



DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

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Date/s Tested: 4/07/2015, 4/10/2015, 4/27/2015, 4/29/2015
Manufacturer/Location: Motorola Solutions Inc., Penang
Sector/Group/Div.: AESS
Date submitted for test: 04/01/2015
DUT Description: APX4000 896-901MHz, 901-902MHz, 935-940MHz, 940-941MHz at 2.5W, 2.402-2.48 GHz at 10mW, 6.25kHz/12.5kHz, Single display, full keypad or limited keypad. Capable of digital and analog FM transmission. Also capable of TDMA transmission. This radio is Bluetooth equipped.
Test TX mode(s): CW (PTT)
Max. Power output: 3.0 W for 896-941 MHz, 10 mW for 2.402-2.48 GHz
Nominal Power: 2.5 W for 896-941 MHz, 10 mW 2.402-2.48 GHz
Tx Frequency Bands: 896-941 MHz, 2.402-2.48 GHz
Signaling type: FM, TDMA, FHSS (Bluetooth)
Model(s) Tested: H51WCF9PW6AN (MUF1802), H51WCH9PW7AN (MUF1803)
Model(s) Certified: H51WCH9PW7AN (MUF1803), H51WCF9PW6AN (MUF1802)
Serial Number(s): 426CRF7189, 426CRF5549
Classification: Occupational/Controlled
FCC ID: AZ489FT5861; 896-941 MHz, 2.402-2.48 GHz
IC: 109U-89FT5861

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.

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Report Revision History

Date	Revision	Comments
05/22/2015	A	PCII Report Due To Added Body Worn Accessory

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 numbers H51WCF9PW6AN (MUF1802) and H51WCH9PW7AN (MUF1803). This device is classified as Occupational/Controlled. The information herein is to show evidence of compliance based on SAR evaluation of the design change (2 knobs vs 1 knob) and additional body worn accessory, PMLN7182A.

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	896-902 MHz	2.75	1.96	1.68	1.21
	935-941 MHz	2.09	1.48	1.15	0.82
*DSS	2402-2480MHz	NA	NA	NA	NA
Simultaneous Results		3.07	2.09	2.00	1.34

*Results not required per KDB

3.0 Abbreviations / Definitions

BT: Bluetooth
 CNR: Calibration Not Required
 CW: Continuous Wave
 C4FM: Continuous 4 Level Frequency Modulation
 CQPSK: Compatible Quadrature Phase Shift Keying
 DSP: Digital Signal Processing
 DUT: Device Under Test
 EME: Electromagnetic Energy
 FHSS: Frequency Hopping Spread Spectrum
 FM: Frequency Modulation
 LMR: Land Mobile Radio
 NA: Not Applicable
 PTT: Push to Talk
 QPSK: Quadrature Pulse Shift Key
 RSM: Remote Speaker Microphone
 SAR: Specific Absorption Rate
 TDMA: Time Division Multiple Access
 TNF: Licensed Non-Broadcast Transmitter Held to Face

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

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

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

4.0 Referenced Standards and Guidelines

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

- IEC62209-1 (2005) Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
- Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C.: 1997.
- IEEE 1528 (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
- 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
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- FCC KDB – 865664 D02 RF Exposure Reporting v01r01
- FCC KDB – 447498 D01 General RF Exposure Guidance v05r02

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 in the LMR bands using frequency modulation (FM) and TDMA signals incorporating traditional simplex two-way radio transmission protocol. This device also contains Bluetooth technology for short range wireless devices.

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%.

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

This device also incorporates a Class 1 Bluetooth device which is a Frequency Hopping Spread Spectrum (FHSS) technology. The Bluetooth radio modem is used to wireless link audio accessories. The maximum actual transmission duty cycle is imposed by the Bluetooth standard. The maximum duty cycle for BT is 76.1%. Refer to section 14.0 Simultaneous Transmission Exclusion.

The intended operating positions are “at the face” with the DUT at least 2.5 cm from the mouth, and “at the body” by means of the offered body worn accessories. Body worn audio and PTT operation is accomplished by means of optional remote accessories that are connected to the radio. Operation at the body without an audio accessory attached is possible by means of BT accessories.

7.0 Optional Accessories and Test Criteria

These devices are offered with optional accessories. The following sections identify the test criteria and details for each accessory category applicable for this PCII filing only. Please refer to initial filing for a detailed listing of previously approved offered accessories.

7.1 Antennas

There is one removable antenna applicable for this PCII filing. The Table below lists its description.

Table 3

Antenna Models	Description	Selected for test	Tested
PMAF4008A	896-941MHz, ½ wave, 0.5 dBi	Yes	Yes

7.2 Battery

The Table below lists the batteries considered in order to demonstrate PCII compliance.

Table 4

Battery Models	Description	Selected for test	Tested	Comments
NNTN8128B	APX4000 IMPRES Lithium Ion Battery Slim	Yes	Yes	
NNTN8560A	IMPRES Lithium Ion Battery TIA4950 IP67 2500mAh	Yes	Yes	
PMNN4448AR	IMPRES Lithium Ion High Cap Battery 2700 mAh	Yes	Yes	

7.3 Body worn Accessories

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

Table 5

Body worn Models	Description	Selected for test	Tested	Comments
PMLN7182A	Hard Leather Carry Case	Yes	Yes	
PMLN4651A	2 inch Belt Clip	Yes	Yes	
NTN5243A	Carry Strap	Yes	Yes	

7.4 Audio Accessories

No audios were needed to demonstrate PCII compliance. Please refer to initial filing for a detailed listing of previously approved offered audio accessories.

8.0 Description of Test System



8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 6

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 7

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

8.3 Description of Simulated Tissue

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

The simulated tissue mixture was mixed based on the Simulated Tissue Composition indicated in Table 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 8

Ingredients	900MHz	
	Head	Body
Sugar	56.5	44.9
Diacetin	0	0
De ionized – Water	40.95	53.06
Salt	1.45	0.94
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 9

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Speag Probe	ES3DV3	3291	7/21/2014	7/21/2015
Speag Probe	ES3DV3	3163	3/24/2015	3/24/2016
Speag DAE	DAE4	1231	3/20/2015	3/20/2016
Speag DAE	DAE4	850	7/23/2014	7/23/2015
Speag Dipole	D900V2	85	2/12/2014	2/12/2016
Power Meter (Keysight)	E4418B	US39251150	2/5/2015	2/5/2016
Power Sensor (Keysight)	8482B	3318A07393	2/10/2015	2/10/2016
Power Meter (Keysight)	E4419B	MY50000505	9/4/2014	9/4/2015
E-Series Avg. Power Sensor	E9301B	MY50290001	9/17//2014	9/17/2015
Power Meter (Keysight)	E4418B	US39251152	2/24/2015	2/24/2016
Power Meter (Keysight)	E4418B	US39251266	1/22/2015	1/22/2016
E-Series Avg. Power Sensor (Keysight)	E9301B	MY41495730	4/14/2015	4/14/2016
E-Series Avg. Power Sensor (Keysight)	E9301B	MY41495733	4/14/2015	4/14/2016
Bi-Directional Coupler (NARDA)	3020A	31744	9/17/2013	9/17/2015
Bi-Directional Coupler	3020A	40295	9/23/2013	9/23/2015
Signal Generator (Keysight)	E4438C	MY44270302	8/25/2014	8/25/2015
AMP (PST) AR Series	AR2729- 10/5506	M2K2A00-001	CNR	CNR
AMP (Amplifier Research)	10WD1000	28782	CNR	CNR
Dickson Temperature Recorder	TM320	7081356	9/16/2014	9/16/2015
Omega Digital Thermometer with J Type TC Probe	HH202A	18800	4/6/2015	4/6/2016
Keysight PNA-L Network Analyzer	N5230C	MY49002155	8/4/2014	8/4/2015
Dielectric Probe Kit (DAK2)	DAK-3.5	1088	9/16/2014	9/16/2015
Dielectric Probe Kit (DAK2)	DAK-12	1040	9/16/2014	9/16/2015

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 10

Dates	Probe Calibration Point	Probe SN	Measured Tissue Parameters		Validation			
			σ	ϵ_r	Sensitivity	Linearity	Isotropy	
CW								
9/11/14	Body	900	3291	1.08	55.4	Pass	Pass	Pass
9/12/14	Head	900		1.00	40.2	Pass	Pass	Pass
4/26/15	Body	900	3163	1.03	52.7	Pass	Pass	Pass
4/23/15	Head	900		1.01	40.3	Pass	Pass	Pass

10.2 System Verification

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

Table 11

Probe Serial #	Tissue Type	Dipole Kit / Serial #	Ref SAR @ 1W (W/kg)	System Check Results Measured (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date
3291	FCC Body	SPEAG D900V2 / 085	10.40 +/- 10%	2.73	10.92	04/07/2015
				2.75	11.00	04/10/2015
3163				2.75	11.00	04/27/2015
				2.80	11.20	04/28/2015
	IEEE/IEC Head			2.54	10.16	04/28/2015*

*System verification done on 04/28/2015 is valid for face scans done on 04/29/2015; scans were taken within 24hrs of system verification.

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 12

Frequency (MHz)	Tissue Type	Conductivity Target (S/m)	Dielectric Constant Target	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
896	FCC Body	1.05 (0.99-1.10)	55.0 (52.3-57.8)	1.10	52.9	04/07/2015
				1.09	53.1	04/10/2015
				1.03	52.7	04/27/2015
	IEEE/IEC Head	0.97 (0.92-1.01)	41.5 (39.4-43.6)	0.98	40.1	04/28/2015*
900	FCC Body	1.05 (1.00-1.10)	55.0 (52.3-57.8)	1.10	52.9	04/07/2015
				1.10	53.0	04/10/2015
				1.03	52.7	04/27/2015
				1.05	52.6	04/28/2015
	IEEE/IEC Head	0.97 (0.92-1.02)	41.5 (39.4-43.6)	0.99	40.1	04/28/2015*
938	FCC Body	1.07 (1.02-1.12)	55.0 (52.2-57.7)	1.09	52.3	04/28/2015
	IEEE/IEC Head	0.99 (0.94-1.04)	41.5 (39.4-43.5)	1.02	39.6	04/28/2015*

*Tissue measurements done on 04/28/2015 is valid for face scans done on 04/29/2015; scans were taken within 24hrs of system verification.

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°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 13

	Target	Measured
Ambient Temperature	18 – 25 °C	Range: 20.3 – 23.1°C Avg. 21.7 °C
Tissue Temperature	NA	Range: 20.7-22.5°C Avg. 21.6°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 14

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

12.2 DUT Configuration(s)

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

12.3 DUT Positioning Procedures

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

12.3.1 Body

The DUT was positioned in highest applicable configuration against the phantom with the offered body worn accessories.

12.3.2 Head

Not applicable.

12.3.3 Face

The DUT was positioned with its' front 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.

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

Where

N_c = Number of channels

F_{high} = Upper channel

F_{low} = Lower channel

F_c = Center channel

12.5 SAR Result Scaling Methodology

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

$$\text{Max_Calc} = \text{SAR_meas} \cdot 10^{\frac{-\text{Drift}}{10}} \cdot \frac{P_{\text{max}}}{P_{\text{int}}} \cdot \text{DC}$$

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 $P_{\text{int}} > P_{\text{max}}$, then $P_{\text{max}}/P_{\text{int}} = 1$.

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 DUT was assessed at the highest applicable configurations found during the initial compliance assessment on file with the FCC. 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 Assessments at the Body

The DUT was assessed with newly offered body worn at the highest applicable configuration at the body found during the initial compliance assessment on file with the FCC. SAR plots of the highest results are presented in appendix E.

Table 15

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#
PMAF4008A	NNTN8128B	PMLN7182A w/ NTN5243A w/o belt loop	None	937.500	2.79	-0.48	3.48	2.47	2.09	1.48	AvG-Ab-150428-07
		896.025		2.88	-0.41	4.79	3.37	2.74	1.93	HvH-Ab-150407-10	
				2.70	-0.66	3.21	2.31	2.07	1.49	AvG-Ab-150427-07	

13.2 Assessments at the Face

The DUT was assessed at the face at the highest applicable configurations at the face found during the initial compliance assessment on file with the FCC. SAR plots of the highest results are presented in appendix E.

Table 16

Antenna	Battery	Carry Accessory	Cable Accessory	Test Freq (MHz)	Init Pwr (W)	SAR Drift (dB)	Meas. 1g-SAR (W/kg)	Meas. 10g-SAR (W/kg)	Max Calc. 1g-SAR (W/kg)	Max Calc. 10g-SAR (W/kg)	Run#
PMAF4008A	NNTN8560A	None	None	896.025	2.81	-0.33	2.92	2.11	1.68	1.21	AvG-Face-150429-01
	PMNN4448AR	None	None	937.500	2.81	-0.39	1.97	1.40	1.15	0.82	AvG-Face-150429-03

13.3 Assessment for Industry Canada

Not Applicable.

13.4 Assessment at the Bluetooth band

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

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{F(\text{GHz})}] = 2.39, \text{ which is } \leq 3 \text{ for 1-g SAR}$$

Where:

Max. Power = 7.61mW (10mW*76.1% duty cycle)

Min. test separation distance = 5mm for actual test separation < 5mm

F(GHz) = 2.48 GHz

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

13.5 Shortened Scan Assessment

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

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#
PMAF4008A	NNTN8128B	PMLN7182A w/ NTN5243A w/o belt loop	None	896.025	2.79	-0.27	4.81	3.43	2.75	1.96	HvH-Ab-150410-02

14.0 Simultaneous Transmission Exclusion for BT

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

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] * [\sqrt{F(\text{GHz})/X}] \leq 0.4 \text{ W/kg (1g)}$$

Where:

X = 7.5 for 1g-SAR; 18.75 for 10g

Max. Power = 7.61mW (10mW*76.1% duty cycle)

Min. test separation distance = 5mm for actual test separation < 5mm

F(GHz) = 2.48 GHz

Based on the equation and parameters above, the 1g/10g estimated SAR for simultaneous transmission is 0.32/0.13 W/kg.

15.0 Results Summary

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

Table 18

Designator	Frequency band (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR
LMR	896-902	2.75	1.96	1.68	1.21
	935-941	2.09	1.48	1.15	0.82
Simultaneous		3.07	2.09	2.00	1.34

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.

The result at the body with the new body worn accessory indicates a Class II Permissive Change. The original SAR result at the face remains the highest reported SAR for this FCC ID.

16.0 Variability Assessment

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

17.0 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.

Appendix A

Measurement Uncertainty Budget

Uncertainty Budget for Device Under Test, for 800 MHz to 3 GHz									
a	b	c	d	e = f(d,k)	f	g	h =	i =	k
							c x f / e	c x g / e	
Uncertainty Component	IEEE	Tol.	Prob	Div.	c _i	c _i	1 g	10 g	v _i
	1528	(± %)	Dist		(1 g)	(10 g)	u _i	u _i	
	section				(±%)	(±%)			
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							11	11	419
Expanded Uncertainty									
(95% CONFIDENCE LEVEL)									
			RSS				22	22	
			k=2						

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) c_i - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) u_i – SAR uncertainty
- h) v_i - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty

Uncertainty Budget for System Verification (dipole & flat phantom) for 900 MHz									
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	$e = f(d,k)$	<i>f</i>	<i>g</i>	$h = c \times f / e$	$i = c \times g / e$	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol.	Prob.	Div.	c_i	c_i	1 g	10 g	v_i
		(± %)	Dist.		(1 g)	(10 g)	u_i (±%)	u_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	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				9	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			$k=2$				18	18	

Notes for uncertainty budget Tables:

- a) Column headings *a-k* are given for reference.
- b) Tol. - tolerance in influence quantity.
- c) Prob. Dist. – Probability distribution
- d) N, R - normal, rectangular probability distributions
- e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
- f) c_i - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) u_i – SAR uncertainty
- h) v_i - 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
S Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: **SCS 108**

Client **Motorola EME**

Certificate No: **ES3-3291_Jul14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3291**

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: **July 21, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013 Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660 Dec13)	Dec-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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: July 21, 2014

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

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., θ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- **NORM_{x,y,z}**: Assessed for E-field polarization θ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- **NORM(f)_{x,y,z}** = NORM_{x,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.
- **DCP_{x,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
- **A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 NORM_{x,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 NORM_x (no uncertainty required).

ES3DV3 – SN:3291

July 21, 2014

Probe ES3DV3

SN:3291

Manufactured: July 6, 2010
Calibrated: July 21, 2014

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

ES3DV3-- SN:3291

July 21, 2014

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.86	1.38	0.82	± 10.1 %
DCP (mV) ^B	105.1	99.8	104.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√ μV	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	173.5	±2.5 %
		Y	0.0	0.0	1.0		168.9	
		Z	0.0	0.0	1.0		167.6	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.24	67.0	19.3	5.67	131.3	±1.4 %
		Y	6.24	66.6	19.2		127.6	
		Z	6.44	67.7	19.7		146.9	
10101-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	7.30	67.3	19.8	6.42	137.0	±1.7 %
		Y	7.39	67.3	19.8		137.3	
		Z	7.25	67.2	19.7		132.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.36	67.5	19.7	5.80	149.4	±1.4 %
		Y	6.18	66.4	19.2		126.3	
		Z	6.28	67.3	19.6		144.6	
10109-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.02	66.9	19.6	6.43	132.0	±1.4 %
		Y	7.15	66.9	19.7		134.2	
		Z	6.98	66.9	19.7		128.3	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.15	67.5	19.8	5.75	145.5	±1.9 %
		Y	6.08	66.7	19.4		147.1	
		Z	5.94	66.7	19.4		141.7	
10111-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	6.82	67.0	19.7	6.44	131.8	±1.7 %
		Y	6.87	66.6	19.5		130.0	
		Z	6.97	67.6	20.1		147.9	
10112-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.36	67.5	20.0	6.59	138.4	±1.9 %
		Y	7.37	67.0	19.8		136.7	
		Z	7.23	67.2	19.9		129.6	
10113-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	7.06	67.2	19.9	6.62	133.6	±1.9 %
		Y	7.14	66.9	19.8		131.7	
		Z	7.22	67.9	20.3		149.7	
10140-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	7.58	67.8	20.1	6.49	142.7	±1.7 %
		Y	7.62	67.5	20.0		140.7	
		Z	7.45	67.4	19.9		134.2	
10142-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.88	67.0	19.6	5.73	146.8	±1.4 %
		Y	5.93	66.6	19.4		144.3	
		Z	5.76	66.6	19.4		138.3	
10143-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.56	66.9	19.7	6.35	128.4	±1.4 %
		Y	6.63	66.5	19.5		127.4	
		Z	6.73	67.7	20.1		144.0	

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10145-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.56	66.6	19.4	5.76	141.0	±1.4 %
		Y	5.63	66.2	19.3		139.5	
		Z	5.48	66.5	19.3		132.8	
10146-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.46	67.7	20.1	6.41	143.9	±1.7 %
		Y	6.57	67.3	20.0		143.2	
		Z	6.34	67.6	20.1		134.8	
10149-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.03	67.0	19.7	6.42	131.0	±1.4 %
		Y	7.14	66.9	19.7		133.8	
		Z	6.97	66.8	19.6		128.1	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.01	66.9	19.5	5.75	143.8	±1.4 %
		Y	6.12	66.9	19.6		147.1	
		Z	5.97	66.9	19.5		141.0	
10155-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	6.75	66.7	19.6	6.43	127.1	±1.7 %
		Y	6.87	66.6	19.6		130.2	
		Z	6.98	67.7	20.2		148.1	
10156-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.80	66.8	19.5	5.79	139.6	±1.4 %
		Y	5.87	66.5	19.4		142.9	
		Z	5.72	66.6	19.5		136.2	
10157-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.77	67.7	20.2	6.49	146.2	±1.7 %
		Y	6.90	67.5	20.2		148.7	
		Z	6.68	67.6	20.2		141.4	
10158-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	6.99	67.0	19.8	6.62	129.0	±1.7 %
		Y	7.13	66.9	19.8		131.6	
		Z	7.23	67.9	20.4		149.7	
10159-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.90	67.9	20.3	6.56	146.9	±1.7 %
		Y	7.00	67.5	20.2		149.2	
		Z	6.81	67.8	20.3		142.2	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.21	66.5	19.2	5.82	126.2	±1.4 %
		Y	6.28	66.3	19.2		128.0	
		Z	6.44	67.5	19.8		146.7	
10161-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.07	67.0	19.7	6.43	131.5	±1.7 %
		Y	7.21	67.0	19.8		135.2	
		Z	7.04	67.1	19.8		128.9	
10166-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	4.91	66.2	19.1	5.46	129.8	±1.2 %
		Y	5.03	65.9	19.0		133.2	
		Z	5.08	67.1	19.7		149.2	
10167-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	5.76	67.3	19.9	6.21	130.5	±1.2 %
		Y	5.95	67.0	19.8		134.5	
		Z	5.67	67.2	19.9		127.0	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.90	67.3	20.0	5.73	149.0	±1.4 %
		Y	5.01	66.7	19.7		147.7	
		Z	4.83	67.0	19.9		141.6	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.59	68.3	20.9	6.52	147.6	±1.7 %
		Y	5.84	68.2	20.8		148.7	
		Z	5.49	68.0	20.7		140.1	

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10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.88	67.2	19.9	5.72	148.5	±1.4 %
		Y	5.02	66.8	19.7		147.3	
		Z	4.81	66.9	19.8		140.9	
10176-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.61	68.4	20.9	6.52	147.6	±1.9 %
		Y	5.83	68.1	20.7		148.5	
		Z	5.48	67.9	20.7		140.4	
10177-CAD	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.89	67.2	20.0	5.73	147.9	±1.4 %
		Y	5.02	66.8	19.7		148.0	
		Z	4.84	67.0	19.9		140.5	
10178-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.62	68.5	21.0	6.52	147.7	±1.7 %
		Y	5.84	68.1	20.7		148.2	
		Z	5.47	67.9	20.7		139.8	
10179-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.60	68.4	20.9	6.50	148.1	±1.7 %
		Y	5.85	68.3	20.8		148.2	
		Z	5.50	68.1	20.8		139.9	
10180-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.60	68.5	20.9	6.50	147.6	±1.7 %
		Y	5.85	68.2	20.8		148.1	
		Z	5.49	68.0	20.7		139.9	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.92	67.4	20.1	5.72	148.0	±1.4 %
		Y	5.01	66.7	19.7		147.2	
		Z	4.85	67.1	19.9		140.6	
10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.58	68.3	20.9	6.52	147.0	±1.9 %
		Y	5.83	68.1	20.7		148.5	
		Z	5.50	68.0	20.7		140.0	
10184-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	4.91	67.3	20.0	5.73	148.2	±1.4 %
		Y	5.03	66.8	19.7		146.9	
		Z	4.84	67.0	19.9		140.7	
10185-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.60	68.4	20.9	6.51	147.0	±1.7 %
		Y	5.83	68.1	20.7		148.2	
		Z	5.50	68.0	20.8		139.1	
10187-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	4.92	67.4	20.0	5.73	147.7	±1.4 %
		Y	5.03	66.8	19.7		147.6	
		Z	4.83	67.0	19.9		140.9	
10188-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.61	68.4	21.0	6.52	146.5	±1.7 %
		Y	5.85	68.1	20.8		148.0	
		Z	5.49	67.9	20.7		139.9	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.14	66.7	19.4	5.81	126.8	±1.7 %
		Y	6.44	67.4	19.8		149.2	
		Z	6.33	67.4	19.8		143.4	
10298-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.66	66.8	19.5	5.72	141.5	±1.4 %
		Y	5.71	66.3	19.3		140.5	
		Z	5.56	66.6	19.4		133.9	
10299-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.63	68.0	20.3	6.39	146.3	±1.7 %
		Y	6.69	67.4	20.0		145.5	
		Z	6.48	67.7	20.2		137.5	

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10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.72	67.3	19.7	6.06	132.4	±1.7 %
		Y	6.78	67.2	19.7		130.6	
		Z	6.92	68.0	20.1		149.6	

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 E²-field uncertainty inside TSL (see Pages8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
150	52.3	0.76	7.68	7.68	7.68	0.05	1.50	± 13.3 %
220	49.0	0.81	7.64	7.64	7.64	0.10	1.90	± 13.3 %
300	45.3	0.87	7.56	7.56	7.56	0.20	1.10	± 13.3 %
450	43.5	0.87	7.33	7.33	7.33	0.19	2.00	± 13.3 %
750	41.9	0.89	6.62	6.62	6.62	0.31	1.91	± 12.0 %
900	41.5	0.97	6.26	6.26	6.26	0.52	1.39	± 12.0 %
1810	40.0	1.40	5.19	5.19	5.19	0.42	1.61	± 12.0 %
1950	40.0	1.40	4.98	4.98	4.98	0.80	1.14	± 12.0 %
2300	39.5	1.67	4.76	4.76	4.76	0.75	1.23	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.74	1.27	± 12.0 %
2600	39.0	1.96	4.39	4.39	4.39	0.80	1.21	± 12.0 %
3500	37.9	2.91	4.37	4.37	4.37	0.80	1.30	± 13.1 %
3700	37.7	3.12	3.99	3.99	3.99	0.80	1.30	± 13.1 %

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

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

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

ES3DV3- SN:3291

July 21, 2014

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
150	61.9	0.80	7.28	7.28	7.28	0.05	1.50	± 13.3 %
220	60.2	0.86	7.12	7.12	7.12	0.05	1.60	± 13.3 %
300	58.2	0.92	7.25	7.25	7.25	0.20	1.70	± 13.3 %
450	56.7	0.94	7.41	7.41	7.41	0.11	1.05	± 13.3 %
750	55.5	0.96	6.33	6.33	6.33	0.57	1.34	± 12.0 %
900	55.0	1.05	6.19	6.19	6.19	0.80	1.16	± 12.0 %
1810	53.3	1.52	4.89	4.89	4.89	0.76	1.33	± 12.0 %
1950	53.3	1.52	4.81	4.81	4.81	0.62	1.44	± 12.0 %
2300	52.9	1.81	4.40	4.40	4.40	0.71	1.25	± 12.0 %
2450	52.7	1.95	4.20	4.20	4.20	0.70	1.16	± 12.0 %
2600	52.5	2.16	4.03	4.03	4.03	0.80	1.00	± 12.0 %
3500	51.3	3.31	3.72	3.72	3.72	0.93	1.30	± 13.1 %
3700	51.0	3.55	3.63	3.63	3.63	0.90	1.39	± 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.

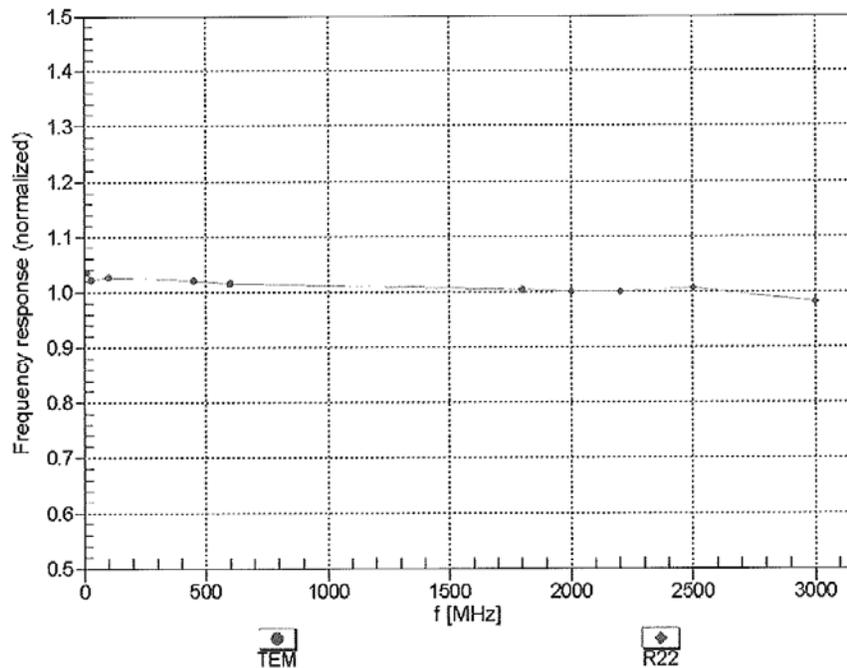
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

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

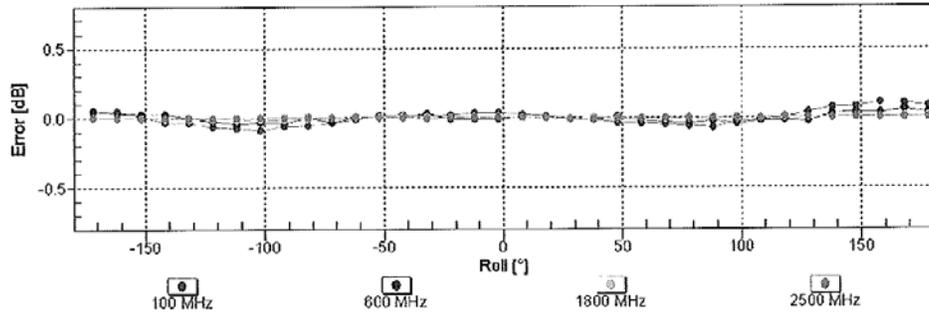
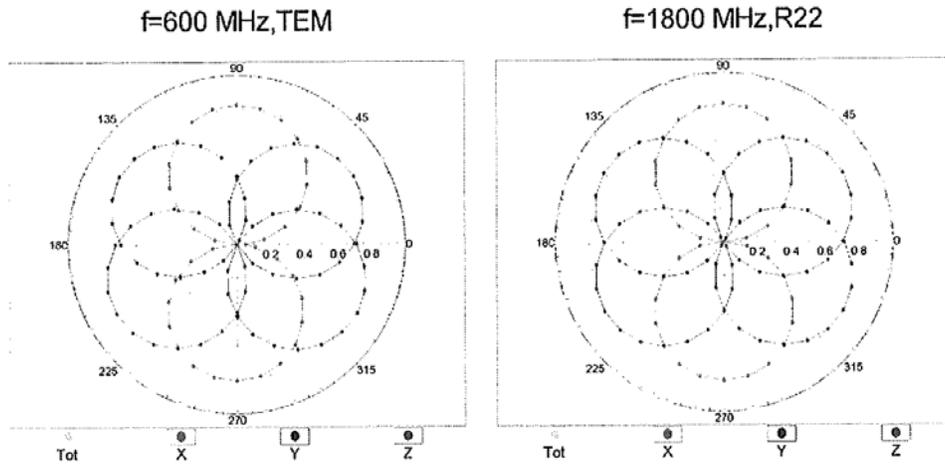


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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Receiving Pattern (ϕ), $\theta = 0^\circ$

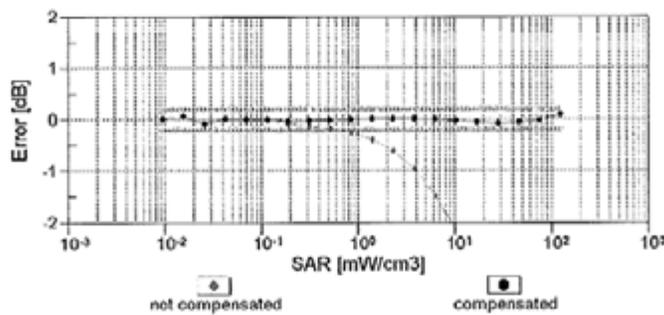
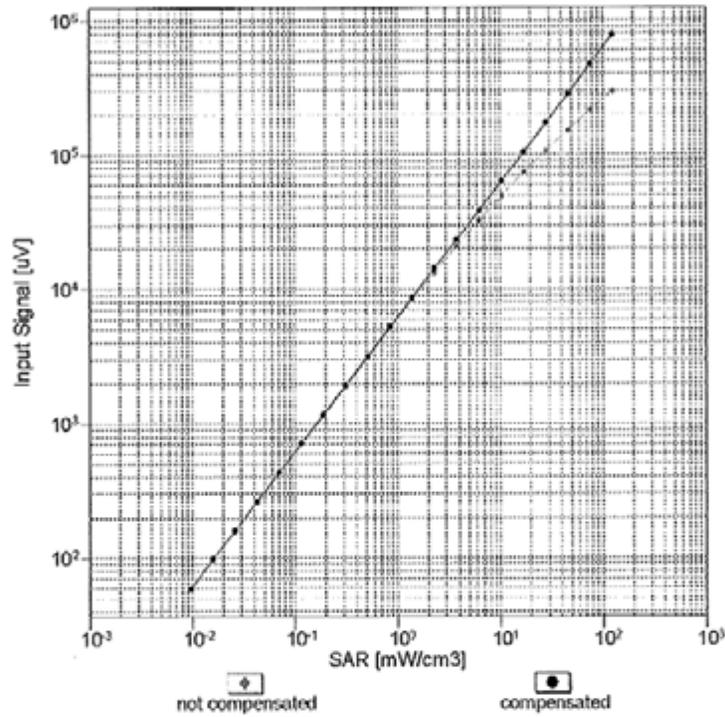


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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

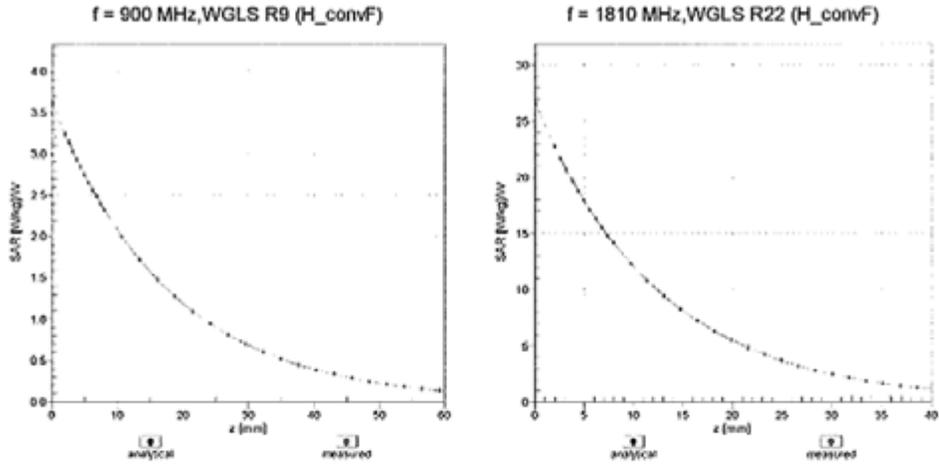


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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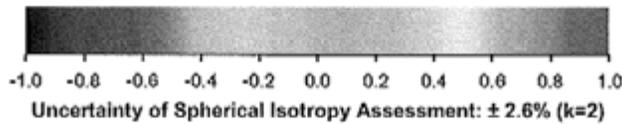
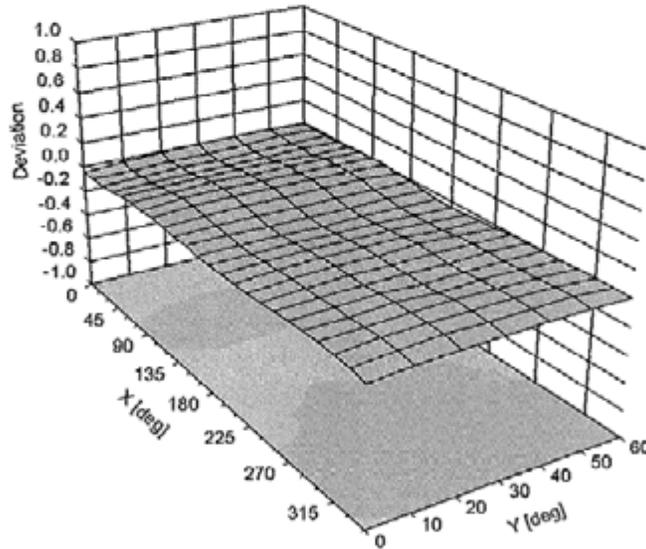
July 21, 2014

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), f = 900 MHz



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-61.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Appendix 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
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: **D900V2-085_Feb14**

CALIBRATION CERTIFICATE

Object: **D900V2 - SN: 085**

Calibration procedure(s): **QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **February 12, 2014**

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 EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 9481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8461A	MY41002317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5059 (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 ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-09 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Anton Kistrali** (Name), **Laboratory Technician** (Function), [Signature] (Signature)

Approved by: **Katja Pokovic** (Name), **Technical Manager** (Function), [Signature] (Signature)

Issued: February 12, 2014

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
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 1528-2013, "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) 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%.

DASY5 Validation Report for Head TSL

Date: 11.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 085

Communication System: UID 0 - CW; Frequency: 900 MHz

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.95 \text{ S/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

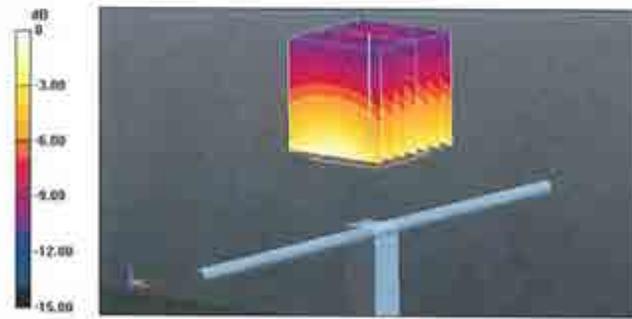
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 58.223 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.91 W/kg

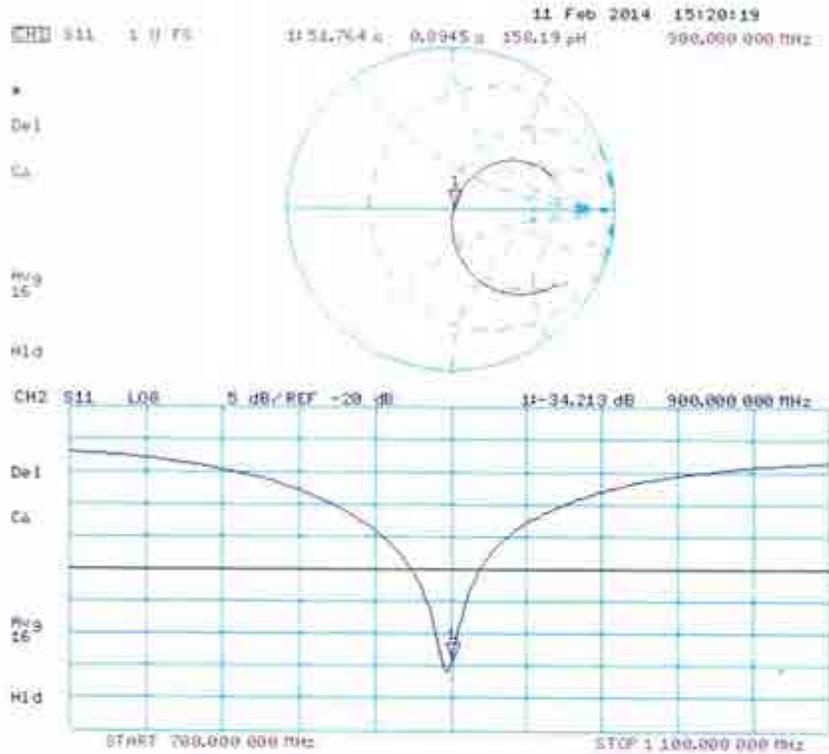
SAR(1 g) = 2.58 W/kg; SAR(10 g) = 1.65 W/kg

Maximum value of SAR (measured) = 3.01 W/kg



0 dB = 3.01 W/kg = 4.79 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 085

Communication System: UID 0 - CW; Frequency: 900 MHz

Medium parameters used: $f = 900$ MHz; $\sigma = 1.03$ S/m; $\epsilon_r = 53.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.98, 5.98, 5.98); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:

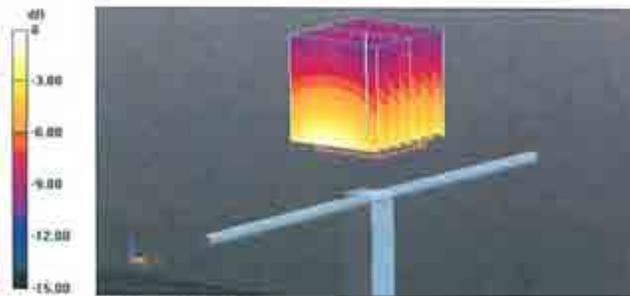
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.048 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.84 W/kg

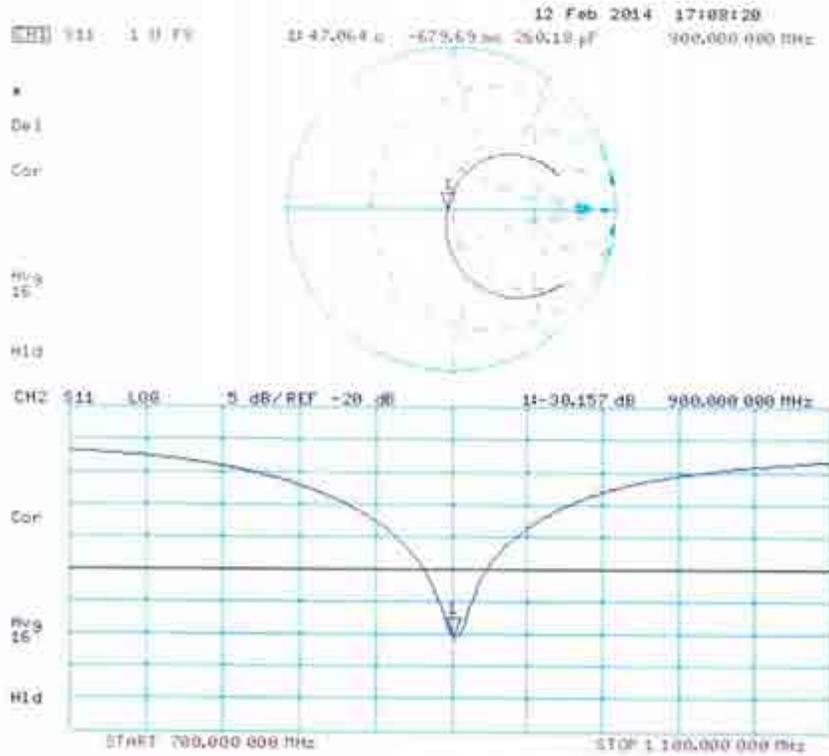
SAR(1 g) = 2.58 W/kg; SAR(10 g) = 1.66 W/kg

Maximum value of SAR (measured) = 3.01 W/kg



0 dB = 3.01 W/kg = 4.79 dBW/kg

Impedance Measurement Plot for Body TSL



Dipole Data

The table below includes dipole impedance and return loss measurement data measured by Motorola Solutions' EME lab. The results meet the requirements stated in KDB 865664.

Dipole 900-085	Head			Body		
	Impedance		Return Loss	Impedance		Return Loss
Date Measured	real Ω	imag $j\Omega$	dB	real Ω	imag $j\Omega$	dB
02/26/14	52.81	-1.09	-30.59	51.56	1.34	-33.88
02/25/15	52.64	-3.19	-27.79	50.90	3.44	-29.10