MOTOROLA SOLUTIONS

STANDARDS MALAYSIA
MS ISO/IEC 17025
TESTING
SAMM No.0826

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

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Date of Report: 12/14/2017
Report Revision: B

Responsible Engineer:	Chang Chi Chern (EME Engineer)
Report Author:	Chang Chi Chern (EME Engineer)
Date/s Tested:	8/22/2017 – 12/14/2017
Manufacturer:	Motorola Solutions Inc.
DUT Description:	Video RSM Si500 (Fusion), display, BT, 5GHz WiFi
Test TX mode(s):	WLAN 802.11b/g/n (2.4 GHz), WLAN 802.11 ac/n (5 GHz), Bluetooth, Bluetooth LE
Max. Power output:	Refer to Part 1. Table 3
Nominal Power:	Refer to Part 1, Table 3
Tx Frequency Bands:	WLAN 2.4 GHz 802.11 b/g/n, WLAN 5 GHz 802.11 ac/n, Bluetooth, Bluetooth LE
Signaling type:	DSSS, OFDM & FHSS (Bluetooth)
Model(s) Tested:	N7001A
Model(s) Certified:	N7001A
Serial Number(s):	372P2B0020, 372P2B0043, 372TTX0098
Classification:	Occupational / Controlled (comply with General Population / Uncontrolled limit)
FCC ID:	AZ489FT7105; WLAN 2.4 GHz 802.11 b/g/n, WLAN 5 GHz 802.11 ac/n, Bluetooth, Bluetooth LE. This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
IC:	109U-89FT7105; This report contains results that are immaterial for IC equipment approval, which are clearly identified.
FCC Test Firm Registration Number:	823256
ISED Test Site registration:	109AK

The test results clearly demonstrate compliance with FCC General Population/Uncontrolled RF Exposure limits of 1.6 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.

Deanna M Zakharia

Deanna Zakharia
EME Lab Senior Resource Manager,
Laboratory Director
Approval Date: 12/14/2017

Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
10/27/2017	A	Initial release
12/14/2017	B	Update SAR result for 2.4 GHz and 5 GHz

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for model number N7001A. This device is classified as Occupational/Controlled but comply with General Population/Uncontrolled SAR limit.

2.0 FCC SAR Summary

Table 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/kg)
		1g-SAR
DTS	2.4GHz WLAN (WLAN 802.11b/g/n)	0.234
NII	5GHz WLAN (WLAN 802.11 ac/n)	0.145
*DSS	Bluetooth	NA

*Results not required per KDB (refer to sections 13.2)

3.0 Abbreviations / Definitions

BT: Bluetooth
CNR: Calibration Not Required
CW: Continuous Wave
DSS: Direct Spread Spectrum
DSSS: Direct Sequence Spread Spectrum
DTS: Digital Transmission System
DUT: Device Under Test
EME: Electromagnetic Energy
FHSS: Frequency Hopping Spread Spectrum
RF: Radio Frequency
NA: Not Applicable
NII: National Information Infrastructure
OFDM: Orthogonal Frequency Division Multiplexing
SAR: Specific Absorption Rate
U-NII: Unlicensed National Information Infrastructure
WLAN: Wireless Local Area Network

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

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

4.0 Referenced Standards and Guidelines

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

- IEC62209-1 (2005) Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
- Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C.: 1997.
- IEEE 1528 (2013), Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronics Engineers (IEEE) C95.1-2005
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6 (2015), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- RSS-102 (Issue 5) – Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
- Australian Communications Authority Radio communications (Electromagnetic Radiation - Human Exposure) Standard (2014)
- ANATEL, Brazil Regulatory Authority, Resolution No. 303 of July 2, 2002 "Regulation of the limitation of exposure to electrical, magnetic, and electromagnetic fields in the radio frequency range between 9 kHz and 300 GHz." and “Attachment to resolution # 303 from July 2, 2002”
- IEC62209-2 Edition 1.0 2010-03, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz).
- FCC KDB – 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 – 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB – 648474 D04 Handset SAR v01r03

5.0 SAR Limits

Table 2

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

6.0 Description of Device Under Test (DUT)

This device operates in the WLAN technology for data capabilities over 802.11 b/g/n (2.4GHz), 802.11ac/n (5GHz) wireless network and Bluetooth technology for short range wireless device.

This device also incorporates a Bluetooth v4.0, which include classis Bluetooth, and Bluetooth low energy. It is Class 1 Bluetooth device with Frequency Hopping Spread Spectrum (FHSS) technology. The Bluetooth radio modem is used to wireless link audio accessories. The maximum actual transmission duty cycle is imposed by the Bluetooth standard. The maximum duty cycle for BT is derived from 5-slots packet type operation which consists of receiving on 1-slot and transmitting on 5-slots, and thus maximum duty cycle=78%

WLAN 2.4GHz 802.11 b/g/n operate using Direct Sequence Spread Spectrum (DSSS) and Orthogonal Frequency-Division Multiplexing (OFDM) with channel bandwidth of 20 MHz WLAN 5GHz 802.11 ac/n operate using Orthogonal Frequency-Division Multiplexing (OFDM) with channel bandwidth of 20MHz, 40MHz, 80MHz.

Table 3 below summarizes the technologies, bands, maximum duty cycles 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 (%)	Nominal Power (mW)	Max Power (mW)
2.4 GHz WLAN-802.11b	2412-2462	DSSS	99.97%	63	79.4
2.4 GHz WLAN-802.11g	2412-2462	OFDM	99.82%	47.9	60.3
2.4 GHz WLAN-802.11n (20 MHz)	2412-2462	OFDM	99.80%	38.0	47.9
2.4 GHz WLAN-802.11n (40 MHz)	2412-2462	OFDM	99.60%	38.9	49.0
5 GHz WLAN-802.11n (20 MHz)	5150-5850	OFDM	99.80%	32.4	40.7
5 GHz WLAN-802.11n (40 MHz)	5150-5850	OFDM	99.60%	35.5	44.7
5 GHz WLAN-802.11ac (20 MHz)	5150-5850	OFDM	98.99%	34.7	43.7
5 GHz WLAN-802.11ac (40 MHz)	5150-5850	OFDM	98.00%	37.2	46.8
5 GHz WLAN-802.11ac (80 MHz)	5150-5850	OFDM	96.15%	35.5	44.7
Bluetooth	2402-2480	FHSS	78%	10.0	11.2
Bluetooth LE	2402-2480	DSSS	50%	10.0	11.2

The intended operating position is “at the body” with the DUT facing front and back against the phantom. The positions “at the body” by mean of the offered body worn accessories.

7.0 Optional Accessories and Test Criteria

The following sections describe the antennas, batteries, and body-worn accessories. Refer to Exhibit 7B for DUT photos of the configurations, antenna locations and accessories.

7.1 Antennas

This device had internal BT/WLAN antenna. The Table below lists it description.

Table 4

Antenna No.	Antenna Models	Description	Selected for test	Tested
1	AN000183A05	Internal WLAN antenna, 2400-2484MHz, 5150-5850 MHz, λ/2 wave, Low -2.56 dBd, Mid -0.59 dBd, High 0.7 dBd Internal BT antenna, 2400-2484 MHz, λ/4 wave, Low -2.57 dBd, Mid -2.41 dBd, High -2.02 dBd	Yes	Yes
2	AN000183A06	Internal GPS antenna, 1560-1610 MHz, λ/4 wave, Low 0.98 dBd, Mid 0.79 dBd, High -0.08 dBd	No	No

7.2 Batteries

There are four batteries offered for this product. The Table below lists their descriptions.

Table 5

Battery No.	Battery Models	Description	Selected for test	Tested	Comments
1	PMNN4507A	Slim (non-IMPRES) battery 1950 mAh	Yes	Yes	Default battery
2	PMNN4508A	High Capacity (non-IMPRES) battery 2925 mAh	Yes	Yes	
3	PMNN4530A	Ultra High Capacity IMPRES battery 3750 mAh	Yes	Yes	
4	PMNN4549A	High Capacity IMPRES Battery 2925 mAh	Yes	Yes	

7.3 Body worn Accessories

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

Table 6

Body worn No.	Body worn Models	Description	Selected for test	Tested	Comments
1	PMLN7698A	Carry Holder with swivel clip (supports Ultra High Cap battery)	Yes	Yes	
2	PMLN7415A	Shoulder Epaulette Strap, Left	Yes	Yes	Tested with PMLN7698A
3	PMLN7416A	Shoulder Epaulette Strap, Right	No	No	By similarity to PMLN7415A
4	PMLN7699A	Carry Holster with Metal Pocket Clip (supports Ultra High Cap Battery)	Yes	Yes	
5	PMLN7700A	Carry Holster with Peter Jones Mounting Stud (supports Ultra High Cap Battery)	Yes	Yes	
6	GMDN0386A	Peter Jones (ILG) Klick Fast sew on dock	Yes	Yes	Tested with PMLN7700A
7	WALN4307A	Peter Jones (ILG) Klick Fast retro fitting garment dock	Yes	Yes	Tested with PMLN7700A

7.4 Audio Accessory

There is one audio offered for this product. The Table below lists it descriptions.

Table 7

Audio No.	Audio Acc. Models	Description	Selected for test	Tested	Comments
1	PMLN7412B	3.5 mm Earpiece, long cord	No	No	Receive only

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	EX3DV4 (E-Field)

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

8.2 Description of Phantom(s)

Table 9

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

8.3 Description of Simulated Tissue

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

The simulated tissue mixture was mixed based on the Simulated Tissue Composition indicated in Table 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	2450 MHz	*5 GHz
	Body	Body
Sugar	NA	NA
Diacetin	34.5	NA
De ionized – Water	65.20	NA
Salt	0.20	NA
HEC	NA	NA
Bact.	0.1	NA

Note: * SPEAG provides Motorola proprietary stimulant ingredients for the 5 GHz band

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	EX3DV4	3735	3/10/2017	3/10/2018
*Speag DAE	DAE4	729	10/12/2016	10/12/2017
†Speag DAE	DAE4	1488	2/14/2017	2/14/2018
*Power Meter	E4418B	MY45100532	11/4/2015	11/4/2017
†Power Meter	E4418B	MY45107917	5/22/2017	5/22/2018
Power Meter	E4418B	MY45100911	7/14/2017	7/14/2019
Power Sensor (With 30dB Pad)	E9301B	MY41495594	7/20/2017	7/20/2018
Power Sensor (With 30dB Pad)	8481B	SG41090258	6/27/2017	6/27/2018
R&S Power Sensor	NRP-Z11	121252	2/6/2017	2/6/2019
Signal Generator (Vector ESG 250 KHz – 6 GHz)	E4438C	MY45091270	7/26/2016	7/26/2018
*Bi-directional Coupler	3022	81639	10/19/2016	10/19/2017
†Bi-directional Coupler	3022	81640	9/15/2017	9/15/2018
*Bi-directional Coupler	3024	61150	11/2/2016	11/2/2017
†Bi-directional Coupler	3024	61182	10/6/2017	10/6/2018
Amplifier	5S1G4	313326	NCR	NCR
Amplifier	5S4G11	312664	NCR	NCR
*Thermometer	HH202A	35881	12/2/2016	12/2/2017
†Thermometer	HH202A	18812	10/13/2017	10/13/2018
*Temperature Probe	JHSS-18U-RSC-6	AGIL700129	12/2/2016	12/2/2017
†Temperature Probe	JHSS-18U-RSC-6	AGIL700245	10/13/2017	10/13/2018
*Dickson Temperature Recorder	TM320	12253047	10/20/2016	10/20/2017
†Dickson Temperature Recorder	TM320	06153216	8/11/2017	8/11/2018
*Dielectric Assessment Kit	DAK-3.5	1156	10/11/2016	10/11/2017
†Dielectric Assessment Kit	DAK-3.5	1120	3/16/2017	3/16/2018
*Network Analyzer	E5071B	MY42403147	11/15/2016	11/15/2017
†Network Analyzer	E5071B	MY42403218	11/24/2017	11/24/2018
SPEAG dipole	D2450V2	782	2/15/2017	2/15/2019
SPEAG dipole	D5GHZV2	1026	11/4/2016	11/4/2018

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								
4/23/2017	Body	2450	3735	2.03	53.1	Pass	Pass	Pass
3/28/2017	Body	5250	3735	5.39	45.1	Pass	Pass	Pass
3/28/2017	Body	5500	3735	5.69	44.6	Pass	Pass	Pass
3/28/2017	Body	5750	3735	6.02	44.2	Pass	Pass	Pass
802.11								
NA	Body	*2450	3735	NA	NA	NA	NA	NA
4/22/2017	Body	5250	3735	5.51	47.5	Pass	Pass	Pass
4/22/2017	Body	5500	3735	5.85	47.0	Pass	Pass	Pass
4/22/2017	Body	5750	3735	6.24	46.5	Pass	Pass	Pass

Note: * WLAN 2450MHz 802.11b system validation not required as the Peak to Average Ratio is < 5dB.

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
3735	FCC Body	SPEAG D2450V2 / 782	50.50 +/- 10%	12.4	49.60	8/22/2017
				12.4	49.60	8/23/2017
				12.3	49.20	10/9/2017
				12.6	50.40	11/29/2017
				12.7	50.80	12/14/2017
		SPEAG D5GHZV2 / 1026	5250 77.80 +/- 10%	7.50	75.00	8/29/2017
				7.43	74.30	8/30/2017
				7.66	76.60	8/31/2017
				7.73	77.30	9/7/2017
				8.51	85.10	11/29/2017
			5500 78.50 +/- 10%	8.25	82.50	9/1/2017
				7.60	76.00	9/4/2017
				8.17	81.70	9/6/2017*
				7.96	79.60	11/30/2017
			5750	7.69	76.90	9/4/2017

			75.10 +/- 10%	7.71	77.10	9/5/2017*
				7.95	79.50	12/5/2017

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

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
2402	FCC Body	1.90 (1.81-2.00)	52.8 (47.5-58.0)	1.91	51.2	11/29/2017
2412	FCC Body	1.91 (1.82-2.01)	52.8 (47.5-58.0)	1.82	47.9	8/22/2017
				1.91	48.7	8/23/2017
				1.92	51.2	11/29/2017
				1.94	50.0	12/14/2017
2437	FCC Body	1.94 (1.84-2.03)	52.7 (47.4-58.0)	2.02	47.9	10/9/2017
2462	FCC Body	1.97 (1.87-2.07)	52.7 (47.4-58.0)	2.05	47.8	10/9/2017
2450	FCC Body	1.95 (1.85-2.05)	52.7 (47.4-58.0)	1.87	47.7	8/22/2017
				1.96	48.6	8/23/2017
				2.00	48.3	8/28/2017
				2.03	47.8	10/9/2017
				1.97	51.0	11/29/2017
				1.98	49.9	12/14/2017
5250	FCC Body	5.36 (4.82-5.89)	48.9 (44.1-53.8)	5.58	45.1	8/29/2017
				5.60	44.9	8/30/2017
				5.43	44.7	8/31/2017
				5.45	44.3	9/6/2017*
				5.49	47.5	11/29/2017
5310	FCC Body	5.43 (4.88-5.97)	48.9 (44.0-53.8)	5.66	45.0	8/29/2017
				5.70	44.8	8/30/2017
				5.50	44.6	8/31/2017
				5.53	44.3	9/6/2017*
				5.57	47.4	11/29/2017
5500	FCC Body	5.65 (5.08-6.21)	48.6 (43.7-53.5)	5.74	44.2	9/1/2017
				5.82	43.9	9/4/2017
				5.77	43.9	9/6/2017*
				5.82	47.0	11/29/2017*
5550	FCC Body	5.71 (5.14-6.28)	48.5 (43.7-53.4)	5.81	44.1	9/1/2017
				5.88	43.8	9/4/2017
				5.82	43.8	9/6/2017*
				5.89	46.9	11/29/2017*

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

Table 14 (Con't)

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
5710	FCC Body	5.89 (5.31-6.48)	48.3 (43.5-53.2)	6.12	43.5	9/4/2017
				6.10	43.7	9/5/2017
				6.02	46.0	12/5/2017
5750	FCC Body	5.94 (5.35-6.54)	48.3 (43.4-53.1)	6.06	43.5	9/4/2017
				6.05	43.8	9/5/2017
				6.07	46.0	12/5/2017

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

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 15

	Target	Measured
Ambient Temperature	18 – 25 ˚C	Range: 18.0 – 22.9˚C Avg. 21.0 ˚C
Tissue Temperature	NA	Range: 19.7-21.1˚C Avg. 20.4˚C

Relative humidity target range is a recommended target

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

12.0 DUT Test Setup and Methodology

12.1 Measurements

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

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

Table 16

<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 device operational at the body as described in section 6.0 while using the applicable accessories listed in section 7.0. All accessories listed in section 7.0 of this report were considered when implementing the standards and guidelines specified in section 4.0.

12.3 DUT Positioning Procedures

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

12.3.1 Body

The DUT was positioned in normal use configuration with its front and back against the phantom with the offered body worn accessories.

12.3.2 Head

Not applicable.

12.3.3 Face

Not applicable.

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.

Standalone BT testing was assessed in sections 13.5 per the guidelines of KDB 447498.

WLAN 2.4GHz tests were performed in 802.11b mode using a duty cycle of 99.97%. WLAN 5GHz tests were performed in 802.11 ac mode using a duty cycle of 98.00% with results scaled to 100% as per guidelines of KDB 248227.

13.0 DUT Test Data

13.1 WLAN assessment at the Body 2.4GHz (802.11 b/g/n)

The tables below represent the output power measurements for WLAN 2.4 GHz 802.11b/g/n for assessments at the Body using battery PMNN4507A because it is the standard battery (refer to Exhibit 7B for battery illustration). These power measurements were used to determine the necessary modes for SAR testing according to KDB 248227 D01 SAR Measurement Procedures for WLAN 2.4 GHz 802.11a/b/g/ Transmitters.

The battery was used during conducted power measurements for all test channels within FCC allocated frequency range which are listed in Table 17.

SAR is not required for 802.11 g/n when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2W/kg.

Table 17

Mode	Channel	Channel Frequency	Modulation	Battery: PMNN4507A Measured Power [mW]	Specified Max Power [mW]	SAR Test (Yes/No)
802.11b	1	2412	DSSS	**77.6**	79.4	Yes
	6	2437		74.3		
	11	2462		74.1		
802.11g	1	2412	OFDM	60.3	60.3	No
	6	2437		57.0		
	11	2462		57.9		
802.11n (20 MHz)	1	2412	OFDM	42.7	47.9	No
	6	2437		45.5		
	11	2462		44.6		
802.11n (40 MHz)	6	2437	OFDM	44.7	49.0	No

Assessments at the Body with all offered Body worn

DUT assessment with WLAN internal antenna, all offered batteries without any cable accessory attachment against phantom with all offered body worn. Refer to Table 17 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 18

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
AN000183A05	PMNN4507A	PMLN7699A @ front of DUT	NONE	2412	0.078	-0.35	0.055	0.061	FD(FAZ)-AB-170822-03#
		PMLN7699A @ back of DUT		2412	0.078	0.09	0.029	0.030	ZR(AM)-AB-170822-10#
		PMLN7700A w/ GMDN0386A @ front of DUT		2412	0.078	0.43	0.043	0.044	ZR(AM)-AB-170822-11#
		PMLN7700A w/ GMDN0386A @ back of DUT		2412	0.078	0.42	0.013	0.013	ZR(AM)-AB-170822-12#
		PMLN7700A w/ WALN4307A@ front of DUT		2412	0.078	-0.44	0.050	0.057	ZR(AM)-AB-170822-13#
		PMLN7700A w/ WALN4307A@ back of DUT		2412	0.078	0.54	0.014	0.014	ZR(AM)-AB-170822-14#
		PMLN7698A @ front of DUT		2412	0.078	0.09	0.102	0.104	ZR(AM)-AB-170822-15#
		PMLN7698A @ back of DUT		2412	0.078	0.08	0.016	0.016	FIE(FAZ)-AB-170822-16#
		PMLN7698A w/ PMLN7415A @ front of DUT		2412	0.078	0.29	0.053	0.054	FIE(FAZ)-AB-170822-17#
		PMLN7698A w/ PMLN7415A @ back of DUT		2412	0.078	-0.17	0.014	0.015	FIE(FAZ)-AB-170823-02
Assessment of Additional Batteries									
AN000183A05	PMNN4508A	PMLN7698A @ front of DUT	NONE	2412	0.079	0.22	0.103	0.104	ZR(AM)-AB-170823-03
	PMNN4530A			2412	0.078	0.69	0.110	0.112	ZR(AM)-AB-170823-06
	PMNN4549A			2412	0.058	0.22	0.170	**0.234**	AZ-AB-171129-10

Notes:
DUT @ Front - Microphone of DUT face in to the carry accessory.
DUT @ Back - Microphone of DUT face out to the carry accessory.

13.2 WLAN assessment at the Body 5GHz (802.11 ac/n)

The tables below represent the output power measurements for WLAN 5 GHz 802.11 ac/n for assessments at the Body using battery PMNN4507A because it is the standard battery (refer to Exhibit 7B for battery illustration). These power measurements were used to determine the necessary modes for SAR testing according to KDB 248227 D01 SAR Measurement Procedures for 802.11 ac/n Transmitters.

The battery was used during conducted power measurements for all test channels within FCC allocated frequency range (5.15-5.85 GHz) which are listed in Table 19.

SAR is not required for 802.11 n when the highest adjusted SAR is ≤ 1.2W/kg.

Table 19

Band	Mode	Channel Bandwidth	Channel	Channel Frequency	Modulation	Battery: PMNN4507A Measured Power [mW]	Specified Max Power [mW]	SAR Test (Yes/No)
U-NII-2A (5.25-5.35GHz)	802.11n	20MHz	52	5260	OFDM	Not required (lower power)	40.7	No
			56	5280				
			60	5300				
			64	5320				
		40MHz	54	5270		Not required (lower power)	44.7	No
			62	5310				
	802.11ac	20MHz	52	5260	OFDM	Not required (lower power)	43.7	No
			56	5280				
			60	5300				
			64	5320				
		40MHz	54	5270		30.3	46.8	Yes
			62	**5310**		**30.7**		
		80MHz	58	5290		Not required (lower power)	44.7	No
U-NII-2C (<5.65GHz) *	802.11n	20MHz	100	5500	OFDM	Not required (lower power)	40.7	No
			112	5560				
			116	5580				
			128	5640				
		40MHz	102	5510		Not required (lower power)	44.7	No
			110	5550				
			118	5590				
			126	5630				
	802.11ac	20MHz	100	5500	OFDM	Not required (lower power)	43.7	No
			112	5560				
			116	5580				
			128	5640				
		40MHz	102	5510		33.7	46.8	Yes
			110	**5550**		**34.1**		
			118	5590		32.4		
			126	5630		32.6		
		80MHz	106	5530		Not required (lower power)	44.7	No
			122	5610				

Table 19 (Con't)

Band	Mode	Channel Bandwidth	Channel	Channel Frequency	Modulation	Battery: PMNN4507A Measured Power [mW]	Specified Max Power [mW]	SAR Test (Yes/No)
U-NII-2C (>5.65GHz) + U-NII-3*	802.11n	20MHz	132	5660	OFDM	Not required (lower power	40.7	No
			149	5745				
			165	5825				
		40MHz	134	5670		Not required (lower power	44.7	No
			142	5710				
			151	5755				
			159	5795				
	802.11ac	20MHz	132	5660	OFDM	Not required (lower power	43.7	No
			149	5745				
			165	5825				
		40MHz	134	5670		32.3	46.8	Yes
			142	**5710**		**34.4**		
			151	5755		33.6		
			159	5795		33.5		
		80MHz	138	5690		Not required (lower power	44.7	No
			155	5775				

Note:
1) U-NII-1 specified max power was equal to U-NII-2A and not required for data if the SAR of U-NII-2A ≤ 1.2 W/kg as per KDB 248227.
2) All 5GHz bands are tested at 802.11 ac 40MHz (highest power) and other configurations were not required if the SAR ≤ 1.2 W/kg as per KDB 248227.
3) "* "per KDB 248227, Table 1.

Assessments at the Body U-NII-2A with all offered Body worn

DUT assessment with WLAN internal antenna, all offered batteries without any cable accessory attachment against phantom with all offered body worn. Refer to Table 19 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 20

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#
AN000183A05	PMNN4507A	PMLN7699A @ front of DUT	NONE	5310	0.034	0.00	0.042	**0.059**	FD(AN)-AB-171129-15
		PMLN7699A @ back of DUT		5310	0.031	0.14	0.018	0.028	AM-AB-170829-08
		PMLN7700A w/ GMDN0386A @ front of DUT		5310	0.031	-0.51	0.023	0.040	AM-AB-170829-09
		PMLN7700A w/ GMDN0386A @ back of DUT		5310	0.031	0.00	0.000	0.000	ZR-AB-170830-09
		PMLN7700A w/ WALN4307A@ front of DUT		5310	0.031	-0.40	0.027	0.046	AM-AB-170830-05#
		PMLN7700A w/ WALN4307A@ back of DUT		5310	0.031	0.00	0.000	0.000	ZR-AB-170907-09#
		PMLN7698A @ front of DUT		5310	0.031	0.43	0.012	0.019	AM-AB-170831-02#
		PMLN7698A @ back of DUT		5310	0.031	0.00	0.001	0.002	ZR-AB-170830-14
		PMLN7698A w/ PMLN7415A @ front of DUT		5310	0.031	0.22	0.014	0.022	AM-AB-170831-04#
		PMLN7698A w/ PMLN7415A @ back of DUT		5310	0.031	-0.84	0.004	0.007	TLC-AB-170831-07
Assessment of Additional Batteries									
AN000183A05	PMNN4508A	PMLN7699A @ front of DUT	NONE	5310	0.032	-0.47	0.021	0.035	TLC-AB-170831-09
	PMNN4530A			5310	0.031	-0.40	0.016	0.027	TLC-AB-170831-10
	PMNN4549A			5310	0.031	-0.51	0.022	0.039	TLC-AB-170831-11

Notes:
DUT @ Front - Microphone of DUT face in to the carry accessory.
DUT @ Back - Microphone of DUT face out to the carry accessory.

Assessments at the Body U-NII-2C with all offered Body worn

DUT assessment with WLAN internal antenna, all offered batteries without any cable accessory attachment against phantom with all offered body worn. Refer to Table 19 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 21

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Run#
AN000183A05	PMNN4507A	PMLN7699A @ front of DUT	NONE	5550	0.034	-0.57	0.012	0.019	AM-AB-170907-02#
		PMLN7699A @ back of DUT		5550	0.034	0.89	0.005	0.007	TLC-AB-170901-04
		PMLN7700A w/ GMDN0386A @ front of DUT		5550	0.034	0.61	0.016	0.022	TLC-AB-170901-05
		PMLN7700A w/ GMDN0386A @ back of DUT		5550	0.034	1.11	0.003	0.004	TLC-AB-170901-06
		PMLN7700A w/ WALN4307A@ front of DUT		5550	0.034	0.19	0.016	0.022	TLC-AB-170901-07
		PMLN7700A w/ WALN4307A@ back of DUT		5550	0.034	0.75	0.002	0.002	TLC-AB-170901-08
		PMLN7698A @ front of DUT		5550	0.034	-0.52	0.007	0.012	TLC-AB-170901-10
		PMLN7698A @ back of DUT		5550	0.034	-0.44	0.007	0.011	TLC-AB-170904-02
		PMLN7698A w/ PMLN7415A @ front of DUT		5550	0.034	-0.36	0.000	0.000	TLC-AB-170904-03
		PMLN7698A w/ PMLN7415A @ back of DUT		5550	0.034	0.43	0.000	0.000	TLC-AB-170904-04
Assessment of Additional Batteries									
AN000183A05	PMNN4508A	PMLN7700A w/ WALN4307A@ front of DUT	NONE	5550	0.033	0.20	0.023	0.033	TLC-AB-170904-05
	PMNN4530A			5550	0.034	0.68	0.022	0.031	FD-AB-170904-06
	PMNN4549A			5550	0.033	0.52	0.078	**0.113**	FD(AN)-AB-171130-02#

Notes:
DUT @ Front - Microphone of DUT face in to the carry accessory.
DUT @ Back - Microphone of DUT face out to the carry accessory.

Assessments at the Body U-NII-3 with all offered Body worn

DUT assessment with WLAN internal antenna, all offered batteries without any cable accessory attachment against phantom with all offered body worn. Refer to Table 19 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 22

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#
AN000183A05	PMNN4507A	PMLN7699A @ front of DUT	NONE	5710	0.034	0.74	0.007	0.010	AM-AB-170905-02#
		PMLN7699A @ back of DUT		5710	0.034	0.00	0.000	0.000	AM-AB-170905-04#
		PMLN7700A w/ GMDN0386A @ front of DUT		5710	0.034	0.07	0.003	0.004	ZR-AB-170905-06#
		PMLN7700A w/ GMDN0386A @ back of DUT		5710	0.034	0.52	0.000	0.000	ZR-AB-170905-09#
		PMLN7700A w/ WALN4307A@ front of DUT		5710	0.034	0.88	0.006	0.008	ZR-AB-170905-10#
		PMLN7700A w/ WALN4307A@ back of DUT		5710	0.034	0.00	0.000	0.000	ZR-AB-170905-12#
		PMLN7698A @ front of DUT		5710	0.034	1.02	0.000	0.000	AM-AB-170905-14
		PMLN7698A @ back of DUT		5710	0.034	-0.78	0.000	0.000	AM-AB-170906-01#
		PMLN7698A w/ PMLN7415A @ front of DUT		5710	0.034	0.73	0.000	0.000	AM-AB-170906-03#
		PMLN7698A w/ PMLN7415A @ back of DUT		5710	0.034	0.27	0.003	0.004	ZR-AB-170906-05#
Assessment of Additional Batteries									
AN000183A05	PMNN4508A	PMLN7699A @ front of DUT	NONE	5710	0.040	0.03	0.008	0.010	AM-AB-170906-11#
	PMNN4530A			5710	0.039	0.08	0.007	0.009	ZR-AB-170906-08#
	PMNN4549A			5710	0.034	0.22	0.103	**0.145**	ZR(AN)-AB-171205-14

Notes:
DUT @ Front - Microphone of DUT face in to the carry accessory.
DUT @ Back - Microphone of DUT face out to the carry accessory.

13.3 Assessment for ISED, Canada

As per ISED Notice 2016-DRS001, additional tests were required for the low, mid and high frequency channels for the configuration with the highest SAR value. The SAR results are in Table 23 below. SAR plots of the highest results per Table (bolded) are presented in Appendix F.

Table 23

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#
AN000183A05	PMNN4549A	PMLN7698A @ front of DUT	NONE	2412	0.058	0.22	0.170	**0.234**	AZ-AB-171129-10
		PMLN7698A @ front of DUT		2437	0.074	-0.19	0.092	0.103	FD-AB-171009-02
		PMLN7698A @ front of DUT		2462	0.077	0.32	0.071	0.073	ZR-AB-171009-04

13.4 Assessment at the Bluetooth band

13.4.1 FCC Requirement

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

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[$\sqrt{F_{(GHz)}}$] = 2.75, which is ≤ 3 for 1-g SAR or 7.5 for 10-g extremity

Where:

Max. power = 8.74 mW (11.2 mW*78% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

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

13.4.2 Industry Canada Requirement

The table below represents the output power measurements for Bluetooth using battery PMNN4507A because it is the standard battery (refer to Exhibit 7B for battery illustration).

Table 24

Channel	Channel Frequency	Battery: PMNN4507A Output Power [mW]	Specified Max Power [mW]
0	2402	8.32	11.22
39	2441	11.21	
78	2480	8.27	

Assessment for Bluetooth as per guideline in RSS-102 Issue 5. SAR measurements for Bluetooth using the same test configuration which resulted in the worst case reported SAR for Wi-Fi on the Bluetooth channel closest to the same tested Wi-Fi channel.

If reported SAR for Bluetooth is <= 0.8 W/kg, no further testing is required for Bluetooth.

Table 25

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#
AN000183A05	PMNN4549A	PMLN7698A @ front of DUT	NONE	2402	0.009	0.55	0.022	**0.028**	AZ-AB-171129-13

13.5 Shortened Scan Assessment

A "shortened" scan using the highest SAR configuration overall from above was performed to validate the SAR drift of the full DASY5™ coarse and zoom scans. Note that the shortened scan represents the zoom scan performance result; this is obtained by first running a coarse scan to find the peak area and then, using a newly charged battery, a zoom scan only was performed. The results of the shortened cube scan presented in Appendix D demonstrate that the scaling methodology used to determine the calculated SAR results presented herein are valid. The SAR result from the Table below is provided in Appendix F.

Table 26

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#
AN000183A05	PMNN4549A	PMLN7698A @ front of DUT	None	2412	0.058	-0.21	0.152	0.219	AZ-AB-171214-20

14.0 Simultaneous Transmissions

WLAN 2.4GHz, 5GHz and BT share the same chipset, transmission path and antenna. The transmissions of these technologies are controlled by switching which only allows one technology to transmit at a single time and therefore do not support simultaneous transmission.

15.0 Results Summary

Based on the test guidelines from section 4.0 and satisfying frequencies within FCC bands , the highest Operational Maximum Calculated 1-gram average SAR values found for this filing:

Table 27

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)
		1g-SAR
FCC / ISED Canada	2.4 GHz (WLAN 802.11 b/g/n)	0.234
	5 GHz (WLAN 802.11 ac/n)	0.145
	*2.4 GHz (Bluetooth)	0.028

* For ISED Canada only. Result not required for FCC per KDB (refer to section 13.2).
All results are scaled to the maximum output power.

The test results clearly demonstrate compliance with FCC General Population/Uncontrolled RF Exposure limits of 1.6 W/kg averaged over 1 gram per the requirements of FCC 47 CFR § 2.1093.

16.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is not required because SAR results are below 0.8 W/kg (General Population / Uncontrolled).

17.0 System Uncertainty

A system uncertainty analysis is not required for this report per KDB 865664 because the highest report SAR value General Population / Uncontrolled exposure is less than 1.5W/kg.

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

Appendix A
Measurement Uncertainty Budget

Uncertainty Budget for System Validation (dipole & flat phantom) for 2450 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 ui (±%)**	**10 g ui (±%)**	v_i
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
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				9	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				18	17	

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

Uncertainty Budget for Device Under Test, for 2450 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	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	419
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				22	22	

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

Uncertainty Budget for System Verification (dipole & flat phantom) for 5.1 to 6 GHz

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	6.6	N	1.00	1	1	6.6	6.6	∞
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	2.0	R	1.73	1	1	1.2	1.2	∞
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	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t. Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
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	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				19	19	

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

Uncertainty Budget for Device Under Test for 5.1 to 6 GHz

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	6.6	N	1.00	1	1	6.6	6.6	∞
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	2.0	R	1.73	1	1	1.2	1.2	∞
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	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
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	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	465
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				23	23	

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

Appendix B
Probe Calibration Certificates

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

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

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

Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **EX3-3735_Mar17**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3735

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: March 10, 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	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
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: March 14, 2017

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

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

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

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

Accreditation No.: **SCS 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).

Probe EX3DV4

SN:3735

Manufactured: February 15, 2010
Calibrated: March 10, 2017

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3735

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.37	0.39	0.46	± 10.1 %
DCP (mV)[B]	105.5	101.6	100.2	

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	141.9	±3.0 %
		Y	0.0	0.0	1.0		141.6	
		Z	0.0	0.0	1.0		149.0	

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: EX3DV4 - SN:3735

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	11.79	11.79	11.79	0.00	1.00	± 13.3 %
300	45.3	0.87	11.08	11.08	11.08	0.08	1.30	± 13.3 %
450	43.5	0.87	10.37	10.37	10.37	0.16	1.30	± 13.3 %
750	41.9	0.89	9.82	9.82	9.82	0.45	0.86	± 12.0 %
835	41.5	0.90	9.44	9.44	9.44	0.50	0.80	± 12.0 %
900	41.5	0.97	9.28	9.28	9.28	0.36	1.00	± 12.0 %
1450	40.5	1.20	8.46	8.46	8.46	0.36	0.80	± 12.0 %
1810	40.0	1.40	7.97	7.97	7.97	0.27	1.01	± 12.0 %
1900	40.0	1.40	7.89	7.89	7.89	0.33	0.85	± 12.0 %
2100	39.8	1.49	7.83	7.83	7.83	0.27	0.80	± 12.0 %
2300	39.5	1.67	7.37	7.37	7.37	0.29	0.88	± 12.0 %
2450	39.2	1.80	7.08	7.08	7.08	0.38	0.86	± 12.0 %
2600	39.0	1.96	6.78	6.78	6.78	0.34	0.89	± 12.0 %
4950	36.3	4.40	5.49	5.49	5.49	0.40	1.80	± 13.1 %
5250	35.9	4.71	4.88	4.88	4.88	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.57	4.57	4.57	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.40	4.40	4.40	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.56	4.56	4.56	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3735

Calibration Parameter Determined in Body Tissue Simulating Media

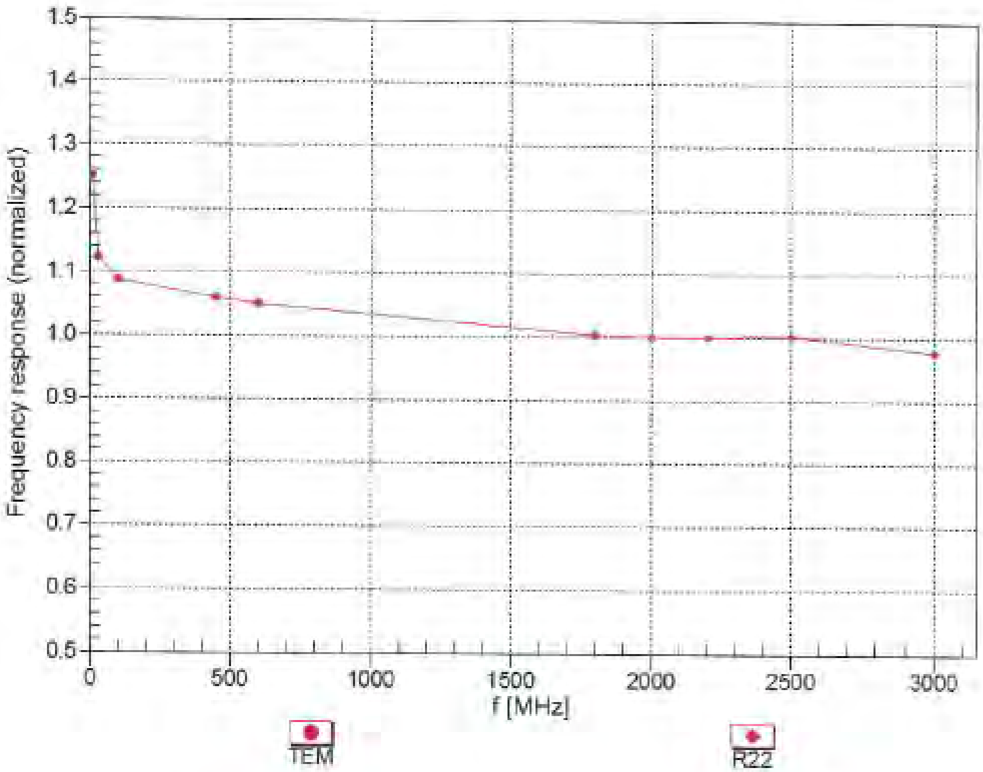
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	11.23	11.23	11.23	0.00	1.00	± 13.3 %
300	58.2	0.92	10.61	10.61	10.61	0.05	1.20	± 13.3 %
450	56.7	0.94	10.56	10.56	10.56	0.07	1.20	± 13.3 %
750	55.5	0.96	9.52	9.52	9.52	0.30	1.00	± 12.0 %
835	55.2	0.97	9.28	9.28	9.28	0.42	0.87	± 12.0 %
900	55.0	1.05	9.19	9.19	9.19	0.44	0.80	± 12.0 %
1450	54.0	1.30	8.07	8.07	8.07	0.34	0.80	± 12.0 %
1810	53.3	1.52	7.88	7.88	7.88	0.36	0.85	± 12.0 %
1900	53.3	1.52	7.76	7.76	7.76	0.30	0.90	± 12.0 %
2100	53.2	1.62	7.73	7.73	7.73	0.40	0.80	± 12.0 %
2300	52.9	1.81	7.32	7.32	7.32	0.42	0.80	± 12.0 %
2450	52.7	1.95	7.24	7.24	7.24	0.41	0.86	± 12.0 %
2600	52.5	2.16	6.90	6.90	6.90	0.36	0.89	± 12.0 %
4950	49.4	5.01	4.51	4.51	4.51	0.40	1.90	± 13.1 %
5250	48.9	5.36	4.35	4.35	4.35	0.40	1.90	± 13.1 %
5500	48.6	5.65	4.00	4.00	4.00	0.40	1.90	± 13.1 %
5600	48.5	5.77	3.75	3.75	3.75	0.50	1.90	± 13.1 %
5750	48.3	5.94	3.83	3.83	3.83	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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

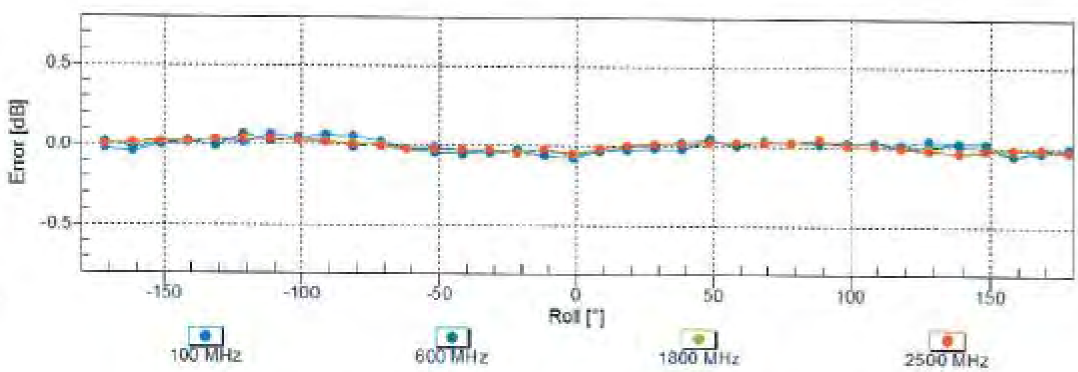


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (φ), ϑ = 0°

f=600 MHz,TEM

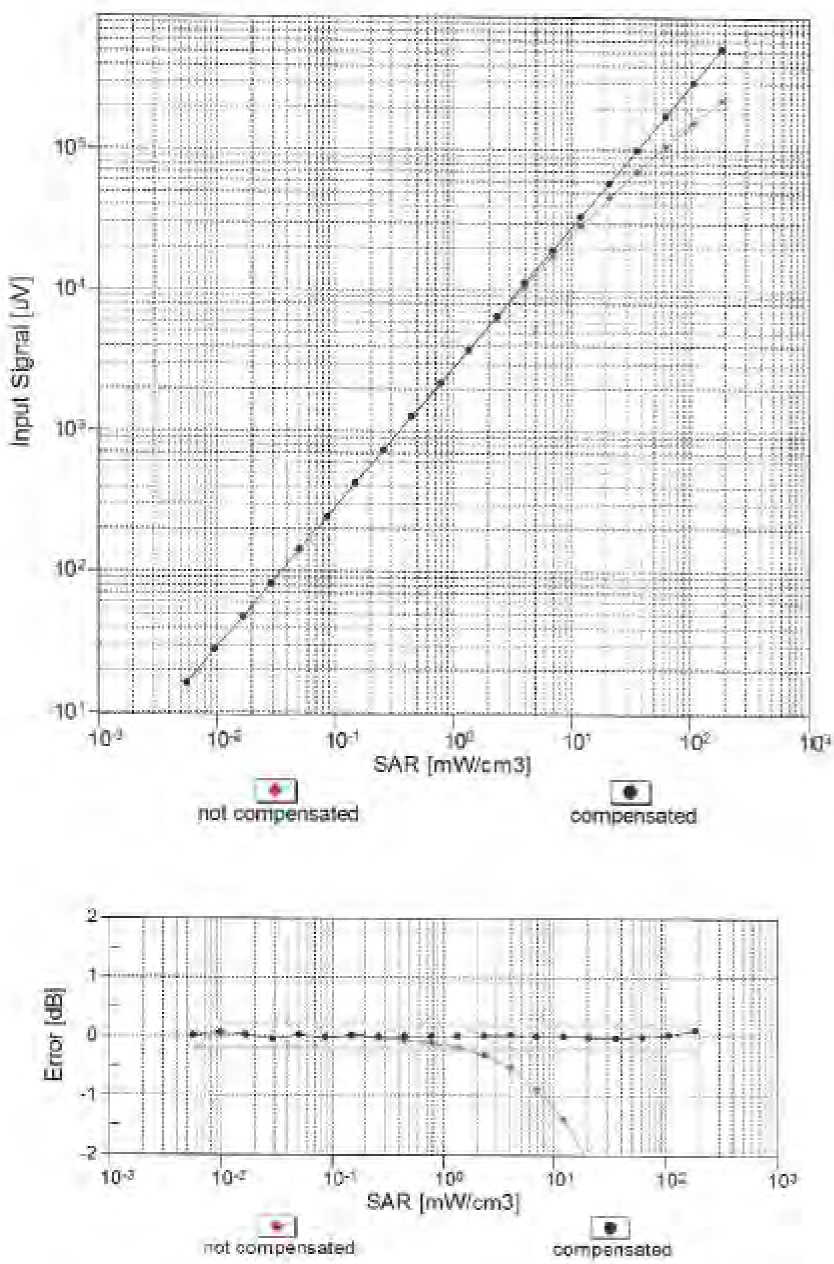
f=1800 MHz,R22



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

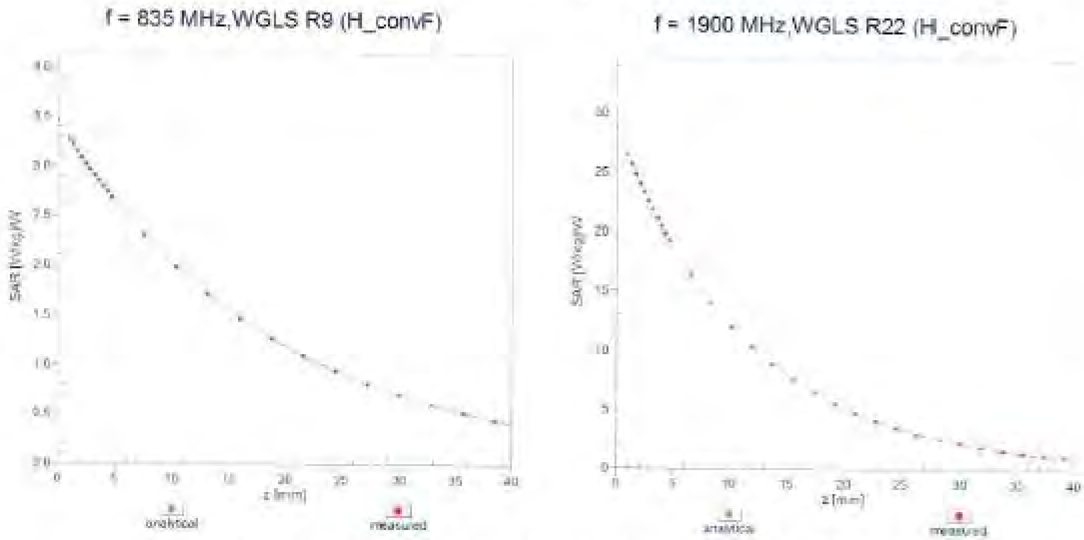
Dynamic Range f(SAR$_{head}$)

(TEM cell , f$_{eval}$= 1900 MHz)



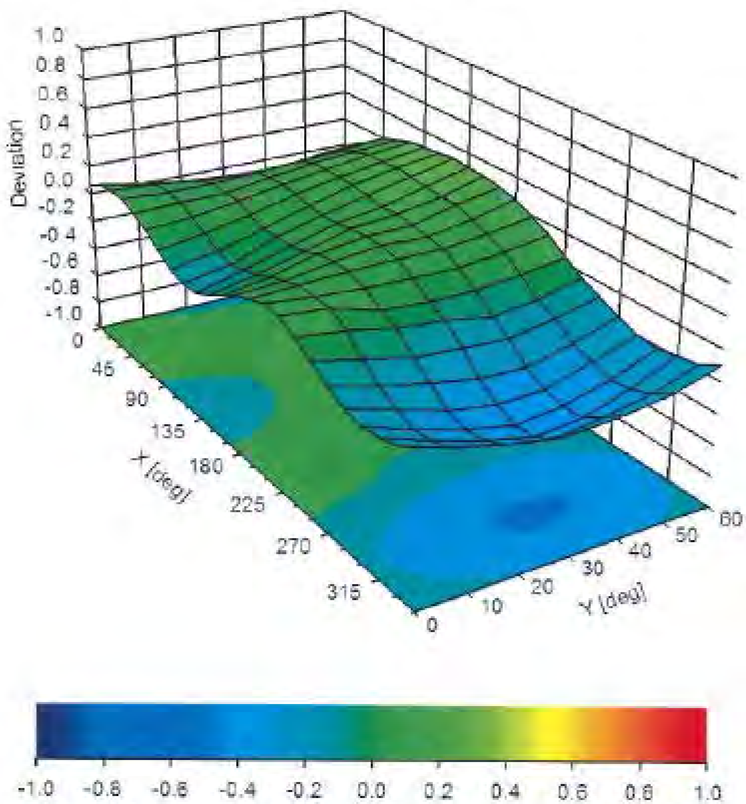
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3735

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-1.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Appendix: Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	141.9	±3.0 %
		Y	0.0	0.0	1.0		141.8	
		Z	0.0	0.0	1.0		149.0	
10021-DAC	GSM-FDD (TDMA, GMSK)	X	3.44	68.2	14.9	9.39	118.0	±2.2 %
		Y	3.22	69.4	16.8		85.0	
		Z	12.08	88.1	24.1		147.1	
10023-DAC	GPRS-FDD (TDMA, GMSK, TN 0)	X	4.06	71.2	16.7	9.57	114.5	±2.7 %
		Y	3.01	68.0	16.2		83.3	
		Z	11.22	87.4	24.1		141.6	
10024-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	5.62	76.3	17.1	6.56	149.2	±2.2 %
		Y	6.09	79.3	19.0		142.0	
		Z	16.49	90.1	22.6		125.8	
10025-DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	X	6.61	75.2	26.4	12.62	77.0	±2.2 %
		Y	5.33	69.5	23.9		56.8	
		Z	7.84	79.0	28.9		89.4	
10026-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1)	X	7.48	79.8	26.6	9.55	147.0	±2.5 %
		Y	5.75	73.4	23.6		120.4	
		Z	9.68	84.4	28.7		127.8	
10027-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	40.65	99.8	23.0	4.80	145.4	±1.7 %
		Y	23.67	96.2	22.9		147.6	
		Z	47.87	100.0	23.5		143.2	
10028-DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	43.00	100.0	22.3	3.55	130.4	±1.7 %
		Y	36.95	99.6	22.6		133.5	
		Z	60.81	99.8	22.1		126.2	
10029-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	X	7.59	81.3	26.3	7.78	145.1	±2.7 %
		Y	5.99	75.7	23.9		143.3	
		Z	9.66	84.1	27.1		146.1	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	5.02	67.8	19.4	4.57	149.2	±0.9 %
		Y	4.68	66.2	18.6		129.2	
		Z	4.84	66.4	18.5		138.5	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	6.17	75.3	25.9	11.01	118.9	±3.0 %
		Y	4.85	69.1	23.0		86.4	
		Z	9.59	86.3	30.7		147.5	
10058-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	X	6.02	76.9	23.7	6.52	133.6	±2.2 %
		Y	5.32	73.9	22.4		138.6	
		Z	7.69	79.7	24.5		131.6	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	4.24	67.6	19.3	3.97	142.4	±0.7 %
		Y	3.96	66.1	18.4		145.9	
		Z	3.98	65.7	18.0		133.7	

10090-DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	X	5.59	77.4	18.0	6.56	143.9	±2.5 %
		Y	5.36	77.0	18.0		139.4	
		Z	14.11	87.2	21.4		126.1	
10099-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	X	7.91	81.7	27.6	9.55	141.4	±2.2 %
		Y	6.07	75.0	24.6		116.8	
		Z	9.76	84.6	28.7		126.1	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.99	68.2	20.8	8.07	124.1	±2.7 %
		Y	10.02	68.1	20.7		128.3	
		Z	10.36	68.9	21.1		144.0	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.14	69.3	21.5	8.10	147.6	±3.0 %
		Y	9.68	67.9	20.6		124.3	
		Z	10.02	68.7	21.1		140.2	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.76	69.1	19.8	3.91	148.6	±0.7 %
		Y	4.37	67.2	18.8		127.1	
		Z	4.48	67.1	18.5		141.7	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	4.23	69.8	20.2	3.46	141.9	±0.7 %
		Y	3.74	67.0	18.7		144.4	
		Z	3.66	66.0	17.9		134.6	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	4.06	69.2	19.8	3.39	141.8	±0.7 %
		Y	3.68	67.1	18.7		143.6	
		Z	3.63	66.3	18.0		133.7	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	4.15	69.1	19.8	3.50	140.8	±0.7 %
		Y	3.76	67.0	18.7		142.9	
		Z	3.72	66.3	18.2		133.4	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	7.03	71.7	25.9	12.49	95.3	±2.7 %
		Y	5.88	66.3	22.9		68.8	
		Z	9.34	76.7	29.6		118.5	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	6.00	72.8	20.9	3.76	128.4	±0.7 %
		Y	4.95	68.7	18.9		133.1	
		Z	4.96	68.0	18.5		142.1	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	5.91	72.8	20.9	3.77	127.8	±0.7 %
		Y	4.93	68.9	19.0		130.8	
		Z	4.87	68.0	18.5		141.9	
10406-AAB	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.96	71.2	20.9	5.22	134.2	±0.9 %
		Y	6.38	69.1	19.8		136.9	
		Z	6.47	68.7	19.5		125.4	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	4.22	76.7	22.6	1.54	149.3	±1.2 %
		Y	3.66	73.6	20.9		128.1	
		Z	2.82	68.3	18.2		138.3	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	10.18	69.2	21.6	8.23	145.8	±3.0 %
		Y	10.09	68.8	21.2		148.6	
		Z	10.04	68.6	21.1		136.8	

10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	10.12	69.4	21.6	8.14	146.6	±2.7 %
		Y	9.97	68.7	21.2		147.5	
		Z	9.96	68.6	21.1		137.7	
10419-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preambule)	X	10.24	69.5	21.7	8.19	148.0	±3.0 %
		Y	10.04	68.8	21.2		149.3	
		Z	10.07	68.7	21.2		140.0	
10458-AAA	CDMA2000 (1xEV-DO, Rev. B, 2 carriers)	X	8.54	69.2	20.7	6.55	135.8	±1.9 %
		Y	8.28	68.3	20.1		137.1	
		Z	8.19	67.6	19.7		129.9	
10459-AAA	CDMA2000 (1xEV-DO, Rev. B, 3 carriers)	X	10.88	69.8	21.8	8.25	136.2	±3.0 %
		Y	10.86	69.4	21.5		138.8	
		Z	10.71	68.6	21.1		133.1	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	5.92	82.8	24.9	1.58	128.2	±0.7 %
		Y	3.52	73.0	20.8		130.5	
		Z	2.89	68.7	18.4		143.9	
10516-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)	X	10.26	69.5	21.7	8.23	145.6	±3.0 %
		Y	10.10	68.8	21.2		147.6	
		Z	10.16	68.9	21.3		140.0	
10525-AAA	IEEE 802.11ac WiFi (20MHz, MCS0, 99pc duty cycle)	X	10.03	68.5	21.2	8.36	122.7	±3.0 %
		Y	10.00	68.2	21.0		124.0	
		Z	10.40	69.1	21.5		142.7	
10526-AAA	IEEE 802.11ac WiFi (20MHz, MCS1, 99pc duty cycle)	X	10.10	68.5	21.3	8.42	123.6	±2.7 %
		Y	10.05	68.2	21.0		123.9	
		Z	10.48	69.2	21.5		143.3	
10534-AAA	IEEE 802.11ac WiFi (40MHz, MCS0, 99pc duty cycle)	X	10.58	69.0	21.4	8.45	129.5	±2.7 %
		Y	10.49	68.6	21.2		129.9	
		Z	10.47	68.5	21.1		123.7	
10535-AAA	IEEE 802.11ac WiFi (40MHz, MCS1, 99pc duty cycle)	X	10.58	69.0	21.4	8.45	129.7	±2.7 %
		Y	10.52	68.7	21.2		132.0	
		Z	10.49	68.5	21.1		124.1	
10544-AAA	IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)	X	11.04	69.5	21.5	8.47	134.3	±2.7 %
		Y	10.75	68.7	21.0		133.9	
		Z	10.88	69.0	21.1		127.7	
10545-AAA	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)	X	11.10	69.6	21.5	8.55	134.0	±2.7 %
		Y	10.82	68.8	21.1		134.4	
		Z	10.97	69.0	21.2		127.9	
10564-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 99pc duty cycle)	X	9.90	68.5	21.2	8.25	122.7	±3.0 %
		Y	9.89	68.3	21.0		124.9	
		Z	10.26	69.1	21.4		142.4	
10571-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 90pc duty cycle)	X	6.11	82.4	24.9	1.99	129.0	±0.7 %
		Y	3.46	71.4	20.1		149.7	
		Z	3.49	70.6	19.3		141.5	

10572-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 90pc duty cycle)	X	6.14	82.6	25.0	1.99	127.7	±0.9 %
		Y	3.59	72.3	20.6		148.0	
		Z	3.56	71.0	19.5		140.0	
10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	10.06	68.6	21.5	8.59	122.5	±3.0 %
		Y	10.34	69.1	21.6		147.4	
		Z	10.50	69.3	21.8		139.6	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	10.61	70.0	22.2	8.60	149.8	±2.7 %
		Y	10.38	69.2	21.7		148.3	
		Z	10.55	69.4	21.8		140.8	
10583-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)	X	10.11	68.7	21.5	8.59	124.6	±2.7 %
		Y	10.35	69.1	21.6		148.8	
		Z	10.51	69.4	21.8		140.5	
10584-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)	X	10.11	68.7	21.5	8.60	123.0	±3.0 %
		Y	10.07	68.4	21.2		123.3	
		Z	10.56	69.5	21.8		141.6	
10591-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	X	10.23	68.8	21.6	8.63	125.2	±3.0 %
		Y	10.15	68.4	21.2		124.7	
		Z	10.65	69.4	21.8		142.5	
10592-AAA	IEEE 802.11n (HT Mixed, 20MHz, MCS1, 90pc duty cycle)	X	10.40	69.0	21.8	8.79	125.2	±2.7 %
		Y	10.34	68.5	21.4		126.6	
		Z	10.85	69.7	22.1		144.2	
10599-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	X	10.86	69.4	21.8	8.79	132.6	±3.0 %
		Y	10.76	69.0	21.5		132.8	
		Z	10.78	68.8	21.5		124.2	
10600-AAA	IEEE 802.11n (HT Mixed, 40MHz, MCS1, 90pc duty cycle)	X	10.94	69.4	21.9	8.88	131.7	±3.0 %
		Y	10.84	69.0	21.6		132.9	
		Z	10.86	68.9	21.6		124.4	
10607-AAA	IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	X	10.26	68.8	21.6	8.64	125.4	±3.0 %
		Y	10.24	68.5	21.3		126.7	
		Z	10.71	69.6	21.9		144.0	
10608-AAA	IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle)	X	10.40	69.0	21.7	8.77	125.8	±3.3 %
		Y	10.36	68.6	21.4		127.2	
		Z	10.87	69.8	22.1		145.4	
10616-AAA	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	X	10.90	69.4	21.9	8.82	131.8	±3.0 %
		Y	10.79	68.9	21.5		132.7	
		Z	10.83	68.9	21.5		123.8	
10617-AAA	IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle)	X	10.91	69.4	21.9	8.81	132.1	±3.0 %
		Y	10.78	69.0	21.5		133.1	
		Z	10.83	68.9	21.5		124.0	
10626-AAA	IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)	X	11.37	69.9	21.9	8.83	136.7	±3.0 %
		Y	11.05	69.1	21.4		134.9	
		Z	11.27	69.5	21.6		128.1	

10627-AAA	IEEE 802.11ac WiFi (80MHz, MCS1, 90pc duty cycle)	X	11.44	70.0	22.0	8.88	137.5	±3.0 %
		Y	11.10	69.1	21.5		135.1	
		Z	11.35	69.5	21.7		128.9	
10648-AAA	CDMA2000 (1x Advanced)	X	4.39	70.8	20.9	3.45	146.1	±0.9 %
		Y	3.84	67.8	19.3		148.6	
		Z	3.78	66.9	18.5		139.2	

[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 Certificates

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

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

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

Accreditation No.: **SCS 0108**

Client **Motorola Solutions MY**

Certificate No: **D2450V2-782_Feb17**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:782
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	February 15, 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	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	04-Jan-17 (No. DAE4-601_Jan17)	Jan-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-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:	Johannes Kurikka	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 15, 2017

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

Certificate No: D2450V2-782_Feb17 Page 1 of 8

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

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

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.5 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.6 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.5 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9 Ω + 4.0 jΩ
Return Loss	- 27.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω + 5.7 jΩ
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.151 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	May 06, 2005

DASY5 Validation Report for Head TSL

Date: 15.02.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:782

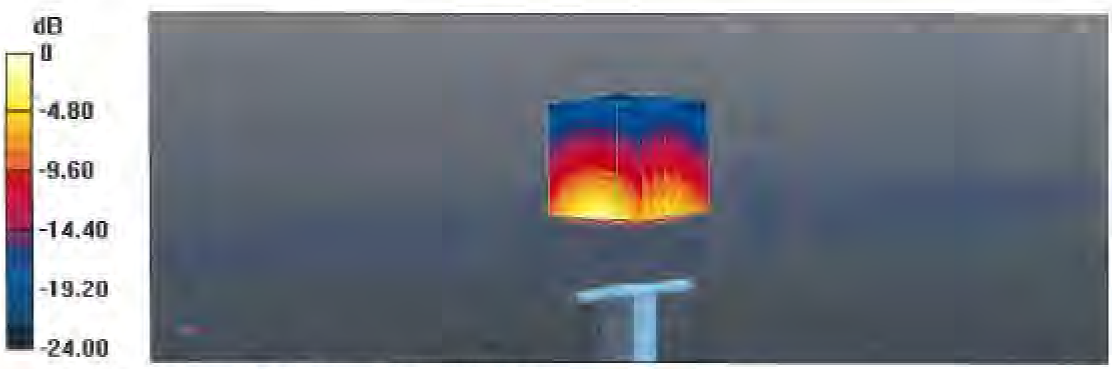
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.87 S/m; ε_r = 37.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.72, 7.72, 7.72); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

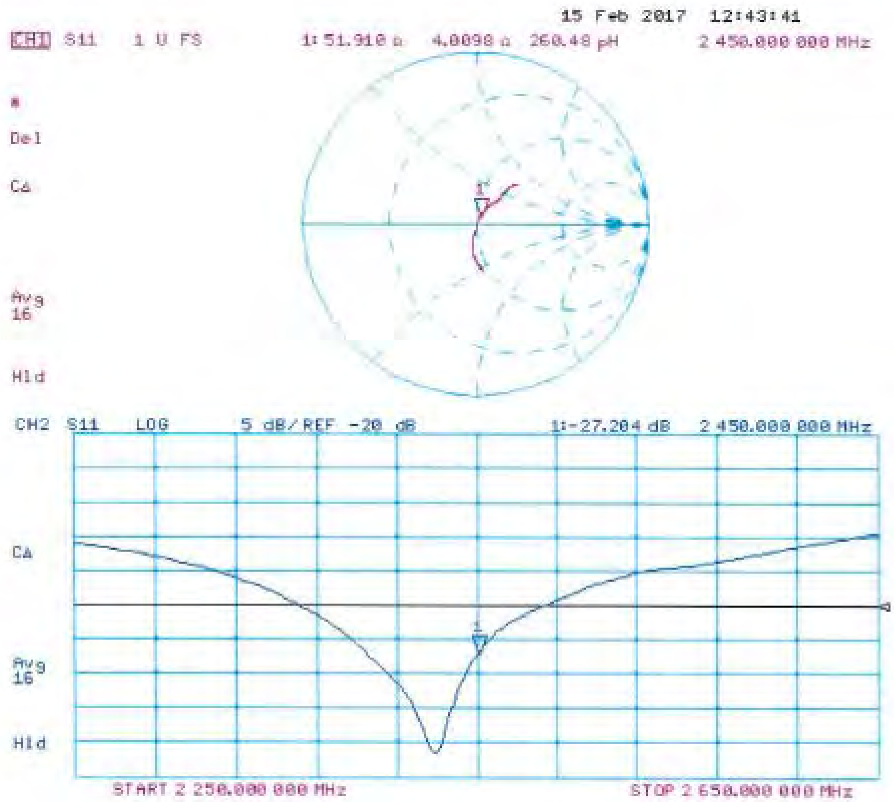
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.0 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 28.4 W/kg
SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.3 W/kg
Maximum value of SAR (measured) = 22.8 W/kg



0 dB = 22.8 W/kg = 13.58 dBW/kg

Certificate No: D2450V2-782_Feb17 Page 5 of 8

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.02.2017

Test Laboratory: SPEAG, Zurich, Switzerland

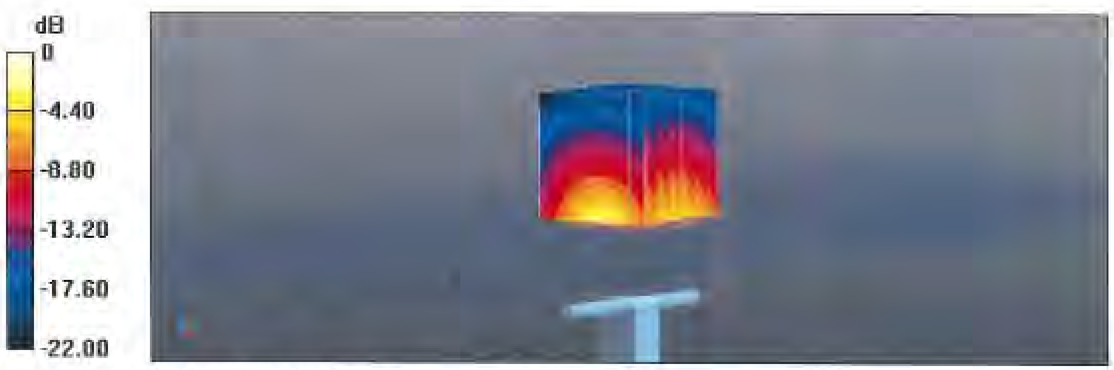
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:782

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 51.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

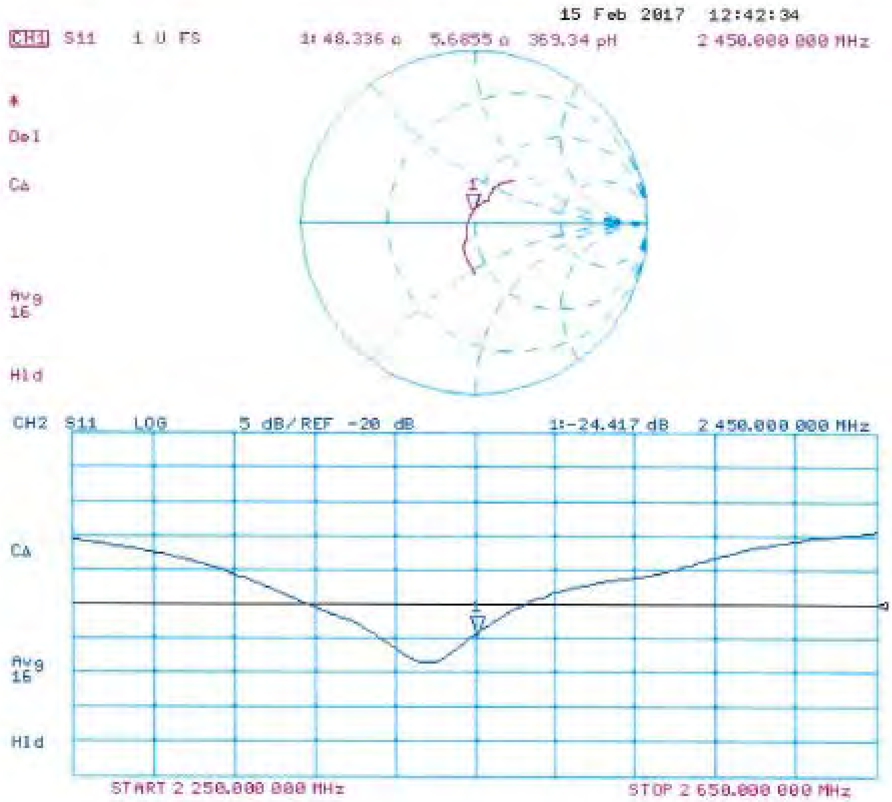
- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.4 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 26.6 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.94 W/kg
Maximum value of SAR (measured) = 20.6 W/kg



0 dB = 20.6 W/kg = 13.14 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client Motorola Solutions MY

Certificate No: D5GHzV2-1026_Nov16

CALIBRATION CERTIFICATE

Object: D5GHzV2 - SN:1026

Calibration procedure(s): QA CAL-22.v2
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: November 04, 2016

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	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	30-Jun-16 (No. EX3-3503_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-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:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 8, 2016

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

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-2, "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
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5000 MHz ± 1 MHz 5250 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5000 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.2	4.45 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	4.33 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5000 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**70.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.4 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.58 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.6 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.6 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.82 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.9 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**82.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	5.08 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.2 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5000 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.3	5.07 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.5 ± 6 %	5.18 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5000 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**71.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.1 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.84 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	5.86 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**78.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.8 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	6.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.98 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**79.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.2 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.1 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5000 MHz

Impedance, transformed to feed point	51.9 Ω - 16.7 jΩ
Return Loss	- 15.8 dB

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	49.6 Ω - 8.3 jΩ
Return Loss	- 21.6 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	53.5 Ω - 4.1 jΩ
Return Loss	- 25.7 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.8 Ω - 3.4 jΩ
Return Loss	- 25.1 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	58.8 Ω - 5.2 jΩ
Return Loss	- 20.5 dB

Antenna Parameters with Body TSL at 5000 MHz

Impedance, transformed to feed point	50.5 Ω - 14.9 jΩ
Return Loss	- 16.7 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	50.9 Ω - 6.0 jΩ
Return Loss	- 24.4 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	53.8 Ω - 3.9 jΩ
Return Loss	- 25.6 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.0 Ω - 3.2 jΩ
Return Loss	- 22.9 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	59.0 Ω - 2.8 jΩ
Return Loss	- 21.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.191 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	February 05, 2004

DASY5 Validation Report for Head TSL

Date: 04.11.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1026

Communication System: UID 0 - CW; Frequency: 5000 MHz, Frequency: 5250 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5000 MHz; σ = 4.33 S/m; ε_r = 35.1; ρ = 1000 kg/m^3
Medium parameters used: f = 5250 MHz; σ = 4.58 S/m; ε_r = 34.7; ρ = 1000 kg/m^3
Medium parameters used: f = 5500 MHz; σ = 4.82 S/m; ε_r = 34.4; ρ = 1000 kg/m^3
Medium parameters used: f = 5600 MHz; σ = 4.93 S/m; ε_r = 34.2; ρ = 1000 kg/m^3
Medium parameters used: f = 5750 MHz; σ = 5.08 S/m; ε_r = 34.0; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(6.1, 6.1, 6.1); Calibrated: 30.06.2016, ConvF(5.42, 5.42, 5.42); Calibrated: 30.06.2016, ConvF(5.02, 5.02, 5.02); Calibrated: 30.06.2016, ConvF(4.89, 4.89, 4.89); Calibrated: 30.06.2016, ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5000 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.30 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 24.4 W/kg
SAR(1 g) = 7.05 W/kg; SAR(10 g) = 2.06 W/kg
Maximum value of SAR (measured) = 15.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.61 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 28.3 W/kg
SAR(1 g) = 7.92 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 17.8 W/kg

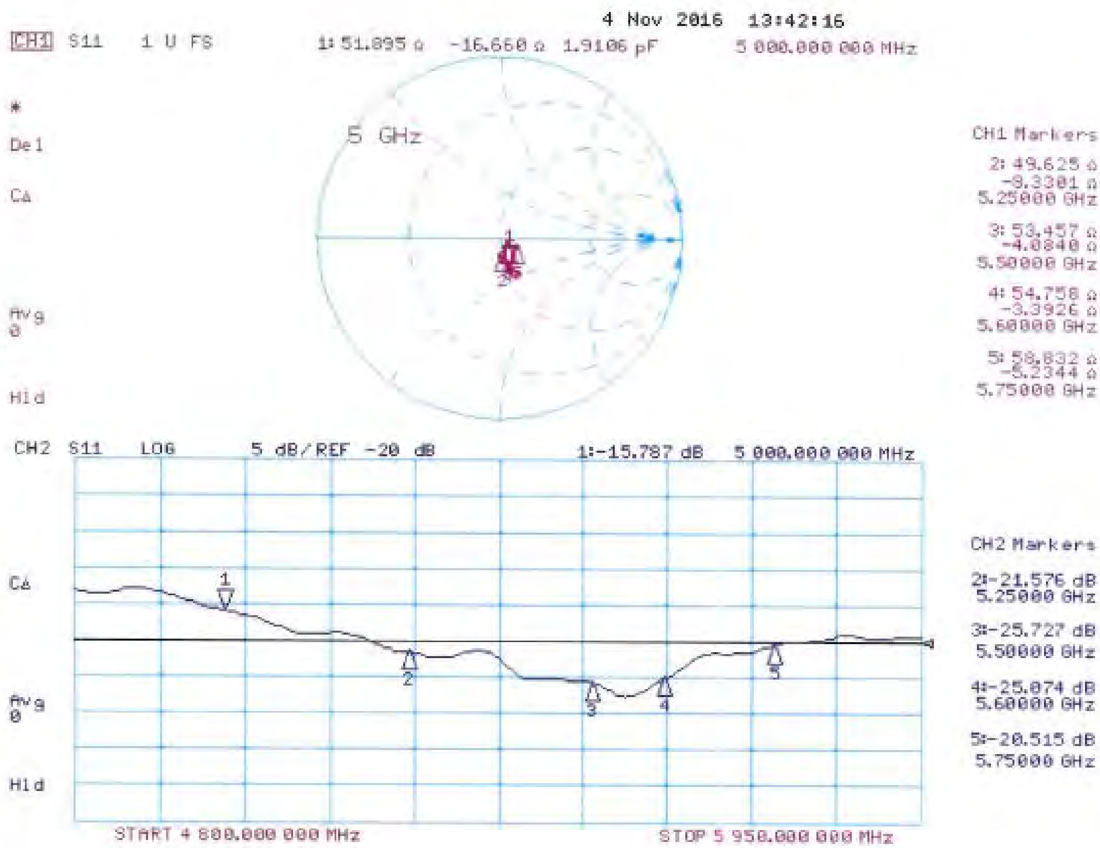
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.97 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 31.3 W/kg
SAR(1 g) = 8.11 W/kg; SAR(10 g) = 2.31 W/kg
Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.99 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 8.37 W/kg; SAR(10 g) = 2.38 W/kg
Maximum value of SAR (measured) = 19.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.61 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 18.8 W/kg

0 dB = 18.8 W/kg = 12.74 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 03.11.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1026

Communication System: UID 0 - CW; Frequency: 5000 MHz, Frequency: 5250 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5000 MHz; σ = 5.18 S/m; ε_r = 47.5; ρ = 1000 kg/m^3
Medium parameters used: f = 5250 MHz; σ = 5.52 S/m; ε_r = 47.0; ρ = 1000 kg/m^3
Medium parameters used: f = 5500 MHz; σ = 5.86 S/m; ε_r = 46.5; ρ = 1000 kg/m^3
Medium parameters used: f = 5600 MHz; σ = 6.00 S/m; ε_r = 46.4; ρ = 1000 kg/m^3
Medium parameters used: f = 5750 MHz; σ = 6.21 S/m; ε_r = 46.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.28, 5.28, 5.28); Calibrated: 30.06.2016, ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016, ConvF(4.4, 4.4, 4.4); Calibrated: 30.06.2016, ConvF(4.35, 4.35, 4.35); Calibrated: 30.06.2016, ConvF(4.3, 4.3, 4.3); Calibrated: 30.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

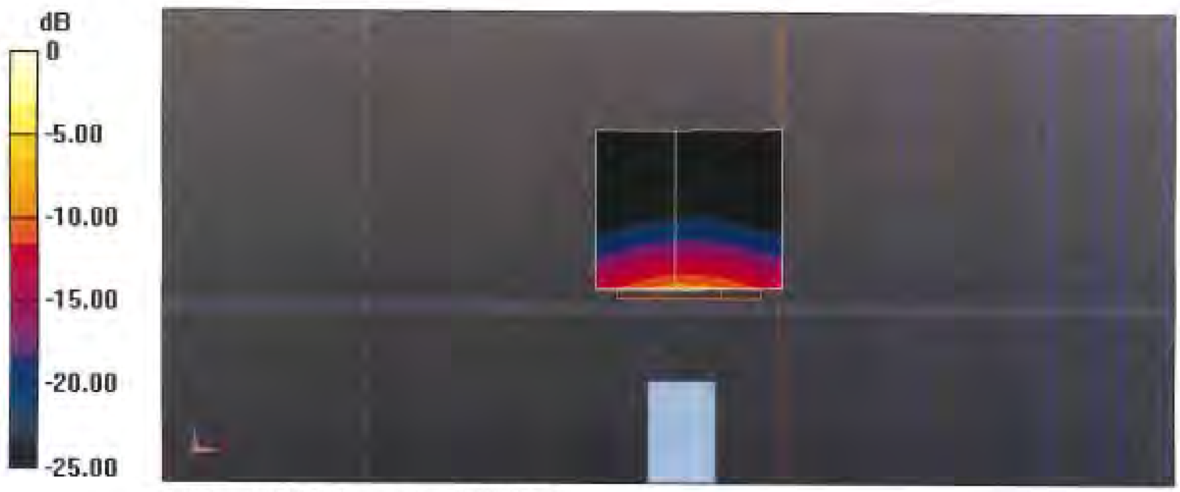
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5000MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.86 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 25.1 W/kg
SAR(1 g) = 7.15 W/kg; SAR(10 g) = 2.03 W/kg
Maximum value of SAR (measured) = 16.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.95 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 29.6 W/kg
SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.19 W/kg
Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.24 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 32.2 W/kg
SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.2 W/kg
Maximum value of SAR (measured) = 18.8 W/kg

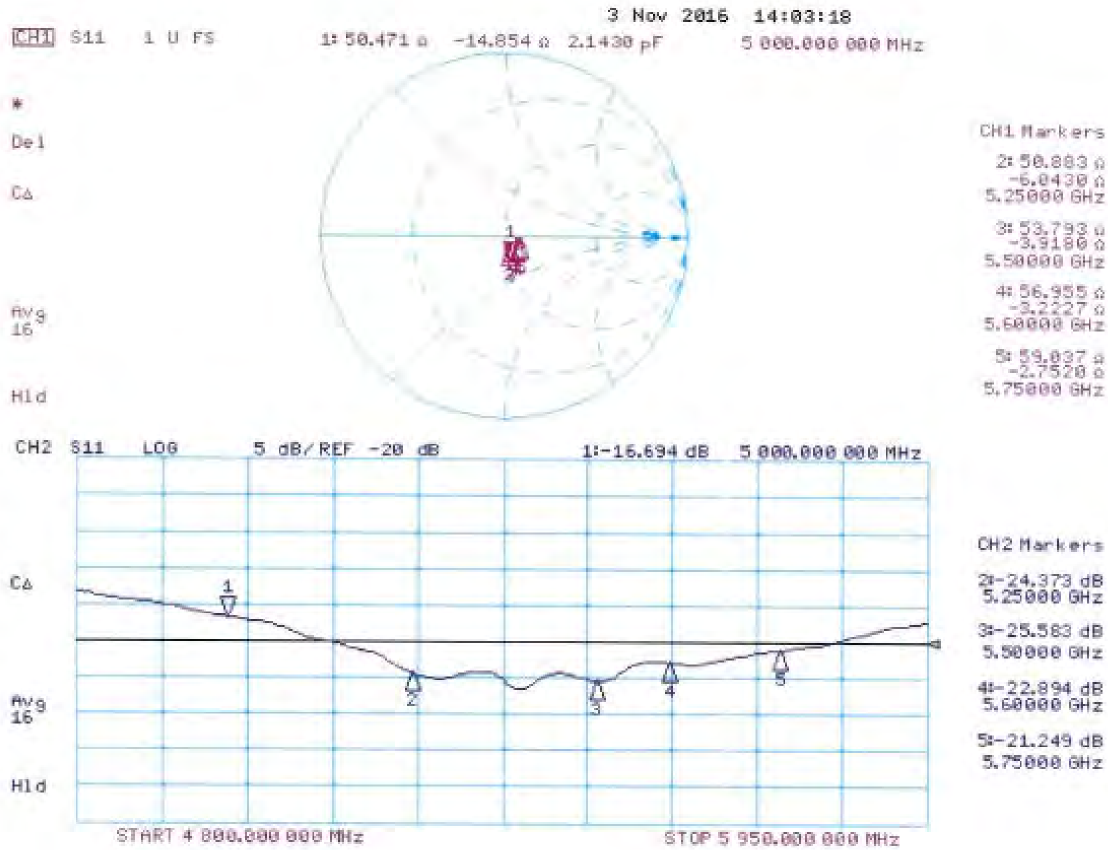
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.13 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.60 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.1 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 18.3 W/kg = 12.62 dBW/kg

Impedance Measurement Plot for Body TSL



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