MOTOROLA SOLUTIONS

ACCREDITED
TESTING CERT # 2518.01

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

Motorola Solutions Inc.
EME Test Laboratory
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Date of Report: 08/04/2014
Report Revision: A

Responsible Engineer:	Deanna Zakharia (Plantation Lab Director EME Test Lab)
Report Author:	Mac Elliott (Principal Staff Engineer)
Date/s Tested:	5/13/2014 - 5/17/2014; 5/19/2014; 6/19/2014 – 6/20/2014; 6/24/2014
Manufacturer/Location:	Motorola, Penang
Sector/Group/Div.:	AESS – Astro Engineering Subscriber Solutions
Date submitted for test:	4/25/2014
DUT Description:	Handheld Portable – 450-520MHz, 5W rated power, 6.25kHz/12.5kHz/25kHz, Capable of digital and analog FM transmission. Also capable of TDMA transmission.
Test TX mode(s):	CW (PTT)
Max. Power output:	5.6W
Nominal Power:	5.0W
Tx Frequency Bands:	450-520 MHz
Signaling type:	FM, TDMA
Model(s) Tested:	H84SDD9PW5AN
Model(s) Certified:	H84SDD9PW5AN; H84SDH9PW7AN
Serial Number(s):	837TQH0035 & 837TQH0024
Classification:	Occupational/Controlled
FCC ID:	AZ489FT4920; Part 90 UHF (450 – 512 MHz) This report contains results that are immaterial for FCC equipment approval, which are clearly identified.

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

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

Zakharia Deanna-EDC015
Digitally signed by Zakharia Deanna-EDC015
DN: cn=Zakharia Deanna-EDC015
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Deanna Zakharia
EMS EME Lab Senior Resource Manager,
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Approval Date: 8/6/2014

Certification Date: 8/6/2014

Certification No.: L1140802P & L1140803P

Part 1 of 2

APPENDICES

Part 2 of 2

APPENDICES

Report Revision History

Date	Revision	Comments
07/3/2014	O	Initial release
08/4/2014	A	Revise Nominal Power to 5.0W from 5.3W

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model number H84SDD9PW5AN. This device is classified as Occupational/Controlled.

2.0 FCC SAR Summary

Table 1

Equipment Class	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
TNF	450 – 512 MHz	5.17	3.61	3.42	2.58

3.0 Abbreviations / Definitions

CNR: Calibration Not Required
CQPSK: Compatible Differential Quadrature Phase-Shift Keying
CW: Continuous Wave
C4FM: Continuous 4 Level FM
DUT: Device Under Test
DSP: Digital Signal Processing
EME: Electromagnetic Energy
FM: Frequency Modulation
NA: Not Applicable
PTT: Push to Talk
SAR: Specific Absorption Rate
TDMA: Time Division Multiple Access
4FSK: 4 Level Frequency Shift Keying

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 (2003), Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronics Engineers (IEEE) C95.1-2005
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6 (2009), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- Australian Communications Authority Radio communications (Electromagnetic Radiation - Human Exposure) Standard (2003)
- ANATEL, Brazil Regulatory Authority, Resolution No. 303 of July 2, 2002 "Regulation of the limitation of exposure to electrical, magnetic, and electromagnetic fields in the radio frequency range between 9 kHz and 300 GHz." and "Attachment to resolution # 303 from July 2, 2002"
- IEC62209-2 Edition 1.0 2010-03, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz).
- FCC KDB – 643646 D01 SAR Test for PTT Radios v01r01 (04/04/2011)
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r02 (12/05/2013)
  D02 RF Exposure Reporting v01r01 (05/28/2013)
- FCC KDB – 447498 D01 General RF Exposure Guidance v05r01 (05/28/2013)

5.0 SAR Limits

Table 2

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

6.0 Description of Device Under Test (DUT)

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

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

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

The model represented under this filing utilizes optional antennas capable of transmitting in the 450 – 520 MHz bands respectively. The nominal output power is 5.0 W with maximum output power of 5.6 W as defined by upper limit of the production line final test station.

The intended operating positions are “at the face” with the DUT at least 2.5cm from the mouth, and “at the body” by means of the offered body worn accessories. Body worn audio and PTT operation is accomplished by means of optional remote accessories that are connected to the radio.

7.0 Optional Accessories and Test Criteria

This device is offered with optional accessories. All accessories were individually evaluated during the test plan creation to determine if testing was required per the guidelines outlined in "SAR Test Reduction Considerations for Occupational PTT Radios" FCC KDB 643646 to assess compliance of this device. The following sections identify the test criteria and details for each accessory category. Refer to Exhibit 7B for antenna separation distances.

7.1 Antennas

There are two removable antennas offered for this product. The table below lists their descriptions.

Table 3

Antenna Models	Description	Selected for test	Tested
PMAE4065A	Antenna w/ GPS, 380-520 MHz & 1575MHz, 1/2 wave, -1.0 dBi	Yes	Yes
FAF5260A	Stubby Antenna w/ GPS, 450-520 MHz & 1575MHz, 1/4 wave, 0 dBi	Yes	Yes

7.2 Batteries

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

Table 4

Battery Models	Description	Selected for test	Tested	Comments
NNTN8128B	IMPRES Li Ion Battery Slim 1900mAh	Yes	Yes	Default battery for body testing
PMNN4424AR	IMPRES Li Ion Battery High Cap 2300 mAh	Yes	Yes	
PMNN4448AR	Li Ion Battery Ultra High Cap 2700mAh	Yes	Yes	Default battery for face testing

7.3 Body worn Accessories

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

Table 5

Body worn Models	Description	Selected for test	Tested	Comments
PMLN7008A	Belt Clip 2.5 in.	Yes	Yes	
PMLN4651A	Belt Clip 2 in.	Yes	Yes	
PMLN6085A	Metal Carry Holder w/2.5 in swivel belt loop	Yes	Yes	
NTN5243A	Carry Strap	Yes	Yes	Tested with PMLN6085A

7.4 Audio Accessories

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

Table 6

Audio Acc. Models	Description	Selected for test	Tested	Comments
PMLN6130A	Impress 2 wire W/ Translucent Tube - Biege	Yes	Yes	Default Audio
ZMN6031A	3 wire kit - beige	Yes	Yes	Tested with NNTN7869A
ZMN6032A	2 wire kit - beige	Yes	Yes	Tested with NNTN7869A
ZMN6038A	2 wire kit - beige	No	No	By Similarity with ZMN6032A
ZMN6039A	3 wire kit - beige	No	No	By Similarity with ZMN6031A
BDN6664A	Receive-Only Earpiece with Standard Earphone (1-Wire), Beige	No	No	Receive Only
BDN6665A	Extra Loud Receive-Only Earpiece with Standard Earphone (1-Wire), Beige	No	No	Receive Only
BDN6667A	Earpiece with Microphone and Push-to-Talk Combined (2-Wire), Beige	No	No	By Similarity with BDN6729A
NNTN7869A	Hirose Surveillance Keyload Adaptor	Yes	Yes	Tested with ZMN6031A or ZMN6032A
BDN6668A	Earpiece with Microphone and Push-to-Talk Separate (3-Wire), Beige	No	No	By Similarity with BDN6730A
BDN6669A	Extra Loud Earpiece with Microphone and Push-to-Talk Combined (2-Wire), Beige	No	No	By Similarity with BDN6729A
BDN6726A	Receive-Only Earpiece with Standard Earphone (1-Wire), Black	No	No	Receive Only
BDN6727A	Extra Loud Receive-Only Earpiece with Standard Earphone (1-Wire), Black	No	No	Receive Only
BDN6730A	Earpiece with Microphone and Push-to-Talk Separate (3-Wire), Black	Yes	Yes	Tested with BDN6783A
BDN6731A	Extra Loud Earpiece with Microphone and Push-to-Talk Combined (2-Wire), Black	No	No	By Similarity with BDN6729A
BDN6729A	Earpiece with Microphone and Push-to-Talk Combined (2-Wire), Black	Yes	Yes	Tested with BDN6783A
PMLN6123A	Impress 3 Wire W/ Trans Tube - Black	No	No	By Similarity with PMLN5097A
PMLN6124A	Impress 3 Wire W/ Trans Tube - Biege	No	No	By Similarity with PMLN5097A
PMLN6127A	Impress 2 Wire Surveillance Kit - Black	No	No	By Similarity with PMLN6130A
PMLN6128A	Impress 2 Wire Surveillance Kit - Biege	No	No	By Similarity with PMLN6130A
PMLN6129A	Impress 2 wire W/ Translucent Tube - Black	No	No	By Similarity with PMLN6130A
RLN5886A	Low Noise Kit Tube	No	No	replacement parts
RLN5887A	High Noise Kit	No	No	replacement parts
PMLN6125A	1 Wire Surveillance Kit - Black	No	No	Receive Only
PMLN6126A	1 Wire Surveillance Kit - Beige	No	No	Receive Only
PMMN4040A	IMPRES IP57 Submersible Remote Speaker Microphone	Yes	Yes	
PMMN4046A	IMPRES SPEAKER MIC W/VOL, IP57	Yes	Yes	
PMMN4050A	IMPRES REMOTE SPEAKER MIC, NC	Yes	Yes	
PMLN5102A	CORE ULTRA-LITE HEADSET	Yes	Yes	
PMLN5096B	CORE EARSET - D-SHELL	Yes	Yes	
PMLN5097A	IMPRES 3 WIRE SURVEILLANCE-BLACK	Yes	Yes	
PMLN5106A	IMPRES 3 WIRE SURVEILLANCE-BEIGE	No	No	By Similarity with PMLN5097A
PMLN5653A	IMPRES Ear Mic System	Yes	Yes	

Table 6 continued

Audio Acc. Models	Description	Selected for test	Tested	Comments
HMN4101B	Display RSM w/o Display and w/o Channel Knob	No	No	By Similarity with HMN4104B
HMN4103B	Display RSM w/o Channel Knob	No	No	By Similarity with HMN4104B
HMN4104B	IMPRES Display Submersible RSM w/jack & Ch. Selector	Yes	Yes	tested with and w/o RMN5116A
PMMN4062A	Large Plus Noise cancelling RSM IP55 3.5MM jack RX only	Yes	Yes	
PMMN4065A	Standard Large IP57 RSM (based on PMM4046 w/ larger speaker)	Yes	Yes	
PMMN4024A	Core RSM	Yes	Yes	
PMMN4025A	Smart RSM	No	No	By Similarity with PMMN4062A
RLN6424A	Rx-Only Secondry Audio Accessory for DRSM	No	No	By Similarity with RMN5116A
PMMN4069A	APX Basic Smart RSM, IP55	No	No	By Similarity with PMMN4062A
PMLN5101A	Impress Temple Transducer	Yes	Yes	
PMLN5275B	Core H/D Headset	Yes	Yes	
RMN5058A	Core L/W Headset	Yes	Yes	
RMN5116A	Temple Transducer Headset	Yes	Yes	Tested w/ HMN4104B
AARLN4885B	3.5mm RX ONLY EARBUD FOR REM SPK MIC short coiled cbl	No	No	Receive Only
RLN4941A	3.5mm RX ONLY EARPIECE W/TRANSLUCENT TUBE-Short coiled cbl	No	No	Receive Only
WADN4190B	3.5mm EAR RCVR W/COIL CBL-Short cbl	No	No	Receive Only
BDN6783A	3.5 mm Audio Adapter	Yes	Yes	Tested with BDN6729A or BDN6730A
PMLN4620B	Rx only earpiece	No	No	Receive Only

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 7

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.8.2.969	DAE3	ES3DV3 (E-Field)

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

8.2 Description of Phantom(s)

Table 8

Phantom Type	Phantom(s) Used	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (wood)
Oval Flat	√	300MHz -6GHz; Er = 4+/- 1, Loss Tangent = ≤0.05	600x400x190			

8.3 Description of Simulated Tissue

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

The simulated tissue mixture was mixed based on the Simulated Tissue Composition indicated in Table 9. During the daily testing of this product, the applicable mixture was used to measure the Di-electric parameters at each of the tested frequencies to verify that the Di-electric parameters were within the tolerance of the tissue specifications.

Simulated Tissue Composition (percent by mass)

Table 9

Ingredients	450MHz	
	Head	Body
Sugar	56.0	46.5
Diacetin	0	0
De ionized – Water	39.1	50.53
Salt	3.8	1.87
HEC	1.0	1.0
Bact.	0.1	0.1

9.0 Additional Test Equipment

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

Table 10

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Speag Probe	ES3DV3	3301	8/27/2013	8/27/2014
Speag DAE	DAE3	363	1/13/2014	1/13/2015
Power Meter (HP)	E4418B	US39251152	2/19/2014	2/19/2015
Power Sensor (HP)	8482B	3318A07393	2/4/2014	2/4/2015
Power Meter (Agilent)	E4418B	US39251150	2/19/2014	2/19/2015
Power Sensor (Agilent)	E9301B	MY50290001	9/4/2013	9/4/2014
Power Meter (Agilent)	E4418B	US39251267	1/27/2014	1/27/2015
Power Sensor (HP)	8481B	3318A10982	4/9/2014	4/9/2015
Bi-Dir. Coupler (NARDA)	3020A	31744	9/17/2013	9/17/2015
Signal Generator (Agilent)	E4438C	MY42081753	1/17/2014	1/17/2016
AMP (PST)	AR2729-10/5506	M2K2A00-001	NCR	NCR
Dickson Temperature Recorder	TM320	7081356	9/6/2013	9/6/2014
Omega Digital Thermometer with J Type TC Probe	HH200A	20857	10/23/2013	10/23/2014
Omega Digital Thermometer with J Type TC Probe	HH202A	18800	3/3/2014	3/3/2015
Omega Digital Thermometer with J Type TC Probe	HH202A	18812	6/10/2013	6/10/2014
Agilent PNA-L Network Analyzer	N5230C	MY49002155	8/1/2013	8/1/2014
Dielectric Probe Kit (DAK)	DAK-3.5	1088	10/22/2013	10/22/2014
Dielectric Probe Kit (DAK)	DAK-12	1040	10/22/2013	10/22/2014
Speag Dipole	D450V3	1075	7/23/2013	7/23/2015

10.0 SAR Measurement System Validation and Verification

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

10.1 System Validation

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

Table 11

Dates	Probe Calibration Point		Probe SN	Measured Tissue Parameters		Validation for CW		
				σ	ϵ_r	Sensitivity	Linearity	Isotropy
09/30/2013	Body	450	3301	0.94	56.8	Pass	Pass	Pass
10/07/2013	Body	450	3301	0.92	56.5			
09/27/2013	Head	450	3301	0.83	42.2	Pass	Pass	Pass
10/07/2013	Head	450	3301	0.85	43.5			

10.2 System Verification

System verification checks were conducted each day during the SAR assessment. The results are normalized to 1W. Appendix D includes DASY plots for each day during the SAR assessment. The Table below summarizes the daily system check results used for the SAR assessment.

Table 12

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
3301	FCC Body	SPEAG D450V3 / 1075	4.51 +/- 10%	1.08	4.32	5/14/2014
				1.08	4.32	5/15/2014
				1.08	4.32	5/16/2014
				1.08	4.32	5/17/2014
	IEEE/IEC Head		4.73 +/- 10%	1.08	4.32	6/19/2014
				1.08	4.32	6/20/2014
				1.10	4.36	6/24/2014

10.3 Equivalent Tissue Test Results

Simulated tissue prepared for SAR measurements is measured daily and within 24 hours prior to actual SAR testing to verify that the tissue is within +/- 5% of target parameters at the center of the transmit band. This measurement is done using the applicable equipment indicated in section 9.0. The Table below summarizes the measured tissue parameters used for the SAR assessment.

Table 13

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
450	FCC Body	0.94 (0.89-0.99)	56.7 (53.9-59.5)	0.94	57.3	5/14/2014
				0.92	56.9	5/15/2014
				0.92	56.9	5/16/2014
				0.92	56.7	5/17/2014
450	IEEE/ IEC Head	0.87 (0.83-0.91)	43.5 (41.3-45.7)	0.84	43.2	6/19/2014
				0.84	42.0	6/20/2014
				0.86	43.1	6/24/2014
466	IEEE/ IEC Head	0.87 (0.83-0.91)	43.4 (41.2-45.6)	0.87	43.4	6/19/2014
				0.85	41.7	6/20/2014
				0.88	42.8	6/24/2014
481	FCC Body	0.94 (0.90-0.99)	56.6 (53.8-59.4)	0.97	56.9	5/14/2014
				0.95	56.5	5/15/2014
512	FCC Body	0.94 (0.90-0.99)	56.5 (53.6-59.3)	0.98	56.4	5/14/2014
				0.97	56.1	5/15/2014
516	FCC Body	0.95 (0.90-0.99)	56.4 (53.6-59.3)	0.97	55.8	5/17/2014
516	IEEE/ IEC Head	0.87 (0.83-0.92)	43.1 (41.0-45.3)	0.91	41.6	6/24/2014
520	FCC Body	0.95 (0.90-0.99)	56.4 (53.6-59.2)	0.97	55.8	5/17/2014
520	IEEE/ IEC Head	0.87 (0.83-0.92)	43.1 (41.0-45.3)	0.91	41.5	6/24/2014

11.0 Environmental Test Conditions

The EME Laboratory’s ambient environment is well controlled resulting in very stable simulated tissue temperature and therefore stable dielectric properties. Simulated tissue temperature is measured prior to each scan to insure it is within +/ - 2^{o}C of the temperature at which the dielectric properties were determined. The liquid depth within the phantom used for measurements was at least 15cm. Additional precautions are routinely taken to ensure the stability of the simulated tissue such as covering the phantoms when scans are not actively in process in order to minimize evaporation. The lab environment is continuously monitored. The Table below presents the range and average environmental conditions during the SAR tests reported herein:

Table 14

	Target	Measured
Ambient Temperature	18 – 25 ˚C	Range: 21.7 – 22.8˚C Avg. 22.1 ˚C
Relative Humidity	30 – 70 %	Range: 46.3 – 58.5 % Avg. 52.3 %
Tissue Temperature	NA	Range: 20.9-22.3˚C Avg. 21.7˚C

Relative humidity target range is a recommended target

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

12.0 DUT Test Setup and Methodology

12.1 Measurements

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

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

Table 15

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

12.2 DUT Configuration(s)

The DUT is a portable device operational at the body and face as described in section 6.0 while using the applicable accessories listed in section 7.0. All accessories listed in section 7.0 of this report were considered when implementing the guidelines specified in KDB 643646.

12.3 DUT Positioning Procedures

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

12.3.1 Body

The DUT was positioned in normal use configuration against the phantom with the offered body worn accessory as well as with and without the offered audio accessories as applicable.

12.3.2 Head

Not applicable.

12.3.3 Face

The DUT was positioned with its' front and back sides separated 2.5cm from the phantom.

12.4 DUT Test Channels

The number of test channels was determined by using the following IEEE 1528 equation. The use of this equation produces the same or more test channels compared to the FCC KDB 447498 number of test channels formula.

$$N_c = 2 * roundup[10 * (f_{high} - f_{low}) / f_c] + 1$$

Where
N_c = Number of channels
F_{high} = Upper channel
F_{low} = Lower channel
F_c = Center channel

12.5 SAR Result Scaling Methodology

The calculated 1-gram and 10-gram averaged SAR results indicated as “Max Calc. 1g-SAR” and “Max Calc.10g-SAR” in the data Tables is determined by scaling the measured SAR to account for power leveling variations and power slump. A Table and graph of output power versus time is provided in Appendix G. For this device the “Max Calc. 1g-SAR” and “Max Calc.10g-SAR” are scaled using the following formula:

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

P_max = Maximum Power (W)
P_int = Initial Power (W)
Drift = DASY drift results (dB)
SAR_meas = Measured 1-g or 10-g Avg. SAR (W/kg)
DC = Transmission mode duty cycle in % where applicable
50% duty cycle is applied for PTT operation

Note: for conservative results, the following are applied:
If P_int > P_max, then P_max/P_int = 1.
Drift = 1 for positive drift

Additional SAR scaling was applied using the methodologies outlined in FCC KDB 865664 using tissue sensitivity values. SAR was scaled for conditions where the tissue permittivity was measured above the nominal target and for tissue conductivity that was measured below the nominal target. Negative or reduced SAR scaling is not permitted.

12.6 DUT Test Plan

The guidelines and requirements outlined in section 4.0 were used to assess compliance of this device. All modes of operation identified in section 6.0 were considered during the development of the test plan. All tests were performed in CW and 50% duty cycle was applied to PTT configurations in the final results.

13.0 DUT Test Data

13.1 LMR assessments at the Body for 450 – 512 MHz band

Battery NNTN8128B was selected as the default battery for assessments at the Body because it is the thinnest battery (refer to Exhibit 7B for battery illustration). The default battery was used during conducted power measurements for all test channels within Part 90 frequency range (450 – 512 MHz) which are listed in Table 16. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 16

Test Freq (MHz)	Power (W)
450.0000	5.26
465.5000	5.34
481.0000	5.43
496.5000	5.42
512.0000	5.26

Assessments at the Body with Body worn PMLN7008A

DUT assessment with offered antennas, default battery and audio accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 16 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 17

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4065A	NNTN8128B	PMLN7008A	PMLN6130A	450.0							
				465.0							
				481.0	5.37	0.32	4.83	3.40	2.52	1.77	HvH-Ab-140514-02
				496.5							
				512.0							
FAF5260A				450.0	5.18	-0.36	8.42	5.90	**4.94**	3.46	HvH-Ab-140514-04
				465.0							
				481.0	5.34	0.02	7.39	5.15	3.87	2.70	HvH-Ab-140514-03
				496.5							
				512.0	5.11	-0.68	5.90	4.16	3.78	2.67	HvH-Ab-140514-05
Assessment of Additional Batteries											
FAF5260A	PMNN4424AR	PMLN7008A	PMLN6130A	450.0	5.26	-0.37	5.76	4.08	3.34	2.37	HvH-Ab-140514-06
				465.0							
				481.0							
				496.5							
				512.0							
	PMNN4448AR			450.0	5.46	-0.33	6.37	4.52	3.52	2.50	HvH-Ab-140514-07
				465.0							
				481.0							
				496.5							
				512.0							

Assessments at the Body with Body worn PMLN4651A
DUT assessment with offered antennas, default battery and audio accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 16 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)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4065A	NNTN8128B	PMLN4651A	PMLN6130A	450.0							
				465.0							
				481.0	5.48	-0.06	4.87	3.43	2.52	1.78	HvH-Ab-140514-08
				496.5							
				512.0							
FAF5260A				450.0	5.14	-0.34	8.39	5.91	**4.94**	3.48	HvH-Ab-140514-10
				465.0							
				481.0	5.35	0.07	7.49	5.25	3.92	2.75	HvH-Ab-140514-09
				496.5							
				512.0	5.12	-0.65	6.46	4.55	4.10	2.89	HvH-Ab-140515-02
Assessment of Additional Batteries											
FAF5260A	PMNN4424AR	PMLN4651A	PMLN6130A	450.0	5.29	-0.41	5.87	4.16	3.41	2.42	HvH-Ab-140515-03
				465.0							
				481.0							
				496.5							
				512.0							
	PMNN4448AR			450.0	5.12	-0.34	6.32	4.50	3.74	2.66	HvH-Ab-140515-04
				465.0							
				481.0							
				496.5							
				512.0							

Assessments at the Body with Body worn PMLN6085A
DUT assessment with offered antennas, default battery and audio accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 16 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 19

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4065A	NNTN8128B	PMLN6085A	PMLN6130A	450.0							
				465.0							
				481.0	5.35	0.37	1.01	0.76	0.53	0.40	HvH-Ab-140515-05
				496.5							
				512.0							
FAF5260A				450.0							
				465.0							
				481.0	5.33	0.11	1.55	1.17	**0.81**	0.61	HvH-Ab-140515-06
				496.5							
				512.0							
Assessment of Additional Batteries											
FAF5260A	PMNN4424AR	PMLN6085A	PMLN6130A	450.0							
				465.0							
				481.0	5.30	-0.12	1.25	0.94	0.68	0.51	HvH-Ab-140515-07
				496.5							
				512.0							
	PMNN4448AR			450.0							
				465.0							
				481.0	5.28	-0.11	1.24	0.94	0.67	0.51	HvH-Ab-140515-08
				496.5							
				512.0							

Assessments at the Body with Body worn PMLN6085A w/ NNTN5243A w/no loop

DUT assessment with offered antennas, default battery and audio accessory per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 16 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)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAE4065A	NNTN8128B	PMLN6085A w/NNTN5243A w/no loop	PMLN6130A	450.0							
				465.0							
				481.0	5.33	0.39	3.94	2.86	2.07	1.50	HvH-Ab-140515-10
				496.5							
				512.0							
FAF5260A				450.0							
				465.0							
				481.0	5.32	0.03	5.56	4.04	**2.93**	2.13	HvH-Ab-140515-09
				496.5							
				512.0							
Assessment of Additional Batteries											
FAF5260A	PMNN4424AR	PMLN6085A w/NNTN5243A w/no loop	PMLN6130A	450.0							
				465.0							
				481.0	5.26	-0.14	4.10	2.96	2.25	1.63	HvH-Ab-140515-11
				496.5							
				512.0							
	PMNN4448AR			450.0							
				465.0							
				481.0	5.26	-0.14	4.29	3.09	2.36	1.70	HvH-Ab-140515-12
				496.5							
				512.0							

Assessment at the Body with other audio accessories

Assessment of applicable additional offered audio accessories per KDB 643646 D01 SAR Test for PTT Radios v01r01. Tests were performed on frequency of highest SAR from body tests above.

Table 21

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (mW/g)	Meas. 10g-SAR (mW/g)	Max Calc. 1g-SAR (mW/g)	Max Calc. 10g-SAR (mW/g)	Run#
FAF5260A	NNTN8128B	PMLN7008A	PMMN4040A	450.00	5.14	-0.32	8.82	6.16	**5.17**	3.61	HvH-Ab-140516-02
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMMN4046A	450.00	5.13	-0.36	8.35	5.82	4.95	3.45	HvH-Ab-140516-03
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMMN4050A	450.00	5.14	-0.34	8.52	5.96	5.02	3.51	HvH-Ab-140516-04
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMLN5102A	450.00	5.12	-0.32	7.83	5.46	4.61	3.21	HvH-Ab-140516-05
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMLN5096B	450.00	5.14	-0.34	7.47	5.20	4.40	3.06	HvH-Ab-140516-06
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMLN5097A	450.00	5.14	-0.31	8.00	5.59	4.68	3.27	HvH-Ab-140516-07
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMLN5653A	450.00	5.10	-0.47	7.91	5.53	4.84	3.38	HvH-Ab-140516-08
				465.50							
				481.00							
				496.50							
				512.00							

Table 21 Continued

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (mW/g)	Meas. 10g-SAR (mW/g)	Max Calc. 1g-SAR (mW/g)	Max Calc. 10g-SAR (mW/g)	Run#
FAF5260A	NNTN8128B	PMLN7008A	HMN4104B	450.00	5.10	-0.33	8.56	5.96	5.07	3.53	HvH-Ab-140516-09
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	HMN4104B w/RMN5116A	450.00	5.12	-0.33	8.75	6.12	5.16	3.61	HvH-Ab-140516-10
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMMN4062A	450.00	5.12	-0.32	8.48	5.93	4.99	3.49	HvH-Ab-140516-11
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMMN4065A	450.00	5.14	-0.28	8.31	5.80	4.83	3.37	HvH-Ab-140516-12
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMMN4024A	450.00	5.11	-0.33	8.44	5.92	4.99	3.50	HvH-Ab-140516-13
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMLN5101A	450.00	5.10	-0.32	7.51	5.23	4.44	3.09	HvH-Ab-140517-02
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	PMLN5275B	450.00	5.11	-0.31	8.16	5.71	4.80	3.36	HvH-Ab-140517-03
				465.50							
				481.00							
				496.50							
				512.00							

Table 21 Continued

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (mW/g)	Meas. 10g-SAR (mW/g)	Max Calc. 1g-SAR (mW/g)	Max Calc. 10g-SAR (mW/g)	Run#
FAF5260A	NNTN8128B	PMLN7008A	RMN5058A	450.00	5.10	-0.31	7.23	5.04	4.26	2.97	HvH-Ab-140517-04
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	NNTN7869A w/ZMN6031A	450.00	5.10	-0.27	7.97	5.56	4.66	3.25	HvH-Ab-140517-05
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	NNTN7869A w/ZMN6032A	450.00	5.10	-0.38	7.52	5.25	4.51	3.15	HvH-Ab-140517-06
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	BDN6783B w_BDN6730A	450.00	5.14	-0.32	8.21	5.74	4.81	3.37	HvH-Ab-140517-07
				465.50							
				481.00							
				496.50							
				512.00							
FAF5260A	NNTN8128B	PMLN7008A	BDN6783B w/BDN6729A	450.00	5.12	-0.30	8.24	5.76	4.83	3.38	HvH-Ab-140517-08
				465.50							
				481.00							
				496.50							
				512.00							

Assessment outside FCC Part 90 at the body

Assessment outside FCC Part 90 with each of the offered antennas using the highest SAR test configuration from Part 90 assessments above. SAR plots of the highest results per table (bolded) are presented in APPENDIX H.

Table 22

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (mW/g)	Meas. 10g-SAR (mW/g)	Max Calc. 1g-SAR (mW/g)	Max Calc. 10g-SAR (mW/g)	Run#
FAF5260A	NNTN8128B	PMLN7008A	PMMN4040A	516.0000	5.26	-0.65	6.01	4.26	3.72	2.63	HvH-Ab-140517-09
				520.0000	4.96	-0.56	6.12	4.32	**3.93**	2.77	HvH-Ab-140517-10

13.2 LMR assessments at the Face for 450 – 512 MHz band

Battery PMNN4448AR was selected as the default battery for assessments at the Face because it has the highest capacity (refer to Exhibit 7B for battery illustration). The default battery was used during conducted power measurements for all test channels within Part 90 frequency range (450 – 512 MHz) which are listed in Table 19. The channel with the highest conducted power will be identified as the default channel per KDB 643646 (SAR Test for PTT Radios). SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 23

Test Freq (MHz)	Power (W)
450.0000	5.45
465.5000	5.59
481.0000	5.47
496.5000	5.47
512.0000	5.41

DUT assessment with offered antennas, default battery with front of DUT positioned 2.5cm facing phantom per KDB 643646. Optional batteries were tested per the requirements of KDB 643646. Refer to Table 23 for highest output power channel. SAR plots of the highest results per Table (bolded) are presented in Appendix E.

Table 24

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (mW/g)	Meas. 10g-SAR (mW/g)	Max Calc. 1g-SAR (mW/g)	Max Calc. 10g-SAR (mW/g)	Run#
PMAE4065A	PMNN4448AR	None	None	450.0							
				465.5	5.60	-0.20	3.76	2.84	1.97	1.49	HvH-Face-140619-02
				481.0							
				496.5							
				512.0							
FAF5260A			None	450.0							
				465.5	5.60	-0.36	5.81	4.38	3.16	2.38	HvH-Face-140619-03
				481.0							
				496.0							
				512.0							
FAF5260A	PMNN4424AR	None	None	450.0							
				465.5	5.50	-0.34	5.48	4.13	3.02	2.27	HvH-Face-140620-02
				481.0							
				495.5							
				512.0							
FAF5260A	NNTN8128B	None	None	450.0							
				465.5	5.22	-0.19	6.10	4.60	**3.42**	2.58	HvH-Face-140624-02
				481.0							
				495.0							
				512.0							

Assessment outside FCC Part 90 at the face

Assessment outside FCC Part 90 with each of the offered antennas using the highest SAR test configuration from Part 90 assessments above. SAR plots of the highest results per table (bolded) are presented in APPENDIX H.

Table 25

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (mW/g)	Meas. 10g-SAR (mW/g)	Max Calc. 1g-SAR (mW/g)	Max Calc. 10g-SAR (mW/g)	Run#
FAF5260A	NNTN8128B	None	None	516.0000	5.00	-0.75	4.25	3.18	**2.83**	2.12	HvH-Face-140624-05
				520.0000	5.16	-0.50	4.06	3.03	2.47	1.84	HvH-Face-140624-06

13.3 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)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
FAF5260	NNTN8128B	NTN8266B	PMLN7008A	450.0000	5.10	-0.15	8.81	6.15	**5.01**	3.50	HvH-Ab-140517-13

14.0 Results Summary

Based on the test guidelines from section 4.0 and satisfying frequencies within FCC bands, the highest Operational Maximum Calculated 1-gram and 10-gram average SAR values found for this filing:

Table 27

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
FCC	450 – 512	5.17	3.61	3.42	2.58
Overall	450 – 520	5.17	3.61	3.42	2.58

All results are scaled to the maximum output power.

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

15.0 Variability Assessment

Per the guidelines in KDB 865664 SAR variability assessment is required because SAR results are above 4.0W/kg (Occupational) or 0.8W/kg (General population) Choose applicable condition.

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

Table 28

Run#	Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq. (MHz)	Adj Calc. 1g-SAR (W/kg)	Ratio	Comments
HvH-Ab-140516-02	FAF5260A	NNTN8128B	PMLN7008A	PMMN4040A	450.0000	4.75	1.04	No additional repeated scans is required due to the Ratio (SAR_{high}/SAR_{low}) < 1.20
HvH-Ab-140517-13						4.56		

16.0 System Uncertainty

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

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

Appendix A
Measurement Uncertainty Budget

Uncertainty Budget for Device Under Test, for 450 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.7	N	1.00	1	1	6.7	6.7	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				12	11	482
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k* =2				23	23	

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 108**

Client **Motorola EME**

Certificate No: **ES3-3301_Aug13**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3301
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v8, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	August 27, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: August 28, 2013

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 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3301

Manufactured: August 27, 2010
Calibrated: August 27, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3301

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.48	1.02	1.24	± 10.1 %
DCP (mV)[B]	100.0	103.1	101.7	

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	172.9	±3.0 %
		Y	0.0	0.0	1.0		142.1	
		Z	0.0	0.0	1.0		157.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.10	66.1	19.2	5.80	108.6	±1.2 %
		Y	6.21	66.9	19.7		123.8	
		Z	6.51	67.8	20.2		137.5	
10109-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.12	66.8	19.8	6.43	116.7	±1.4 %
		Y	7.21	67.6	20.3		130.3	
		Z	7.50	68.3	20.6		146.1	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.86	65.8	19.1	5.75	107.0	±1.2 %
		Y	5.90	66.4	19.5		120.2	
		Z	6.15	67.1	19.8		134.4	
10111-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	6.84	66.4	19.7	6.44	111.7	±1.2 %
		Y	6.89	67.1	20.1		126.3	
		Z	7.26	68.0	20.5		142.9	
10112-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.36	67.0	20.0	6.59	116.8	±1.7 %
		Y	7.47	67.9	20.5		133.1	
		Z	7.80	68.6	20.8		149.5	
10113-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	7.08	66.6	19.9	6.62	113.1	±1.4 %
		Y	7.16	67.5	20.3		128.9	
		Z	7.51	68.2	20.7		144.8	
10142-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	6.17	67.5	20.1	5.73	148.0	±1.2 %
		Y	5.75	66.4	19.5		119.5	
		Z	5.99	67.0	19.8		132.7	
10143-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.60	66.4	19.6	6.35	109.0	±1.4 %
		Y	6.66	67.2	20.1		124.9	
		Z	6.97	67.7	20.3		139.8	
10145-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.85	67.1	19.9	5.76	142.6	±1.2 %
		Y	5.50	66.3	19.5		115.9	
		Z	5.74	66.6	19.6		129.0	
10146-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.80	68.1	20.6	6.41	147.0	±1.4 %
		Y	6.32	67.1	20.1		119.0	
		Z	6.69	67.7	20.4		133.0	

10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.31	67.6	20.2	5.75	149.1	±1.2 %
		Y	5.93	66.6	19.6		122.0	
		Z	6.18	67.2	19.9		135.0	
10155-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	6.84	66.4	19.7	6.43	110.9	±1.2 %
		Y	6.88	67.1	20.0		129.0	
		Z	7.24	68.0	20.5		143.3	
10156-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	6.09	67.3	20.1	5.79	145.5	±1.2 %
		Y	5.68	66.2	19.5		119.4	
		Z	5.97	66.9	19.8		132.3	
10157-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.58	66.3	19.7	6.49	106.7	±1.2 %
		Y	6.59	66.9	20.0		123.8	
		Z	7.00	67.9	20.5		138.6	
10158-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	7.04	66.5	19.7	6.62	111.3	±1.4 %
		Y	7.09	67.2	20.1		130.3	
		Z	7.54	68.3	20.8		145.1	
10159-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.67	66.3	19.7	6.56	107.7	±1.2 %
		Y	6.69	67.0	20.1		124.5	
		Z	7.14	68.0	20.6		139.8	
10166-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	5.22	66.6	19.6	5.46	134.3	±0.9 %
		Y	4.89	65.9	19.2		112.2	
		Z	5.15	66.4	19.5		124.6	
10167-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	6.12	67.5	20.3	6.21	135.5	±1.2 %
		Y	5.71	66.9	20.0		112.6	
		Z	6.11	67.5	20.3		126.3	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.04	66.7	19.9	5.72	128.1	±0.9 %
		Y	4.99	67.3	20.3		146.6	
		Z	5.01	66.6	19.8		118.6	
10176-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.82	67.8	20.8	6.52	127.4	±1.2 %
		Y	5.74	68.6	21.4		144.6	
		Z	5.76	67.6	20.6		118.3	
10177-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	5.06	66.8	19.9	5.73	128.2	±0.9 %
		Y	5.09	67.9	20.7		146.2	
		Z	5.02	66.7	19.8		118.5	
10178-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.83	67.8	20.8	6.52	127.4	±1.2 %
		Y	5.80	68.9	21.6		146.0	
		Z	5.78	67.7	20.7		118.4	
10179-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.81	67.8	20.7	6.50	127.6	±1.2 %
		Y	5.76	68.8	21.4		144.7	
		Z	5.75	67.6	20.6		118.2	
10180-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.82	67.9	20.8	6.50	127.5	±1.2 %
		Y	5.74	68.7	21.4		144.5	
		Z	5.79	67.8	20.7		118.8	

10184-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	5.03	66.6	19.8	5.73	127.1	±0.9 %
		Y	5.05	67.7	20.5		145.7	
		Z	5.02	66.6	19.8		119.3	
10185-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.79	67.6	20.7	6.51	127.2	±1.2 %
		Y	5.74	68.6	21.4		144.0	
		Z	5.81	67.8	20.7		118.5	
10187-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	5.05	66.7	19.9	5.73	128.0	±0.9 %
		Y	5.08	67.8	20.6		145.3	
		Z	5.02	66.6	19.8		119.3	
10188-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.81	67.7	20.7	6.52	127.6	±0.9 %
		Y	5.71	68.4	21.2		142.0	
		Z	5.80	67.7	20.7		119.2	
10298-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.93	67.2	19.9	5.72	142.2	±1.2 %
		Y	5.54	66.3	19.5		115.7	
		Z	5.85	66.9	19.8		132.3	
10299-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.95	68.3	20.7	6.39	149.5	±1.4 %
		Y	6.47	67.3	20.2		119.7	
		Z	6.86	68.0	20.5		137.0	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3301

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	45.3	0.87	7.40	7.40	7.40	0.27	1.18	± 13.4 %
450	43.5	0.87	6.85	6.85	6.85	0.20	2.30	± 13.4 %
750	41.9	0.89	6.39	6.39	6.39	0.29	1.93	± 12.0 %
900	41.5	0.97	6.06	6.06	6.06	0.34	1.77	± 12.0 %
1810	40.0	1.40	5.17	5.17	5.17	0.67	1.27	± 12.0 %
1950	40.0	1.40	5.00	5.00	5.00	0.49	1.54	± 12.0 %
2300	39.5	1.67	4.83	4.83	4.83	0.67	1.33	± 12.0 %
2450	39.2	1.80	4.55	4.55	4.55	0.66	1.43	± 12.0 %
2600	39.0	1.96	4.38	4.38	4.38	0.80	1.32	± 12.0 %
3500	37.9	2.91	4.22	4.22	4.22	1.00	1.18	± 13.1 %
3700	37.7	3.12	3.98	3.98	3.98	1.00	1.12	± 13.1 %

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3301

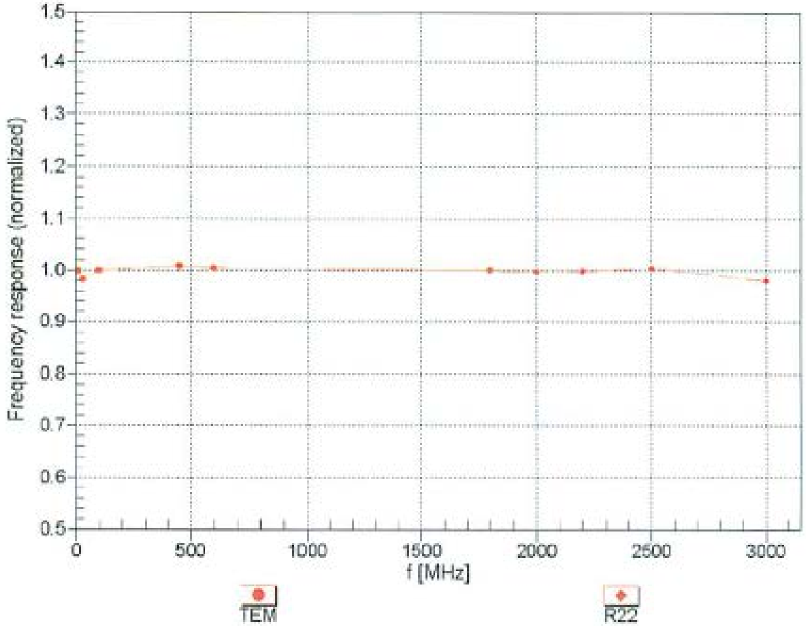
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	58.2	0.92	7.07	7.07	7.07	0.22	1.61	± 13.4 %
450	56.7	0.94	7.11	7.11	7.11	0.09	1.20	± 13.4 %
750	55.5	0.96	6.01	6.01	6.01	0.38	1.77	± 12.0 %
900	55.0	1.05	5.89	5.89	5.89	0.51	1.49	± 12.0 %
1810	53.3	1.52	4.80	4.80	4.80	0.68	1.32	± 12.0 %
1950	53.3	1.52	4.76	4.76	4.76	0.58	1.56	± 12.0 %
2300	52.9	1.81	4.40	4.40	4.40	0.80	1.22	± 12.0 %
2450	52.7	1.95	4.23	4.23	4.23	0.80	1.04	± 12.0 %
2600	52.5	2.16	4.04	4.04	4.04	0.80	1.01	± 12.0 %
3500	51.3	3.31	3.81	3.81	3.81	1.00	1.01	± 13.1 %
3700	51.0	3.55	3.58	3.58	3.58	1.00	1.22	± 13.1 %

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

Frequency Response of E-Field

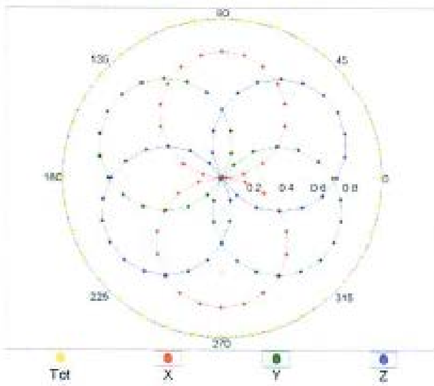
(TEM-Cell:ifi110 EXX, Waveguide: R22)



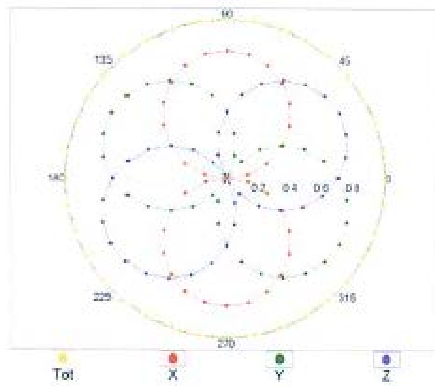
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

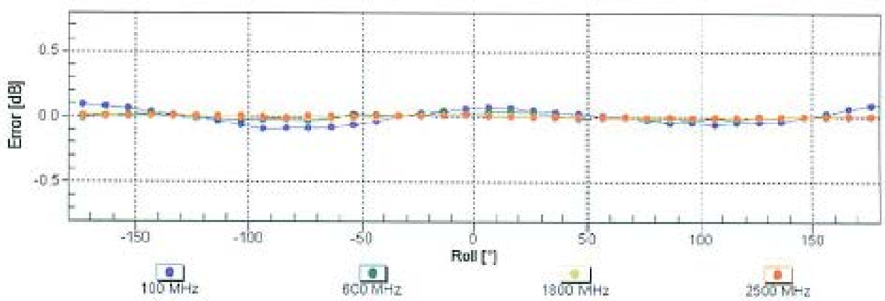
Receiving Pattern (φ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

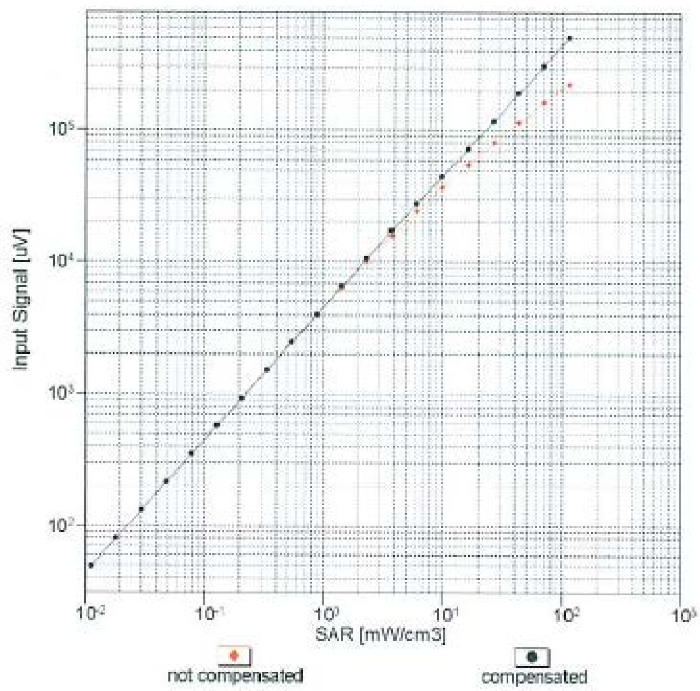


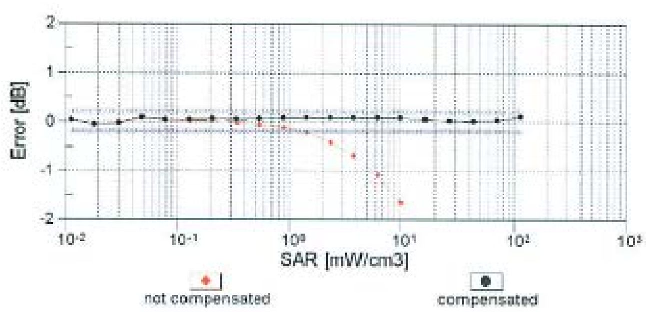


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

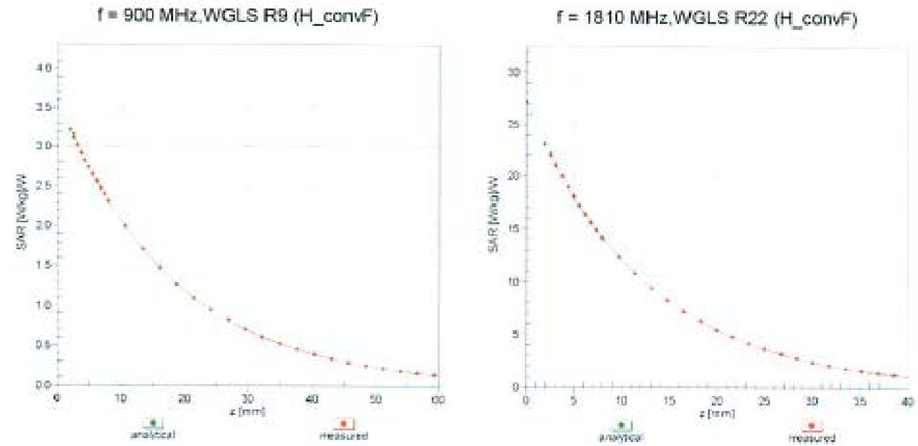
(TEM cell , f = 900 MHz)





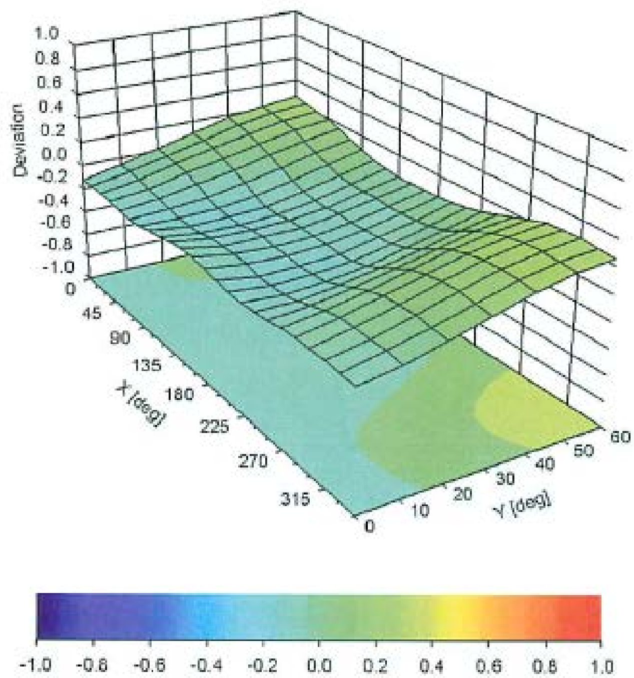
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3301

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-73.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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info@speag.com, http://www.speag.com

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV3**
Serial Number:	**3301**
Place of Assessment:	**Zurich**
Date of Assessment:	**August 29, 2013**
Probe Calibration Date:	**August 27, 2013**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 450, 900 or at 1810 MHz.

Assessed by:

Schmid & Partner Engineering AG

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Dosimetric E-Field Probe ES3DV3 SN:3291

Conversion factor (± standard deviation)

150 ± 50 MHz	*ConvF*	8.24 ± 10%	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
250 ± 50 MHz	*ConvF*	7.67 ± 10%	ε_r = 47.6 ± 5% σ = 0.83 ± 5% mho/m (head tissue)
150 ± 50 MHz	*ConvF*	7.85 ± 10%	ε_r = 61.9 ± 5% σ = 0.80 ± 5% mho/m (body tissue)
250 ± 50 MHz	*ConvF*	7.57 ± 10%	ε_r = 59.4 ± 5% σ = 0.88 ± 5% mho/m (body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also DASY Manual.

Appendix C
Dipole Calibration Certificates

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

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

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

Accreditation No.: SCS 108

Client **Motorola EME**

Certificate No: D450V3-1075_Jul13

CALIBRATION CERTIFICATE

Object	D450V3 - SN: 1075
Calibration procedure(s)	QA CAL-15.v7 Calibration procedure for dipole validation kits below 700 MHz
Calibration date:	July 23, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ET3DV6	SN: 1507	28-Dec-12 (No. ET3-1507_Dec12)	Dec-13
DAE4	SN: 654	18-Jul-13 (No. DAE4-654_Jul13)	Jul-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: July 23, 2013

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

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

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	44.0 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.73 W/kg ± 18.1 % (k=2)**

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

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.1 ± 6 %	0.95 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.51 W/kg ± 18.1 % (k=2)**

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

Appendix

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 24, 2010

DASY5 Validation Report for Head TSL

Date: 23.07.2013

Test Laboratory: The name of your organization

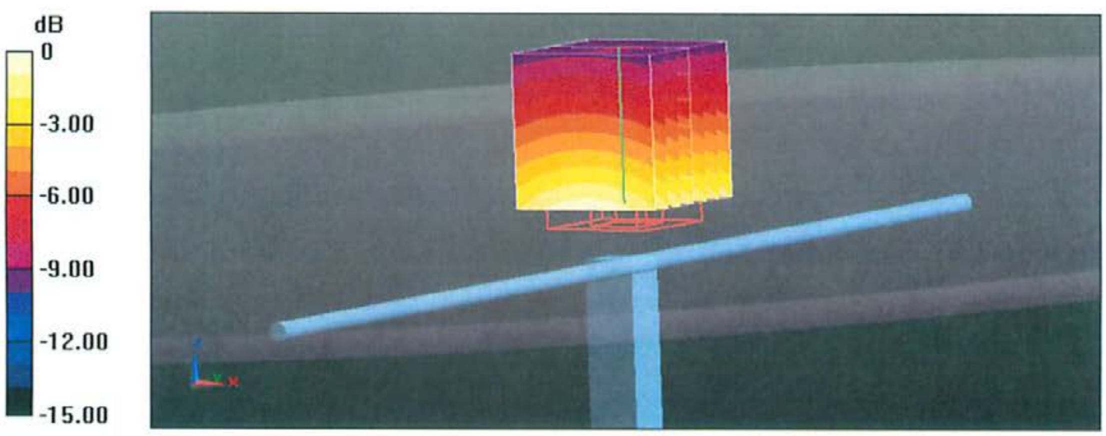
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1075

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

DASY52 Configuration:

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

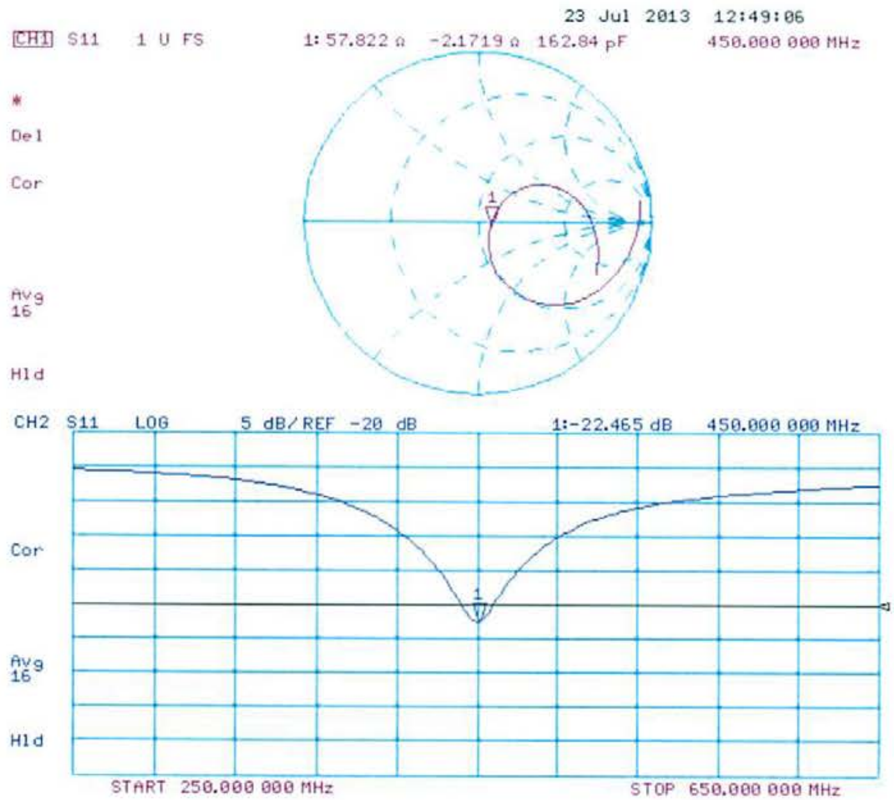
Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.426 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.84 W/kg
SAR(1 g) = 1.2 W/kg; SAR(10 g) = 0.794 W/kg
Maximum value of SAR (measured) = 1.28 W/kg



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

Certificate No: D450V3-1075_Jul13 Page 5 of 8

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.07.2013

Test Laboratory: The name of your organization

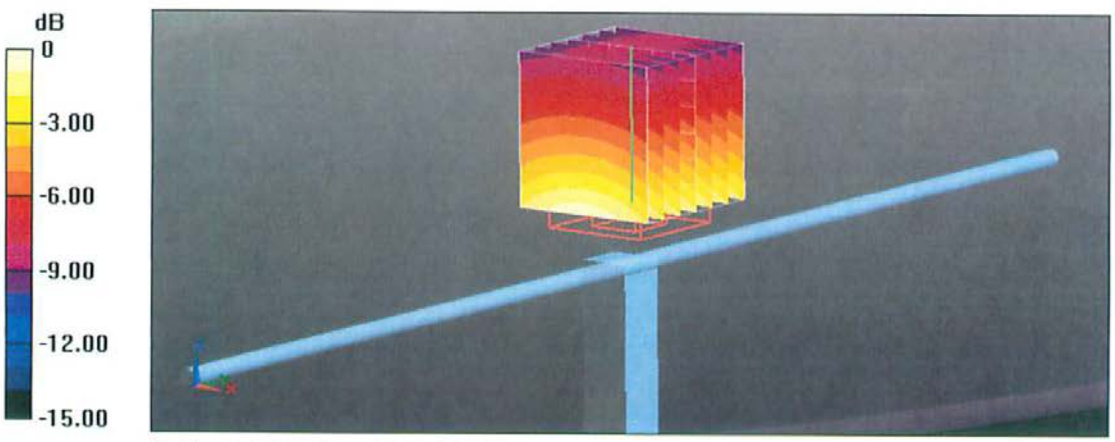
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1075

Communication System: UID 0 - CW ; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.95 S/m; ε_r = 56.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(7.03, 7.03, 7.03); Calibrated: 28.12.2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 18.07.2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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



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

Impedance Measurement Plot for Body TSL