MOTOROLA SOLUTIONS

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TESTING CERT # 2518.05

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 2

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Date of Report:	**10/14/2011**
Report Revision:	**O**
Report ID:	**SAR rpt_PMUE3877A_Rev.O _111014_SR9554**

Responsible Engineer:	CheeChin Tan/ PeiLoo Tey (EME Section Manager)
Report Author:	CheeChin Tan/ PeiLoo Tey (EME Section Manager)
Date/s Tested:	8/22/2011 – 9/30/2011
Manufacturer/Location:	Motorola, Penang
Sector/Group/Div.:	EMS
Date submitted for test:	8/09/2011
DUT Description:	403-470 MHz 2W, 2.402-2.480 GHz (Bluetooth), GOB
Test TX mode(s):	CW (PTT) for UHF; CW (77% duty cycle for Bluetooth)
Max. Power output:	2.4 W for UHF; 4 mW for Bluetooth
Nominal Power:	2.0 W for UHF; 2.5 mW for Bluetooth
Tx Frequency Bands:	403-470 MHz, 2402-2480 MHz
Signaling type:	TDMA (UHF); FHSS (Bluetooth)
Model(s) Tested:	PMUE3877A
Model(s) Certified:	PMUE3877A
Serial Number(s):	DFLTMN03SL, DFLTMN03S6, DFLTMN03SN
Classification:	Occupational/Controlled
FCC ID:	ABZ99FT4090; Rule part 90 (406.1 - 470 MHz); Rule part 15 (2402-2480 MHz)
IC:	109AB-99FT4090; (406.1-430 MHz and 450-470 MHz)

* Refer to section 15 of part 1 for highest SAR summary results.

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 47 CFR 2.1093(d). 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 3.0 of this report. This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc, 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.

Digitally signed by Zakharia Deanna-EDC015
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Approval Date: 10/17/2011

Certification Date: 10/17/2011

Certification No.: L1110918

Part 1 of 2

APPENDICES

Part 2 of 2

Report Revision History

Date	Revision	Comments
10/14/2011	O	Initial release

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 EMS EME Test Laboratory for model number PMUE3877A.

2.0 Abbreviations / Definitions

CNR: Calibration Not Required
BT: Bluetooth
CW: Continuous Wave
DUT: Device Under Test
FHSS: Frequency Hopping Spread Spectrum
FM: Frequency Modulation
NA: Not Applicable
PTT: Push to Talk
4FSK: 4 Level Frequency Shift Keying
TDMA: Time Division Multiple Access
EDR: Enhanced Data Rate
SAR: Specific Absorption Rate
GFSK: Gaussian Frequency-Shift Keying
DQPSK: Differential Quadrature Phase-Shift Keying
DPSK: Differential Phase-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.

3.0 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)

- United States Federal Communications Commission, Code of Federal Regulations; Rule Part 47CFR § 2.1093 sub-part J:1999

- Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.

- 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 (1999), 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).

* The IEC62209-1 and IEEE 1528 are applicable for hand-held devices used in close proximity to the ear only.

4.0 SAR Limits

TABLE 1

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

5.0 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. For this device the "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" are scaled using the following formula:

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

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 KDB450824 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.

6.0 Description of Device Under Test (DUT):

This device contains transmit and receive circuitry for digital two way radio communications. This device is also wireless BT compatible.

The modulation scheme used for digital two-way radio communications is 4 Level Frequency Shift Keying (4FSK) and Time Division Multiple Access (TDMA). 4FSK is a modulation technique that transmits information by altering the frequency of the radio frequency (RF) signal. Data is converted into complex symbols, which alter the RF signal and transmit the information. When the signal is received, the change in frequency is converted back into symbols and then into the original data. The system can accommodate 2-voice channels in a standard 12.5 kHz channel as used in two-way radio. Time Division Multiple Access (TDMA) is used to allocate portions of the RF signal by dividing time into two slots. Time allocation enables independent units to transmit voice information without interference from each other. Transmission from a unit or base station is accommodated in time-slot lengths of 30 milliseconds and frame lengths of 60 milliseconds. The 4FSK TDMA modulation technique requires sophisticated algorithms and a digital signal processor (DSP) to perform voice compressions/decompressions and RF modulation/demodulation. This device is intended to be used with a maximum duty cycle of 50%.

Bluetooth Details: This device supports Bluetooth 2.1 + EDR and incorporates Class 1 Bluetooth, utilizes the Frequency Hopping Spread Spectrum (FHSS) technology. Transmit output power is +4dBm (2.5mW) and receiver sensitivity is -70 dBm. Modulation schemes being used are GFSK with 79 hopping channels (for basic rate) and pi/4 DQPSK and 8 DPSK (for EDR). Worst case duty cycle is derived from a 5- slot packet type operation which consists of receiving on 1-slot and transmitting on 5 slots, and thus maximum duty cycle = 77%.

The model represented under this filing utilizes fixed antennas for the 403-470 MHz (UHF) band and fixed internal antenna for 2402-2480 MHz (Bluetooth) band. The nominal output power and maximum output powers for each of the applicable bands are indicated in table 2 below. The max power is defined by upper limit of the production line final test station. The intended operating positions are “at the face” with the DUT or Wireless at least 1 inch 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 either connected to the radio or through wireless.

TABLE 2

Frequency Band	Nominal Output Power	Maximum Output Power
403-470 MHz	2 W	2.4 W
2402-2480 MHz	2.5 mW	4 mW

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. The following sections identify the test criteria and details for each accessory category.

7.1 Batteries:

All offered batteries were tested. Table below lists the batteries and their descriptions.

TABLE 3

Battery Models	Description	*Tested	Comments
PMNN4425A	Battery Pack, 1370 mAh Li-ion	Yes	Height = 114mm, tested with battery cover PMLN6000A
HKNN4013A	Battery Pack, 1800 mAh Li-ion	Yes	Height = 114mm, tested with battery cover PMLN6001A

*Refer to Exhibit 7B for antenna separation distances.

7.2 Antennas:

All offered antennas were tested. Table below lists the antennas and their descriptions.

TABLE 4

Antenna Models	Description	*Tested
PMAE4078A	403-425MHz, Hybrid; ¼ wave; -1.5dBi gain	Yes
PMAE4076A	420-445MHz, Hybrid; ¼ wave; -1.5dBi gain	Yes
PMAE4077A	438-470MHz, Hybrid; ¼ wave; -1.5dBi gain	Yes
PMLN5971A	IFA Bluetooth (2402-2480 MHz) ¼ wave, 0dBi	No

*Refer to Exhibit 7B for antenna separation distances.

7.3 Body worn Accessories:

All additional body worn accessories were tested. The table below lists the body worn accessories and their descriptions.

TABLE 5

Body worn Models	Description	*Tested	Comments
PMLN5956A	Holster, Carry Holder	Yes	
PMLN6074A	Wrist Strap	No	

*Refer to Exhibit 7B for antenna separation distances**.**

7.4 Audio Accessories:

All additional audio accessories were tested. The table below lists the audio accessories and their descriptions.

TABLE 6

Audio Acc. Models	Description	Tested	Comments
Head set and Ear Piece w/ Microphone			
PMLN5957A	Surveillance Earpiece with in-line microphone and PTT	Yes	
PMLN5958A	Swivel Earpiece with in-line microphone and PTT	Yes	

8.0 Description of Test System:

8.1 Descriptions of Robotics/Probes/Readout Electronics:

The laboratory utilizes a Dosimetric Assessment System (DASY4™) SAR measurement system Version 4.7 build 80 manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. The test system consists of a Stäubli RX90L robot, DAE4, and ES3DV3 E-field probe. The DASY4™ system is operated per the instructions in the DASY4™ Users Manual. The complete manual is available directly from SPEAG™. All measurement equipment used to assess EME 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)

8.2.1 Dual Flat Phantom

Not Applicable.

8.2.2 SAM Phantom

Not Applicable.

8.2.3 Elliptical Flat Phantom

TABLE 7

Phantom ID (s)	Material Parameters	Phantom Dimensions LxWxD (mm)	Material Thickness (mm)	Support Structure Material	Loss Tangent (wood)
ELI4 1103 ELI4 1037 ELI4 1028	300MHz -6GHz; Er = 4+/- 1, Loss Tangent = ≤0.05	600x400x190	2mm +/- 0.2mm	Wood	< 0.05

8.3 Description of Simulated Tissue:

The simulated tissue used is compliant to that specified in FCC Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01) and IEEE Std 1528 - 2003 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques". The simulated tissue used is also compliant to that specified in IEC62209-1 (2005) and adopted by CENELEC as EN62209-1 (2006).

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 8 below for 450 MHz. During the daily testing of this product, the applicable mixture was used to measure the Di-electric parameters at 450, 403, 406, 416, 420, 425, 433, 438, 445, 449, 450, 459, 460, 470 MHz frequencies to verify that the Di-electric parameters were within the tolerance of the tissue specifications.

Simulated Tissue Composition (by mass)

TABLE 8

% of listed 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

Reference section 10.1 for target parameters

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
Power Meter	E4419B	MY45100911	6/9/2011	6/9/2012
Power Sensor	8482B	SG41090258	6/10/2011	6/10/2012
Power Meter	E4418B	MY45100739	6/9/2011	6/9/2012
Power Sensor	8481B	MY41091243	6/10/2011	6/9/2012
Power Meter	E4418B	MY45101014	10/15/2010	10/15/2011
Power Sensor	8481B	SG41090248	11/18/2010	11/18/2011
Signal Generator	E4438C	MY45091014	10/11/2010	10/11/2012
*Thermometer	HH806AU	080307	8/25/2010	8/25/2011
*Therm. Probe	80PK-22	8765	9/3/2010	9/3/2011
Thermometer	HH202A	35882	7/18/2011	7/18/2012
Therm. Probe	80PK-22	9135	7/20/2011	7/20/2012
Dickson Temp & RH Data Logger	TM320	06153216	6/1/2011	6/1/2012
Amplifier	10W1000C	312858	CNR	CNR
Amplifier	5S1G4	312988	CNR	CNR
NARDA Bi-Directional Coupler	3020A	41935	10/19/2010	10/19/2011
NARDA Bi-Directional Coupler	3022	81639	10/19/2010	10/19/2011
Tissue Station				
Network Analyzer (HP)	E5071B	MY42403147	10/11/2010	10/11/2011
Dielectric Probe Kit (HP)	85070E	MY44300183	CNR	CNR
Dipole				
Speag Dipole	D450V3	1053	4/18/2011	4/18/2013
Cables				
CABLE N-type to SMA	TM8-N2S1-60	6072702 001	CNR	CNR
CABLE N-type to N-type	TM8-NKNK-36	6072701 001	CNR	CNR
CABLE N-type to N-type	TM8-NKNK-36	6072701 002	CNR	CNR

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

10.0 SAR Measurement System Verification:

The SAR measurements were conducted with probe model/serial number ES3DV3/SN3096. The system performance check was conducted daily and within 24 hours prior to testing. DASY output files of the probe/dipole calibration certificates and system performance test results are included in appendices B, C, D respectively.

Dipole validation scans using head tissue equivalent medium are provided in APPENDIX D. The EMS EME lab validated the dipole to the applicable IEEE 1528-2003 system performance targets. Within the same day system validation was performed using FCC body tissue parameters to generate the system performance target values for body at the applicable frequency. The results of the EMS EME system performance validation are provided herein.

10.1 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. Frequencies in blue are outside FCC Part 90.

TABLE 10

Frequency (MHz)	Tissue Type	Conductivity Target & Range (S/m)	Dielectric Constant Target & Range	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
403	FCC Body	0.93 (0.88 -0.97)	57.2 (54.34– 60.06)			
				0.89	56.1	9/29/11
	IEEE / IEC Head	0.87 (0.83-0.91)	44.1 (41.89-46.31)			
				0.83	44.6	9/29/11
416	FCC Body	0.94 (0.89-0.99)	57.0 (54.15-59.85)	0.90	55.9	9/29/11
	IEEE/ IEC Head	0.87 (0.83-0.91)	43.9 (41.70-46.09)	0.84	44.3	9/29/11
420	FCC Body	0.94 (0.89-0.99)	57.0 (54.15-59.85)	0.91	56.2	8/23/11
	IEEE/ IEC Head	0.87 (0.83-0.91)	43.9 (41.70-46.09)	0.85	44.4	8/24/11
438	FCC Body	0.94 (0.89-0.99)	56.82 (53.99-59.66)	0.92	55.7	8/23/11
				0.92	55.3	8/24/11
	IEEE/ IEC Head	0.87 (0.83-0.91)	43.62 (41.44-45.80)	0.87	44.1	8/24/11
450	FCC Body	0.94 (0.89-0.99)	56.70 (53.87-59.54)	0.93	55.4	8/23/11
				0.93	55.5	9/29/11
	IEEE / IEC Head	0.87 (0.83-0.91)	43.5 (41.33-45.68)	0.88	43.8	8/24/11
				0.87	43.6	9/29/11
				0.87	43.6	9/30/11

Frequency (MHz)	Tissue Type	Conductivity Target & Range (S/m)	Dielectric Constant Target & Range	Conductivity Meas. (S/m)	Dielectric Constant Meas.	Tested Date
460	FCC Body	0.95 (0.90-1.00)	56.7 (53.9-59.6)	0.93	55.1	9/29/11
	IEEE/ IEC Head	0.87 (0.83-0.91)	43.4 (41.23-45.57)	0.88	43.5	9/30/11
470	FCC Body	0.94 (0.89-0.99)	56.6 (53.77-59.43)	0.94	55.0	9/29/11
	IEEE/ IEC Head	0.87 (0.83-0.91)	43.4 (41.23-45.57)	0.88	43.3	9/30/11

10.2 System Check Test Results:

System performance checks were conducted each day during the SAR assessment. The results are normalized to 1W. APPENDIX D explains how the targets were set and 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 #	Probe Cal Date	Tissue Type	Dipole Kit / Serial #	Reference SAR @ 1W (W/kg)	System Check Test Results when normalized to 1W (W/kg)	Tested Date
3096	12/9/2010	FCC Body	SPEAG D450V3 / 1053	4.48+/- 10%	4.34	8/23/11
					4.50	9/29/11
		IEEE/ IEC Head	SPEAG D450V3 / 1053	4.59+/- 10%	4.50	8/24/11
					4.44	9/30/11

Note: See APPENDIX D for an explanation of the reference SAR targets stated above.

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 12

	Target	Measured
Ambient Temperature	18 - 25 ˚C	Range: 21.3-23.2˚C Avg. 22.3˚C
Relative Humidity	30 - 70 %	Range: 43.8-55.2% Avg. 49.5%
Tissue Temperature	NA	Range: 20.2-21.7˚C Avg. 20.9˚C

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

12.0 DUT Test Methodology

12.1 Measurements

SAR measurements were performed using the DASY system described in section 8.0 using coarse and 5x5x7 zoom scan. Elliptical flat phantoms filled with applicable simulated tissue were used for body and face testing.

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 D01.

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 intended use configuration against the phantom with the offered body worn and audio accessories where applicable.

12.3.2 Head:

Not applicable.

12.3.3 Face:

The DUT was positioned with its' front side separated 2.5cm from the phantom.

12.4 DUT Test Channels:

The number of test channels was determined by the following equation.

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

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

12.5 DUT Test Plan:

The guidelines and requirements outlined in "SAR Test Reduction Considerations for Occupational PTT Radios" FCC KDB 643646 D01 dated 4/4/11 for head (face) and body 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.
Tests at the body without the offered audio accessory are to satisfy intended use operation with offered wireless BT accessories. In some cases the initial power listed herein may exceed the reported maximum power due to software step size tuning limitations. However, the initial powers measured are not greater than the allowed 5% of the reported maximum power.

Note that test results that are outside the relevant FCC frequency allocations are presented herein in blue font. Tests outside Part 90 allocation were performed using the highest configuration for both body and face.

13.0 DUT Test Data

13.1 Assessment at the Body – Radio power output:

The battery PMNN4425A was selected as default battery to assess at the Body since it is the higher power among the thinnest batteries (refers to Exhibit 7B for the dimension of the battery). The conducted power measurement for all test channels within part 90 frequency range (406.1-470 MHz) using the battery PMNN4425A is indicated in Table 13. The channel with highest conducted power will be identified as the default channel per KDB 643646 D01 SAR Test for PTT Radios v01r01.

TABLE 13

Test Freq (MHz)	Power (W)
Serial number DFLTMN03S6 for 403-425 MHz	
406.125	2.26
415.6	2.27
425	2.25
Serial number DFLTMN03SN for 420-445MHz	
420	2.36
432.5	2.29
445	2.22
Serial number DFLTMN03SL for 438-470 MHz	
438	2.23
448.7	2.16
459.3	2.12
470	2.15

13.2 Assessment at the Body with Body-worn PMLN5956A:

Assessment of offered antennas with the default battery and body-worn accessory PMLN5956A per KDB 643646 D01 SAR Test for PTT Radios v01r01 – Body SAR Test Considerations for Body-worn Accessories. Refer to Table 13 for the highest output power channel. Highest SAR results from each table are bolded. SAR plots of the highest results are presented in appendix E-G.

TABLE 14

Assessments at the Body (CW mode)											
Antenna	**Battery**	**Carry Accessory**	**Additional attachments**	**Test Freq. (MHz)**	**Initial Power (W)**	**SAR Drift (dB)**	**Meas. 1g-SAR (W/kg)**	**Meas. 10g-SAR (W/kg)**	**Max Calc.1 g-SAR (W/kg)**	**Max Calc. 10g-SAR (W/kg)**	**Run#**
PMAE4078A (403-425 MHz)	PMNN4425A	PMLN5956A Carry Holder	PMLN5957A Earpiece	406.125							
				415.6	2.430	-0.697	2.799	2.040	1.64	1.20	CcC-AB-110929-02
				425							
PMAE4076A (420-445 MHz)	PMNN4425A	PMLN5956A Carry Holder	PMLN5957A Earpiece	420	2.450	-0.739	2.675	1.954	1.59	1.16	CcC-AB-110823-09
				432.5							
				445							
PMAE4077A (438-470 MHz)	PMNN4425A	PMLN5956A Carry Holder	PMLN5957A Earpiece	438	2.380	-0.798	3.291	2.393	**1.99**	**1.45**	PS-AB-110823-10
				448.7							
				459.3							
				470							

Assessment of the worst case antenna from above with body-worn accessory PMLN5956A with additional battery per KDB 643646 D01 SAR Test for PTT Radios v01r01 – Body SAR Test Considerations for Body-worn Accessories.

TABLE 15

Assessments at the Body (CW mode)											
Antenna	**Battery**	**Carry Accessory**	**Additional attachments**	**Test Freq. (MHz)**	**Initial Power (W)**	**SAR Drift (dB)**	**Meas. 1g-SAR (W/kg)**	**Meas. 10g-SAR (W/kg)**	**Max Calc.1 g-SAR (W/kg)**	**Max Calc. 10g-SAR (W/kg)**	**Run#**
PMAE4077A (438-470 MHz)	HKNN4013A	PMLN5956A Carry Holder	PMLN5957A Earpiece	438	2.380	-0.637	2.867	2.081	**1.67**	**1.22**	PS-AB-110823-11

13.3 Assessment at the Body with additional audio accessory:

Assessment per KDB 643646 D01 Body SAR Test Considerations for Audio Accessories without Built-in Antenna; Sec 1, A. when overall < 4.0 W/kg, SAR tests for that audio accessory is not necessary. This was applicable to all remaining accessories.

13.4 Assessments of wireless BT configurations:

Assessment using the overall highest SAR configuration at the body from above without attached audio cable.

TABLE 16

Assessments at the Body (CW mode)											
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#
PMAE4077A (438-470 MHz)	PMNN4425A	PMLN5956A Carry Holder	None	438	2.380	-0.717	4.200	3.067	**2.50**	**1.82**	PS-AB-110823-12

13.5 Assessments of outside FCC Part 90 at body:

Assessment using highest SAR configuration from Part 90 assessment above (PS-AB-110823-12; Table 16) across the offered antennas (if applicable).

TABLE 17

Assessments at the Body (CW mode)											
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#
PMAE4078A (403-425 MHz)	PMNN4425A	PMLN5956A Carry Holder	None	403	2.400	-0.653	2.911	2.115	1.69	1.23	CcC-AB-110929-03

13.6 Assessment at the Face - Radio power output:

The highest conducted power battery HKNN4013A was selected as the default battery. The conducted power measurement for all test channels within Part 90 frequency range (406.1-470 MHz) using battery HKNN4013A is listed in Table 18. The channel with the highest conducted power was used as the default channel per KDB 643646 D01 SAR Test for PTT Radios v01r01.

TABLE 18

Test Freq (MHz)	Power (W)
Serial number DFLTMN03S6 for 403-425 MHz	
406.125	2.27
415.6	2.29
425	2.29
Serial number DFLTMN03SN for 420-445MHz	
420	2.35
432.5	2.29
445	2.24
Serial number DFLTMN03SL for 438-470 MHz	
438	2.20
448.7	2.18
459.3	2.12
470	2.13

13.7 Assessment at the Face:

Assessment of each of the offered antennas with the default battery per KDB 643646 D01 SAR Test for PTT Radios v01r01 – Head SAR Test Consideration. Refer to Table 18 for highest power channel. Highest SAR results from each table are bolded. SAR plots of the highest results are presented in appendix E-G.

TABLE 19

<table>
<tr><th colspan="13">Assessments at the Face (CW mode)</th></tr>
<tr><th>Antenna</th><th>Battery</th><th>Carry Accessory</th><th>Cable Accessory</th><th>Test Freq (MHz)</th><th>Init Pwr (W)</th><th>SAR Drift (dB)</th><th>Meas. 1g-SAR (mW/g)</th><th>Meas. 10g-SAR (mW/g)</th><th>Max Calc. 1g-SAR (mW/g)</th><th>Max Calc. 10g-SAR (mW/g)</th><th>Run#</th></tr>
<tr><td rowspan="3">PMAE4078A (403-425 MHz)</td><td rowspan="3">HKNN4013A</td><td rowspan="3">None</td><td rowspan="3">None</td><td>406.125</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>415.6</td><td>2.460</td><td>-0.484</td><td>3.551</td><td>2.575</td><td>1.98</td><td>1.44</td><td>CcC-FACE-110929-08</td></tr>
<tr><td>425</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">PMAE4076A (420-445 MHz)</td><td rowspan="3">HKNN4013A</td><td rowspan="3">None</td><td rowspan="3">None</td><td>420</td><td>2.430</td><td>-0.668</td><td>2.425</td><td>1.765</td><td>1.41</td><td>1.03</td><td>CcC-FACE-110824-03</td></tr>
<tr><td>432.5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>445</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">PMAE4077A (438-470 MHz)</td><td rowspan="4">HKNN4013A</td><td rowspan="4">None</td><td rowspan="4">None</td><td>438</td><td>2.420</td><td>-0.661</td><td>3.748</td><td>2.740</td><td>2.18</td><td>1.60</td><td>CcC-FACE-110824-04</td></tr>
<tr><td>448.7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>459.3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>470</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Assessment of additional offered battery per KDB 643646 D01 SAR Test for PTT Radios v01r01 – Head SAR Test Consideration.

TABLE 20

Assessments at the Face (CW mode)											
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#**
PMAE4077A (438-470 MHz)	PMNN4425A	None	None	438	2.420	-0.787	3.657	2.670	**2.19**	**1.60**	CcC-FACE-110824-05

13.8 Assessment of outside FCC Part 90 at the face:

Assessment using highest SAR configuration from Part 90 assessment above (Run# CcC-Face-110824-05) across the offered antennas (if applicable).

TABLE 21

Assessments at the Face (CW mode)											
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#**
PMAE4078A (403-425 MHz)	PMNN4425A	None	None	403	2.420	-0.633	2.189	1.589	**1.27**	**0.92**	CcC-FACE-110929-09

13.9 Assessment of Industry Canada frequency range:

Based on the assessment results for body and face per KDB643646 D01, testing is not required to perform at 450 – 470 MHz, due to the overall SAR is < 4.00 W/kg. Therefore, additional tests have performed at 450 – 470 MHz, to be compliance with Industry Canada frequency range. Assessment using the overall highest SAR configuration from both body and face assessments. Highest SAR results from both body and face assessments are bolded.

TABLE 22

Assessments at the Body (CW mode)											
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#**
PMAE4077A (438-470 MHz)	PMNN4425A	PMLN5956A Carry Holder	None	450	2.440	-0.831	3.287	2.407	**1.99**	**1.46**	CcC-AB-110929-04
PMAE4077A (438-470 MHz)	PMNN4425A	PMLN5956A Carry Holder	None	460	2.450	-1.420	2.203	1.605	1.53	1.11	CcC-AB-110929-06
PMAE4077A (438-470 MHz)	PMNN4425A	PMLN5956A Carry Holder	None	470	2.410	-1.110	1.501	1.101	0.97	0.71	CcC-AB-110929-07

TABLE 23

Assessments at the Face (CW mode)											
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#**
PMAE4077A (438-470 MHz)	PMNN4425A	None	None	450	2.400	-0.636	3.223	2.352	**1.87**	**1.36**	CcC-FACE-110929-10
PMAE4077A (438-470 MHz)	PMNN4425A	None	None	460	2.340	-0.615	2.461	1.791	1.45	1.06	PS-FACE-110930-02
PMAE4077A (438-470 MHz)	PMNN4425A	None	None	470	2.370	-1.090	1.500	1.090	0.98	0.71	PS-FACE-110930-03

13.10 Shorten Scan Assessment

Short scan assessment: A "shortened" scan was performed to validate the SAR drift of the full DASY4™ coarse and 5x5x7 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 5x5x7 zoom scan only was performed. The results of the shortened cube scan presented in APPENDIX E demonstrate that the scaling methodology used to determine the calculated SAR results presented herein are valid. Both SAR results from the table below are provided 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#**
Shorten scan											
PMAE4077A (438-470 MHz)	PMNN4425A	PMLN5956A Carry Holder	None	438	2.400	-0.384	4.584	3.348	2.50	1.83	PS-AB-110824-09
Full scan											
PMAE4077A (438-470 MHz)	PMNN4425A	PMLN5956A Carry Holder	None	438	2.380	-0.717	4.200	3.067	2.50	1.82	PS-AB-110823-12

14.0 Simultaneous Transmission Exclusion:

Bluetooth testing not required due to Bluetooth power is 4 mW which is less than 60/f-GHz per FCC correspondent EA778949/EA670193, and less than 12mW (KDB 648474; Pref for 2.45GHz).

15.0 Conclusion:

The highest Operational Maximum Calculated 1-gram and 10-gram average SAR values found for this filing: Model PMUE3877A :

Results for FCC Part 90 (406.1-470 MHz)

TABLE 25

Frequency Range (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
	1g-SAR	10g-SAR	1g-SAR	10g-SAR
406.1-470	2.50	1.83	2.19	1.60

The test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of **8.0 W/kg** requirements of 47 CFR 2.1093(d).

Results for Industry Canada (406.1-430 MHz and 450-470 MHz)

TABLE 26

Frequency Range (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
	1g-SAR	10g-SAR	1g-SAR	10g-SAR
406.1-430	1.59	1.16	1.41	1.03
450-470	1.99	1.46	1.87	1.36

Results for entire band (403-470 MHz)

TABLE 27

Frequency Range (MHz)	Max Calc at Body (W/kg)		Max Calc at Face (W/kg)	
	1g-SAR	10g-SAR	1g-SAR	10g-SAR
403-470	2.50	1.83	2.19	1.60

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 47 CFR 2.1093(d). 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.

APPENDIX A
Measurement Uncertainty

The Measurement Uncertainty tables indicated in this APPENDIX are applicable to the DUT ranging from 100 MHz to 800 MHz, 800 MHz to 3 GHz and for Dipole test frequencies ranging from 300 MHz to 800 MHz and 800 MHz to 3 GHz. Therefore, the highest tolerance for the probe calibration uncertainty is indicated.

TABLE 1

Uncertainty Budget for Device Under Test, for 100 MHz to 800 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	10.0	N	1.00	1	1	10.0	10.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				14	13	965
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				27	27	

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TABLE 2

Uncertainty Budget for System Validation (dipole & flat phantom) for 300 MHz to 800 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	9.0	N	1.00	1	1	9.0	9.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	R	1.73	0.64	0.43	1.2	0.8	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	R	1.73	0.6	0.49	0.6	0.5	∞
Combined Standard Uncertainty			RSS				11	11	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				22	22	

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Notes for Tables 1 and 2
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
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 MY (Precision)**

Certificate No: **ES3-3096_Dec10**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3096
Calibration procedure(s)	QA CAL-01.v6, QA CAL-12.v6, QA CAL-14.v3, QA CAL-23.v3 and QA CAL-25.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	December 9, 2010

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	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	30-Dec-09 (No. ES3-3013_Dec09)	Dec-10
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: December 14, 2010

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
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
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	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 effect 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.
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* 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:3096

Manufactured:	July 12, 2005
Last calibrated:	December 14, 2009
Recalibrated:	December 9, 2010

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 SN:3096

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.25	1.10	1.25	± 10.1%
DCP (mV)[B]	100.7	100.7	100.5	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	150.3	± 3.1 %
			Y	0.00	0.00	1.00	137.8	
			Z	0.00	0.00	1.00	155.4	

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 5 and 6).

[B] Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 SN:3096

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz][C]	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth	Unc (k=2)
450	± 50 / ± 100	43.5 ± 5%	0.87 ± 5%	6.23	6.23	6.23	0.15	1.72	± 13.3%
750	± 50 / ± 100	41.9 ± 5%	0.89 ± 5%	6.20	6.20	6.20	0.89	1.04	± 11.0%
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	5.84	5.84	5.84	0.90	1.07	± 11.0%
1810	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	4.94	4.94	4.94	0.45	1.61	± 11.0%
2300	± 50 / ± 100	39.5 ± 5%	1.67 ± 5%	4.61	4.61	4.61	0.37	1.80	± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	4.37	4.37	4.37	0.43	1.63	± 11.0%
2600	± 50 / ± 100	39.0 ± 5%	1.96 ± 5%	4.22	4.22	4.22	0.57	1.49	± 11.0%
3500	± 50 / ± 100	37.9 ± 5%	2.91 ± 5%	4.10	4.10	4.10	0.80	1.15	± 13.1%

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

DASY/EASY - Parameters of Probe: ES3DV3 SN:3096

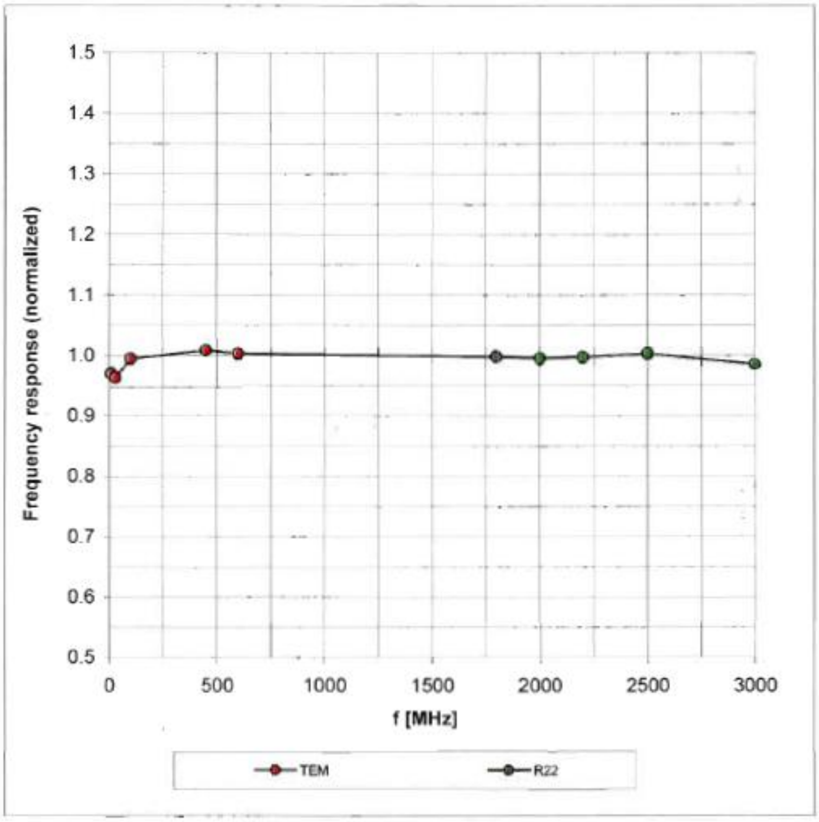
Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz][C]	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth	Unc (k=2)
450	± 50 / ± 100	56.7 ± 5%	0.94 ± 5%	6.54	6.54	6.54	0.08	0.65	± 13.3%
750	± 50 / ± 100	55.5 ± 5%	0.96 ± 5%	5.97	5.97	5.97	0.99	1.05	± 11.0%
900	± 50 / ± 100	55.0 ± 5%	1.05 ± 5%	5.76	5.76	5.76	0.99	1.06	± 11.0%
1810	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.79	4.79	4.79	0.29	2.69	± 11.0%
2300	± 50 / ± 100	52.8 ± 5%	1.85 ± 5%	4.49	4.49	4.49	0.39	1.98	± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.45	4.45	4.45	0.57	1.54	± 11.0%
2600	± 50 / ± 100	52.5 ± 5%	2.16 ± 5%	4.16	4.16	4.16	0.94	1.13	± 11.0%
3500	± 50 / ± 100	51.3 ± 5%	3.31 ± 5%	3.55	3.55	3.55	0.80	1.20	± 13.1%

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

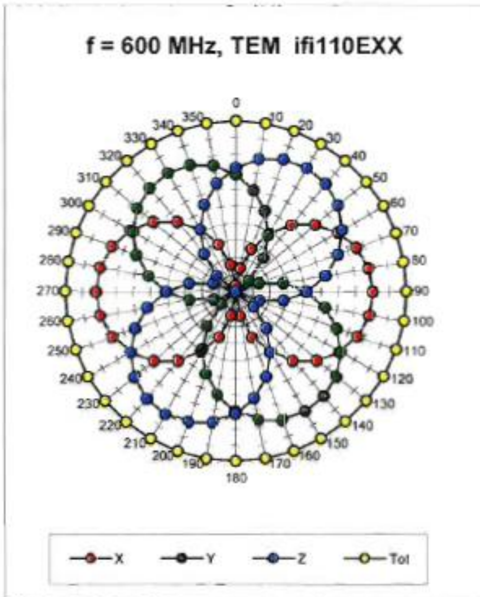
Frequency Response of E-Field

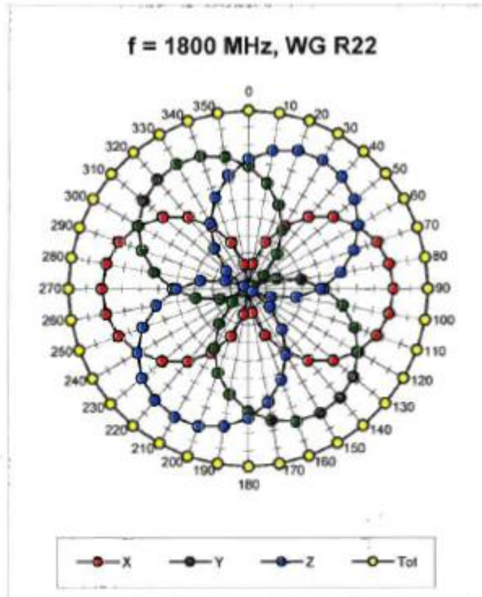
(TEM-Cell:ifi110 EXX, Waveguide: R22)

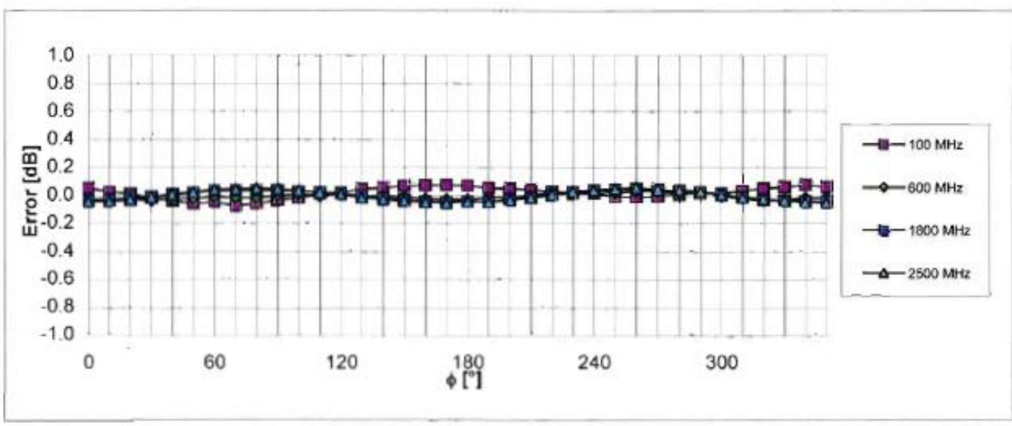


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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



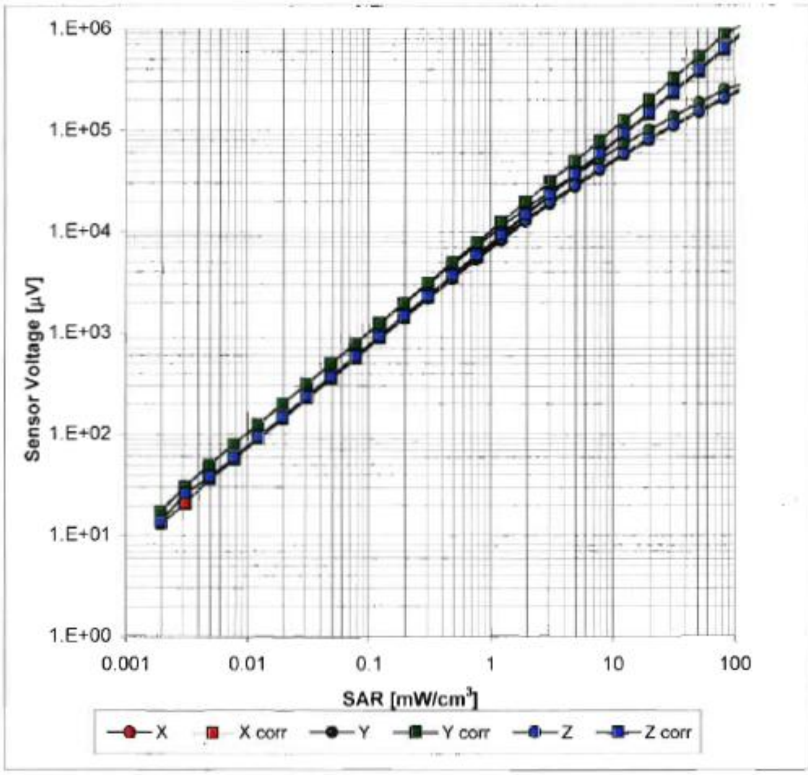


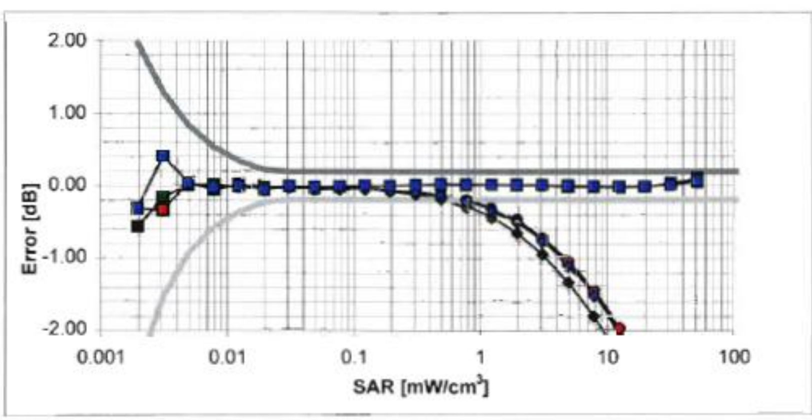


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

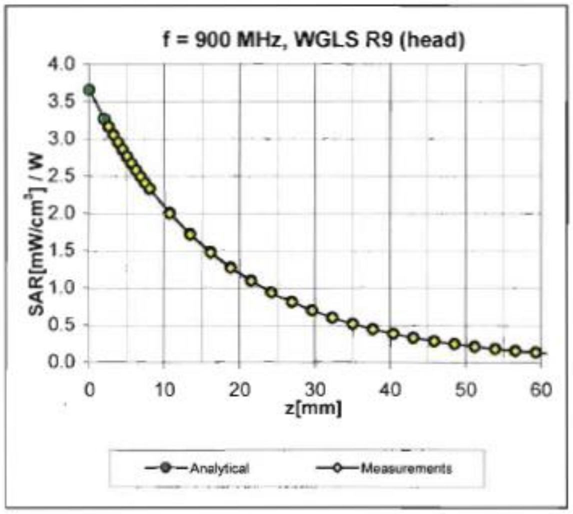
(TEM cell, f = 900 MHz)

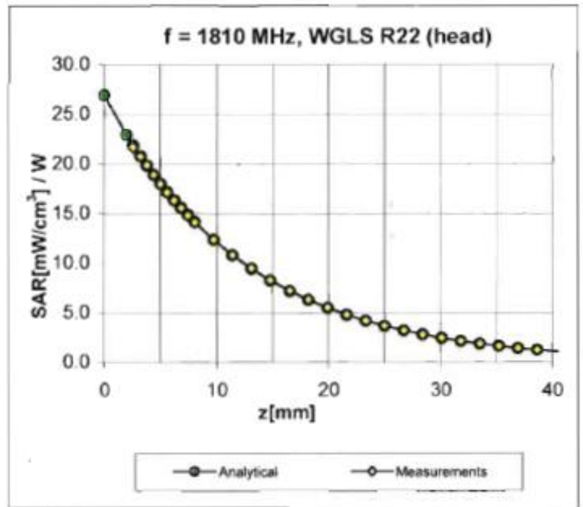




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

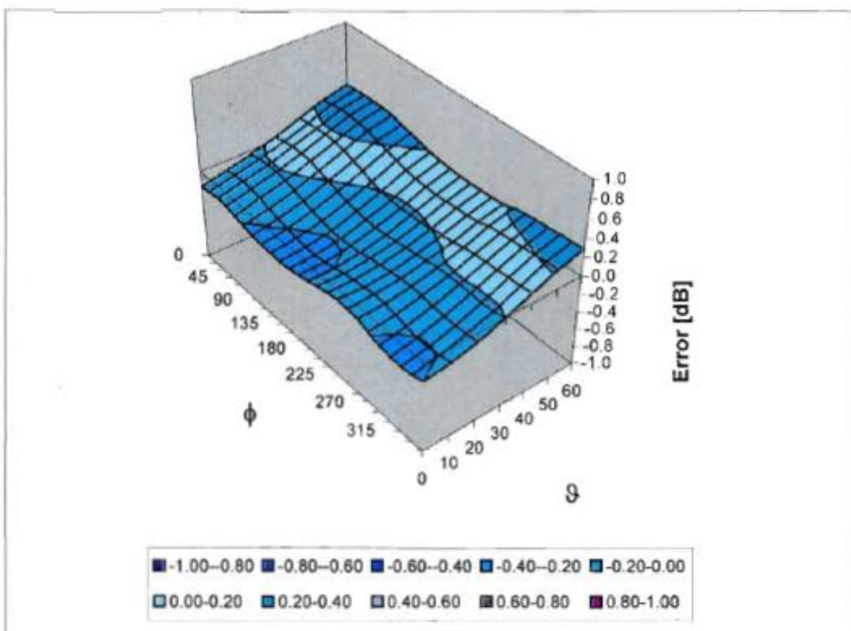
Conversion Factor Assessment





Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
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

Schmid & Partner Engineering AG

s p e a g

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV3**
Serial Number:	**3096**
Place of Assessment:	**Zurich**
Date of Assessment:	**December 14, 2010**
Probe Calibration Date:	**December 9, 2010**

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 900 MHz or at 1810 MHz.

Assessed by:

Schmid & Partner Engineering AG

s p e a g

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Dosimetric E-Field Probe ES3DV3 SN:3096

Conversion factor (± standard deviation)

Frequency		ConvF	Tissue parameters
150 ± 50 MHz	*ConvF*	7.9 ± 10%	ε_r = 52.3, σ = 0.76 mho/m (head tissue)
250 ± 50 MHz	*ConvF*	7.2 ± 10%	ε_r = 47.6, σ = 0.83 mho/m (head tissue)
300 ± 50 MHz	*ConvF*	7.1 ± 9%	ε_r = 45.3, σ = 0.87 mho/m (head tissue)
150 ± 50 MHz	*ConvF*	7.7 ± 10%	ε_r = 61.9, σ = 0.80 mho/m (body tissue)
250 ± 50 MHz	*ConvF*	7.3 ± 10%	ε_r = 59.4, σ = 0.88 mho/m (body tissue)
300 ± 50 MHz	*ConvF*	7.1 ± 9%	ε_r = 58.2, σ = 0.92 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 MY (Precision)**

Certificate No: D450V3-1053_Apr11

CALIBRATION CERTIFICATE

Object	D450V3 - SN: 1053
Calibration procedure(s)	QA CAL-15.v5 Calibration Procedure for dipole validation kits below 800 MHz
Calibration date:	April 18, 2011

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41495277	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.3 / 06327	29-Mar-11 (No. 217-01168)	Apr-12
Reference Probe ET3DV6	SN: 1507	30-Apr-10 (No. ET3-1507_Apr10)	Apr-11
DAE4	SN: 654	23-Apr-10 (No. DAE4-654_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	04-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: April 19, 2011

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
ConF	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.

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Flat Phantom V4.4	Shell thickness: 6 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Area Scan Resolution	dx, dy = 15 mm	
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	45.3 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	398 mW input power	1.94 mW / g
SAR normalized	normalized to 1W	4.87 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**4.79 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	398 mW input power	1.29 mW / g
SAR normalized	normalized to 1W	3.24 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**3.18 mW / g ± 17.6 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	60.3 Ω + 1.0 jΩ
Return Loss	- 20.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.350 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.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 16, 2005

DASY5 Validation Report for Head TSL

Date/Time: 18.04.2011 13:15:15

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1053

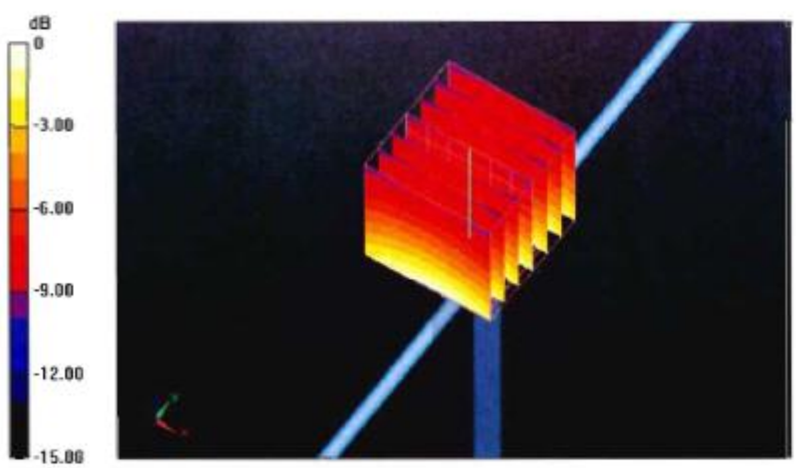
Communication System: CW; Frequency: 450 MHz; Duty Cycle: 1:1
Medium: HSL450
Medium parameters used: f = 450 MHz; σ = 0.9 mho/m; ε_r = 45.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.62, 6.62, 6.62); Calibrated: 30.04.2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 23.04.2010
- Phantom: Flat Phantom 4.4 ; Type: Flat Phantom 4.4; Serial: 1002
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Pin=398mW /d=15mm /Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 49.716 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 2.997 W/kg
SAR(1 g) = 1.94 mW/g; SAR(10 g) = 1.29 mW/g
Maximum value of SAR (measured) = 2.073 mW/g



0 dB = 2.070mW/g

Certificate No: D450V3-1053_Apr11 Page 5 of 6

Impedance Measurement Plot for Head TSL