MOTOROLA SOLUTIONS

ACCREDITED
TESTING CERT # 2518.01

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 5

Motorola Solutions, Inc. **EME Test Laboratory** 8000 West Sunrise Blvd Fort Lauderdale, FL. 33322	**Date of Report:** **11/01/2012** **Report Revision:** **D** **Report ID:** **SR10523 LEX 700 Rev D 110112**

Responsible Engineer:	Stephen Whalen (Principal Staff Engineer)
Report Author:	Stephen Whalen (Principal Staff Engineer)
Date/s Tested:	5/09/2012 – 6/13/2012; 7/25-26/2012
Manufacturer/Location:	Motorola Solutions, Inc./One Motorola Plaza, Holtsville NY 11742-1300, USA
Sector/Group/Div.:	MSI
Date submitted for test:	04/05/2012
DUT Description:	The LEX 700 Mission Critical Handheld includes the following connectivity options to the field: " Band 14 Public Safety LTE " Band 13 Verizon Wireless LTE " CDMA2000: CDMA 1x, CDMA 1x EVDO (Rev0, RevA)" 802.11 a/b/g/n Wi-Fi " Mission Critical Wireless and Bluetooth Personal Area Network" Mobile VPN with prioritization.
Test TX mode(s):	WLAN 802.11a/b/g/n, CDMA/EVDO and LTE
Max. Power output:	Refer to Section 6 of Part 1 of Report
Nominal Power:	Refer to Section 6 of Part 1 of Report
Tx Frequency Bands:	LTE B13: 777-787MHz; LTE B14: 788-798MHz; CDMA (BC0): 824-849MHz, CDMA (BC1): 1850-1910MHz;EVDO (BC0): 824-849MHz, EVDO (BC1): 1850-1910MHz; BT:2402-2480MHz; WLAN802.11 b/g/n:2412-2462MHz, ;WLAN802.11a/n: 5.15-5.25 GHz; 5.25-5.35 GHz; 5.47-5.725 GHz and 5.725-5.85 GHz
Signaling type:	LTE-FDD (QPSK & 16 QAM); CDMA2000: CDMA 1x, CDMA 1x EVDO (Rev0, RevA) GMSK modulation; Bluetooth FHSS; WLAN (802.11 a/b/g/n), OFDM & DSSS
Model(s) Tested:	LEX 700
Model(s) Certified:	LEX 700
Serial Number(s):	12053522500135; 12053522500224; 12053522500102; 12053522500227
Classification:	General Population/Uncontrolled Environment
FCC ID:	UZ7LEX700; Rule parts 15, 90, 22, 27 & 24
IC:	109AN-LEX700

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

The test results clearly demonstrate compliance with FCC General Population/Uncontrolled RF Exposure limits of 1.6 W/kg averaged over 1 gram per the requirements of 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 2.0 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 EME Laboratory.
I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements. This reporting format is consistent with the suggested guidelines of the TIA TSB-150 December 2004. The results and statements contained in this report pertain only to the device(s) evaluated.

Deanna M Zakharia **Deanna Zakharia** **EMS EME Lab Senior Resource Manager,** **Laboratory Director** **Approval Date:** 11/01/2012	**Certification Date**: 8/01/2012 **Certification No.:** **L1120801P**

Part 1 of 5

APPENDICES

Part 2 of 5

APPENDICES (continued)

Part 3 of 5

APPENDICES (continued)

Part 4 of 5

Part 5 of 5

Report Revision History

Date	Revision	Comments
6/29/2012	O	Initial release
8/01/2012	A	Corrected Body Worn Kit Number
8/23/2012	B	Part 4 of 5, TABLE H.1 was updated to reflect +/-10% Dielectric Constant Target range.
9/28/2012	C	Updated sections 6.0, 10.0, Appendix A and Appendix I per FCC correspondence
11/01/2012	D	Appendix A pg 17 was reworded. Appendix A Table 1 frequency range was changed to 750-800MHz and the probe calibration was changed to 6.0%.

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for model number LEX 700.

2.0 Abbreviations / Definitions

BT: Bluetooth
CDMA: Code division multiple access
CNR: Calibration Not Required
CPU: Computer Processing Unit
DC: Duty Cycle
DUT: Device Under Test
DSSS: Direct Sequence Spread Spectrum
EME: Electromagnetic Energy
EVDO: Evolution-Data Optimized or Evolution-Data Only
FHSS: Frequency Hopping Spread Spectrum
LTE: Long Term Evolution
NA: Not Applicable
OFDM: Orthogonal Frequency Division Multiplexing
PTT: Push to Talk
QAM: Quadrature Amplitude Modulation
QPSK**:** Quadrature Phase-Shift Keying
RF: Radio Frequency
RX: Receive
SAR: Specific Absorption Rate
TX: Transmit
UNII: Unlicensed National Information Infrastructure
VoIP: Voice Over Internet Protocol
VoWLAN: Voice Over WLAN
WAN: Wide Area Network
WLAN: Wireless Local-Area Network

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

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(d) sub-part J:2011

- 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 (2009), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz

- Australian Communications Authority Radio communications (Electromagnetic Radiation - Human Exposure) Standard (2003)

- ANATEL, Brazil Regulatory Authority, Resolution No. 303 of July 2, 2002 "Regulation of the limitation of exposure to electrical, magnetic, and electromagnetic fields in the radio frequency range between 9 kHz and 300 GHz." and "Attachment to resolution # 303 from July 2, 2002"

- IEC62209-2 Edition 1.0 2010-03, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz).

Federal Communications Commission KDB Publications;

KDB 648474 - D01 - SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas

KDB 941225 - D05 SAR for LTE Devices

KDB 248227 D01- SAR Measurement Procedures for 802.11 a/b/g Transmitters

KDB 941225 D01 - SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do, WCDMA/HSDPA/HSPA

4.0 SAR Limits

TABLE 1

EXPOSURE LIMITS	SAR (W/kg) (General Population / Uncontrolled Exposure Environment)	SAR (W/kg) (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. A table and graph of output power versus time is provided in each applicable appendix. 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 corrections were applied using the methodologies outlined in IEC 62209-2 based on tissue parameters. 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. Scaling was only applied for positive (increased) SAR.

6.0 Description of Device Under Test (DUT)

The LEX 700 is a Mission Critical Data Handheld device with voice and data applications over Public Safety LTE broadband, cellular and IP networks. In addition, the device offers data capabilities over 802.11 a/b/g/n wireless networks and offers a Bluetooth Personal Area Network which includes audio headset profile for hands-free operation.

This device may be used while held against the head in voice mode, in front of the face in PTT mode, and against the body in phone, PTT or Data modes.

The associated technologies and user configurations are as follows;
LTE – Head and Body
CDMA – Head and Body
WLAN (2.4GHz & 5GHz) – Head and Body
Bluetooth – Head and Body
Exhibit 7B includes a photo of all antennas and their locations.

This device supports simultaneous transmissions between voice and data applications. Refer to Appendix I, Table I.1 for possible simultaneous transmission combinations. This device does not support "hotspot" mode.

6.1 LEX 700 Transceivers;

WLAN 802.11b/g/n (2.4 GHz ISM band): Direct Sequence Spread Spectrum (DSSS). DUT works in accordance with the IEEE 802.11b/g/n standard.

- 802.11b/g/n: 2400-2483.5 MHz, TX (2412 – 2462 MHz)

Bluetooth is Frequency Hopping Spread Spectrum (FHSS). The Bluetooth is used for any application in which data/voice is exchanged with an external Bluetooth device. The maximum actual transmission duty cycle is imposed by the Bluetooth standard: for single-slot operation the Bluetooth device transmits for duration of one time slot (625 microseconds). Bluetooth maximum duty cycle is 100%**.**

- BT 2400-2483.5MHz, TX (2402 – 2480 MHz)

CDMA2000: CDMA 1x, CDMA 1x EVDO (Rev0, RevA) GMSK modulation. CDMA/EVDO Maximum duty cycle is 100%.

- EVDO BC0/BC1 - BC0: 824.7-848.31 MHz (TX) and 869-894 MHz (RX), BC1:1851.25-1908.75 MHz (TX) and 1930-1990 MHz (RX)
- CDMA BC0/BC1 - BC0: 824.7-848.31 MHz (TX) and 869-894 MHz (RX), BC1: 1851.25-1908.75 MHz (TX)and 1930-1990 MHz (RX)

LTE B14&B13 module supports two bandwidths: 5MHz and 10 MHz frequency division duplexing (FDD). LTE provides downlink peak rates of at least 100 Mbps, an uplink of at least 50 Mbps. optional modulation schemes are: QPSK and 16 QAM. LTE Maximum duty cycle is 100%

- Band 14 Public Safety LTE -788-798 MHz (TX) and 758-768 MHz (RX)
- Band 13 Verizon Wireless LTE-777-787 MHz (TX) and 746-756 MHz (RX)

WLAN 802.11a/n (5 GHz UNII band): Orthogonal Frequency Division Multiplexing (OFDM). DUT works in accordance with the IEEE 802.11a/n standard.

- 802.11a/n: 5.15-5.25 GHz; 5.25-5.35 GHz; 5.47-5.725 GHz and 5.725-5.85 GHz

6.2 LEX 700 rated conducted power:

- Bluetooth: 1mW

- WLAN 2.4 GHz 802.11b: Main/Diversity antenna [50.0mW / 42mW]
- WLAN 2.4 GHz 802.11g: Main/Diversity antenna [37.0mW / 30mW]
- WLAN 2.4 GHz 802.11n: Main/Diversity antenna[33.0mW / 28mW]

- WLAN802.11a, 5GHz
  Main/Diversity antenna [21mW / 14mW] at channels 36–48
  Main/Diversity antenna [46mW /30mW] at channels 52-64
  Main/Diversity antenna [41mW / 29mW] at channels 100-140
  Main/Diversity antenna [39mW / 33mW] at channels 149-165

- WLAN802.11n, 5GHz
  Main/Diversity antenna [21mW / 11mW] at channels 36-48
  Main/Diversity antenna [44mW / 26mW] at channels 52-64
  Main/Diversity antenna [39mw / 29mW] at channels 100-140
  Main/Diversity antenna [43mW / 33mW] at channels 149-165

- LTE: B13 5MHz [200mW / 200mW] (QPSK/16QAM)
  B13 10MHz [200mW / 200mW] (QPSK/16QAM)
  B14 5MHz [200mW / 200mW] (QPSK/16QAM)
  B14 10MHz [200mW / 200mW] (QPSK/16QAM)

- CDMA/EVDO:
  CDMA2000 REV0 800 EVDO REV0/REVA 800 (BC0) 160mW
  CDMA2000 REV0 1900 EVDO REV0/REVA 1900 (BC1) 160mW

6.3 LEX700 maximum conducted output power:

- Bluetooth: 1.6mW

- WLAN 2.4 GHz 802.11b: Main/Diversity antenna 51.3mW/ 42.58mW
- WLAN 2.4 GHz 802.11g: Main/Diversity antenna 38.1mW / 30.86mW
- WLAN 2.4 GHz 802.11n: Main/Diversity antenna 33.9mW / 28.82mW

- WLAN802.11a 5.0GHz
  Main/Diversity antenna [21.26mW / 15.2mW] at channels 36 - 48
  Main/Diversity antenna [46.8mW /30.42mW] at channels 52-64
  Main/Diversity antenna [41.2mW / 29.45mW] at channels 100-140
  Main/Diversity antenna [39.8mW / 33.83mW] at channels 149-165

- WLAN802.11n 5.0GHz
  Main/Diversity antenna [21.26mW / 11.5mW] at channels 36-48
  Main/Diversity antenna [44.95mW / 26.3mW] at channels 52-64
  Main/Diversity antenna [39.8mW / 29.85mW] at channels 100-140
  Main/Diversity antenna [43.7mW / 33.21mW] at channels 149-165

- LTE:
  B13 5MHz [210mW (QPSK) / 214mW (16QAM)]
  B13 10MHz [210mW (QPSK) / 214mW (16QAM)]
  B14 5MHz [220mW (QPSK) / 225mW (16QAM)]
  B14 10MHz [230mW (QPSK) / 240mW (16QAM)]

- CDMA/EVDO:
  CDMA2000 REV0 800 EVDO REV0/REVA 800 (BC0) 182mW
  CDMA2000 REV0 1900 EVDO REV0/REVA 1900 (BC1) 186mW

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 Antennas

There are seven internal antennas offered for this product. The table below lists their description by band.

TABLE 2

Antenna Models	Description	*Tested
25.90AD1.001	Inverted-F Antenna [Main] WLAN 2.4 GHz (802.11 b/g/n) ¼ wave -1.1 dBi WLAN 5 GHz (802.11 a/n) ¼ wave 1.8 dBi	Yes
25.90AD2.001	Inverted-F Antenna [Diversity] WLAN 2.4 GHz (802.11 b/g/n) ¼ wave -0.3 dBi WLAN 5 GHz (802.11 a/n) ¼ wave 2.75 dBi	Yes
25.90AD4.001	Inverted-F Antenna [Main] 800MHz (LTE/CDMA/EVDO) ¼ wave -0.6 dBi 1900MHz (CDMA/EVDO) ¼ wave 2.1 dBi	Yes
25.90A8N.011	Inverted-F Antenna 2.4GHz BT ¼ wave -3.5 dBi	No
25.90AD3.001	Inverted-F Antenna [Diversity] 800MHz (LTE/CDMA/EVDO) ¼ wave -1dBi 1900MHz (CDMA/EVDO) Diversity ¼ wave 1.5 dBi	No - RX only
**25.90AD3.001	Inverted-F Antenna [Monitoring] 800MHz (LTE/CDMA/EVDO) ¼ wave -2.5 dBi	No
25.90A8L.011	Inverted-F Antenna 1575MHz (GPS) ¼ wave - 6.0 dBi	No - RX only

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

**Monitoring antenna is in standby mode most of the time. It has transmission bursts for a few *m*sec for location updates according to base station request for other WAN that are not in use.

7.2 Batteries

There are two batteries offered for this product. The table below lists the battery descriptions.

TABLE 3

Battery Models	Description	Tested	Comments
82-154162-01	Li Ion 1880 mAh	Yes	Tested with battery cover 60.15U26.001
82-154162-02	Li Ion 3760 mAh	Yes	Tested with battery cover 60.15U27.001

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

7.3 Body Worn Accessories

There is only one body worn holster that is available. The table below lists the body worn accessory and description.

TABLE 4

Body worn Models	Description	Tested	Comments
TTN1002A	Belt mount holster - leather	Yes	

7.4 Data Cable

The table below lists the offered data cable and its description. Exhibit 7B illustrates photo of the tested data cable.

TABLE 5

Data Cable Model	Description	Tested	Comments
25-128458-01R	USB Charge / Data cable	Yes	

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

The laboratory utilizes a Dosimetric Assessment System (DASY5™) SAR measurement system Version 52.8.1.838 manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. The test system consists of a Stäubli RX90L robot, DAE and E-field probe. 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 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 Flat Phantom

TABLE 6

Phantom ID	Material Parameters	Phantom Dimensions (mm)	Material Thickness (mm)	Support structure material	Loss Tangent (wood)
DUAL1002-Side A and B	200MHz -6GHz; Er = 3-5 Loss Tangent = <0.05	414X390	2mm +/- 0.2mm	Wood	< 0.05
Triple Flat 1117-2 and 1117-3	200MHz -6GHz; Er = 3-5 Loss Tangent = <0.05	280X175	2mm +/- 0.2mm	Wood	< 0.05

8.2.2 SAM Phantom

TABLE 7

Phantom ID	Material Parameters	Material Thickness (mm)	Support structure material	Loss Tangent (wood)
SAMTP1208 SAMTP1209 SAMTP1234	300MHz -6GHz; Er = <5, Loss Tangent = <0.05	2mm +/- 0.2mm	Wood	< 0.05

8.2.3 Elliptical Phantom

TABLE 8

Phantom ID	Material Parameters	Phantom Dimensions (mm)	Material Thickness (mm)	Support structure material	Loss Tangent (wood)
Oval 1016 Oval 1022	375MHz – 6 GHz; Er =< 5, Loss Tangent =< .05	600X400	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 9 below for 800 /1900 MHz and 2.450 / 5.0(1) GHz. 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(2).

TABLE 9: Simulated Tissue Composition (by mass)

% of listed ingredients	835 MHz		900 MHz		1880 MHz		1950 MHz		2450MHz		5GHz (1) Band	
	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Sugar	57.0	44.9	56.5	44.9	NA	NA	NA	NA	NA	NA	NA	NA
Diacetin	NA	NA	NA	NA	51.5	34.5	51.5	35.0	51.0	34.5	NA	NA
De ionized - Water	40.45	53.06	40.95	53.06	48.03	64.97	48.03	64.52	48.8	65.20	NA	NA
Salt	1.45	0.94	1.45	0.94	0.37	0.43	.37	0.38	0.1	.20	NA	NA
HEC	1	1	1	1	NA	NA	NA	NA	NA	NA	NA	NA
Bact.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	NA	NA

Note: 1) SPEAG provides Motorola proprietary stimulant ingredients for the 5GHz band.
2) 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 10

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Power Meter (Agilent)	E4419B	MY45103725	3/30/2012	3/30/2013
E-Series Avg. Power Sensor (Agilent)	E9301B	MY50280001	8/8/2011	8/8/2012
E-Series Avg. Power Sensor (Agilent)	E9301B	MY50290001	8/8/2011	8/8/2012
Power Meter (Agilent)	E4419B	MY50000505	9/6/2011	9/6/2012
E-Series Avg. Power Sensor (Agilent)	E9301B	MY41495730	4/3/2012	4/3/2013
E-Series Avg. Power Sensor (Agilent)	E9301B	MY41495733	4/3/2012	4/3/2013
Bi-Directional Coupler (NARDA)	3022	77115	3/2/2012	3/2/2014
Bi-Directional Coupler (NARDA)	3024	61150	11/14/2011	11/14/2013
Bi-Directional Coupler (NARDA)	3020A	40296	2/9/2012	2/9/2014
Bi-Directional Coupler (NARDA)	3020A	40295	6/3/2010	6/3/2012
Signal Generator (Agilent)	E4428C	MY47381119	6/24/2011	6/24/2013
Signal Generator (Agilent)	E4438C	MY42082269	1/24/2012	1/24/2014
Signal Generator (HP)	E4421B	US40051446	8/12/2010	8/12/2012
AMP (ComTech PST)	AR88258-10	N1R1A001-1015	CNR	CNR
AMP (ComTech PST)	AR88258-10	M3Y6A00-1007	CNR	CNR
Temperature Recording Equipment				
Dickson Temperature Recorder	TM320	7081356	9/7/2011	9/7/2012
Dickson Temperature Recorder	TM325	12121144	5/18/2012	5/18/2013
Omega Digital Thermometer with J Type TC Probe	HH202A	18800	2/22/2012	2/22/2013
Omega Digital Thermometer with J Type TC Probe	HH202A	18801	5/23/2012	5/23/2013
Omega Digital Thermometer with J Type TC Probe	HH200A	20857	10/28/2011	10/28/2012
Tissue Station				
Agilent PNA-L Network Analyzer	N5230A	MY45001092	6/9/2011	6/9/2012
Agilent PNA-L Network Analyzer	N5230A	MY45001092	6/4/2012	6/4/2013
Network Analyzer (HP)	8753D	3410A09135	2/17/2012	2/17/2013
Dielectric Probe Kit (HP)	85070C	US99360076	CNR	CNR
Dipole				
Speag Dipole	D2450V2	703	5/24/2011	5/24/2013
Speag Dipole	D5GHzV2	1017	9/20/2011	9/20/2013
Speag Dipole	D835V2	435	2/24/2012	2/24/2014
Speag Dipole	D835V2	427	1/27/2011	1/27/2013
Speag Dipole	D1900V2	521	8/17/2011	8/17/2013

TABLE 10 (continued)

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Speag E-Field Probe	ES3DV3	3185	11/17/2011	11/17/2012
Speag E-Field Probe	EX3DV4	3735	10/26/2011	10/26/2012
Speag E-Field Probe	ES3DV3	3147	1/25/2012	1/25/2013

10.0 SAR Measurement System Verification

SAR system verifications were performed for all SAR probes used in the measurements for the specific frequency bands and tissue equivalent liquids (head and body) for testing this device.

10.1 Equivalent Tissue Test Results

Refer to Appendix E for WLAN 2.4GHz (802.11b/g/n)
Refer to Appendix F for CDMA/EVDO
Refer to Appendix G for LTE B13 & B14
Refer to Appendix H for WLAN 5GHz (802.11 a/n)

10.2 System Performance Results

Refer to Appendix E for WLAN 2.4GHz (802.11b/g/n)
Refer to Appendix F for CDMA/EVDO
Refer to Appendix G for LTE B13 & B14
Refer to Appendix H for WLAN 5GHz (802.11 a/n)

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 11

	Target	Measured
Ambient Temperature	18 - 25 ˚C	Range: 20.5 – 22.3˚C Avg. 21.5 ˚C
Relative Humidity	30 - 70 %	Range: 23.6 – 62.1% Avg. 53.9%
Tissue Temperature	NA	Range: 20.0 – 22.3˚C Avg. 21.0˚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

Refer to Appendix E for WLAN 2.4GHz (802.11b/g/n)
Refer to Appendix F for CDMA/EVDO
Refer to Appendix G for LTE B13 & B14
Refer to Appendix H for WLAN 5GHz (802.11 a/n)

13.0 DUT Test Data

Refer to Appendix E for WLAN 2.4GHz (802.11b/g/n)
Refer to Appendix F for CDMA/EVDO
Refer to Appendix G for LTE B13 & B14
Refer to Appendix H for WLAN 5GHz (802.11 a/n)

14.0 Simultaneous Transmission Exclusion and Bluetooth Exclusion

Refer to Appendix I

15.0 Conclusion

The highest Operational Maximum Calculated 1-gram and 10-gram average SAR values found for this filing: Model LEX 700

TABLE 12

Frequency (MHz)	Max Calc at Body (mW/g)		Max Calc at Face (mW/g)		Max Calc at Head (mW/g)	
	1g-SAR	10g-SAR	1g-SAR	10g-SAR	1g-SAR	10g-SAR
802.11b 2.412-2.462 GHz	0.231	0.120	0.037	0.021	0.473	0.238
CDMA/EVDO (800/1900MHz)	0.813	0.435	0.337	0.201	1.099	0.618
LTE (B13 & B14)	0.621	0.476	0.457	0.346	0.688	0.542
802.11a 5.18- 5.32 GHz 5.5 – 5.7 GHz 5.745 – 5.825 GHz	0.671	0.245	0.077	0.032	0.607	0.181

Simultaneous transmission
Appendix I concludes that the SAR peak location separation ratios are below the applicable threshold of 0.3 and therefore simultaneous transmission SAR is not required.

The test results clearly demonstrate compliance with FCC General Population/Uncontrolled RF Exposure limits of **1.6** W/kg averaged over 1 gram per the requirements of 47 CFR 2.1093(d). The 10 grams result is not applicable to FCC filing.

APPENDIX A
Measurement Uncertainty

The Measurement Uncertainty tables indicated in this APPENDIX are applicable to the DUT test frequencies ranging from 750MHz to 800MHz, 800MHz to 3GHz and 3GHz to 6GHz; for Dipole test frequencies ranging from 800MHz to 3GHz and 3GHz to 6GHz.

The probe's measurement uncertainty changes with frequency and the uncertainty budgets in this appendix cover multiple frequency ranges. Therefore the probe's highest uncertainty for the given frequency range of the uncertainty budget is used.

Table 1 - Uncertainty Budget for Device Under Test: 750 - 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	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	419
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				22	22	

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Table 2 - Uncertainty Budget for Device Under Test: 800 – 3000 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.0	N	1.00	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	419
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				22	22	

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Table 3 - Uncertainty Budget for Device Under Test: 3 – 6 GHz

a	***b***	***c***	***d***	***e = f(d,k)***	***f***	***g***	***h = c x f / e***	***i = c x g / e***	***k***
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob Dist**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.6	N	1.00	1	1	6.6	6.6	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	2.0	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11	11	465
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				23	23	

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Table 4 - Uncertainty Budget for System Verification: 300 – 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	6.7	N	1.00	1	1	6.7	6.7	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	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				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				19	19	

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Table 5 - Uncertainty Budget for System Verification: 800 – 3000 MHz

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.0	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	

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Table 6 - Uncertainty Budget for System Verification: 3 – 6 GHz

a	*b*	*c*	*d*	*e =* *f(d,k)*	*f*	*g*	*h =* *c x f / e*	*i =* *c x g / e*	*k*
Uncertainty Component	**IEEE 1528 section**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1 g)**	**c_i (10 g)**	**1 g u_i (±%)**	**10 g u_i (±%)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.6	N	1.00	1	1	6.6	6.6	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	2.0	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t. Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	0.8	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.5	∞
Combined Standard Uncertainty			RSS				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				19	19	

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Notes for Tables 1, 2, 3, 4, 5 and 6.
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 EME**

Certificate No: **ES3-3185_Nov11**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3185
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	November 17, 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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	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
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: November 17, 2011

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

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

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, 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:3185

Manufactured: March 25, 2008
Calibrated: November 17, 2011

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3185

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.41	1.23	1.07	± 10.1 %
DCP (mV)[B]	100.2	99.3	101.9	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	121.6	±2.5 %
			Y	0.00	0.00	1.00	114.3	
			Z	0.00	0.00	1.00	107.5	

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3185

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	45.3	0.87	6.75	6.75	6.75	0.25	1.06	± 13.4 %
450	43.5	0.87	6.22	6.22	6.22	0.14	1.68	± 13.4 %
750	41.9	0.89	5.95	5.95	5.95	0.80	1.00	± 12.0 %
900	41.5	0.97	5.64	5.64	5.64	0.80	1.00	± 12.0 %
1810	40.0	1.40	5.07	5.07	5.07	0.80	1.36	± 12.0 %
1950	40.0	1.40	4.79	4.79	4.79	0.80	1.29	± 12.0 %
2300	39.5	1.67	4.56	4.56	4.56	0.80	1.29	± 12.0 %
2450	39.2	1.80	4.24	4.24	4.24	0.80	1.28	± 12.0 %
2600	39.0	1.96	4.08	4.08	4.08	0.80	1.32	± 12.0 %
3500	37.9	2.91	4.03	4.03	4.03	0.95	1.20	± 13.1 %
3700	37.7	3.12	3.71	3.71	3.71	0.95	1.20	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3185

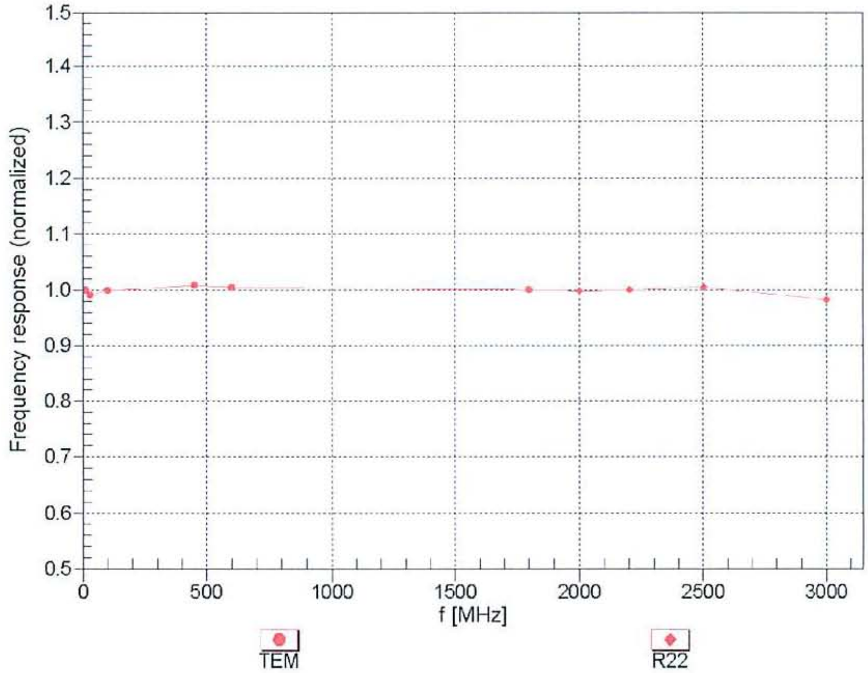
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	58.2	0.92	6.73	6.73	6.73	0.23	1.79	± 13.4 %
450	56.7	0.94	6.67	6.67	6.67	0.09	1.00	± 13.4 %
750	55.5	0.96	5.89	5.89	5.89	0.80	1.00	± 12.0 %
900	55.0	1.05	5.75	5.75	5.75	0.80	1.00	± 12.0 %
1810	53.3	1.52	4.61	4.61	4.61	0.80	1.33	± 12.0 %
1950	53.3	1.52	4.63	4.63	4.63	0.77	1.35	± 12.0 %
2300	52.9	1.81	4.26	4.26	4.26	0.80	1.24	± 12.0 %
2450	52.7	1.95	4.11	4.11	4.11	0.80	1.00	± 12.0 %
2600	52.5	2.16	3.96	3.96	3.96	0.80	1.00	± 12.0 %
3500	51.3	3.31	3.38	3.38	3.38	0.90	1.22	± 13.1 %
3700	51.0	3.55	3.31	3.31	3.31	0.99	1.35	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

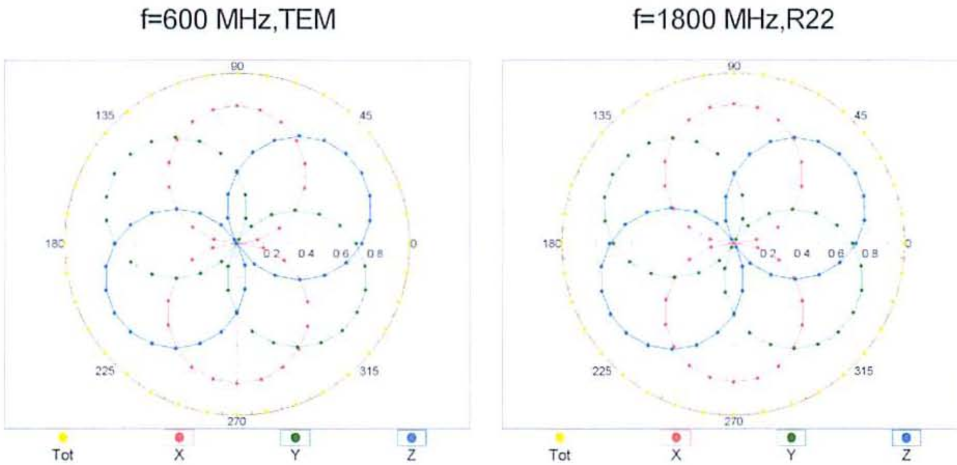
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF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

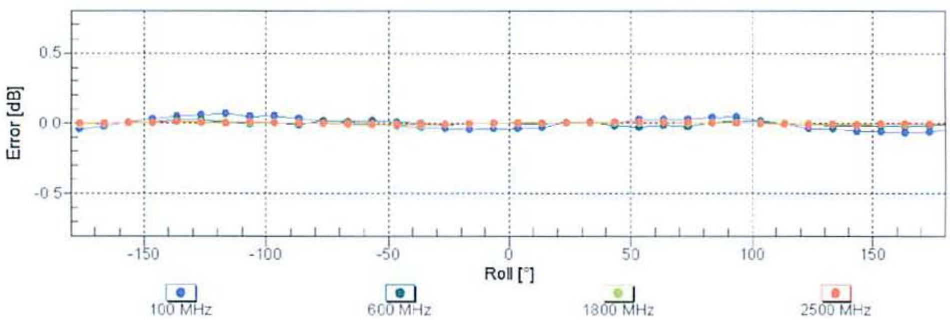
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

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

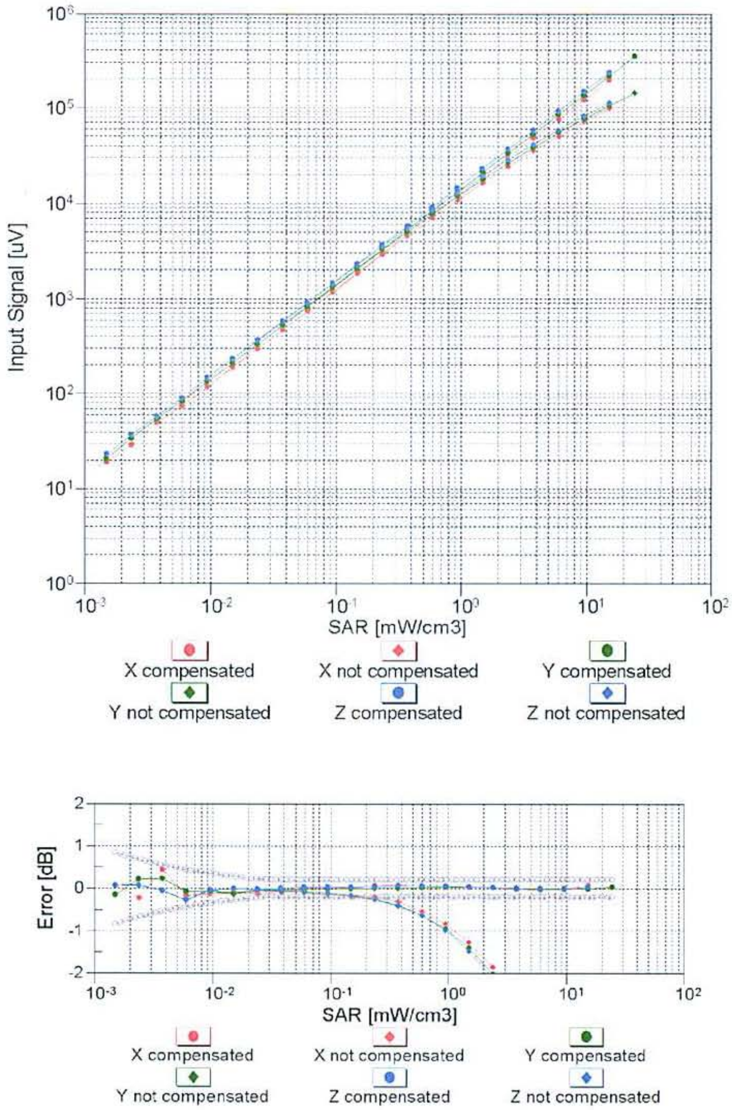




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

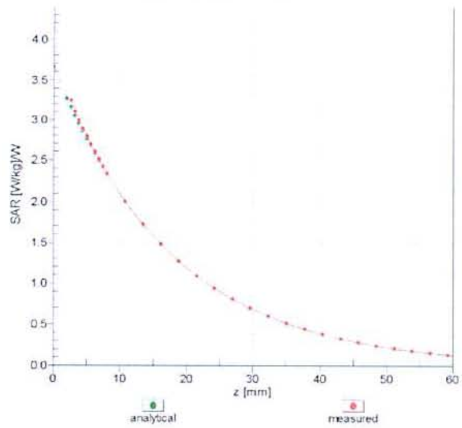
Dynamic Range f(SAR_{head})

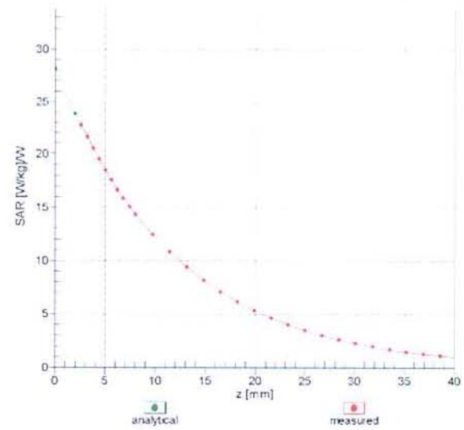
(TEM cell , f = 900 MHz)



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

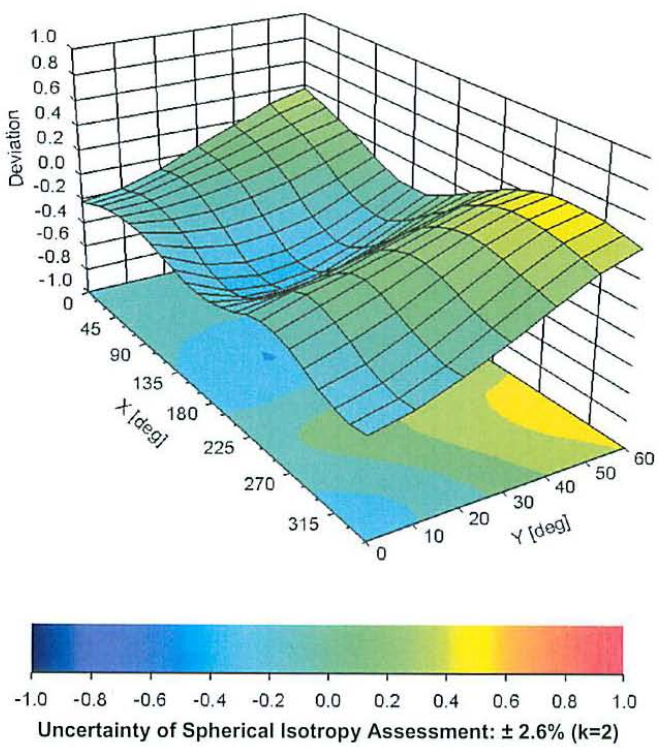
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3185

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:	**3185**
Place of Assessment:	**Zurich**
Date of Assessment:	**November 21, 2011**
Probe Calibration Date:	**November 17, 2011**

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

Dosimetric E-Field Probe ES3DV3 SN:3185

Conversion factor (± standard deviation)

150 ± 50 MHz	*ConvF*	**7.7 ± 10%**	**ε_r = 52.3** **σ = 0.76 mho/m** (head tissue)
250 ± 50 MHz	*ConvF*	**7.0 ± 10%**	**ε_r = 47.6** **σ = 0.83 mho/m** (head tissue)
150 ± 50 MHz	*ConvF*	**7.4 ± 10%**	**ε_r = 61.9** **σ = 0.80 mho/m** (body tissue)
250 ± 50 MHz	*ConvF*	**7.0 ± 10%**	**ε_r = 59.4** **σ = 0.88 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.

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

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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: **EX3-3735_Sep11**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3735
Calibration procedure(s)	QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	September 26, 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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	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
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
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: September 27, 2011

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

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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 affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, 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 EX3DV4

SN:3735

Manufactured: February 15, 2010
Calibrated: September 26, 2011

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.52	0.46	0.43	± 10.1 %
DCP (mV)[B]	100.9	99.3	101.2	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	116.1	±2.7 %
			Y	0.00	0.00	1.00	110.6	
			Z	0.00	0.00	1.00	106.5	

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
4950	36.3	4.40	5.34	5.34	5.34	0.30	1.80	± 13.1 %
5200	36.0	4.66	5.15	5.15	5.15	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.80	4.80	4.80	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.38	4.38	4.38	0.50	1.80	± 13.1 %
5600	35.5	5.07	4.08	4.08	4.08	0.55	1.80	± 13.1 %
5800	35.3	5.27	4.16	4.16	4.16	0.55	1.80	± 13.1 %

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

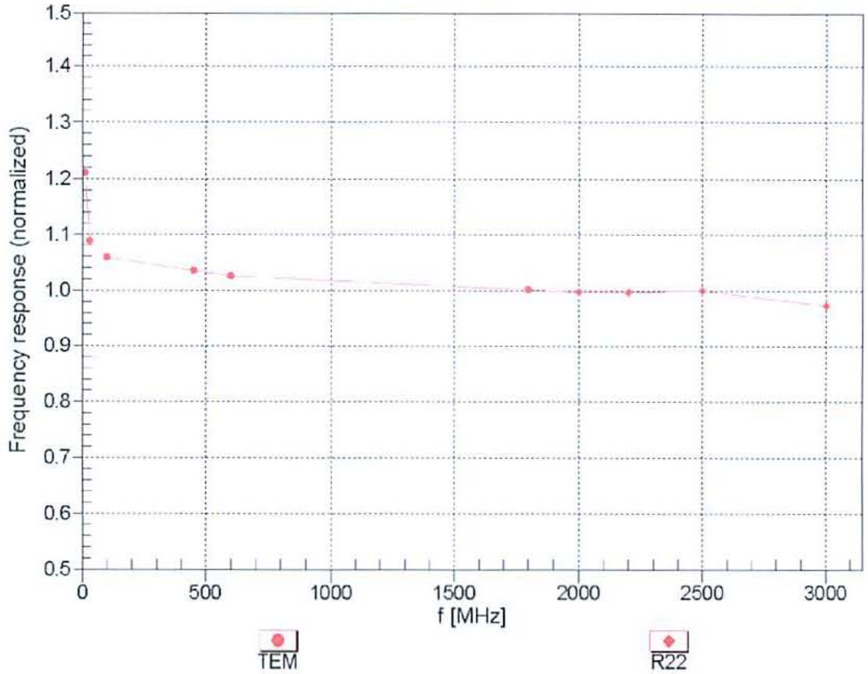
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3735

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
4950	49.4	5.01	4.34	4.34	4.34	0.50	1.95	± 13.1 %
5200	49.0	5.30	4.10	4.10	4.10	0.60	1.95	± 13.1 %
5300	48.9	5.42	3.80	3.80	3.80	0.60	1.95	± 13.1 %
5500	48.6	5.65	3.53	3.53	3.53	0.65	1.95	± 13.1 %
5600	48.5	5.77	3.35	3.35	3.35	0.65	1.95	± 13.1 %
5800	48.2	6.00	3.59	3.59	3.59	0.65	1.95	± 13.1 %

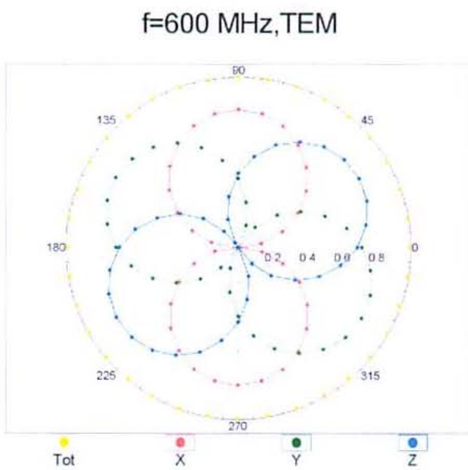
[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of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

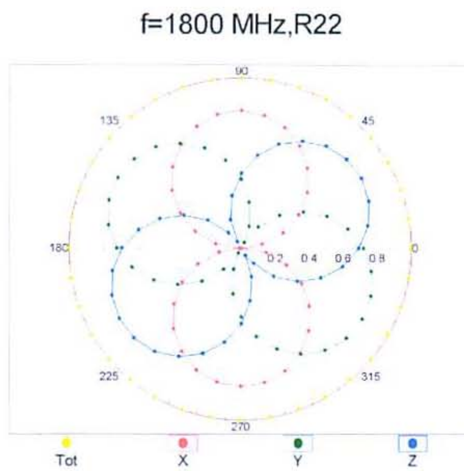
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

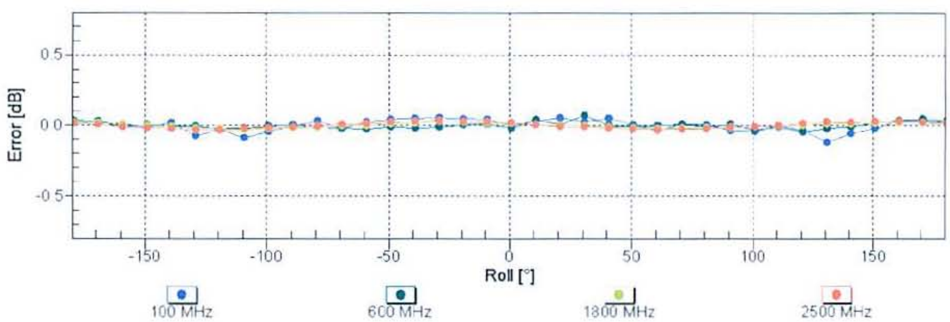


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

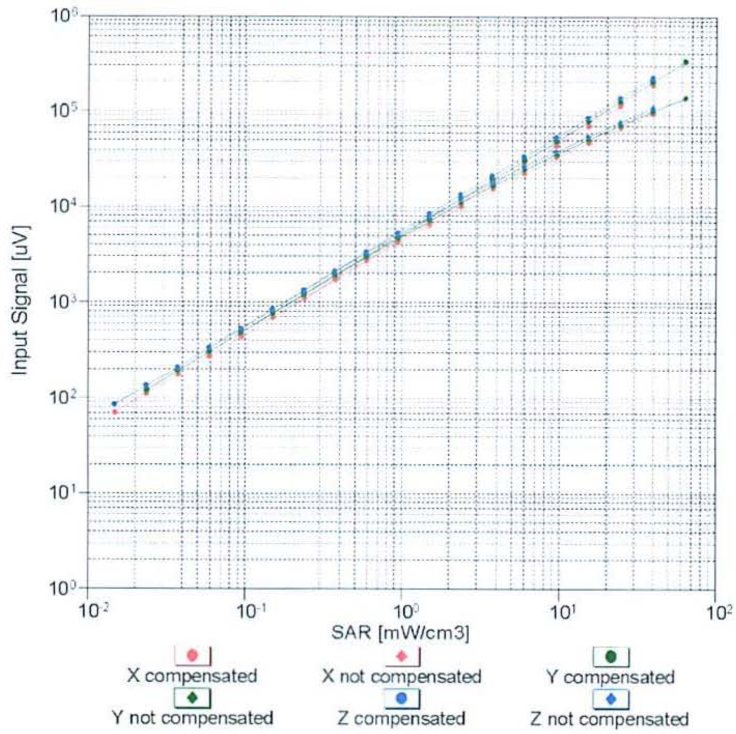


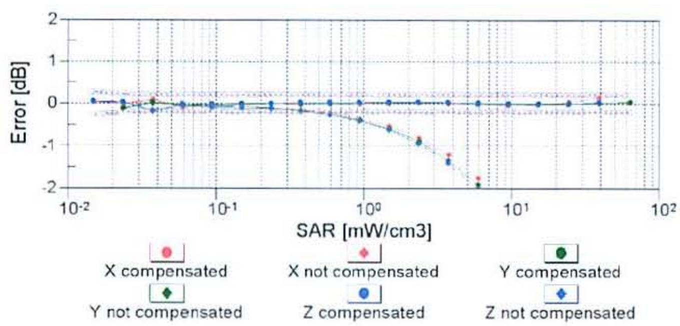




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

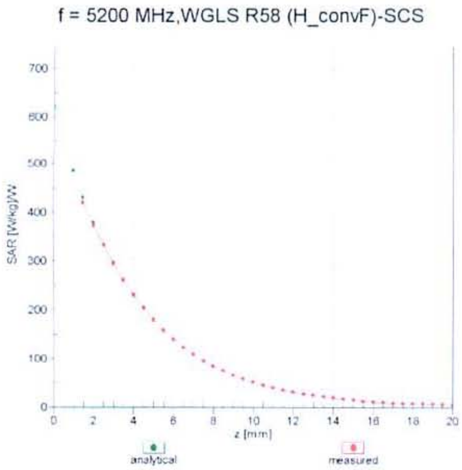
Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

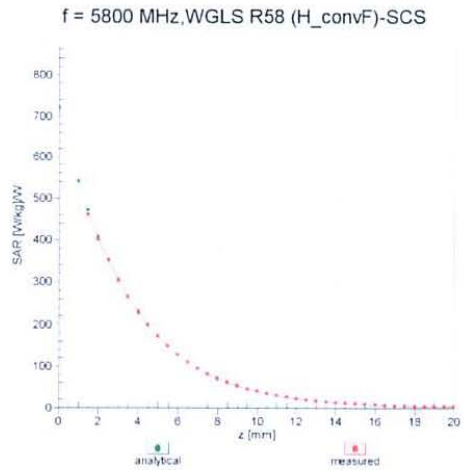




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

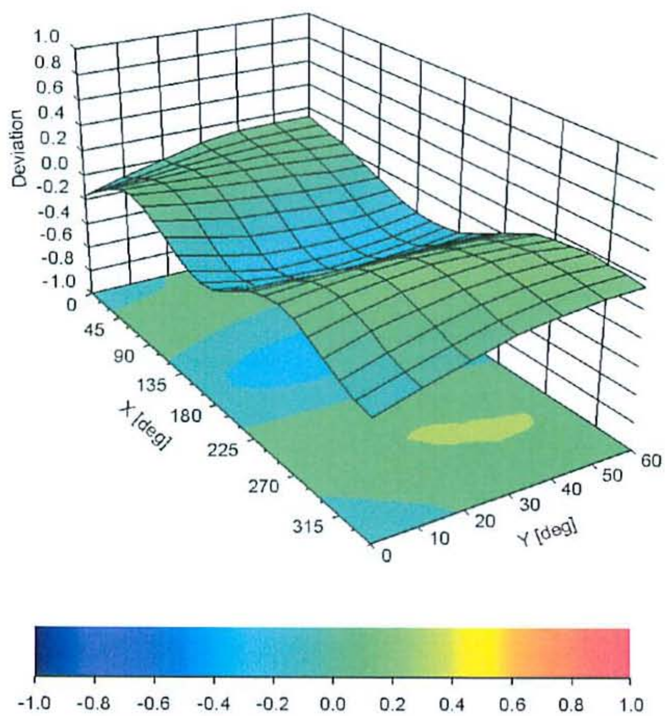
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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

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	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

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

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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: **ES3-3147_Jan12/2**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3147_Jan12)

Object	ES3DV3 - SN:3147
Calibration procedure(s)	QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	January 25, 2012

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	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
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: April 11, 2012

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

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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 affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, 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:3147

Manufactured: July 12, 2007
Calibrated: January 25, 2012

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3147

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.26	1.20	1.18	± 10.1 %
DCP (mV)[B]	100.8	104.2	104.7	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	107.9	±2.7 %
			Y	0.00	0.00	1.00	113.9	
			Z	0.00	0.00	1.00	106.4	
10108	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	5.79	X	6.61	68.4	20.5	143.2	±1.4 %
			Y	6.52	67.8	20.0	138.0	
			Z	6.56	67.7	20.0	138.1	
10109	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	6.42	X	7.01	66.7	19.7	104.8	±1.4 %
			Y	7.48	68.1	20.4	147.1	
			Z	7.60	68.4	20.6	147.7	
10110	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	5.75	X	6.29	67.8	20.3	139.7	±1.2 %
			Y	6.17	67.1	19.7	133.6	
			Z	6.24	67.1	19.7	135.0	
10111	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	6.44	X	7.32	68.4	20.8	148.1	±1.9 %
			Y	7.26	68.0	20.4	142.1	
			Z	7.36	68.2	20.6	142.9	
10154	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	5.76	X	6.25	67.6	20.1	139.6	±1.2 %
			Y	6.18	67.1	19.7	134.9	
			Z	6.30	67.3	19.9	134.8	
10155	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	6.43	X	7.33	68.4	20.8	148.1	±1.7 %
			Y	7.24	67.9	20.4	143.3	
			Z	7.34	68.1	20.5	142.8	
10156	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	5.79	X	6.03	67.3	20.0	136.0	±1.2 %
			Y	5.99	66.9	19.7	131.8	
			Z	6.07	67.0	19.8	131.4	
10157	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	6.49	X	7.11	68.5	20.9	143.1	±1.7 %
			Y	7.03	68.0	20.5	138.4	
			Z	7.11	67.9	20.5	137.6	
10175	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	5.73	X	5.06	66.9	19.9	122.1	±0.9 %
			Y	5.03	66.7	19.8	117.5	
			Z	5.08	66.2	19.4	117.6	
10176	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	6.52	X	5.94	68.4	21.1	122.4	±1.2 %
			Y	5.75	67.6	20.5	117.0	
			Z	5.90	67.5	20.5	118.2	

10177	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	5.73	X	5.06	66.9	19.9	122.2	±0.9 %
			Y	4.97	66.5	19.6	117.6	
			Z	5.11	66.4	19.6	117.3	
10178	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	6.52	X	5.92	68.3	21.1	122.5	±0.9 %
			Y	5.73	67.5	20.5	116.8	
			Z	5.93	67.6	20.5	117.8	

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3147

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	45.3	0.87	7.00	7.00	7.00	0.24	1.05	± 13.4 %
450	43.5	0.87	6.50	6.50	6.50	0.14	1.70	± 13.4 %
750	41.9	0.89	6.29	6.29	6.29	0.20	2.38	± 12.0 %
900	41.5	0.97	5.97	5.97	5.97	0.24	2.24	± 12.0 %
1810	40.0	1.40	5.18	5.18	5.18	0.80	1.17	± 12.0 %
1950	40.0	1.40	4.97	4.97	4.97	0.62	1.28	± 12.0 %
2300	39.5	1.67	4.78	4.78	4.78	0.80	1.23	± 12.0 %
2450	39.2	1.80	4.49	4.49	4.49	0.74	1.32	± 12.0 %
2600	39.0	1.96	4.30	4.30	4.30	0.75	1.34	± 12.0 %
3500	37.9	2.91	4.25	4.25	4.25	1.00	0.94	± 13.1 %
3700	37.7	3.12	3.78	3.78	3.78	1.00	1.18	± 13.1 %

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

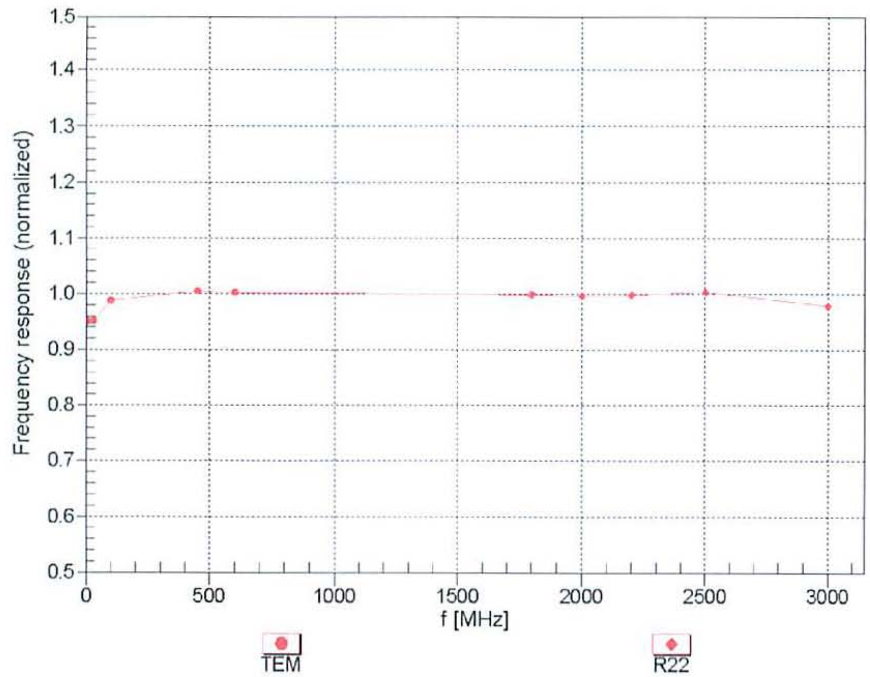
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3147

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	58.2	0.92	6.81	6.81	6.81	0.20	1.31	± 13.4 %
450	56.4	0.94	6.92	6.92	6.92	0.09	1.00	± 13.4 %
750	55.5	0.96	6.15	6.15	6.15	0.80	1.14	± 12.0 %
900	55.0	1.05	6.03	6.03	6.03	0.80	1.12	± 12.0 %
1810	53.3	1.52	4.82	4.82	4.82	0.45	1.80	± 12.0 %
1950	53.3	1.52	4.74	4.74	4.74	0.62	1.46	± 12.0 %
2300	52.9	1.81	4.33	4.33	4.33	0.80	1.15	± 12.0 %
2450	52.7	1.95	4.23	4.23	4.23	0.80	0.99	± 12.0 %
2600	52.5	2.16	4.08	4.08	4.08	0.67	1.01	± 12.0 %
3500	51.3	3.31	3.45	3.45	3.45	1.00	1.34	± 13.1 %
3700	51.0	3.55	3.40	3.40	3.40	0.76	1.62	± 13.1 %

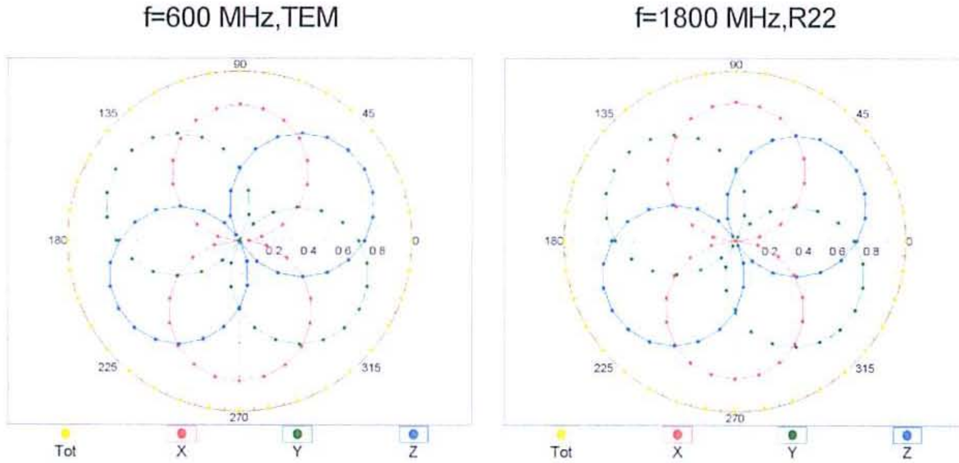
[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of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

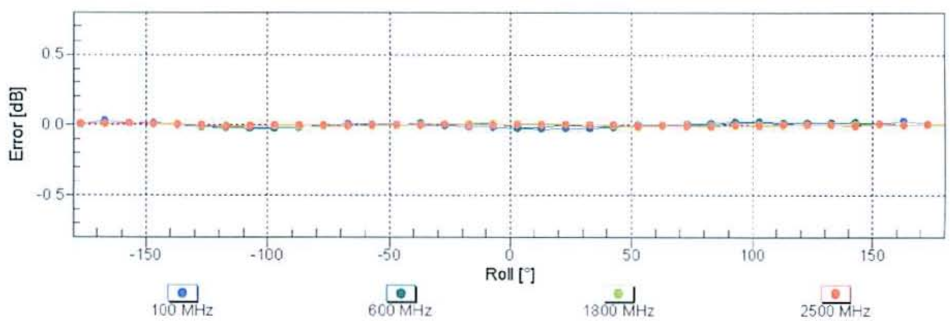
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

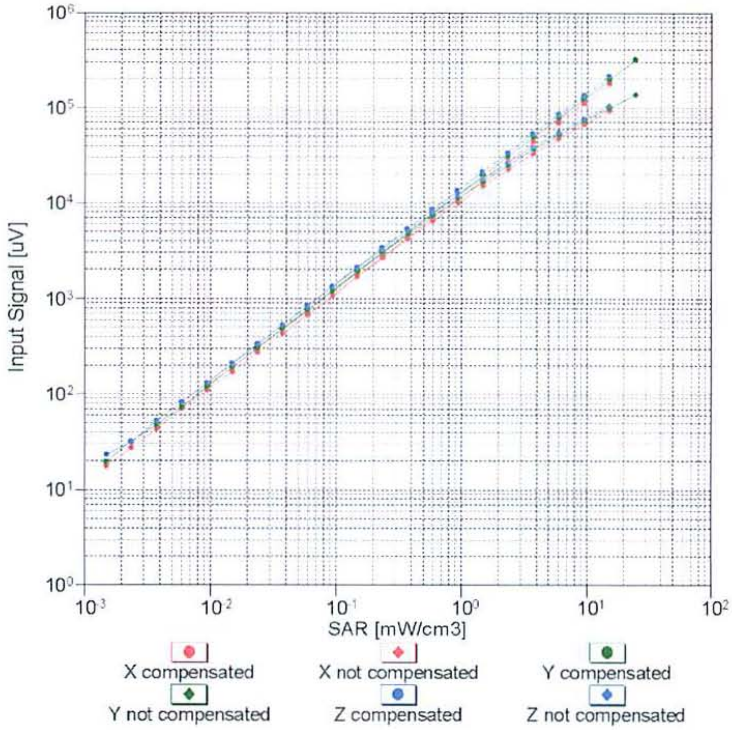
Receiving Pattern (ϕ), $\vartheta = 0°$

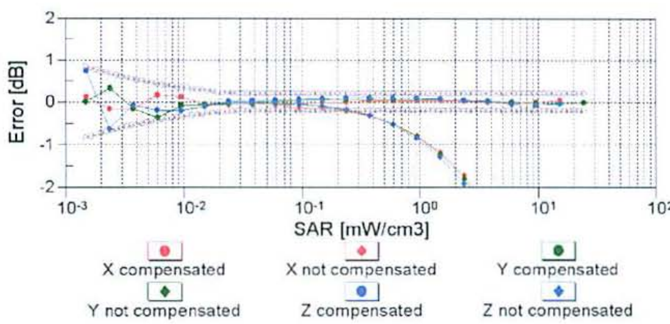




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

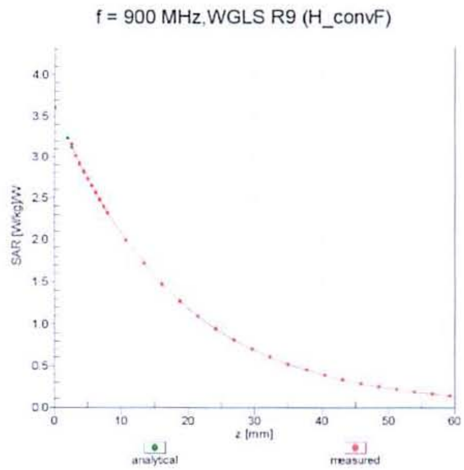
Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

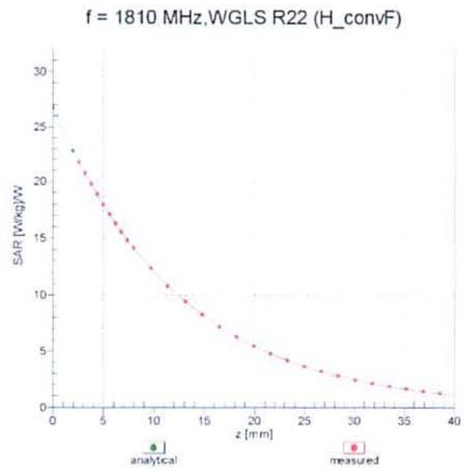




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

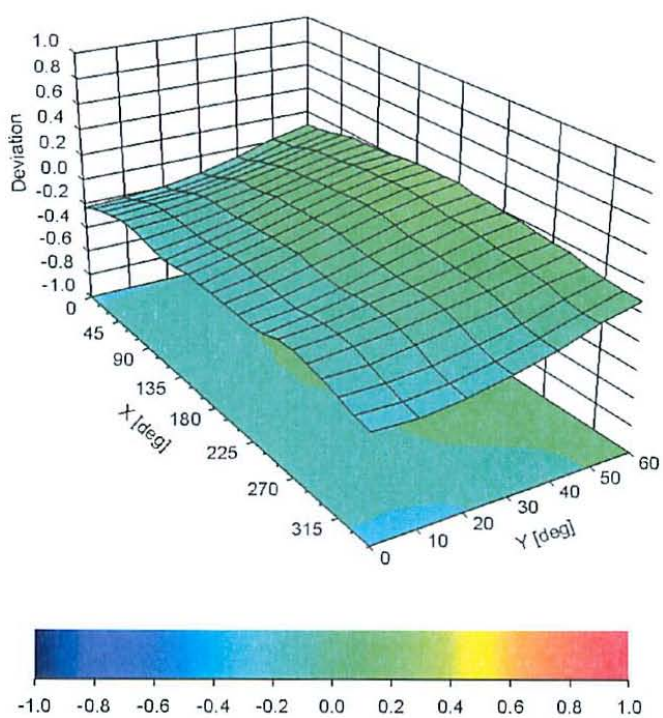
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3147

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

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s p e a g

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV3**
Serial Number:	**3147**
Place of Assessment:	**Zurich**
Date of Assessment:	**January 27, 2012**
Probe Calibration Date:	**January 25, 2012**

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

Assessed by:

Schmid & Partner Engineering AG

s p e a g

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Dosimetric E-Field Probe ES3DV3 SN:3147

Conversion factor (± standard deviation)

150 ± 50 MHz	*ConvF*	8.1 ± 10%	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
150 ± 50 MHz	*ConvF*	7.8 ± 10%	ε_r = 61.9 ± 5% σ = 0.80 ± 5% mho/m (body tissue)

Important Note:

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

Please see also DASY Manual.