CAD	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	7.10	67.6	20.3	6.43	144.0	±1.7 %
		Y	6.93	66.7	19.6		135.0	
		Z	7.06	67.4	20.3		136.1	
10156-CAD	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.86	66.6	19.6	5.79	132.5	±1.4 %
		Y	5.94	66.6	19.4		148.0	
		Z	6.04	67.3	20.1		149.4	
10157-CAD	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.88	67.5	20.3	6.49	139.1	±1.4 %
		Y	6.70	66.6	19.6		130.0	
		Z	6.83	67.3	20.3		131.8	
10160-CAC	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.52	67.4	19.9	5.82	139.8	±1.4 %
		Y	6.31	66.4	19.2		131.6	
		Z	6.47	67.2	19.9		134.3	
10161-CAC	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.46	68.0	20.5	6.43	147.9	±1.7 %
		Y	7.28	67.2	19.8		139.9	
		Z	7.40	67.8	20.4		141.3	
10166-CAD	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	5.26	67.0	19.8	5.46	146.2	±1.2 %
		Y	5.10	65.9	18.9		137.5	
		Z	5.20	66.6	19.7		140.5	
10167-CAD	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	6.21	68.0	20.5	6.21	147.9	±1.4 %
		Y	6.11	67.3	19.9		141.5	
		Z	6.20	67.9	20.6		145.1	
10169-CAC	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.11	67.1	20.0	5.73	137.1	±1.2 %
		Y	4.97	66.1	19.2		128.7	
		Z	5.09	66.9	20.1		134.8	
10170-CAC	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	6.01	68.6	21.2	6.52	140.6	±1.7 %
		Y	5.76	67.1	20.0		128.6	
		Z	5.90	68.0	21.0		135.3	
10175-CAD	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.08	67.0	19.9	5.72	138.1	±1.7 %
		Y	5.19	67.1	19.8		149.2	
		Z	5.09	66.9	20.1		135.6	
10176-CAD	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.98	68.5	21.1	6.52	139.5	±1.7 %
		Y	5.72	67.0	20.0		127.8	
		Z	5.92	68.1	21.0		136.1	

ES3DV3– SN:3196 May 17, 2017

10177-CAF	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	5.09	67.0	20.0	5.73	137.8	±1.7 %
		Y	5.15	66.9	19.7		149.7	
		Z	5.09	66.9	20.1		135.5	
10178-CAD	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.96	68.4	21.0	6.52	139.4	±1.4 %
		Y	5.74	67.0	20.0		128.0	
		Z	5.93	68.2	21.1		135.7	
10181-CAC	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.08	67.0	20.0	5.72	137.3	±1.4 %
		Y	5.15	66.9	19.7		149.6	
		Z	5.08	66.9	20.0		136.0	
10182-CAC	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.99	68.5	21.1	6.52	140.2	±1.4 %
		Y	5.75	67.1	20.1		128.3	
		Z	5.92	68.1	21.0		136.0	
10184-CAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	5.08	67.0	20.0	5.73	137.5	±1.4 %
		Y	5.13	66.8	19.6		149.7	
		Z	5.08	66.8	20.0		135.5	
10185-CAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.99	68.5	21.1	6.51	140.4	±1.4 %
		Y	5.77	67.2	20.1		128.7	
		Z	5.95	68.3	21.1		135.9	
10187-CAD	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	5.10	67.0	20.0	5.73	137.7	±1.2 %
		Y	4.94	65.9	19.1		127.3	
		Z	5.11	66.9	20.1		135.0	
10188-CAD	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.99	68.5	21.1	6.52	141.3	±1.7 %
		Y	5.75	67.1	20.1		129.1	
		Z	5.94	68.2	21.0		136.0	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.32	69.9	22.1	8.10	149.3	±2.5 %
		Y	9.93	68.6	21.2		136.9	
		Z	10.25	69.7	22.1		144.6	
10225-CAB	UMTS-FDD (HSPA+)	X	6.96	66.8	19.5	5.97	126.9	±1.4 %
		Y	7.05	67.0	19.4		142.8	
		Z	7.10	67.3	19.9		144.5	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.05	67.2	19.2	4.87	146.9	±1.2 %
		Y	5.88	66.4	18.5		136.3	
		Z	6.02	67.0	19.2		140.4	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.38	66.5	18.7	3.96	128.6	±0.9 %
		Y	4.48	66.7	18.6		141.5	
		Z	4.53	67.1	19.2		146.6	
10297-AAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.39	67.4	20.0	5.81	134.6	±1.4 %
		Y	6.16	66.3	19.1		126.6	
		Z	6.34	67.1	19.9		130.2	
10298-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.70	66.4	19.5	5.72	128.8	±1.4 %
		Y	5.79	66.5	19.4		144.2	
		Z	5.89	67.2	20.1		146.6	
10299-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.71	67.5	20.2	6.39	135.5	±1.4 %
		Y	6.54	66.6	19.5		127.4	
		Z	6.64	67.2	20.2		129.0	

Certificate No: ES3-3196_May17 Page 14 of 18

ES3DV3– SN:3196 May 17, 2017

10311-AAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.01	68.2	20.4	6.06	141.6	±1.7 %
		Y	6.76	67.1	19.6		133.7	
		Z	6.92	67.8	20.3		135.3	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.59	67.8	18.6	1.54	148.4	±0.7 %
		Y	2.50	66.6	17.5		141.3	
		Z	2.62	68.0	19.0		142.7	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	10.26	69.8	22.1	8.14	147.2	±2.5 %
		Y	9.97	68.8	21.4		139.1	
		Z	10.18	69.6	22.1		141.7	
10430-AAA	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)	X	9.52	69.2	22.0	8.28	133.2	±1.9 %
		Y	9.19	68.0	21.1		124.7	
		Z	9.46	69.0	22.0		127.4	
10431-AAA	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)	X	10.13	69.7	22.3	8.38	141.6	±2.5 %
		Y	9.84	68.7	21.5		133.3	
		Z	10.08	69.6	22.3		136.1	
10432-AAA	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)	X	10.35	69.9	22.3	8.34	145.3	±2.5 %
		Y	10.06	68.8	21.5		137.2	
		Z	10.28	69.7	22.3		139.8	
10433-AAA	LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)	X	10.59	70.1	22.4	8.34	149.7	±2.5 %
		Y	10.26	69.0	21.5		139.9	
		Z	10.53	69.9	22.4		144.9	
10434-AAA	W-CDMA (BS Test Model 1, 64 DPCH)	X	9.81	69.7	22.5	8.60	132.3	±2.2 %
		Y	9.51	68.5	21.6		125.0	
		Z	9.76	69.6	22.5		129.2	
10435-AAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.19	72.9	24.2	7.82	127.6	±2.2 %
		Y	7.59	73.6	24.4		147.3	
		Z	7.07	72.3	24.1		124.7	
10457-AAA	UMTS-FDD (DC-HSDPA)	X	8.35	67.3	20.1	6.62	139.7	±1.4 %
		Y	8.12	66.5	19.4		128.3	
		Z	8.32	67.2	20.1		135.4	
10460-AAA	UMTS-FDD (WCDMA, AMR)	X	2.90	68.0	19.1	2.39	143.8	±0.9 %
		Y	2.85	67.4	18.5		132.5	
		Z	2.99	68.8	19.7		138.4	
10461-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.38	73.6	24.6	7.82	132.5	±3.0 %
		Y	7.55	73.6	24.3		145.4	
		Z	7.23	72.9	24.4		126.5	
10462-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.72	73.8	24.9	8.30	126.2	±2.7 %
		Y	8.15	74.7	25.1		140.6	
		Z	8.45	76.2	26.4		149.1	
10464-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.27	73.2	24.4	7.82	127.9	±2.5 %
		Y	7.46	73.4	24.2		140.3	
		Z	7.79	75.0	25.6		148.8	

Certificate No: ES3-3196_May17 Page 15 of 18

10465-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.64	73.4	24.7	8.32	124.5	±3.0 %
		Y	8.16	74.7	25.1		140.5	
		Z	8.38	75.9	26.3		147.0	
10467-AAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.11	72.6	24.1	7.82	125.3	±2.5 %
		Y	7.44	73.3	24.2		139.5	
		Z	7.82	75.2	25.6		149.0	
10468-AAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.57	76.6	26.4	8.32	149.6	±3.0 %
		Y	8.14	74.6	25.1		140.9	
		Z	8.46	76.3	26.4		149.0	
10470-AAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.89	75.4	25.6	7.82	148.3	±2.7 %
		Y	7.51	73.6	24.3		140.6	
		Z	7.81	75.1	25.6		148.1	
10471-AAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.51	76.4	26.3	8.32	149.0	±3.0 %
		Y	8.14	74.6	25.1		141.1	
		Z	8.44	76.2	26.4		146.4	
10473-AAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.86	75.3	25.5	7.82	148.1	±2.7 %
		Y	7.48	73.5	24.3		141.1	
		Z	7.76	74.9	25.5		147.8	
10474-AAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.51	76.4	26.3	8.32	149.1	±3.0 %
		Y	8.13	74.6	25.1		141.7	
		Z	8.40	76.0	26.3		147.9	
10477-AAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.57	76.7	26.5	8.32	148.4	±3.0 %
		Y	8.17	74.7	25.2		142.2	
		Z	8.39	76.0	26.3		148.1	
10479-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.41	72.1	23.7	7.74	130.6	±2.7 %
		Y	7.11	70.5	22.6		126.0	
		Z	7.44	72.1	23.9		130.3	
10480-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.20	73.1	24.4	8.18	136.4	±3.0 %
		Y	7.90	71.6	23.3		130.3	
		Z	8.19	73.0	24.5		134.3	
10482-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.16	73.0	24.1	7.71	142.7	±3.3 %
		Y	7.79	71.3	22.9		136.9	
		Z	8.07	72.6	24.1		140.2	
10483-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.56	71.7	23.7	8.39	127.2	±2.7 %
		Y	9.01	72.7	24.0		148.0	
		Z	9.13	73.5	24.9		148.2	
10485-AAB	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.29	73.3	24.2	7.59	148.2	±2.5 %
		Y	7.91	71.7	23.0		140.3	
		Z	8.08	72.6	24.0		141.9	
10486-AAB	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.80	71.9	23.9	8.38	130.9	±2.7 %
		Y	9.04	72.2	23.7		149.2	
		Z	8.62	71.3	23.6		125.3	
10488-AAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.12	71.6	23.3	7.70	128.9	±2.7 %
		Y	8.42	72.1	23.3		147.2	
		Z	8.65	73.3	24.4		147.8	

ES3DV3– SN:3196 May 17, 2017

10489-AAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.11	72.0	23.9	8.31	137.4	±2.7 %
		Y	8.58	70.0	22.4		127.9	
		Z	8.95	71.5	23.6		130.3	
10491-AAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.67	72.3	23.5	7.74	135.2	±2.5 %
		Y	8.08	70.0	22.1		125.2	
		Z	8.48	71.6	23.3		128.7	
10492-AAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.70	72.6	24.1	8.41	144.0	±2.7 %
		Y	9.18	70.6	22.8		135.3	
		Z	9.54	72.0	23.9		138.6	
10494-AAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.68	72.5	23.7	7.74	133.9	±2.5 %
		Y	8.08	70.2	22.2		124.5	
		Z	8.51	71.9	23.5		127.7	
10495-AAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.60	72.5	24.1	8.37	142.9	±2.7 %
		Y	9.17	70.8	22.9		135.6	
		Z	9.48	72.1	23.9		137.9	
10497-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.00	72.9	24.1	7.67	144.0	±3.0 %
		Y	7.60	71.0	22.7		136.2	
		Z	7.89	72.4	24.0		139.2	
10498-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.34	71.4	23.6	8.40	124.4	±3.0 %
		Y	8.78	72.3	23.8		144.6	
		Z	8.94	73.3	24.8		145.4	
10500-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.79	71.1	23.1	7.67	125.5	±2.5 %
		Y	8.03	71.5	23.0		140.7	
		Z	8.44	73.3	24.4		146.1	
10501-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.98	72.0	24.0	8.44	133.9	±2.7 %
		Y	8.50	70.0	22.6		125.3	
		Z	8.84	71.5	23.8		128.5	
10503-AAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.11	71.6	23.3	7.72	128.9	±2.5 %
		Y	8.46	72.3	23.4		147.4	
		Z	8.77	73.7	24.6		149.9	
10504-AAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.12	72.1	23.9	8.31	137.9	±3.0 %
		Y	8.56	69.9	22.4		127.3	
		Z	8.98	71.6	23.7		132.5	
10506-AAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.66	72.5	23.7	7.74	133.6	±2.2 %
		Y	8.00	70.0	22.1		122.6	
		Z	8.54	72.0	23.6		129.3	
10507-AAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.56	72.4	24.0	8.36	142.4	±3.0 %
		Y	9.00	70.3	22.6		132.3	
		Z	9.54	72.3	24.1		139.8	
10509-AAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	9.43	73.2	24.1	7.99	139.9	±2.7 %
		Y	8.75	70.8	22.6		128.7	
		Z	9.34	72.9	24.1		135.9	

ES3DV3– SN:3196 May 17, 2017

10510-AAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.51	71.0	23.2	8.49	122.3	±2.7 %
		Y	9.71	71.2	23.1		140.2	
		Z	10.19	72.9	24.4		147.3	
10512-AAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	9.02	72.8	23.7	7.74	135.0	±2.5 %
		Y	8.41	70.7	22.3		126.5	
		Z	9.01	72.8	23.8		133.0	
10513-AAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	10.08	73.0	24.3	8.42	147.1	±2.7 %
		Y	9.44	70.8	22.8		136.6	
		Z	10.02	72.8	24.3		144.2	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	2.69	68.5	18.9	1.58	145.5	±0.7 %
		Y	2.62	67.5	18.1		139.0	
		Z	2.73	68.7	19.3		143.9	
10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	10.41	69.9	22.3	8.25	146.6	±2.2 %
		Y	10.14	68.9	21.5		138.8	
		Z	10.38	69.8	22.3		142.6	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	3.47	71.3	20.1	1.99	145.7	±0.7 %
		Y	3.22	69.4	19.0		137.8	
		Z	3.47	71.3	20.4		142.7	
10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	3.56	71.9	20.4	1.99	144.9	±0.7 %
		Y	3.39	70.5	19.4		138.7	
		Z	3.52	71.7	20.6		142.1	
10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	10.83	70.6	22.9	8.59	146.0	±2.7 %
		Y	10.51	69.5	22.0		140.4	
		Z	10.78	70.4	22.9		142.4	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	10.88	70.7	22.9	8.60	147.2	±2.7 %
		Y	10.55	69.6	22.1		139.9	
		Z	10.79	70.5	22.9		141.6	
10591-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	10.96	70.7	22.9	8.63	148.2	±2.7 %
		Y	10.64	69.6	22.0		142.7	
		Z	10.91	70.5	22.9		144.1	
10592-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	11.14	70.9	23.1	8.79	147.7	±2.7 %
		Y	10.84	69.8	22.3		143.1	
		Z	11.11	70.8	23.1		144.3	
10599-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	11.15	70.1	22.5	8.79	126.8	±2.5 %
		Y	10.76	69.0	21.7		121.6	
		Z	11.13	70.1	22.6		124.8	
10600-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	11.22	70.2	22.6	8.88	126.7	±2.2 %
		Y	10.85	69.1	21.8		122.4	
		Z	11.24	70.2	22.7		124.7	

E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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Schmid & Partner
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Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **ES3-3122_Apr18**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3122
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	April 18, 2018

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 NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

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

Issued: April 19, 2018

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

Certificate No: ES3-3122_Apr18 Page 1 of 18

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Schmid & Partner
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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, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
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"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3122

Manufactured: July 11, 2006
Calibrated: April 18, 2018

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.30	1.19	1.39	± 10.1 %
DCP (mV)[B]	101.7	102.8	102.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	212.2	±3.5 %
		Y	0.0	0.0	1.0		209.0	
		Z	0.0	0.0	1.0		170.3	

Note: For details on UID parameters see Appendix.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	7.20	7.20	7.20	0.08	1.20	± 13.3 %
300	45.3	0.87	7.01	7.01	7.01	0.13	1.20	± 13.3 %
450	43.5	0.87	6.80	6.80	6.80	0.23	1.30	± 13.3 %
750	41.9	0.89	6.61	6.61	6.61	0.80	1.17	± 12.0 %
835	41.5	0.90	6.31	6.31	6.31	0.61	1.31	± 12.0 %
900	41.5	0.97	6.18	6.18	6.18	0.66	1.28	± 12.0 %
1450	40.5	1.20	5.64	5.64	5.64	0.80	1.12	± 12.0 %
1810	40.0	1.40	5.24	5.24	5.24	0.39	1.66	± 12.0 %
1900	40.0	1.40	5.21	5.21	5.21	0.44	1.51	± 12.0 %
2100	39.8	1.49	5.28	5.28	5.28	0.80	1.20	± 12.0 %
2300	39.5	1.67	4.86	4.86	4.86	0.80	1.21	± 12.0 %
2450	39.2	1.80	4.64	4.64	4.64	0.69	1.32	± 12.0 %
2600	39.0	1.96	4.46	4.46	4.46	0.80	1.33	± 12.0 %
3500	37.9	2.91	4.38	4.38	4.38	0.80	1.25	± 13.1 %
3700	37.7	3.12	4.08	4.08	4.08	0.70	1.25	± 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:3122

Calibration Parameter Determined in Body Tissue Simulating Media

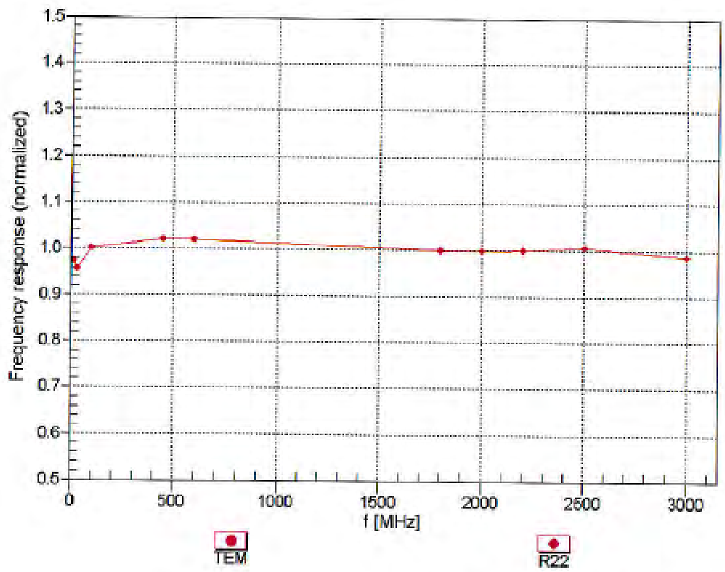
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	6.82	6.82	6.82	0.08	1.20	± 13.3 %
300	58.2	0.92	6.79	6.79	6.79	0.10	1.20	± 13.3 %
450	56.7	0.94	6.95	6.95	6.95	0.10	1.30	± 13.3 %
750	55.5	0.96	6.39	6.39	6.39	0.54	1.37	± 12.0 %
835	55.2	0.97	6.28	6.28	6.28	0.80	1.14	± 12.0 %
900	55.0	1.05	6.22	6.22	6.22	0.58	1.33	± 12.0 %
1450	54.0	1.30	5.39	5.39	5.39	0.80	1.12	± 12.0 %
1810	53.3	1.52	5.02	5.02	5.02	0.51	1.53	± 12.0 %
1900	53.3	1.52	4.81	4.81	4.81	0.67	1.36	± 12.0 %
2100	53.2	1.62	5.09	5.09	5.09	0.57	1.53	± 12.0 %
2300	52.9	1.81	4.58	4.58	4.58	0.80	1.24	± 12.0 %
2450	52.7	1.95	4.52	4.52	4.52	0.80	1.18	± 12.0 %
2600	52.5	2.16	4.26	4.26	4.26	0.79	1.20	± 12.0 %
3500	51.3	3.31	3.86	3.86	3.86	0.70	1.30	± 13.1 %
3700	51.0	3.55	3.85	3.85	3.85	0.70	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.

ES3DV3– SN:3122

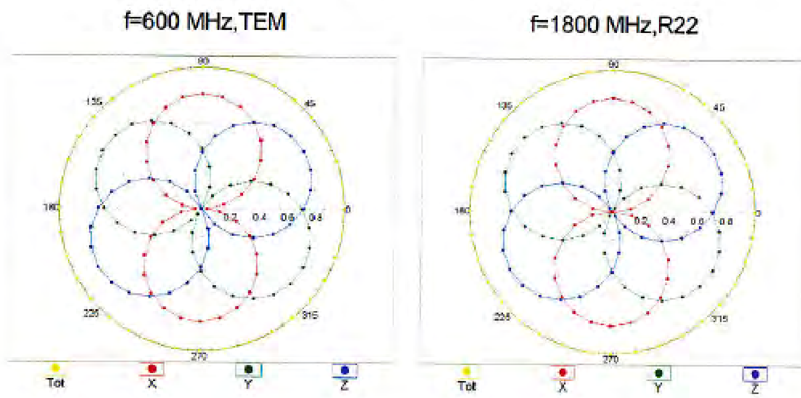
April 18, 2018

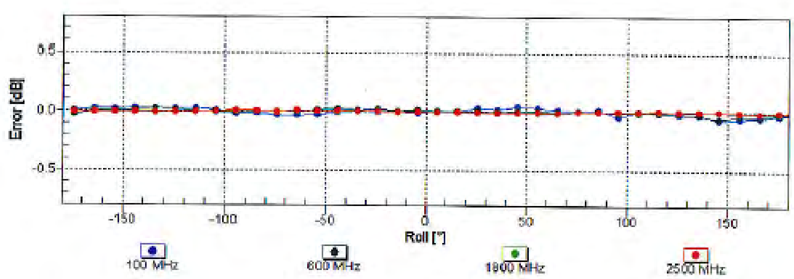
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

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

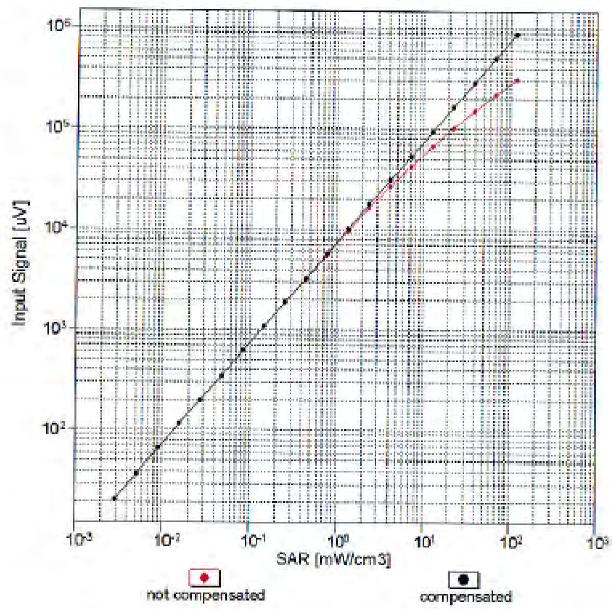


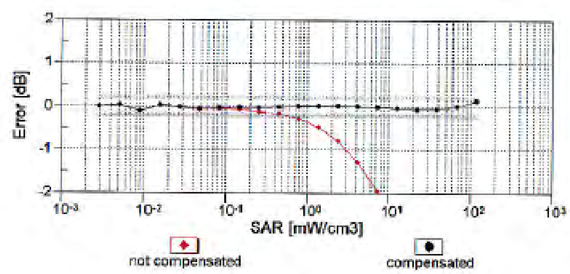


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

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

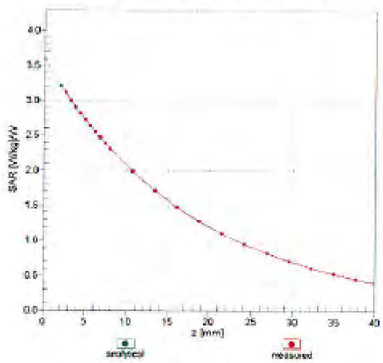


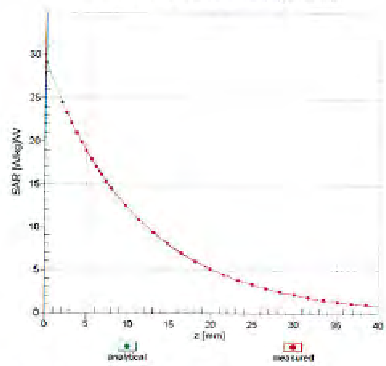


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ES3DV3– SN:3122 April 18, 2018

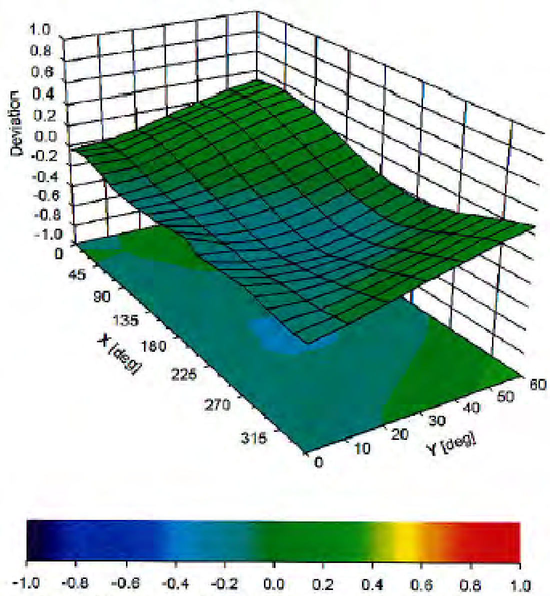
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: ES3-3122_Apr18 Page 10 of 18

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	25.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Appendix: 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	212.2	±3.5 %
		Y	0.0	0.0	1.0		209.0	
		Z	0.0	0.0	1.0		170.3	
10011-CAB	UMTS-FDD (WCDMA)	X	2.98	64.8	17.0	2.91	126.1	±0.7 %
		Y	3.13	65.9	17.9		124.0	
		Z	3.15	66.2	18.0		136.1	
10097-CAB	UMTS-FDD (HSDPA)	X	4.38	65.4	17.7	3.98	134.3	±0.7 %
		Y	4.50	66.1	18.2		132.7	
		Z	4.48	66.2	18.3		145.2	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.34	65.2	17.5	3.98	134.1	±0.7 %
		Y	4.49	66.0	18.2		132.3	
		Z	4.50	66.3	18.3		145.2	
10100-CAD	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.27	67.0	19.3	5.67	140.9	±1.2 %
		Y	6.41	67.6	19.8		139.9	
		Z	5.90	65.7	18.8		108.7	
10101-CAD	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	6.87	65.7	18.9	6.42	106.2	±1.4 %
		Y	7.57	68.1	20.4		149.7	
		Z	7.03	66.4	19.4		115.6	
10108-CAE	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.22	66.8	19.4	5.80	138.9	±1.2 %
		Y	6.37	67.5	19.9		137.7	
		Z	5.89	65.6	18.8		107.6	
10109-CAE	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.24	67.4	19.9	6.43	148.0	±1.4 %
		Y	7.38	68.0	20.4		146.2	
		Z	6.83	66.2	19.3		113.4	
10110-CAE	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.97	66.4	19.2	5.75	136.1	±1.2 %
		Y	6.07	66.9	19.6		135.0	
		Z	6.07	67.0	19.7		147.6	
10111-CAE	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	7.04	67.2	19.8	6.44	145.2	±1.2 %
		Y	7.15	67.8	20.3		143.0	
		Z	6.63	66.0	19.3		110.9	
10117-CAC	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.95	68.4	21.0	8.07	128.7	±1.9 %
		Y	10.18	69.0	21.5		127.3	
		Z	10.18	69.1	21.5		141.1	
10140-CAD	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	7.06	65.9	19.1	6.49	107.8	±1.2 %
		Y	7.20	66.4	19.5		105.6	
		Z	7.24	66.6	19.5		117.5	
10142-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.88	66.4	19.2	5.73	134.9	±1.2 %
		Y	5.92	66.7	19.5		132.9	
		Z	5.90	66.8	19.6		145.1	
10143-CAD	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.86	67.2	19.8	6.35	142.8	±1.2 %
		Y	6.92	67.6	20.2		140.2	
		Z	6.39	65.8	19.2		108.6	

10145-CAE	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.65	66.0	19.0	5.76	131.7	±0.9 %
		Y	5.68	66.4	19.4		129.3	
		Z	5.69	66.7	19.5		140.8	
10146-CAE	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.63	67.1	19.8	6.41	137.8	±1.2 %
		Y	6.68	67.6	20.2		134.4	
		Z	6.66	67.7	20.3		146.5	
10149-CAD	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.25	67.4	20.0	6.42	147.7	±1.4 %
		Y	7.35	67.9	20.4		145.9	
		Z	6.83	66.2	19.3		113.4	
10154-CAE	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.99	66.5	19.3	5.75	136.2	±1.2 %
		Y	6.07	66.9	19.6		134.5	
		Z	6.07	67.0	19.7		147.4	
10155-CAE	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	7.06	67.3	19.9	6.43	145.5	±1.4 %
		Y	7.14	67.7	20.3		142.7	
		Z	6.59	65.9	19.2		110.4	
10156-CAE	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.81	66.1	19.1	5.79	133.7	±1.2 %
		Y	5.87	66.5	19.5		131.2	
		Z	5.86	66.7	19.6		143.6	
10157-CAE	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.87	67.2	19.9	6.49	140.8	±1.2 %
		Y	6.94	67.7	20.4		138.5	
		Z	6.41	65.9	19.3		107.2	
10160-CAD	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.37	66.8	19.4	5.82	141.1	±1.2 %
		Y	6.51	67.4	19.9		139.7	
		Z	6.01	65.7	18.9		108.6	
10161-CAD	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.33	67.5	20.0	6.43	149.2	±1.4 %
		Y	7.44	68.0	20.4		147.2	
		Z	6.88	66.2	19.3		114.2	
10166-CAE	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	5.07	65.6	18.8	5.46	126.4	±0.9 %
		Y	5.09	66.0	19.1		124.0	
		Z	5.12	66.3	19.3		136.0	
10167-CAE	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	6.07	66.9	19.6	6.21	130.6	±1.2 %
		Y	6.12	67.4	20.1		127.4	
		Z	6.13	67.7	20.2		139.8	
10169-CAD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.95	65.8	19.0	5.73	120.9	±0.9 %
		Y	5.02	66.5	19.6		118.9	
		Z	5.03	66.6	19.6		130.3	
10170-CAD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.79	67.1	20.0	6.52	121.6	±1.2 %
		Y	5.87	67.7	20.5		118.9	
		Z	5.88	67.9	20.5		130.8	
10175-CAE	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.94	65.8	18.9	5.72	121.0	±0.9 %
		Y	5.03	66.5	19.5		118.8	
		Z	5.04	66.7	19.6		130.1	
10176-CAE	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.81	67.2	20.0	6.52	121.6	±1.2 %
		Y	5.88	67.8	20.6		118.6	
		Z	5.90	68.0	20.6		130.7	

ES3DV3– SN:3122 April 18, 2018

10177-CAG	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.97	65.9	19.0	5.73	121.3	±0.9 %
		Y	5.02	66.4	19.5		118.7	
		Z	5.04	66.7	19.6		130.4	
10178-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.82	67.2	20.0	6.52	121.9	±1.2 %
		Y	5.84	67.6	20.4		118.9	
		Z	5.91	68.0	20.6		131.0	
10181-CAD	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.94	65.7	18.9	5.72	121.0	±0.9 %
		Y	5.02	66.4	19.5		118.7	
		Z	5.06	66.8	19.7		130.4	
10182-CAD	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.80	67.1	19.9	6.52	121.6	±1.2 %
		Y	5.86	67.7	20.5		118.8	
		Z	5.91	68.0	20.6		130.8	
10184-CAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	4.96	65.9	19.0	5.73	121.0	±0.9 %
		Y	5.03	66.5	19.6		118.7	
		Z	5.03	66.6	19.6		130.0	
10185-CAD	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.80	67.1	20.0	6.51	121.5	±1.2 %
		Y	5.88	67.8	20.5		118.7	
		Z	5.92	68.1	20.7		130.9	
10187-CAE	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	4.95	65.8	18.9	5.73	120.9	±0.9 %
		Y	5.03	66.4	19.5		119.0	
		Z	5.02	66.5	19.5		130.1	
10188-CAE	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.81	67.1	20.0	6.52	121.6	±1.2 %
		Y	5.87	67.7	20.5		118.9	
		Z	5.91	68.0	20.6		131.0	
10196-CAC	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.69	68.1	20.9	8.10	124.2	±1.9 %
		Y	9.87	68.7	21.5		122.8	
		Z	9.88	68.9	21.5		136.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.58	65.3	18.5	5.97	107.4	±1.2 %
		Y	6.57	65.5	18.7		104.1	
		Z	6.70	66.1	19.0		116.2	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.90	66.4	18.6	4.87	146.3	±0.9 %
		Y	6.00	66.9	19.0		144.2	
		Z	5.62	65.8	18.3		112.0	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.25	65.6	18.0	3.96	130.0	±0.7 %
		Y	4.34	66.2	18.5		128.8	
		Z	4.37	66.5	18.6		140.4	
10297-AAC	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.29	67.1	19.6	5.81	138.4	±1.2 %
		Y	6.38	67.4	19.9		137.2	
		Z	5.90	65.7	18.9		106.8	
10298-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.72	66.2	19.1	5.72	132.5	±1.2 %
		Y	5.78	66.7	19.6		130.4	
		Z	5.74	66.7	19.6		142.0	
10299-AAC	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.73	67.1	19.8	6.39	139.4	±1.2 %
		Y	6.79	67.7	20.3		136.6	
		Z	6.79	67.9	20.4		149.1	

Certificate No: ES3-3122_Apr18 Page 14 of 18

10311-AAC	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.77	67.4	19.8	6.06	143.5	±1.2 %
		Y	6.94	68.0	20.3		142.6	
		Z	6.39	66.2	19.2		110.2	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.33	65.6	17.0	1.54	129.1	±0.5 %
		Y	2.47	66.6	17.8		127.4	
		Z	2.44	66.8	17.9		139.9	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.79	68.3	21.2	8.23	125.1	±1.9 %
		Y	10.02	69.0	21.7		122.7	
		Z	9.95	68.9	21.6		136.4	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	9.68	68.3	21.1	8.14	124.1	±1.7 %
		Y	9.88	68.9	21.6		121.6	
		Z	9.84	68.9	21.5		135.2	
10430-AAB	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)	X	9.17	67.9	21.0	8.28	114.8	±1.7 %
		Y	9.27	68.5	21.6		111.7	
		Z	9.24	68.6	21.6		123.3	
10431-AAB	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)	X	9.64	68.2	21.2	8.38	120.8	±1.9 %
		Y	9.80	68.8	21.7		118.2	
		Z	9.78	68.9	21.7		131.0	
10432-AAB	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)	X	9.81	68.3	21.2	8.34	123.7	±1.9 %
		Y	10.05	69.1	21.9		121.5	
		Z	9.98	69.0	21.7		135.3	
10433-AAB	LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)	X	9.99	68.5	21.3	8.34	126.5	±1.9 %
		Y	10.26	69.3	21.9		124.6	
		Z	10.17	69.2	21.8		137.9	
10435-AAC	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.10	71.6	23.1	7.82	112.9	±1.9 %
		Y	7.32	72.6	23.9		111.3	
		Z	7.64	73.9	24.5		123.1	
10457-AAA	UMTS-FDD (DC-HSDPA)	X	7.93	66.1	19.2	6.62	119.3	±1.4 %
		Y	8.08	66.6	19.6		118.1	
		Z	8.09	66.7	19.6		130.5	
10460-AAA	UMTS-FDD (WCDMA, AMR)	X	2.62	65.9	17.6	2.39	123.9	±0.5 %
		Y	2.76	66.9	18.4		122.0	
		Z	2.79	67.5	18.7		134.0	
10461-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.13	71.6	23.1	7.82	113.1	±1.9 %
		Y	7.43	73.0	24.1		111.8	
		Z	7.64	73.8	24.4		122.7	
10462-AAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.65	72.3	23.7	8.30	112.2	±2.2 %
		Y	7.95	73.7	24.7		111.2	
		Z	8.26	74.9	25.2		122.1	
10464-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.11	71.6	23.1	7.82	112.9	±1.9 %
		Y	7.35	72.7	23.9		111.4	
		Z	7.58	73.6	24.3		122.6	

10465-AAA	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.68	72.4	23.8	8.32	111.9	±1.9 %
		Y	7.92	73.6	24.6		111.2	
		Z	8.26	74.8	25.1		122.0	
10467-AAC	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.15	71.7	23.2	7.82	112.9	±1.9 %
		Y	7.43	73.0	24.1		111.0	
		Z	7.66	73.9	24.5		122.9	
10468-AAC	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.68	72.4	23.8	8.32	112.4	±1.9 %
		Y	7.93	73.6	24.7		110.9	
		Z	8.22	74.7	25.1		121.8	
10470-AAC	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.09	71.5	23.1	7.82	112.7	±1.9 %
		Y	7.34	72.7	23.9		111.2	
		Z	7.62	73.7	24.4		122.5	
10471-AAC	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.67	72.4	23.8	8.32	112.3	±2.2 %
		Y	7.88	73.4	24.5		110.9	
		Z	8.24	74.7	25.1		122.2	
10473-AAC	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.12	71.6	23.2	7.82	112.9	±1.9 %
		Y	7.37	72.8	24.0		111.2	
		Z	7.60	73.7	24.4		122.6	
10474-AAC	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.73	72.6	23.9	8.32	112.4	±1.9 %
		Y	7.87	73.4	24.6		111.0	
		Z	8.21	74.6	25.0		121.8	
10477-AAC	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	7.64	72.3	23.7	8.32	111.8	±2.2 %
		Y	7.90	73.5	24.6		111.1	
		Z	8.18	74.6	25.0		121.9	
10479-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.45	71.3	22.9	7.74	120.3	±2.2 %
		Y	7.66	72.3	23.7		118.0	
		Z	7.88	73.2	24.1		129.9	
10480-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.25	72.2	23.6	8.18	123.2	±2.2 %
		Y	8.45	73.3	24.4		120.5	
		Z	8.67	74.1	24.7		133.0	
10482-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.03	71.7	23.1	7.71	127.5	±2.2 %
		Y	8.19	72.5	23.7		125.5	
		Z	8.42	73.5	24.2		138.2	
10483-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.13	72.6	23.9	8.39	134.8	±2.7 %
		Y	9.37	73.7	24.7		132.1	
		Z	9.59	74.6	25.1		146.2	
10485-AAC	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.00	71.7	22.9	7.59	129.1	±2.2 %
		Y	8.29	72.8	23.8		127.4	
		Z	8.44	73.5	24.1		140.5	
10486-AAC	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.23	72.6	23.9	8.38	137.5	±2.7 %
		Y	9.54	73.8	24.8		135.8	
		Z	9.69	74.4	25.0		149.2	
10488-AAC	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.43	72.1	23.2	7.70	133.5	±2.5 %
		Y	8.75	73.3	24.1		131.7	
		Z	8.90	73.8	24.3		146.1	

10489-AAC	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.50	72.7	23.9	8.31	143.4	±2.7 %
		Y	9.76	73.6	24.6		141.5	
		Z	8.33	69.4	22.2		106.1	
10491-AAC	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.89	72.5	23.4	7.74	136.5	±2.5 %
		Y	9.25	73.7	24.2		138.1	
		Z	7.77	69.3	21.8		103.9	
10492-AAC	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.48	68.5	21.6	8.41	101.7	±2.2 %
		Y	10.41	74.3	25.0		148.8	
		Z	8.85	69.9	22.5		111.1	
10494-AAC	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.83	72.6	23.4	7.74	137.3	±2.5 %
		Y	9.23	73.8	24.3		136.5	
		Z	7.73	69.3	21.8		102.7	
10495-AAC	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.90	73.0	24.1	8.37	148.8	±3.0 %
		Y	10.25	74.1	24.9		147.7	
		Z	8.73	69.8	22.4		110.1	
10497-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	7.88	71.5	22.9	7.67	126.6	±2.2 %
		Y	8.14	72.7	23.8		124.7	
		Z	8.32	73.5	24.1		137.7	
10498-AAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.98	72.6	23.9	8.40	132.5	±2.7 %
		Y	9.18	73.5	24.6		129.8	
		Z	9.41	74.4	25.0		143.5	
10500-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.22	71.9	23.1	7.67	131.3	±2.2 %
		Y	8.51	73.0	24.0		129.2	
		Z	8.66	73.7	24.2		142.6	
10501-AAA	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.44	72.7	24.0	8.44	140.1	±2.7 %
		Y	9.70	73.7	24.8		137.6	
		Z	8.19	69.2	22.2		103.6	
10503-AAC	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.41	72.0	23.2	7.72	133.4	±2.5 %
		Y	8.78	73.3	24.1		132.4	
		Z	8.93	73.9	24.3		146.1	
10504-AAC	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.47	72.6	23.8	8.31	143.3	±2.7 %
		Y	9.78	73.7	24.7		141.4	
		Z	8.34	69.4	22.2		106.3	
10506-AAC	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	8.81	72.5	23.4	7.74	137.6	±2.2 %
		Y	9.27	74.0	24.4		136.6	
		Z	7.75	69.4	21.9		102.8	
10507-AAC	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	9.84	72.8	24.0	8.36	148.2	±2.7 %
		Y	10.25	74.1	24.9		147.3	
		Z	8.73	69.7	22.3		110.1	
10509-AAC	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	9.51	73.2	23.8	7.99	144.0	±2.5 %
		Y	10.02	74.6	24.8		143.6	
		Z	8.39	69.9	22.2		107.5	

ES3DV3– SN:3122 April 18, 2018

10510-AAC	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.90	69.0	21.8	8.49	104.8	±1.9 %
		Y	9.29	70.1	22.6		104.4	
		Z	9.32	70.3	22.7		115.7	
10512-AAC	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	9.20	73.1	23.6	7.74	141.4	±2.2 %
		Y	9.71	74.6	24.5		140.9	
		Z	8.12	70.0	22.1		105.9	
10513-AAC	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	8.75	68.9	21.8	8.42	103.2	±1.9 %
		Y	9.18	70.2	22.7		102.7	
		Z	9.18	70.3	22.7		114.3	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	2.40	66.0	17.2	1.58	129.3	±0.5 %
		Y	2.48	66.6	17.8		128.1	
		Z	2.48	67.0	18.0		140.0	
10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	9.86	68.4	21.2	8.25	124.9	±1.9 %
		Y	10.07	69.1	21.7		122.7	
		Z	10.05	69.1	21.7		136.5	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	3.14	68.9	18.5	1.99	129.3	±0.7 %
		Y	3.26	69.5	19.1		127.8	
		Z	3.46	71.1	19.7		140.3	
10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	3.02	68.2	18.2	1.99	128.8	±0.5 %
		Y	3.29	69.8	19.2		127.7	
		Z	3.48	71.2	19.7		139.7	
10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	10.24	69.0	21.7	8.59	125.8	±2.2 %
		Y	10.50	69.8	22.3		123.8	
		Z	10.46	69.7	22.3		137.2	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	10.24	69.0	21.7	8.60	125.5	±2.2 %
		Y	10.55	69.9	22.4		123.8	
		Z	10.47	69.8	22.3		136.8	
10591-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	10.36	69.0	21.8	8.63	127.3	±3.0 %
		Y	10.67	69.9	22.5		125.9	
		Z	10.57	69.8	22.3		138.9	
10592-AAB	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	10.54	69.3	22.0	8.79	127.5	±3.3 %
		Y	10.87	70.2	22.7		126.3	
		Z	10.80	70.1	22.6		140.1	
10599-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	10.88	69.6	22.1	8.79	132.3	±2.2 %
		Y	11.27	70.6	22.8		131.4	
		Z	11.17	70.4	22.7		145.6	
10600-AAB	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	10.98	69.7	22.2	8.88	132.5	±3.5 %
		Y	11.36	70.7	22.9		131.7	
		Z	11.27	70.6	22.8		146.1	

[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Appendix C
Dipole Calibration Certificate

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
C 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 Solutions MY**

Certificate No: **D450V3-1054_Oct17**

CALIBRATION CERTIFICATE

Object: D450V3 - SN:1054

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

Calibration date: October 25, 2017

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 3877	31-Dec-16 (No. EX3-3877_Dec16)	Dec-17
DAE4	SN: 654	24-Jul-17 (No. DAE4-654_Jul17)	Jul-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (No. 217-02285)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

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

Issued: October 26, 2017

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

Certificate No: D450V3-1054_Oct17 Page 1 of 8

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

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

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

Accreditation No.: **SCS 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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
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	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.5 ± 6 %	0.87 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	**4.48 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.750 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.00 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	55.2 ± 6 %	0.93 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.57 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.759 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.05 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	57.9 Ω - 4.1 jΩ
Return Loss	- 21.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	54.4 Ω - 8.9 jΩ
Return Loss	- 20.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.349 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 16, 2005

DASY5 Validation Report for Head TSL

Date: 25.10.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.87 S/m; ε_r = 43.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

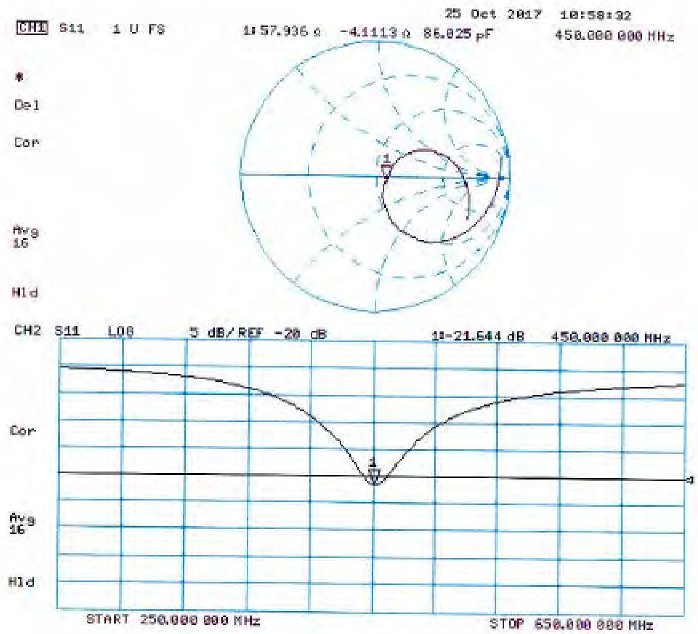
- Probe: EX3DV4 - SN3877; ConvF(10.5, 10.5, 10.5); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 24.07.2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 43.28 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 1.74 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.750 W/kg
Maximum value of SAR (measured) = 1.52 W/kg

0 dB = 1.52 W/kg = 1.82 dBW/kg

Certificate No: D450V3-1054_Oct17 Page 5 of 8

Impedance Measurement Plot for Head TSL



Certificate No: D450V3-1054_Oct17 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 25.10.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.93 S/m; ε_r = 55.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

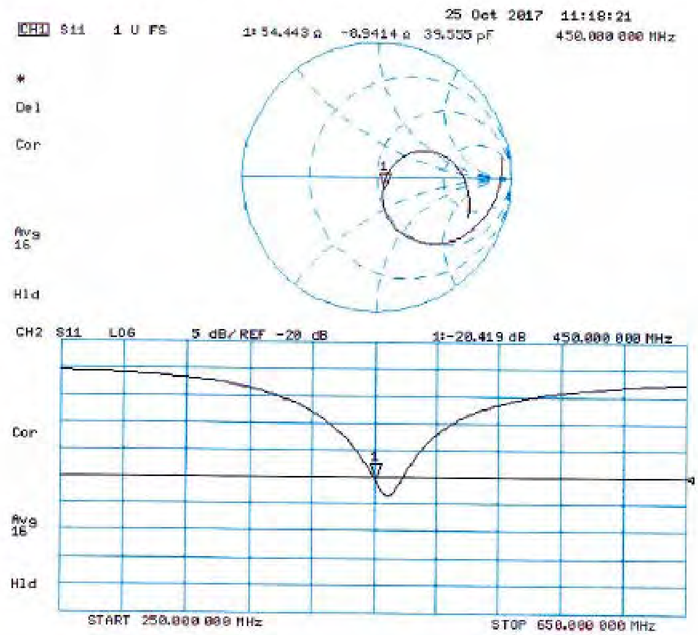
- Probe: EX3DV4 - SN3877; ConvF(10.7, 10.7, 10.7); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 24.07.2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 42.19 V/m; Power Drift = -0.05dB
Peak SAR (extrapolated) = 1.76 W/kg
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.759 W/kg
Maximum value of SAR (measured) = 1.53 W/kg

0 dB = 1.53 W/kg = 1.85 dBW/kg

Certificate No: D450V3-1054_Oct17 Page 7 of 8

Impedance Measurement Plot for Body TSL



Certificate No: D450V3-1054_Oct17 Page 8 of 8

Dipole Data

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

APPENDIX D
System Verification Check Scans

Motorola Solutions, Inc. EME Laboratory
Date/Time: 3/28/2018 4:06:22 AM

Robot#: DASY5-PG-4 | Run: ZR(ZZ)-SYSP-450H-180328-05
Dipole Model# D450V3
Phantom#: ELI4 1050
Tissue Temp: 21.0 (C)
Serial#: 1054
Test Freq: 450.0000 (MHz)
Start Power: 250 (mW)
Rotation (1D): 0.14dB
Adjusted SAR (1W): 4.56 mW/g (1g)

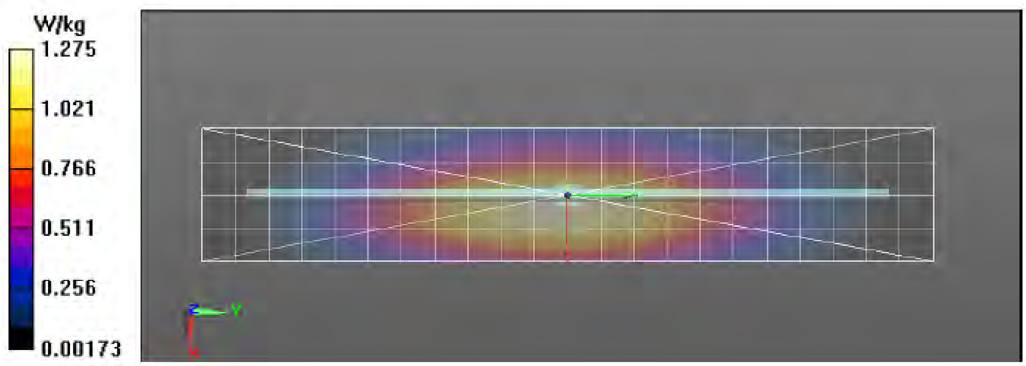
Comments:

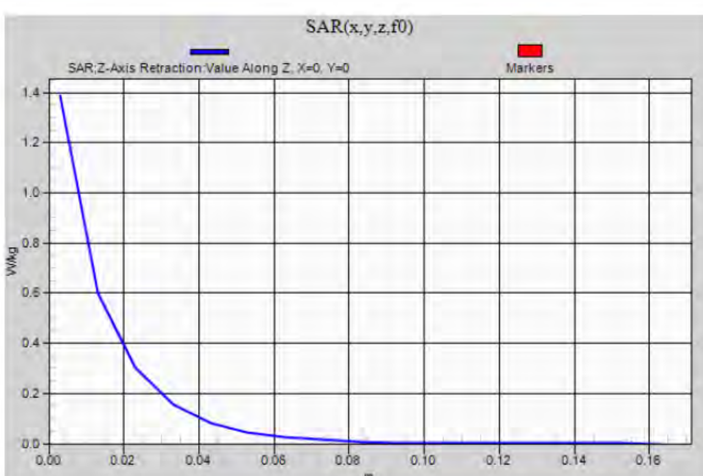
Duty Cycle: 1:1, Medium parameters used: f = 450 MHz; σ = 0.9 S/m; ε_r = 42.2; ρ = 1000 kg/m^3
Probe: ES3DV3 - SN3196, , Frequency: 450 MHz, ConvF(7.11, 7.11, 7.11); Calibrated: 5/17/2017
Electronics: DAE4 Sn684, Calibrated: 5/12/2017

Below 2 GHz-Rev.2/System Performance Check/Dipole Area Scan 2 (41x221x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 40.20 V/m; Power Drift = -0.07 dB
Fast SAR: SAR(1 g) = 1.17 W/kg; SAR(10 g) = 0.829 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 1.37 W/kg

Below 2 GHz-Rev.2/System Performance Check/0-Degree Cube (5x5x7)/Cube 0:
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 40.20 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 1.89 W/kg
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.754 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 1.39 W/kg

Below 2 GHz-Rev.2/System Performance Check/Z-Axis Retraction (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=10mm





Motorola Solutions, Inc. EME Laboratory

Date/Time: 4/18/2018 5:14:51 PM

Robot#: DASY5-PG-4 | Run:	ZR(ZZ)-SYSP-450B-180418-06
Dipole Model#	D450V3
Phantom#:	ELI4 1040
Tissue Temp:	21.3 (C)
Serial#:	1054
Test Freq:	450.0000 (MHz)
Start Power:	250 (mW)
Rotation (1D):	0.033 dB
Adjusted SAR (1W):	4.88 mW/g (1g)

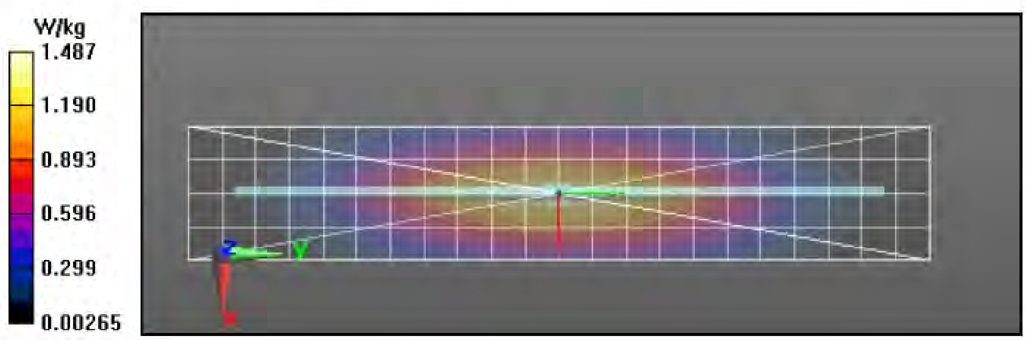
Comments:

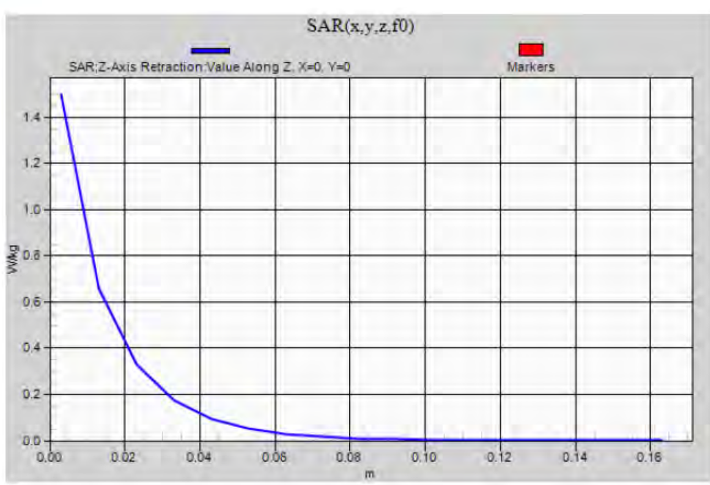
Duty Cycle: 1:1, Medium parameters used: f = 450 MHz; σ = 0.98 S/m; ε_r = 54.3; ρ = 1000 kg/m^3
Probe: ES3DV3 - SN3196, , Frequency: 450 MHz, ConvF(7, 7, 7); Calibrated: 5/17/2017
Electronics: DAE4 Sn684, Calibrated: 5/12/2017

Below 2 GHz-Rev.2/System Performance Check/Dipole Area Scan 2 (41x221x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 39.31 V/m; Power Drift = 0.02 dB
Fast SAR: SAR(1 g) = 1.26 W/kg; SAR(10 g) = 0.874 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 1.49 W/kg

Below 2 GHz-Rev.2/System Performance Check/0-Degree Cube (5x5x7)/Cube 0:
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 39.31 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 2.05 W/kg
SAR(1 g) = 1.22 W/kg; SAR(10 g) = 0.808 W/kg (SAR corrected for target medium)

Below 2 GHz-Rev.2/System Performance Check/Z-Axis Retraction (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=10mm
Maximum value of SAR (measured) = 1.50 W/kg





Motorola Solutions, Inc. EME Laboratory

Date/Time: 4/20/2018 8:02:47 PM

Robot#: DASY5-PG-4 | Run: LOH-SYSP-450B-180420-07
Dipole Model# D450V3
Phantom#: ELI4 1040
Tissue Temp: 19.8 (C)
Serial#: 1054
Test Freq: 450.0000 (MHz)
Start Power: 250 (mW)
Rotation (1D): 0.03dB
Adjusted SAR (1W): 4.64 mW/g (1g)

Comments:

Duty Cycle: 1:1, Medium parameters used: f = 450 MHz; σ = 0.97 S/m; ε_r = 54.2; ρ = 1000 kg/m^3
Probe: ES3DV3 - SN3196, , Frequency: 450 MHz, ConvF(7, 7, 7); Calibrated: 5/17/2017
Electronics: DAE4 Sn684, Calibrated: 5/12/2017

Below 2 GHz-Rev.2/System Performance Check/Dipole Area Scan 2 (41x221x1):

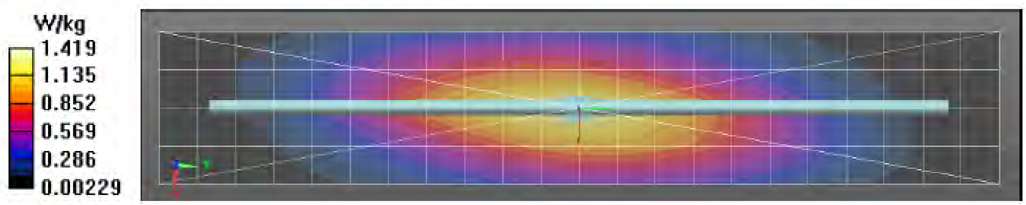
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 38.85 V/m; Power Drift = -0.12 dB
Fast SAR: SAR(1 g) = 1.21 W/kg; SAR(10 g) = 0.842 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 1.43 W/kg

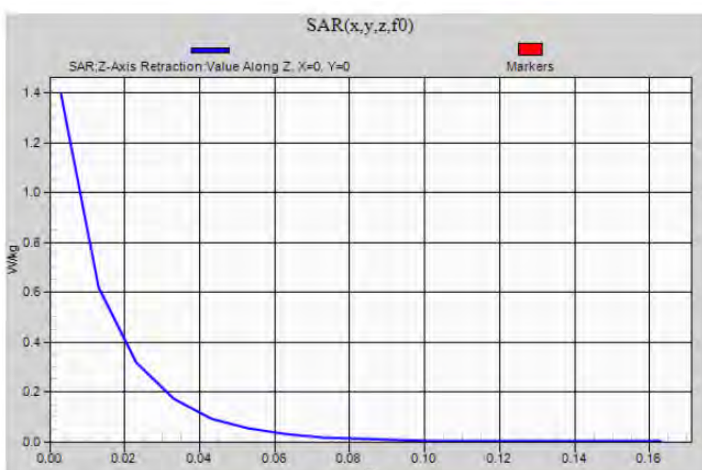
Below 2 GHz-Rev.2/System Performance Check/0-Degree Cube (5x5x7)/Cube 0:

Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 38.85 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 1.92 W/kg
SAR(1 g) = 1.16 W/kg; SAR(10 g) = 0.771 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 1.40 W/kg

Below 2 GHz-Rev.2/System Performance Check/Z-Axis Retraction (1x1x17):

Measurement grid: dx=20mm, dy=20mm, dz=10mm
Maximum value of SAR (measured) = 1.39 W/kg





Motorola Solutions, Inc. EME Laboratory
Date/Time: 4/21/2018 12:28:46 AM

Robot#: DASY5-PG-4 | Run: LOH-SYSP-450H-180421-01#
Dipole Model# D450V3
Phantom#: ELI4 1109
Tissue Temp: 19.2 (C)
Serial#: 1054
Test Freq: 450.0000 (MHz)
Start Power: 250 (mW)
Rotation (1D): 0.029dB
Adjusted SAR (1W): 4.68mW/g (1g)

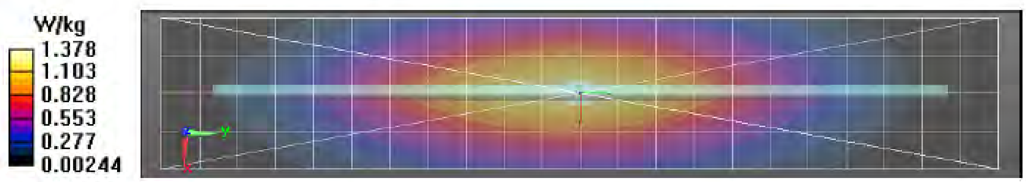
Comments:

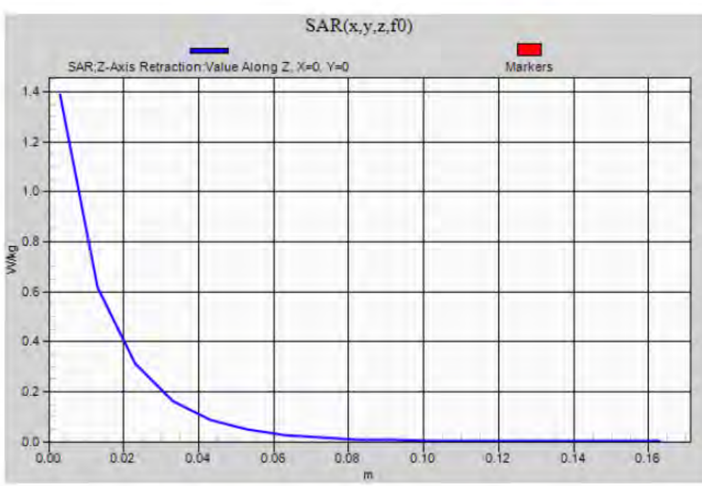
Duty Cycle: 1:1, Medium parameters used: f = 450 MHz; σ = 0.88 S/m; ε_r = 43.2; ρ = 1000 kg/m^3
Probe: ES3DV3 - SN3196, , Frequency: 450 MHz, ConvF(7.11, 7.11, 7.11); Calibrated: 5/17/2017
Electronics: DAE4 Sn684, Calibrated: 5/12/2017

Below 2 GHz-Rev.2/System Performance Check/Dipole Area Scan 2 (41x221x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 40.26 V/m; Power Drift = -0.03 dB
Fast SAR: SAR(1 g) = 1.2 W/kg; SAR(10 g) = 0.833 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 1.38 W/kg

Below 2 GHz-Rev.2/System Performance Check/0-Degree Cube (5x5x7)/Cube 0:
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 40.26 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.87 W/kg
SAR(1 g) = 1.17 W/kg; SAR(10 g) = 0.769 W/kg (SAR corrected for target medium)

Below 2 GHz-Rev.2/System Performance Check/Z-Axis Retraction (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=10mm
Maximum value of SAR (measured) = 1.39 W/kg





Motorola Solutions, Inc. EME Laboratory
Date/Time: 5/17/2018 3:02:10 PM

Robot#: DASY5-PG-4 | Run#: AM(ZZ)-SYSP-450H-180517-12
Dipole Model# D450V3
Phantom#: ELI4 1109
Tissue Temp: 20.1 (C)
Serial#: 1054
Test Freq: 450.0000 (MHz)
Start Power: 250.00 (mW)
Rotation (1D): 0.049 dB
Adjusted SAR (1W): 4.72 mW/g (1g)

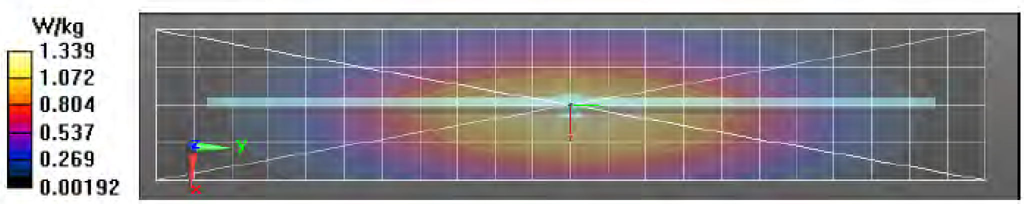
Comments:

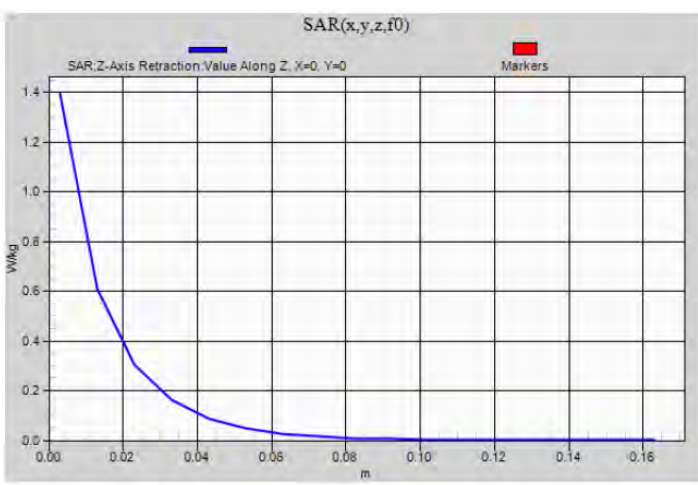
Duty Cycle: 1:1, Medium parameters used: f = 450 MHz; σ = 0.87 S/m; ε_r = 42; ρ = 1000 kg/m^3
Probe: ES3DV3 - SN3122, , Frequency: 450 MHz, ConvF(6.8, 6.8, 6.8); Calibrated: 4/18/2018
Electronics: DAE4 Sn850, Calibrated: 3/7/2018

Below 2 GHz-Rev.2/System Performance Check/Dipole Area Scan 2 (41x221x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 40.37 V/m; Power Drift = -0.01 dB
Fast SAR: SAR(1 g) = 1.2 W/kg; SAR(10 g) = 0.844 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 1.38 W/kg

Below 2 GHz-Rev.2/System Performance Check/0-Degree Cube (5x5x7)/Cube 0:
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 40.37 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.91 W/kg
SAR(1 g) = 1.18 W/kg; SAR(10 g) = 0.777 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 1.40 W/kg

Below 2 GHz-Rev.2/System Performance Check/Z-Axis Retraction (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=10mm





Motorola Solutions, Inc. EME Laboratory
Date/Time: 5/18/2018 3:02:10 AM

Robot#: DASY5-PG-4 | Run#: LOH-SYSP-450B-180518-03
Dipole Model# D450V3
Phantom#: ELI4 1040
Tissue Temp: 21.7 (C)
Serial#: 1054
Test Freq: 450.0000 (MHz)
Start Power: 250.00 (mW)
Rotation (1D): 0.12dB
Adjusted SAR (1W): 4.84mW/g (1g)

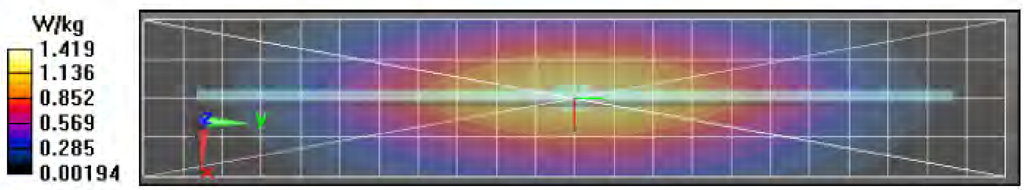
Comments:

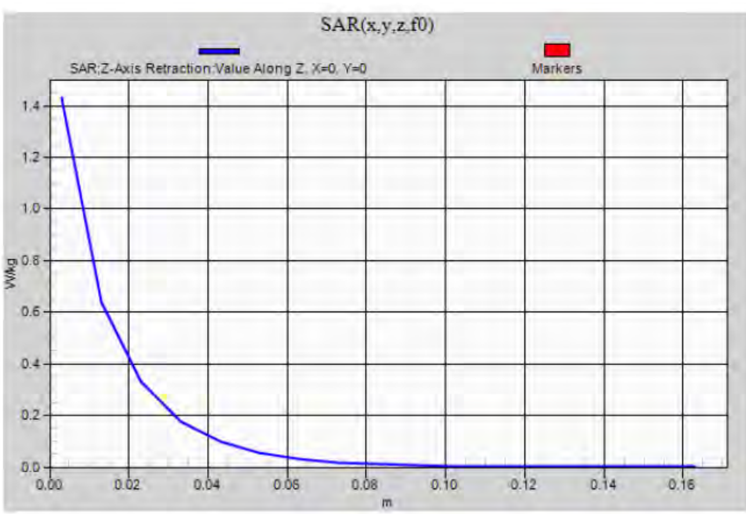
Duty Cycle: 1:1, Medium parameters used: f = 450 MHz; σ = 0.94 S/m; ε_r = 55; ρ = 1000 kg/m^3
Probe: ES3DV3 - SN3122, , Frequency: 450 MHz, ConvF(6.95, 6.95, 6.95); Calibrated: 4/18/2018
Electronics: DAE4 Sn850, Calibrated: 3/7/2018

Below 2 GHz-Rev.2/System Performance Check/Dipole Area Scan 2 (41x221x1):
Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 39.04 V/m; Power Drift = 0.01 dB
Fast SAR: SAR(1 g) = 1.24 W/kg; SAR(10 g) = 0.862 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 1.42 W/kg

Below 2 GHz-Rev.2/System Performance Check/0-Degree Cube (5x5x7)/Cube 0:
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 39.04 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.97 W/kg
SAR(1 g) = 1.21 W/kg; SAR(10 g) = 0.803 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 1.43 W/kg

Below 2 GHz-Rev.2/System Performance Check/Z-Axis Retraction (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=10mm





APPENDIX E
DUT Scans - (Shortened Scan and Highest SAR configurations)

Shortened Scan of Highest SAR configuration

Motorola Solutions, Inc. EME Laboratory
Date/Time: 4/20/2018 11:14:04 PM

Robot#: DASY5-PG-4 | Run#: LOH-AB-180420-10
Model#: AAH01QDC9JA2AN (PMUE4147B)
Phantom#: ELI4 1040
Tissue Temp: 19.6 (C)
Serial#: 752TUFQ452
Antenna: PMAE4003A
Test Freq: 430.000 (MHz)
Battery: PMNN4098A
Carry Acc: HLN6602A
Audio Acc: PMLN6854A
Start Power: 4.33 (W)

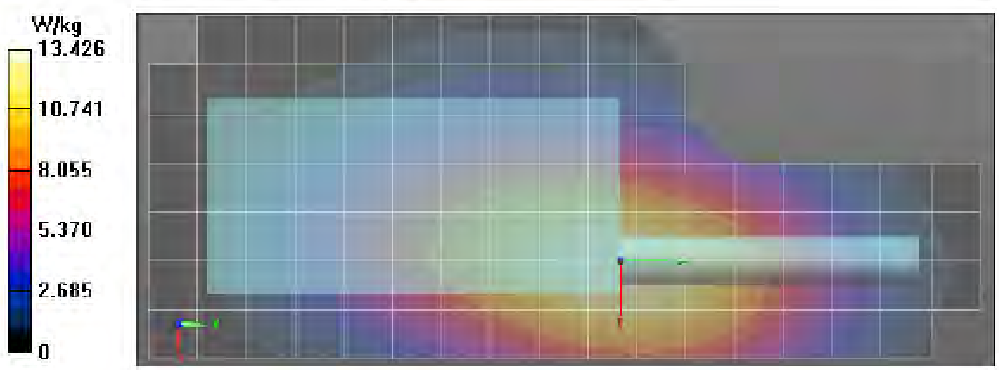
Comments:
Duty Cycle: 1:1, Medium parameters used: f = 430 MHz; σ = 0.96 S/m; ε_r = 54.5; ρ = 1000 kg/m^3
Probe: ES3DV3 - SN3196, , Frequency: 430 MHz, ConvF(7, 7, 7); Calibrated: 5/17/2017
Electronics: DAE4 Sn684, Calibrated: 5/12/2017

Below 2 GHz-Rev.2/Ab Scan/1-Area Scan (81x201x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 125.0 V/m; Power Drift = -0.71 dB
Fast SAR: SAR(1 g) = 12.1 W/kg; SAR(10 g) = 8.82 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 13.6 W/kg

Below 2 GHz-Rev.2/Ab Scan/2-Volume 2D Scan (41x41x1): Interpolated grid: dx=0.7500 mm, dy=0.7500 mm, dz=1.000 mm
Reference Value = 125.0 V/m; Power Drift = -0.76 dB
Fast SAR: SAR(1 g) = 11.4 W/kg; SAR(10 g) = 8.38 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 12.6 W/kg

Below 2 GHz-Rev.2/Ab Scan/4-Z-Axis Scan (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=10mm
Maximum value of SAR (measured) = 12.5 W/kg

Below 2 GHz-Rev.2/Ab Scan/3-Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 127.4 V/m; Power Drift = -0.50 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 12.6 W/kg; SAR(10 g) = 9.12 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 14.2 W/kg



Shortened scan reflects highest SAR producing configuration and is compared to the full scan.

Scan Description	Referenced Table	Test Time (min.)	SAR 1g (W/kg)
Shorten scan (zoom)	19	10	7.84
Full scan (area & zoom)	18	30	7.79

Highest Body SAR Configuration Result

Motorola Solutions, Inc. EME Laboratory
Date/Time: 4/18/2018 10:50:40 PM

Robot#: DASY5-PG-4 | Run#: LOH-AB-180418-11
Model#: AAH01QDC9JA2AN(PMUE4147B)
Phantom#: ELI4 1040
Tissue Temp: 20.8 (C)
Serial#: 752TUFQ452
Antenna: PMAE4003A
Test Freq: 430.000 (MHz)
Battery: PMNN4098A
Carry Acc: HLN6602A
Audio Acc: PMLN6854A
Start Power: 4.36 (W)

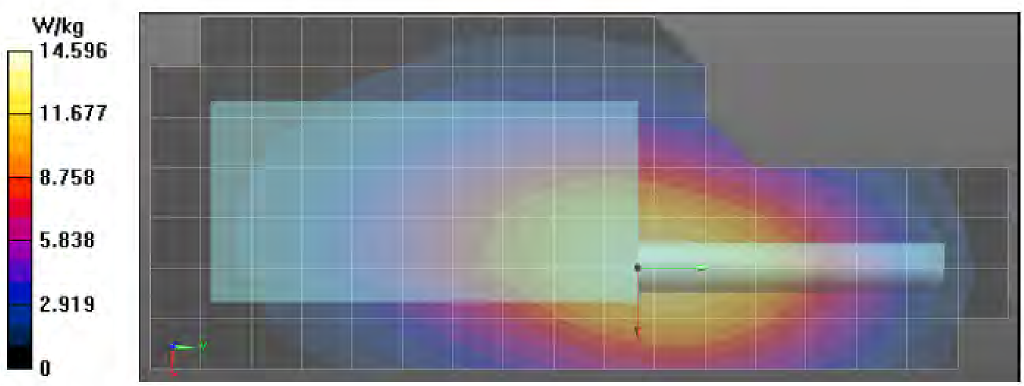
Comments:

Duty Cycle: 1:1, Medium parameters used: f = 430 MHz; σ = 0.97 S/m; ε_r = 54.6; ρ = 1000 kg/m^3
Probe: ES3DV3 - SN3196, , Frequency: 430 MHz, ConvF(7, 7, 7); Calibrated: 5/17/2017
Electronics: DAE4 Sn684, Calibrated: 5/12/2017

Below 2 GHz-Rev.2/Ab Scan/1-Area Scan (81x201x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 128.8 V/m; Power Drift = -0.60 dB
Fast SAR: SAR(1 g) = 13 W/kg; SAR(10 g) = 9.37 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 14.6 W/kg

Below 2 GHz-Rev.2/Ab Scan/3-Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 128.8 V/m; Power Drift = -0.61 dB
Peak SAR (extrapolated) = 18.0 W/kg
SAR(1 g) = 12.3 W/kg; SAR(10 g) = 8.82 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 14.0 W/kg

Below 2 GHz-Rev.2/Ab Scan/4-Z-Axis Scan (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=10mm



Highest Face SAR Configuration Result

Motorola Solutions, Inc. EME Laboratory
Date/Time: 3/28/2018 5:26:50 AM

Robot#: DASY5-PG-4 | Run#: ZR(ZZ)-FACE-180328-06
Model#: AAH01QDC9JA2AN (PMUE4147B)
Phantom#: ELI4 1050
Tissue Temp: 20.9 (C)
Serial#: 752TUFQ452
Antenna: PMAE4002A
Test Freq: 430.0000 (MHz)
Battery: NNTN4970A
Carry Acc: @ front
Audio Acc: N/A
Start Power: 4.20 (W)

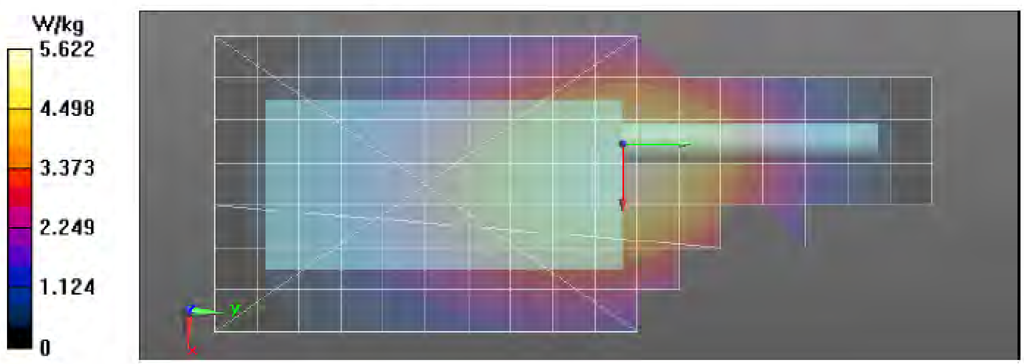
Comments:

Duty Cycle: 1:1, Medium parameters used: f = 430 MHz; $\sigma = 0.89$ S/m; $\varepsilon_r = 42.6$; $\rho = 1000$ kg/m^3
Probe: ES3DV3 - SN3196, , Frequency: 430 MHz, ConvF(7.11, 7.11, 7.11); Calibrated: 5/17/2017
Electronics: DAE4 Sn684, Calibrated: 5/12/2017

Below 2 GHz-Rev.2/Face Scan/1-Area Scan (71x181x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Reference Value = 78.89 V/m; Power Drift = -0.03 dB
Fast SAR: SAR(1 g) = 5.11 W/kg; SAR(10 g) = 3.74 W/kg (SAR corrected for target medium)
Maximum value of SAR (interpolated) = 5.71 W/kg

Below 2 GHz-Rev.2/Face Scan/3-Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 78.89 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 7.09 W/kg
SAR(1 g) = 5.03 W/kg; SAR(10 g) = 3.68 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 5.66 W/kg

Below 2 GHz-Rev.2/Face Scan/4-Z-Axis Scan (1x1x17): Measurement grid: dx=20mm, dy=20mm, dz=10mm
Maximum value of SAR (measured) = 5.65 W/kg



APPENDIX F
DUT Test Position Photos

1.0 Highest SAR Test Position per body location

1.1 Body

DUT with antenna PMAE4003A with offered battery PMNN4098A and chest pack HLN6602A against the phantom with an audio accessory PMLN6854A attached.

Antenna kit #	Separation Distances (mm)		
	@ bottom surface of the DUT	@ antenna's base	@ antenna's tip
PMAE4003A	10	23	21

1.2 Face

Front of DUT with antenna PMAE4002A and battery NNTN4970A separated 2.5cm from the phantom without an audio accessory attached.

Antenna kit #	Separation Distances (mm)		
	@ bottom surface of the DUT	@ antenna's base	@ antenna's tip
PMAE4002A	30	33	38