MOTOROLA SOLUTIONS

TESTING CERT # 2518.01

DECLARATION OF COMPLIANCE SAR ASSESSMENT Part 1 of 6

Motorola Solutions Inc.
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Date of Report: 04/15/2016
Report Revision: B

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Date/s Tested:	LTE - 08/14/2015-08/26/2015, 09/16/2015 - 09/21/2015; GSM – 07/09/2015-07/15/2015 & 07/20/2015-07/22/2015; WCDMA – 07/16/2015, 07/17/2015, 07/20/2015-07/22/2015 & 08/26/2015-08/28/2015; WLAN – 07/29/2015-08/06/2015 & 09/17/2015-09/21/2015, 10/20/2015 & 11/07/2015-11/09/2015
Manufacturer:	Motorola Solutions Inc.
DUT Description:	Mission Critical Handheld Portable
Test TX mode(s):	GSM/GPRS, WCDMA, WLAN, LTE & BT
Max. Power output:	Refer to Part 1 Table 3
Nominal Power:	Refer to Part 1, Table 3
Tx Frequency Bands:	GSM: B2, B3, B5 & B8; WCDMA: B1, B2, B4, B5 & B8; WLAN: 2.4GHz / 5GHz; LTE; B3, B4, B5, B7, B8, B20, B26 & B28 & BT
Signaling type:	TDMA, CDMA, LTE, DSSS, OFDM & FHSS
Model(s) Tested:	LEX L10i
Model(s) Certified:	LEX L10i
Serial Number(s):	171PRQ0394, 171PRJ0703 & 171PRL0854
Classification:	General Population/Uncontrolled
FCC ID:	AZ489FT7078; GSM (B2 & B5), WCDMA (B2, B4 & B5), LTE (B4, B5, B7, B26) WLAN & BT - This report contains results that are immaterial for FCC equipment approval, which are clearly identified.

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 4.0 of this report. This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc EME Laboratory.
I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements. This reporting format is consistent with the suggested guidelines of the TIA TSB-150 December 2004. The results and statements contained in this report pertain only to the device(s) evaluated.

Deanna Zakharia

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Certification No.: L1151175P

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APPENDICES

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Report Revision History

Date	Revision	Comments
02/03/2016	A	Initial release
04/15/2016	B	Update antenna gain for BT/WLAN 2.4GHz

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurements performed at the Motorola Solutions Inc. EME Test Laboratory for handheld portable model LEX L10i. This device is classified as General Population/Uncontrolled.

2.0 SAR Summary

Table 1

Equipment Class	Mode	Max Calc at Body (W/kg)		Max Calc at Hot Spot (W/kg)		Max Calc at Head (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR	1g-SAR	10g-SAR
PCE	GSM/GPRS/EGPRS B5 (824.2-848.8MHz)	0.45	0.32	1.02	0.77	0.61	0.47
*NA	GSM/GPRS/EGPRS B8 (880.2-914.8MHz)	0.31	0.21	0.73	0.53	0.59	0.43
*NA	GSM/GPRS/EGPRS B3 (1710.2-1784.8MHz)	0.32	0.20	0.40	0.26	0.43	0.25
PCE	GSM/GPRS/EGPRS B2 (1850.2-1909.8MHz)	0.31	0.19	0.38	0.24	0.37	0.22
*NA	WCDMA B1 (1920-1980MHz)	0.61	0.38	0.93	0.57	0.77	0.47
PCE	WCDMA B2 (1850-1910MHz)	0.65	0.42	0.94	0.60	0.86	0.53
PCE	WCDMA B4 (1710-1755MHz)	0.82	0.51	0.84	0.53	0.92	0.55
PCE	WCDMA B5 (824-849MHz)	0.52	0.36	0.95	0.71	0.54	0.42
*NA	WCDMA B8 (880-915MHz)	0.38	0.25	0.79	0.57	0.59	0.44
*NA	LTE B3 (1710-1785MHz)	0.61	0.39	0.78	0.49	0.64	0.40
PCE	LTE B4 (1710-1755MHz)	0.63	0.40	0.81	0.52	0.77	0.48
PCE	LTE B5 (824-849MHz)	0.44	0.31	0.75	0.56	0.43	0.33
PCE	LTE B7 (2500-2570MHz)	0.59	0.33	0.93	0.49	1.00	0.52
*NA	LTE B8 (880-915MHz)	0.36	0.24	0.62	0.45	0.48	0.36
*NA	LTE B20 (832-862MHz)	0.41	0.28	0.73	0.55	0.46	0.35
PCE	LTE B26 (814-849MHz)	0.41	0.28	0.74	0.55	0.49	0.38
NA	LTE B28 (703-748MHz)	0.33	0.24	0.67	0.49	0.51	0.38
DTS	2.4 GHz WLAN	0.09	0.05	0.11	0.05	0.23	0.11
DTS	5GHz WLAN	0.03	0.01	0.57	0.19	0.41	0.12
DSS	BT	**NR	**NR	**NR	**NR	**NR	**NR
FCC Simultaneous Results		0.91	0.56	1.59	0.96	1.41	0.67
*NA - Overall Simultaneous Results		0.91	0.56	1.59	0.96	1.41	0.67

*NA – Not applicable to FCC

**NR - Results not required per KDB (refer to sections 13.2 and 14.0)

3.0 Abbreviations / Definitions

BT: Bluetooth
CNR: Calibration Not Required
DL: Downlink
DSS: Direct Spread Spectrum
DTM: Dual Transfer Mode
DTS: Digital Transmissions Systems
DUT: Device Under Test
EME: Electromagnetic Energy
EGPRS: Enhanced Data Rates for GSM
FHSS: Frequency Hopping Spread Spectrum
GFSK: Gaussian Frequency-Shift Keying
GPRS: General Packet Radio Service
GSM: Global System for Mobile
LTE: Long Term Evolution
NA: Not Applicable
OFDM: Orthogonal Frequency Division Multiplexing
PCE: PCS Licensed Transmitter held to ear
QPSK: Quadrature Pulse Shift Key
RB: Resource Blocks
SAR: Specific Absorption Rate
SC-FDMA: Single Carrier Frequency Division Multiple Access
TDD: Time Division Duplex
TDMA: Time Division Multiple Access
UL: Up Link
UMTS: Universal Mobile Telecommunications System
VoLTE: Voice over LTE
WCDMA: Wideband Code Division Multiple Access
WLAN: Wireless Local Area Network
4FSK: 4 Level Frequency Shift Keying
16QAM: 16 State Quadrature Amplitude Modulation

4.0 Referenced Standards and Guidelines

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

- IEC62209-1 (2005) Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)
- Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C.: 1997.
- IEEE 1528 (2013), Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronics Engineers (IEEE) C95.1-2005
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6 (2015), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- RSS-102 (Issue 5) – Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
- Australian Communications Authority Radio communications (Electromagnetic Radiation - Human Exposure) Standard (2014)
- ANATEL, Brazil Regulatory Authority, Resolution No. 303 of July 2, 2002 "Regulation of the limitation of exposure to electrical, magnetic, and electromagnetic fields in the radio frequency range between 9 kHz and 300 GHz." and "Attachment to resolution # 303 from July 2, 2002"
- IEC62209-2 Edition 1.0 2010-03, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz).
- FCC KDB – 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB – 865664 D02 RF Exposure Reporting v01r02
- FCC KDB – 447498 D01 General RF Exposure Guidance v06
- FCC KDB – 941225 D05 SAR for LTE Devices v02r05
- FCC KDB – 941225 D01 3G SAR Procedures v03r01
- FCC KDB – 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB - 648474 D04 Handset SAR v01r03

5.0 SAR Limits

Table 2

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

6.0 Description of Device Under Test (DUT)

The DUT is a mission critical handheld portable device with the following technologies;

This device includes LTE technology, which is capable of OFDM (Orthogonal Frequency Division Multiplexing) on the downlink and SC-FDMA (Single Carrier Frequency Division Multiple Access) on the uplink. TDD is not supported. Table 3 below lists the LTE bands and associated duty cycles and output powers. LTE data is located in appendix E.

This device includes GSM/EDGE/GPRS technologies which operate in Time Division Multiple Access (TDMA). The DUT is designated class B, multi-slot class 12 supporting maximum 4 UL or 4 DL with a total maximum of 5 slots. This device does not support DTM. The maximum duty cycles and output powers are defined in Table 3. GSM/EDGE/GPRS data is located in appendix F.

This device includes WCDMA technology which operates in Wideband Code Division Multiple Access. The device supports HSPA+ (QPSK only on the uplink) but does not support Dual-Carrier HSPA. The maximum duty cycles and output powers are defined in Table 3. WCDMA data is located in appendix G.

This device includes WLAN 802.11 a/b/g/n technology with channel bandwidths of 20MHz & 40MHz. The maximum duty cycles and output powers are defined in Table 3. WLAN data is located in appendix H.

This device includes standard and low energy Bluetooth (BT) technologies. The Bluetooth radio is used for wireless links to transfer data. Table 3 below lists these technologies along with their duty cycles and output powers. The standard BT uses Frequency Hopping Spread Spectrum (FHSS) while BT LE uses DSSS. Refer to section 14.0 Simultaneous Transmission Exclusion.

Maximum output powers in Table 3 are defined as upper limit of the production line final test station.

Table 3

Radio Type	TX Band (MHz)	Transmission	Max Duty Cycle (%)	Nominal Power (mW)	Max Power (mW)
GSM/GPRS/EGPRS – B5	824 -849	TDMA	50	1584.9	1995.3
GSM/GPRS/EGPRS – B8	880-915	TDMA	50	1584.9	1995.3
GSM/GPRS/EGPRS – B3	1710-1785	TDMA	50	794.3	1000.0
GSM/GPRS/EGPRS – B2	1850-1910	TDMA	50	794.3	1000.0
UMTS-B1	1920-1980	WCDMA	100	199.5	251.2
UMTS-B2	1850-1910	WCDMA	100	199.5	251.2
UMTS-B4	1710-1755	WCDMA	100	199.5	251.2
UMTS-B5	824 -849	WCDMA	100	199.5	251.2
UMTS-B8	880-915	WCDMA	100	199.5	251.2
LTE-B3	1710-1785	SC-FDMA	100	199.5	251.2
LTE-B4	1710-1755	SC-FDMA	100	199.5	251.2
LTE-B5	824 -849	SC-FDMA	100	199.5	251.2
LTE-B7	2500-2570	SC-FDMA	100	177.8	199.5
LTE-B8	880-915	SC-FDMA	100	199.5	251.2
LTE-B20	832-862	SC-FDMA	100	199.5	251.2
LTE-B26	814-849	SC-FDMA	100	199.5	251.2
LTE-B28	703-748	SC-FDMA	100	199.5	251.2
WLAN - 802.11b	2.4 GHz	DSSS	99.9	15.8	22.4
WLAN - 802.11g	2.4 GHz	DSSS/OFDM	99.9	15.8	22.4
WLAN - 802.11n	2.4 GHz	OFDM	99.9	15.8	22.4
WLAN - 802.11a	5GHz	OFDM	92	25.1	35.5
WLAN - 802.11n	5GHz	OFDM	92	20.0	28.2
BT	2.4 GHz	FHSS	75	4.0	6.3
BT LE	2.4 GHz	DSSS	60	1.6	2.5

The intended operating positions are “at the body”, hotspot mode and “at the side of the head” and “at the body”.

7.0 Accessories and Test Criteria

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

7.1 Antennas

The table below describes the three transmitting antennas.

Table 4

Antenna Models	Description	*Tested
Ant 1 - PL1000248	LTE/UMTS/GSM Tx/Rx Inverted-L Monopole Antenna 1710-2690 MHz ¼ wave, 28.7mm, 0.8 to -0.6 dBi	Yes
Ant 2 - PL1000248	LTE/UMTS/GSM Tx/Rx Inverted-L Monopole Antenna 703-960 MHz ¼ wave, 57.8mm,-0.4 to -2.2 dBi	Yes
Ant 3 - MC0121016	WiFi/BT Tx/Rx Inverted-L Monopole Antenna 2400-2484 MHz ¼ wave, 27.0mm, 1.0 dBi 5150-5850 MHz 1/2 wave, 27.0mm, 0.5 dBi	Yes

7.2 Battery

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

Table 5

Battery Models	Description	Selected for test	Tested	Comments
PMNN4472B	Standard Li-ion 2340mAh	Yes	Yes	Default battery
PMNN4475B	Extended Li-ion 4680mAh	Yes	Yes	

7.3 Body worn Accessories

The Table below includes the body worn accessory and description.

Table 6

Body worn Models	Description	Selected for test	Tested	Comments
HKLN4618A	Leather holster	Yes	Yes	

8.0 Description of Test System

8.1 Descriptions of Robotics/Probes/Readout Electronics

Table 8

Dosimetric System type	System version	DAE type	Probe Type
Schmid & Partner Engineering AG SPEAG DASY 5	52.8.8 (1222)	DAE3 & DAE 4	ES3DV3/EX3DV4 (E-Field)

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

8.2 Description of Phantom(s)

Table 9

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

8.3 Description of Simulated Tissue

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

The simulated tissue mixture was mixed based on the Simulated Tissue Composition indicated in Table 10. During the daily testing of this product, the applicable mixture was used to measure the Di-electric parameters at each of the tested frequencies to verify that the Di-electric parameters were within the tolerance of the tissue specifications.

Simulated Tissue Composition (percent by mass)
Table 10

	835MHz		900MHz		1880MHz		1950MHz		2450MHz		5GHz [1]	
Ingredients	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	48.75	65.20	NA	NA
Salt	1.45	0.94	1.45	0.94	0.37	0.43	0.37	0.38	0.15	0.20	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.

9.0 Additional Test Equipment

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

Table 11

Equipment Type	Model Number	Serial Number	Calibration Date	Calibration Due Date
Speag Probe	ES3DV3	3301	9/24/2014	9/24/2015
Speag Probe	ES3DV3	3291	7/06/2015	7/06/2016
Speag Probe	EX3DV4	3612	4/28/2015	4/28/2016
Speag DAE	DAE3	363	1/15/2015	1/15/2016
Speag DAE	DAE4	850	8/24/2015	8/24/2016
Power Meter (Keysight)	E4419B	MY45103725	3/2/2015	3/2/2016
E-Series Avg. Power Sensor (Keysight)	E9301B	MY41495593	3/17/2015	3/17/2016
N-Series Avg. Power Sensor (Keysight)	N8482B	MY52080004	2/10/2015	2/10/2016
Bi-Directional Coupler (NARDA)	3020A	40296	1/31/2014	1/31/2016
Bi-Directional Coupler (NARDA)	3022	70181	11/1/2013	11/1/2015
Bi-Directional Coupler (NARDA)	3024	61136	2/3/2015	2/3/2017
Signal Generator (Keysight)	E4438C	MY44270302	6/18/2015	6/18/2017
Wideband Radio Communication Tester	CMW500	103948	6/3/2015	6/3/2016
AMP (ComTech PST)	AR88258-10	M3Y6A00-1007	CNR	CNR
AMP (Amplifier Research)	10W1000	5924	CNR	CNR
Dickson Temperature Recorder	TM320	7081356	9/16/2014	9/16/2015*
Dickson Temperature Recorder	TM325	12121144	6/17/2015	6/17/2016
Omega Digital Thermometer with J Type TC Probe	HH202A	18800	4/6/2015	4/6/2016
LKM Electronic Digital Thermometer with Pt100 Sensor Probe	DTM3000	3014	9/11/2014	9/11/2015*
Keysight PNA-L Network Analyzer	N5230C	MY49002155	8/3/2015	8/3/2016
Keysight PNA-L Network Analyzer	N5230C	MY49002155	8/4/2014	8/4/2015*
Dielectric Probe Kit (DAK2)	DAK-3.5	1088	9/16/2014	9/16/2015*
Dielectric Probe Kit (DAK2)	DAK-12	1040	9/16/2014	9/16/2015*
Dielectric Probe Kit (DAK1)	DAK-3.5	1059	4/21/2015	4/21/2016
Dielectric Probe Kit (DAK1)	DAK-12	1013	4/21/2015	4/21/2016
Speag Dipole	D750V3	1098	10/15/2013	10/15/2015
Speag Dipole	D900V2	085	2/12/2014	2/12/2016
Speag Dipole	D1900V2	521	3/24/2015	30/24/2017
Speag Dipole	D1800V2	278	4/10/2014	4/10/2016
Speag Dipole	D2450V2	703	5/11/2015	5/11/2017
Speag Dipole	D2450V2	704	3/13/2015	3/13/2017
Speag Dipole	D2600V2	1002	2/13/2015	2/13/2017
Speag Dipole	D5GHzV2	1022	3/23/2015	3/23/2017

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

10.0 SAR Measurement System Validation and Verification

DASY output files of the probe and dipole calibration certificates are included in appendices B & C.

10.1 System Validation

The SAR measurement system was validated according to procedures in KDB 865664. The validation status summary tables are listed in the following appendices;

Appendix E for LTE
Appendix F for GSM/GPRS/EDGE
Appendix G for WCDMA
Appendix H for WLAN

10.2 System Verification

System verification was conducted each day during the SAR assessment. The system verification results are summarized in the following appendices;

Appendix E for LTE
Appendix F for GSM/GPRS/EDGE
Appendix G for WCDMA
Appendix H for WLAN

10.3 Equivalent Tissue Test Results

Measured dielectric properties for simulated tissue are listed in the following appendices;

Appendix E for LTE
Appendix F for GSM/GPRS/EDGE
Appendix G for WCDMA
Appendix H for WLAN

11.0 Environmental Test Conditions

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

Table 15

	Target	Measured
Ambient Temperature	18 – 25 ˚C	Range: 20.3 – 24.4˚C Avg. 21.6 ˚C
Tissue Temperature	NA	Range: 20.5-24.7˚C Avg. 21.9˚C

Relative humidity target range is a recommended target

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

12.0 Measurement Setup

12.1 Measurements

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

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

Table 16

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

12.2 DUT Configuration(s)

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

12.3 DUT Positioning Procedures

The positioning of the device for each body location is described in the following appendices;

Appendix E for LTE
Appendix F for GSM/GPRS/EDGE
Appendix G for WCDMA
Appendix H for WLAN

12.4 DUT Test Channels

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

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

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

12.5 SAR Result Scaling Methodology

The calculated 1-gram and 10-gram averaged SAR results indicated as "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" in the data Tables is determined by scaling the measured SAR to account for power leveling variations and drift. Appendix F includes a shortened scan to justify SAR scaling for drift. For this device the "Max Calc. 1g-SAR" and "Max Calc.10g-SAR" are scaled using the following formula:

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

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

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

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

Table 17

Antenna Pos.	Battery	Test position	Carry Case	Cable Accessory	Freq (MHz)	Initial Power (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 Number
Ant 2	Standard PMNN4472B	Back of DUT @ 1cm	None	None	824.4	1.324	-0.01	1.000	0.754	1.00	0.76	Short ErC-Ab-150713-11
					824.4	1.324	0.14	1.020	0.765	**1.02**	**0.77**	Full ErC-Ab-150713-10

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

12.6 DUT Test Plan

The guidelines and requirements outlined in section 4.0 were used to assess compliance of this device. All modes of operation identified in section 6.0 were considered during the development of the test plan.

Standalone and simultaneous BT testing were assessed in sections 13.2 and 14.0 per the guidelines of KDB 447498.

13.0 DUT Test Data

13.1 SAR Data

Refer to the following appendices;

Appendix E for LTE
Appendix F for GSM/GPRS/EDGE
Appendix G for WCDMA
Appendix H for WLAN

13.2 Assessment at the Bluetooth band

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

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[$\sqrt{F_{(GHz)}}$] = 1.5, which is ≤ 3 for 1-g SAR

Where:

Max. power = 4.7mW (6.3mW*75% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

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

14.0 Simultaneous Transmission Exclusion for BT

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

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] *[√F(GHz)/X] = 0.2W/kg, which is ≤ 0.4 W/kg (1g)

Where:

X = 7.5 for 1g-SAR; 18.75 for 10g
Max. power = 4.7mW (6.3mW*75% duty cycle)
Min. test separation distance = 5mm for actual test separation < 5mm
F(GHz) = 2.48 GHz

Per the result from the calculation above, simultaneous exclusion is applied and therefore SAR results are not reported herein.

15.0 Simultaneous Transmission Scenarios

Table 18

No.	Capable Transmit Configuration	Body	Hot Spot	Head
1	1 LTE + WLAN (2.4 GHz or 5GHz)	Yes	Yes	Yes
2	1 WCDMA + WLAN (2.4 GHz or 5GHz)	Yes	Yes	Yes
3	1 GSM + WLAN (2.4 GHz or 5GHz)	Yes	Yes	Yes
4	1 LTE + BT	Yes	Yes	Yes
5	1 WCDMA + BT	Yes	Yes	Yes
6	1 GSM + BT	Yes	Yes	Yes

WLAN 2.4GHz, 5.0GHz and BT share the same chipset, transmission path and antenna. The transmissions of these technologies are controlled by switching which only allows one technology to transmit at a single time and therefore do not support simultaneous transmission.

16.0 Results Summary

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

Table 19

Equipment Class	Mode	Max Calc at Body (W/kg)		Max Calc at Hot Spot (W/kg)		Max Calc at Head (W/kg)	
		1g-SAR	10g-SAR	1g-SAR	10g-SAR	1g-SAR	10g-SAR
PCE	GSM/GPRS/EGPRS B5 (824.2-848.8MHz)	0.45	0.32	1.02	0.77	0.61	0.47
*NA	GSM/GPRS/EGPRS B8 (880.2-914.8MHz)	0.31	0.21	0.73	0.53	0.59	0.43
*NA	GSM/GPRS/EGPRS B3 (1710.2-1784.8MHz)	0.32	0.20	0.40	0.26	0.43	0.25
PCE	GSM/GPRS/EGPRS B2 (1850.2-1909.8MHz)	0.31	0.19	0.38	0.24	0.37	0.22
*NA	WCDMA B1 (1920-1980MHz)	0.61	0.38	0.93	0.57	0.77	0.47
PCE	WCDMA B2 (1850-1910MHz)	0.65	0.42	0.94	0.60	0.86	0.53
PCE	WCDMA B4 (1710-1755MHz)	0.82	0.51	0.84	0.53	0.92	0.55
PCE	WCDMA B5 (824-849MHz)	0.52	0.36	0.95	0.71	0.54	0.42
*NA	WCDMA B8 (880-915MHz)	0.38	0.25	0.79	0.57	0.59	0.44
*NA	LTE B3 (1710-1785MHz)	0.61	0.39	0.78	0.49	0.64	0.40
PCE	LTE B4 (1710-1755MHz)	0.63	0.40	0.81	0.52	0.77	0.48
PCE	LTE B5 (824-849MHz)	0.44	0.31	0.75	0.56	0.43	0.33
PCE	LTE B7 (2500-2570MHz)	0.59	0.33	0.93	0.49	1.00	0.52
*NA	LTE B8 (880-915MHz)	0.36	0.24	0.62	0.45	0.48	0.36
*NA	LTE B20 (832-862MHz)	0.41	0.28	0.73	0.55	0.46	0.35
PCE	LTE B26 (814-849MHz)	0.41	0.28	0.74	0.55	0.49	0.38
NA	LTE B28 (703-748MHz)	0.33	0.24	0.67	0.49	0.51	0.38
DTS	2.4 GHz WLAN	0.09	0.05	0.11	0.05	0.23	0.11
DTS	5GHz WLAN	0.03	0.01	0.57	0.19	0.41	0.12
DSS	BT	**NR	**NR	**NR	**NR	**NR	**NR
FCC Simultaneous Results		0.91	0.56	1.59	0.96	1.41	0.67
*NA - Overall Simultaneous Results		0.91	0.56	1.59	0.96	1.41	0.67

*NA – Not applicable to FCC

**NR - Results not required per KDB (refer to sections 13.2 and 14.0)

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 OET Bulletin 65. The 10 grams result is not applicable to FCC filing.

17.0 System Uncertainty

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

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

Appendix A
Measurement Uncertainty Budget

Uncertainty Budget for System Verification (dipole & flat phantom) for 650 MHz to 2700 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	

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

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

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

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

a	*b*	*c*	*d*	*e = f(d,k)*	*f*	*g*	*h = c x f / e*	*i = c x g / e*	*k*
Uncertainty Component	IEEE 1528 section	**Tol. (± %)**	**Prob. Dist.**	**Div.**	c_i (1 g)	c_i (10 g)	**1 g** u_i (±%)	**10 g** u_i (±%)	v_i
Measurement System									
Probe Calibration	E.2.1	6.6	N	1.00	1	1	6.6	6.6	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	2.0	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t. Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	2.1	R	1.73	1	1	1.2	1.2	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8, 6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Dielectric Parameter Correction	--	1.4	N	1.00	1	0.79	1.4	1.1	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				10	9	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				19	19	

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

Uncertainty Budget for Device Under Test for 5.1 to 6 GHz

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

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

Appendix B
Probe Calibration Certificates

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

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

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

Accreditation No.: SCS 108

Client **Motorola EME**

Certificate No: **ES3-3301_Sep14**

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3301

Calibration procedure(s) QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: September 24, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 24, 2014

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

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3301

Manufactured: August 27, 2010
Calibrated: September 24, 2014

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.48	1.01	1.24	± 10.1 %
DCP (mV)[B]	99.8	104.7	100.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	196.0	±3.3 %
		Y	0.0	0.0	1.0		194.9	
		Z	0.0	0.0	1.0		182.9	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.64	66.0	17.0	1.87	135.0	±0.7 %
		Y	2.82	68.5	18.8		134.3	
		Z	3.36	71.1	20.0		147.5	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.10	70.3	23.0	9.46	133.1	±3.0 %
		Y	10.53	69.5	22.7		126.7	
		Z	10.96	69.9	22.8		122.1	
10059-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	2.97	67.5	17.7	2.12	133.5	±0.7 %
		Y	3.51	72.2	20.5		133.9	
		Z	3.80	72.5	20.5		147.3	
10060-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	6.67	83.5	23.9	2.83	144.1	±0.7 %
		Y	9.03	93.1	28.5		141.8	
		Z	11.85	95.0	28.5		134.1	
10061-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	7.74	82.2	23.9	3.60	148.4	±0.9 %
		Y	6.90	83.6	25.5		143.8	
		Z	10.31	88.0	26.4		138.3	
10071-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	11.29	70.7	23.5	9.83	129.8	±3.5 %
		Y	10.67	69.7	23.1		124.6	
		Z	11.81	71.9	24.2		146.4	
10072-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	10.90	70.5	23.3	9.62	127.2	±3.3 %
		Y	10.74	71.0	23.8		147.7	
		Z	11.49	72.0	24.2		144.5	
10073-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	10.94	70.7	23.7	9.94	122.7	±4.1 %
		Y	10.70	70.9	24.0		142.0	
		Z	11.64	72.4	24.7		141.5	
10074-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	11.13	71.1	24.2	10.30	120.8	±3.3 %
		Y	10.82	71.3	24.5		138.7	
		Z	11.69	72.4	24.9		139.5	
10075-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	12.35	74.4	26.5	10.77	149.2	±4.4 %
		Y	10.96	71.6	25.1		135.6	
		Z	12.00	73.1	25.7		137.3	
10076-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	12.37	74.5	26.7	10.94	146.4	±3.8 %
		Y	10.95	71.6	25.2		133.8	
		Z	12.11	73.4	25.9		136.7	

10077-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	12.42	74.7	26.9	11.00	146.0	±4.1 %
		Y	10.95	71.7	25.4		132.9	
		Z	12.13	73.6	26.1		135.9	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.16	66.3	18.9	5.67	126.3	±1.4 %
		Y	6.28	67.2	19.7		126.8	
		Z	6.46	67.5	19.7		140.3	
10101-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	7.31	67.0	19.6	6.42	136.2	±1.7 %
		Y	7.34	67.5	20.1		135.9	
		Z	7.29	66.9	19.7		125.5	
10102-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	7.61	67.3	19.8	6.60	138.6	±1.7 %
		Y	7.60	67.7	20.2		137.8	
		Z	7.56	67.1	19.9		127.8	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.37	67.1	19.5	5.80	148.7	±1.7 %
		Y	6.36	67.6	20.1		148.8	
		Z	6.39	67.2	19.7		138.1	
10109-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	7.06	66.6	19.5	6.43	132.2	±1.7 %
		Y	7.06	67.2	20.0		131.7	
		Z	7.34	67.5	20.1		146.5	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.04	66.6	19.3	5.75	144.8	±1.7 %
		Y	6.02	67.1	19.9		143.8	
		Z	6.05	66.6	19.4		134.0	
10111-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	6.80	66.4	19.4	6.44	128.2	±1.7 %
		Y	6.77	66.9	19.9		126.8	
		Z	7.09	67.3	20.0		142.1	
10112-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.35	67.0	19.7	6.59	134.9	±1.9 %
		Y	7.28	67.3	20.2		132.1	
		Z	7.63	67.9	20.4		148.0	
10113-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	7.06	66.6	19.6	6.62	130.4	±1.7 %
		Y	7.00	67.1	20.1		128.1	
		Z	7.36	67.6	20.3		142.4	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.24	68.9	21.3	8.10	138.8	±2.2 %
		Y	10.25	69.3	21.7		136.5	
		Z	10.13	68.6	21.2		126.6	
10115-CAA	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	X	10.79	69.5	21.8	8.46	143.2	±2.5 %
		Y	10.69	69.5	21.9		140.9	
		Z	10.72	69.3	21.7		131.5	
10116-CAA	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	X	10.30	69.0	21.4	8.15	139.8	±2.2 %
		Y	10.23	69.2	21.6		137.9	
		Z	10.12	68.5	21.1		127.7	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.24	68.9	21.3	8.07	139.7	±2.2 %
		Y	10.19	69.1	21.5		138.1	
		Z	10.11	68.5	21.1		128.8	
10118-CAA	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	X	10.96	69.7	22.0	8.59	144.6	±2.5 %
		Y	10.85	69.8	22.1		142.9	
		Z	10.79	69.2	21.7		133.6	

10119-CAA	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	X	10.30	69.1	21.4	8.13	140.0	±2.2 %
		Y	10.24	69.2	21.6		138.0	
		Z	10.18	68.7	21.3		127.6	
10140-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	7.54	67.3	19.8	6.49	138.8	±1.7 %
		Y	7.53	67.7	20.3		137.3	
		Z	7.51	67.2	19.8		128.5	
10141-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	X	7.67	67.3	19.8	6.53	139.5	±1.7 %
		Y	7.67	67.8	20.3		138.8	
		Z	7.64	67.2	19.9		130.2	
10142-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.85	66.3	19.1	5.73	141.0	±1.4 %
		Y	5.82	66.8	19.7		141.6	
		Z	5.90	66.5	19.4		133.1	
10143-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.82	67.2	19.8	6.35	148.8	±1.7 %
		Y	6.75	67.7	20.4		147.1	
		Z	6.87	67.3	20.0		139.7	
10144-CAB	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	X	6.88	66.5	19.5	6.65	126.1	±1.7 %
		Y	7.08	68.0	20.7		148.4	
		Z	7.18	67.4	20.2		139.9	
10145-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.55	65.8	18.9	5.76	136.3	±1.4 %
		Y	5.55	66.7	19.8		135.4	
		Z	5.63	66.1	19.2		128.4	
10146-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.50	67.0	19.8	6.41	140.2	±1.4 %
		Y	6.45	67.9	20.5		139.5	
		Z	6.56	67.1	20.0		131.2	
10147-CAB	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	X	6.78	67.2	20.0	6.72	140.5	±1.7 %
		Y	6.71	68.0	20.8		139.3	
		Z	6.86	67.4	20.3		132.8	
10149-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.07	66.7	19.5	6.42	130.9	±1.7 %
		Y	7.09	67.3	20.1		130.4	
		Z	7.37	67.7	20.2		146.5	
10150-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	X	7.32	66.9	19.7	6.60	133.1	±1.9 %
		Y	7.30	67.3	20.2		132.6	
		Z	7.61	67.8	20.3		148.4	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.02	66.5	19.2	5.75	144.2	±1.7 %
		Y	6.03	67.1	19.9		144.2	
		Z	6.06	66.6	19.5		133.8	
10155-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	6.78	66.3	19.3	6.43	128.0	±1.7 %
		Y	6.80	67.0	20.0		126.5	
		Z	7.09	67.3	20.0		141.8	
10156-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.80	66.2	19.1	5.79	140.8	±1.4 %
		Y	5.80	66.9	19.9		138.6	
		Z	5.84	66.3	19.4		130.6	
10157-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.83	67.2	19.9	6.49	147.7	±1.7 %
		Y	6.76	67.8	20.6		143.9	
		Z	6.83	67.1	20.0		135.6	

10158-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	7.07	66.7	19.6	6.62	129.7	±1.7 %
		Y	7.03	67.2	20.2		126.9	
		Z	7.37	67.6	20.3		143.3	
10159-CAB	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.97	67.5	20.1	6.56	148.9	±1.9 %
		Y	6.87	68.0	20.7		144.7	
		Z	6.98	67.4	20.2		136.2	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.21	66.1	18.9	5.82	126.6	±1.4 %
		Y	6.51	67.8	20.2		148.5	
		Z	6.51	67.2	19.7		139.2	
10161-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.16	66.9	19.6	6.43	134.6	±1.7 %
		Y	7.13	67.4	20.2		130.6	
		Z	7.43	67.7	20.2		146.8	
10162-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	X	7.38	67.1	19.8	6.58	135.8	±1.7 %
		Y	7.31	67.4	20.3		132.2	
		Z	7.67	68.0	20.4		148.4	
10166-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	4.98	65.6	18.7	5.46	133.0	±1.2 %
		Y	4.98	66.6	19.7		129.0	
		Z	5.21	66.5	19.5		142.4	
10167-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	5.92	66.8	19.6	6.21	134.2	±1.7 %
		Y	5.80	67.5	20.4		130.1	
		Z	6.23	67.9	20.4		147.0	
10168-CAB	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	X	6.38	67.0	20.0	6.79	134.8	±1.9 %
		Y	6.25	67.7	20.8		129.5	
		Z	6.70	68.1	20.8		146.8	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.00	66.5	19.4	5.73	147.6	±1.4 %
		Y	4.93	67.4	20.4		142.9	
		Z	5.05	66.7	19.8		134.0	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.79	67.8	20.4	6.52	148.0	±1.7 %
		Y	5.57	68.1	21.1		141.2	
		Z	5.86	68.0	20.7		134.6	
10171-AAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	5.79	67.9	20.4	6.49	148.0	±1.7 %
		Y	5.58	68.3	21.2		141.0	
		Z	5.84	67.9	20.7		135.8	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.99	66.5	19.4	5.72	147.0	±1.4 %
		Y	4.93	67.4	20.4		142.3	
		Z	5.05	66.7	19.8		134.1	
10176-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.79	67.8	20.4	6.52	148.0	±1.7 %
		Y	5.58	68.1	21.1		141.1	
		Z	5.84	67.8	20.7		134.3	
10177-CAD	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.99	66.5	19.4	5.73	146.6	±1.7 %
		Y	4.93	67.4	20.4		142.6	
		Z	5.06	66.7	19.8		134.1	
10178-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.80	67.8	20.4	6.52	147.7	±1.7 %
		Y	5.59	68.2	21.1		141.1	
		Z	5.84	67.8	20.6		133.7	

10179-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.83	68.0	20.6	6.50	148.0	±1.7 %
		Y	5.58	68.2	21.1		141.3	
		Z	5.85	68.0	20.7		134.7	
10180-CAB	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.80	67.9	20.4	6.50	148.0	±1.7 %
		Y	5.60	68.3	21.2		141.4	
		Z	5.85	67.9	20.7		134.4	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.98	66.5	19.4	5.72	147.1	±1.4 %
		Y	4.93	67.4	20.4		142.7	
		Z	5.02	66.6	19.7		133.7	
10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.81	67.9	20.5	6.52	148.3	±1.7 %
		Y	5.59	68.2	21.1		141.9	
		Z	5.83	67.8	20.6		134.0	
10183-AAA	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	X	5.79	67.8	20.4	6.50	147.6	±1.7 %
		Y	5.58	68.2	21.1		142.1	
		Z	5.83	67.8	20.6		134.5	
10184-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	5.00	66.6	19.4	5.73	147.3	±1.4 %
		Y	4.95	67.4	20.4		143.6	
		Z	5.03	66.6	19.7		133.5	
10185-CAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.79	67.8	20.4	6.51	147.8	±1.7 %
		Y	5.60	68.2	21.2		142.3	
		Z	5.83	67.8	20.6		133.9	
10186-AAB	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	X	5.81	67.9	20.5	6.50	148.0	±1.7 %
		Y	5.60	68.3	21.1		142.4	
		Z	5.86	68.0	20.7		135.5	
10187-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	5.00	66.6	19.5	5.73	147.0	±1.4 %
		Y	4.94	67.4	20.4		143.7	
		Z	5.06	66.7	19.8		134.4	
10188-CAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.80	67.8	20.5	6.52	147.6	±1.9 %
		Y	5.60	68.2	21.1		142.6	
		Z	5.85	67.8	20.7		134.3	
10189-AAB	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	X	5.81	67.9	20.5	6.50	148.0	±1.9 %
		Y	5.60	68.2	21.1		142.9	
		Z	5.85	67.9	20.7		135.6	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.87	68.5	21.1	8.09	133.0	±2.5 %
		Y	9.82	68.9	21.6		129.5	
		Z	10.22	69.3	21.7		146.8	
10194-CAA	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	X	9.96	68.7	21.2	8.12	135.0	±2.5 %
		Y	9.91	69.1	21.7		131.8	
		Z	10.26	69.4	21.8		148.7	
10195-CAA	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	X	10.11	68.9	21.4	8.21	136.5	±2.5 %
		Y	9.92	68.8	21.6		132.7	
		Z	10.41	69.6	21.9		149.8	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.91	68.6	21.2	8.10	135.0	±2.5 %
		Y	9.74	68.6	21.4		131.1	
		Z	10.23	69.4	21.7		149.1	

10197-CAA	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)	X	9.97	68.7	21.2	8.13	135.5	±2.5 %
		Y	9.86	68.9	21.6		132.8	
		Z	10.30	69.5	21.8		149.9	
10198-CAA	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)	X	10.18	69.0	21.5	8.28	136.5	±2.2 %
		Y	10.01	69.0	21.7		133.4	
		Z	9.98	68.3	21.2		123.7	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.79	68.5	21.1	8.03	134.3	±2.7 %
		Y	9.67	68.7	21.4		131.7	
		Z	10.05	69.1	21.5		149.2	
10220-CAA	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	X	9.98	68.7	21.3	8.13	135.9	±2.2 %
		Y	9.85	68.8	21.5		133.1	
		Z	9.92	68.5	21.2		123.4	
10221-CAA	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	X	10.17	68.9	21.4	8.27	136.5	±2.2 %
		Y	10.03	69.0	21.7		134.2	
		Z	10.01	68.4	21.2		124.6	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.24	69.0	21.3	8.06	141.0	±2.2 %
		Y	10.21	69.2	21.6		139.4	
		Z	10.09	68.5	21.1		128.8	
10223-CAA	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	X	10.86	69.7	21.9	8.48	146.1	±2.5 %
		Y	10.79	69.8	22.1		143.7	
		Z	10.67	69.1	21.6		133.7	
10224-CAA	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	X	10.25	69.1	21.3	8.08	140.7	±2.2 %
		Y	10.21	69.2	21.6		139.2	
		Z	10.08	68.5	21.1		128.5	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.10	66.1	19.0	5.81	126.0	±1.4 %
		Y	6.43	67.8	20.3		149.8	
		Z	6.41	67.3	19.8		139.5	
10298-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.66	66.1	19.1	5.72	139.4	±1.4 %
		Y	5.66	66.9	19.9		138.4	
		Z	5.73	66.3	19.3		130.2	
10299-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.67	67.3	19.9	6.39	145.2	±1.7 %
		Y	6.56	67.8	20.5		142.3	
		Z	6.69	67.3	20.0		134.0	
10300-AAA	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	X	6.86	67.4	20.1	6.60	144.3	±1.7 %
		Y	6.75	68.0	20.7		142.9	
		Z	6.91	67.5	20.2		134.8	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.65	66.6	19.3	6.06	129.1	±1.7 %
		Y	6.73	67.4	20.1		128.2	
		Z	7.00	67.9	20.2		143.1	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.53	65.9	17.0	1.71	136.4	±0.7 %
		Y	3.41	73.0	21.4		135.7	
		Z	3.03	69.8	19.4		149.3	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.12	68.8	21.5	8.36	134.2	±2.2 %
		Y	10.03	69.2	21.9		130.1	
		Z	10.06	68.6	21.5		122.4	

10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.33	65.2	16.6	1.54	137.1	±0.7 %
		Y	3.11	71.7	20.8		137.0	
		Z	2.76	68.8	19.0		127.4	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.99	68.7	21.3	8.23	133.7	±2.5 %
		Y	9.92	69.0	21.8		130.4	
		Z	10.32	69.5	21.9		149.8	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	9.87	68.6	21.3	8.14	133.6	±2.5 %
		Y	9.78	68.9	21.7		129.5	
		Z	10.24	69.6	21.9		149.1	
10419-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preambule)	X	9.99	68.8	21.4	8.19	134.9	±2.2 %
		Y	9.81	68.8	21.6		130.3	
		Z	9.81	68.2	21.1		122.9	

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 11 and 12).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
150	52.3	0.76	7.37	7.37	7.37	0.06	1.20	± 13.3 %
220	49.0	0.81	7.38	7.38	7.38	0.08	1.20	± 13.3 %
300	45.3	0.87	7.67	7.67	7.67	0.18	1.30	± 13.3 %
450	43.5	0.87	6.74	6.74	6.74	0.19	2.05	± 13.3 %
750	41.9	0.89	6.53	6.53	6.53	0.34	1.79	± 12.0 %
900	41.5	0.97	6.23	6.23	6.23	0.32	1.85	± 12.0 %
1810	40.0	1.40	5.04	5.04	5.04	0.74	1.21	± 12.0 %
1950	40.0	1.40	4.87	4.87	4.87	0.75	1.24	± 12.0 %
2300	39.5	1.67	4.75	4.75	4.75	0.80	1.21	± 12.0 %
2450	39.2	1.80	4.49	4.49	4.49	0.72	1.31	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.80	1.26	± 12.0 %
3500	37.9	2.91	4.29	4.29	4.29	1.00	1.13	± 13.1 %
3700	37.7	3.12	4.11	4.11	4.11	1.00	1.11	± 13.1 %

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

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

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
150	61.9	0.80	7.03	7.03	7.03	0.08	1.30	± 13.3 %
220	60.2	0.86	7.46	7.46	7.46	0.08	1.20	± 13.3 %
300	58.2	0.92	7.06	7.06	7.06	0.10	1.50	± 13.3 %
450	56.7	0.94	7.10	7.10	7.10	0.11	1.20	± 13.3 %
750	55.5	0.96	6.15	6.15	6.15	0.60	1.36	± 12.0 %
900	55.0	1.05	6.00	6.00	6.00	0.45	1.58	± 12.0 %
1810	53.3	1.52	4.79	4.79	4.79	0.80	1.22	± 12.0 %
1950	53.3	1.52	4.83	4.83	4.83	0.48	1.74	± 12.0 %
2300	52.9	1.81	4.48	4.48	4.48	0.70	1.25	± 12.0 %
2450	52.7	1.95	4.31	4.31	4.31	0.80	1.16	± 12.0 %
2600	52.5	2.16	4.15	4.15	4.15	0.64	0.92	± 12.0 %
3500	51.3	3.31	3.64	3.64	3.64	1.00	1.32	± 13.1 %
3700	51.0	3.55	3.56	3.56	3.56	1.00	1.28	± 13.1 %

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

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

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

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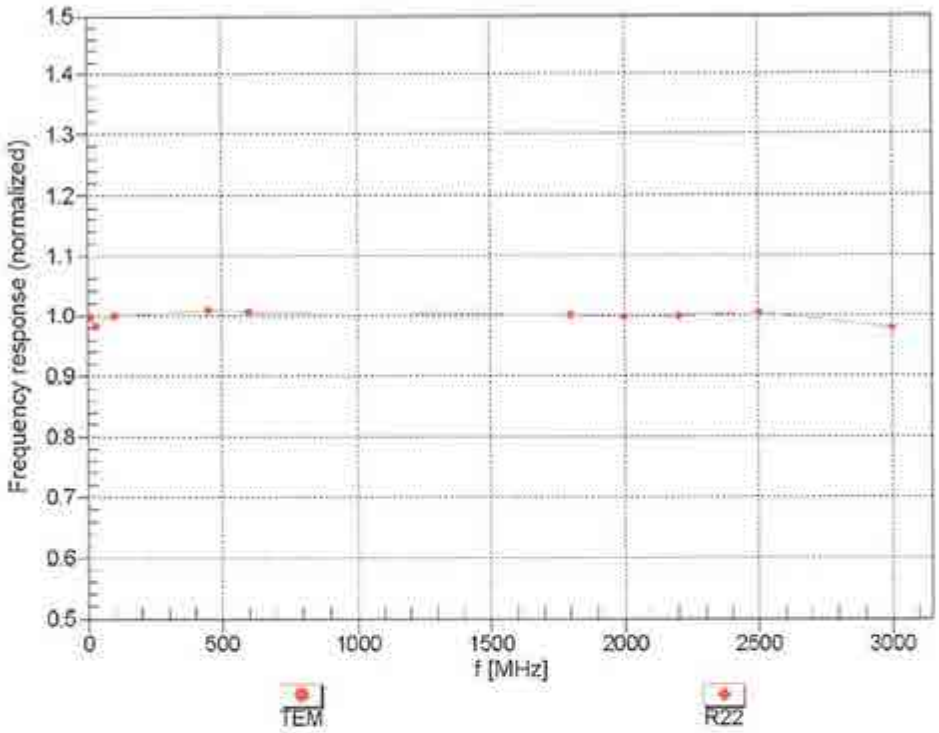
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

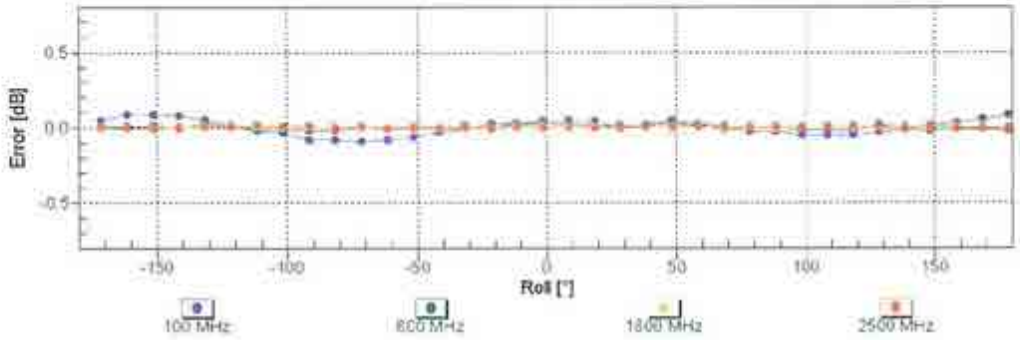


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM

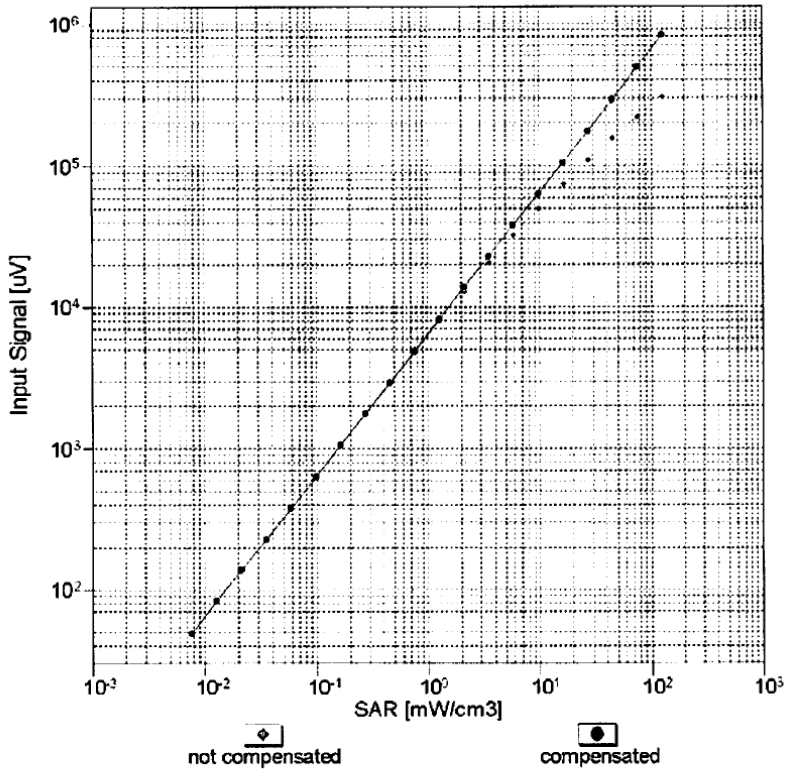
f=1800 MHz,R22

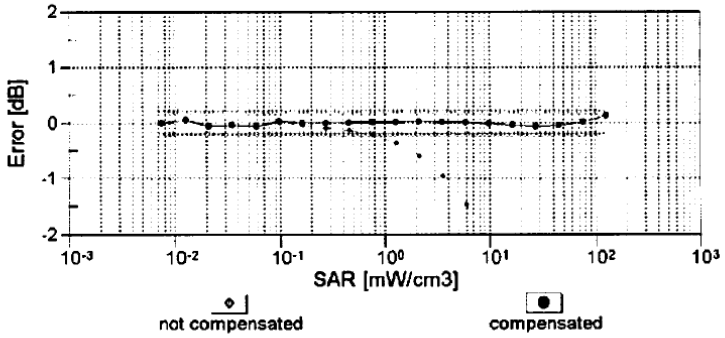


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ES3DV3– SN:3301 September 24, 2014

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



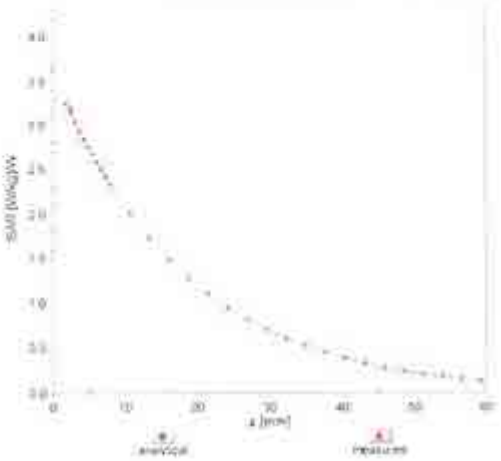


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

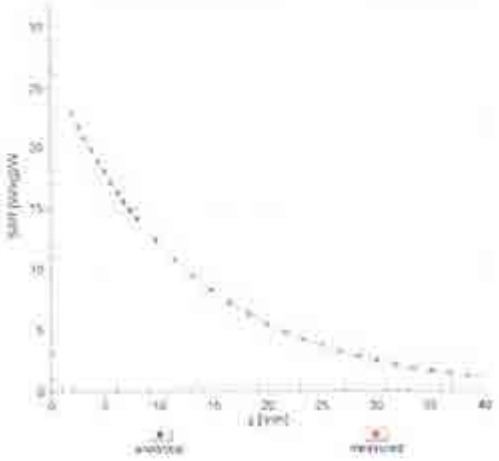
ES3DV3- SN:3301 September 24, 2014

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

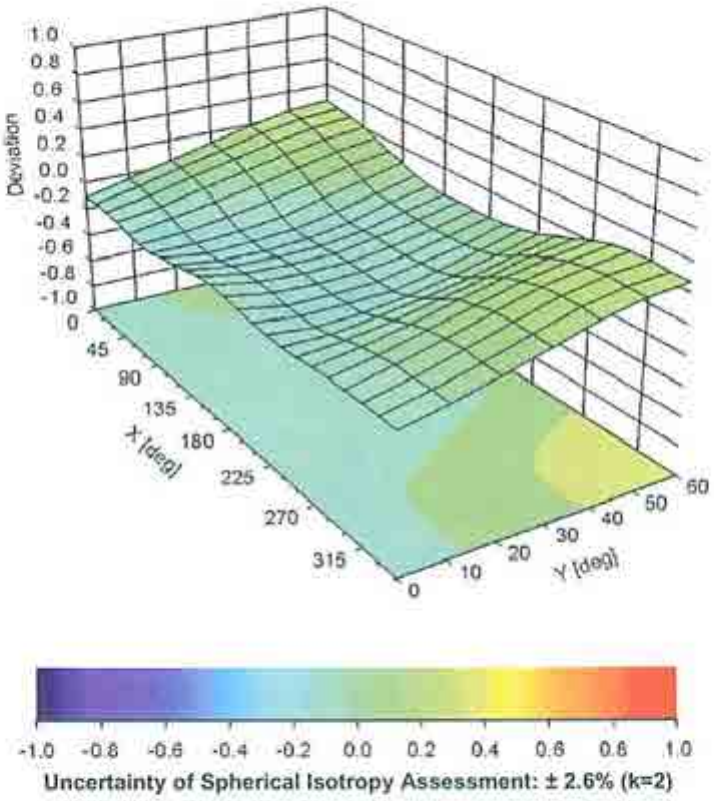


f = 1810 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-71.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	2 mm

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

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

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

Accreditation No.: **SCS 0108**

Client **Motorola EME** Certificate No: **EX3-3612_Apr15**

CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3612

Calibration procedure(s) QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: April 28, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: April 29, 2015

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

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

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3612

Manufactured: March 23, 2007
Calibrated: April 28, 2015

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3612

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)^A	0.45	0.49	0.40	± 10.1 %
DCP (mV)^B	97.2	96.7	98.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	156.0	±3.0 %
		Y	0.0	0.0	1.0		145.6	
		Z	0.0	0.0	1.0		142.9	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.09	70.4	20.0	1.87	140.0	±0.7 %
		Y	2.83	68.1	18.6		130.1	
		Z	3.35	71.9	20.6		130.3	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.68	69.5	22.7	9.46	134.1	±3.0 %
		Y	10.66	69.1	22.2		145.3	
		Z	10.84	70.0	23.0		148.1	
10059-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	3.26	71.4	20.7	2.12	138.4	±0.7 %
		Y	3.00	69.1	19.2		128.4	
		Z	3.40	72.1	20.8		130.1	
10060-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	5.17	85.6	26.9	2.83	143.6	±0.7 %
		Y	3.16	74.7	22.1		131.8	
		Z	5.00	84.4	26.1		134.2	
10061-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	4.31	77.3	23.8	3.60	139.7	±0.5 %
		Y	3.42	71.7	20.9		130.5	
		Z	4.32	77.1	23.4		133.4	
10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.34	69.0	21.9	8.68	135.7	±2.5 %
		Y	10.14	68.3	21.3		124.8	
		Z	10.13	68.6	21.6		127.6	
10063-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	X	10.20	69.0	21.9	8.63	133.4	±2.5 %
		Y	10.01	68.2	21.3		124.2	
		Z	10.06	68.7	21.7		129.5	
10064-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	X	10.65	69.3	22.4	9.09	135.3	±2.5 %
		Y	10.48	68.6	21.7		125.9	
		Z	10.52	69.1	22.1		130.3	
10065-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	X	10.23	68.9	22.1	9.00	129.9	±2.7 %
		Y	10.46	69.2	22.1		148.4	
		Z	10.16	68.8	22.0		126.2	
10066-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	X	10.43	69.0	22.5	9.36	127.8	±3.0 %
		Y	10.65	69.4	22.4		147.1	
		Z	10.37	69.1	22.4		125.0	
10067-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	X	10.95	69.6	23.2	10.12	126.6	±3.3 %
		Y	11.14	69.8	23.1		145.6	
		Z	11.31	70.7	23.8		149.3	

10068-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	X	11.24	70.8	24.1	10.24	147.4	±3.3 %
		Y	10.92	69.6	23.1		139.2	
		Z	11.08	70.5	23.8		142.2	
10069-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	X	11.50	70.9	24.4	10.56	146.8	±3.5 %
		Y	11.21	69.8	23.4		141.5	
		Z	11.34	70.7	24.1		143.0	
10071-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	11.02	70.3	23.5	9.83	149.0	±3.3 %
		Y	10.77	69.3	22.7		145.7	
		Z	10.92	70.2	23.4		145.8	
10072-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	10.56	70.1	23.4	9.62	145.0	±3.3 %
		Y	10.24	68.9	22.3		138.0	
		Z	10.40	69.8	23.0		140.3	
10073-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	10.46	70.0	23.6	9.94	138.5	±3.3 %
		Y	10.12	68.7	22.5		132.2	
		Z	10.34	69.8	23.3		135.8	
10074-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	10.53	70.2	24.0	10.30	134.5	±3.3 %
		Y	10.15	68.7	22.8		128.2	
		Z	10.40	70.0	23.7		131.3	
10075-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	10.58	70.3	24.4	10.77	128.6	±3.8 %
		Y	10.33	69.2	23.4		144.5	
		Z	10.71	70.9	24.6		148.9	
10076-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	10.80	71.1	25.0	10.94	148.0	±3.8 %
		Y	10.24	69.0	23.4		140.9	
		Z	10.66	70.8	24.7		145.5	
10077-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	10.77	71.1	25.1	11.00	146.7	±3.8 %
		Y	10.19	69.0	23.5		139.5	
		Z	10.64	70.9	24.8		144.0	
10114-CAB	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.46	69.1	21.6	8.10	141.7	±2.2 %
		Y	10.36	68.7	21.1		140.4	
		Z	10.39	69.0	21.4		140.3	
10115-CAB	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	X	10.99	69.6	22.0	8.46	146.5	±2.5 %
		Y	10.86	69.2	21.5		142.1	
		Z	10.95	69.6	21.9		145.1	
10116-CAB	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	X	10.52	69.3	21.6	8.15	143.5	±2.5 %
		Y	10.35	68.7	21.1		138.6	
		Z	10.46	69.2	21.5		141.5	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.51	69.3	21.6	8.07	144.9	±2.5 %
		Y	10.33	68.6	21.1		139.7	
		Z	10.44	69.2	21.5		142.9	
10118-CAB	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	X	11.16	69.9	22.2	8.59	149.3	±2.7 %
		Y	10.97	69.3	21.7		142.0	
		Z	11.09	69.8	22.0		146.8	
10119-CAB	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	X	10.54	69.3	21.7	8.13	145.4	±2.2 %
		Y	10.35	68.7	21.1		138.6	
		Z	10.45	69.2	21.5		141.7	

10193-CAB	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	10.10	69.0	21.6	8.09	139.2	±2.2 %
		Y	10.01	68.5	21.1		134.8	
		Z	9.95	68.7	21.3		134.8	
10194-CAB	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	X	10.12	69.0	21.6	8.12	138.8	±2.2 %
		Y	10.03	68.5	21.1		134.5	
		Z	10.00	68.8	21.4		134.5	
10195-CAB	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	X	10.28	69.2	21.7	8.21	141.0	±2.2 %
		Y	10.16	68.6	21.2		135.5	
		Z	10.14	68.9	21.5		135.4	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.06	68.9	21.5	8.10	139.1	±2.2 %
		Y	9.98	68.4	21.1		134.6	
		Z	9.94	68.7	21.3		134.6	
10197-CAB	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)	X	10.15	69.0	21.6	8.13	139.9	±2.5 %
		Y	10.06	68.5	21.1		134.9	
		Z	10.03	68.8	21.4		135.2	
10198-CAB	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)	X	10.30	69.1	21.7	8.27	141.2	±2.5 %
		Y	10.21	68.7	21.3		135.1	
		Z	10.20	69.0	21.6		136.1	
10219-CAB	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.96	68.9	21.5	8.03	139.2	±2.2 %
		Y	9.87	68.4	21.0		133.5	
		Z	9.84	68.7	21.3		133.4	
10220-CAB	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	X	10.15	69.0	21.6	8.13	140.3	±2.2 %
		Y	10.07	68.6	21.2		134.8	
		Z	10.06	68.9	21.4		135.3	
10221-CAB	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	X	10.31	69.2	21.7	8.27	141.1	±2.2 %
		Y	10.23	68.7	21.3		135.9	
		Z	10.21	69.0	21.6		136.5	
10222-CAB	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.50	69.3	21.6	8.06	147.0	±2.5 %
		Y	10.31	68.7	21.1		139.9	
		Z	10.39	69.1	21.4		141.9	
10223-CAB	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	X	10.59	68.6	21.4	8.48	124.0	±2.5 %
		Y	10.87	69.2	21.6		143.1	
		Z	10.98	69.7	21.9		146.5	
10224-CAB	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	X	10.53	69.5	21.7	8.08	147.9	±2.5 %
		Y	10.32	68.8	21.2		138.8	
		Z	10.40	69.2	21.5		141.6	
10315-AAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.36	72.4	21.1	1.71	141.1	±0.7 %
		Y	2.93	69.1	19.2		135.6	
		Z	3.27	71.8	20.5		136.0	
10316-AAB	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.22	69.0	21.8	8.36	139.3	±2.5 %
		Y	10.07	68.4	21.2		129.6	
		Z	10.04	68.7	21.5		131.4	
10317-AAB	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	10.27	69.2	21.9	8.36	140.9	±2.5 %
		Y	10.10	68.5	21.2		132.2	
		Z	10.11	68.8	21.6		133.9	

10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	3.34	72.6	21.3	1.54	142.4	±0.7 %
		Y	2.98	69.7	19.5		136.4	
		Z	3.26	72.0	20.6		137.5	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.18	89.0	21.7	8.23	140.5	±2.2 %
		Y	10.00	88.4	21.1		129.6	
		Z	9.99	88.7	21.4		131.7	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	10.20	89.1	21.8	8.23	142.4	±2.5 %
		Y	10.02	88.4	21.1		131.9	
		Z	10.02	88.7	21.4		134.2	
10418-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Long preambule)	X	10.08	89.0	21.7	8.14	141.4	±2.2 %
		Y	9.92	88.4	21.1		131.2	
		Z	9.92	88.8	21.4		133.1	
10419-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 99pc duty cycle, Short preambule)	X	10.15	89.1	21.7	8.19	142.3	±2.2 %
		Y	9.97	88.3	21.1		130.7	
		Z	10.00	88.8	21.5		134.2	

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 8 and 9).
[B] Numerical linearization parameter: uncertainty not required.
[C] 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:3612

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
150	52.3	0.76	9.97	9.97	9.97	0.00	1.00	± 13.3 %
220	49.0	0.81	9.88	9.88	9.88	0.00	1.00	± 13.3 %
2450	39.2	1.80	6.26	6.26	6.26	0.39	0.80	± 12.0 %
4950	36.3	4.40	4.96	4.96	4.96	0.30	1.80	± 13.1 %
5200	36.0	4.66	4.66	4.66	4.66	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.47	4.47	4.47	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.45	4.45	4.45	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.18	4.18	4.18	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.38	4.38	4.38	0.40	1.80	± 13.1 %

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

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3612

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
150	61.9	0.80	9.64	9.64	9.64	0.00	1.00	± 13.3 %
220	60.2	0.86	9.18	9.18	9.18	0.00	1.00	± 13.3 %
2450	52.7	1.95	6.40	6.40	6.40	0.34	0.80	± 12.0 %
4950	49.4	5.01	4.46	4.46	4.46	0.35	1.90	± 13.1 %
5200	49.0	5.30	4.37	4.37	4.37	0.35	1.90	± 13.1 %
5300	48.9	5.42	4.07	4.07	4.07	0.40	1.90	± 13.1 %
5500	48.6	5.65	3.78	3.78	3.78	0.40	1.90	± 13.1 %
5600	48.5	5.77	3.65	3.65	3.65	0.45	1.90	± 13.1 %
5800	48.2	6.00	3.95	3.95	3.95	0.45	1.90	± 13.1 %

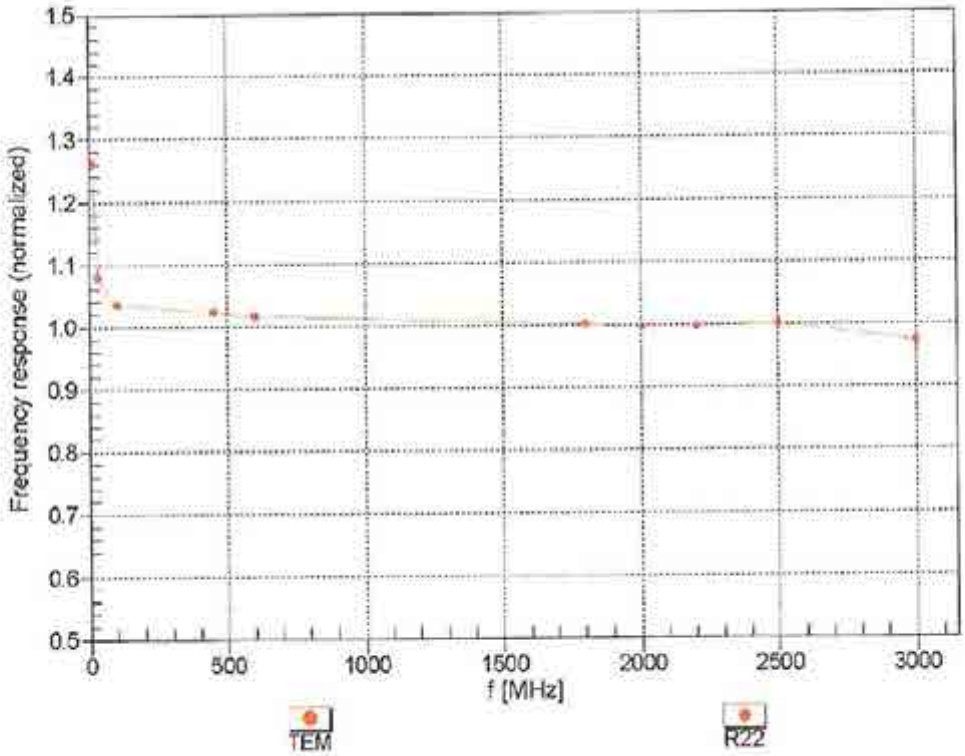
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz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

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

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

EX3DV4– SN:3612 April 28, 2015

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

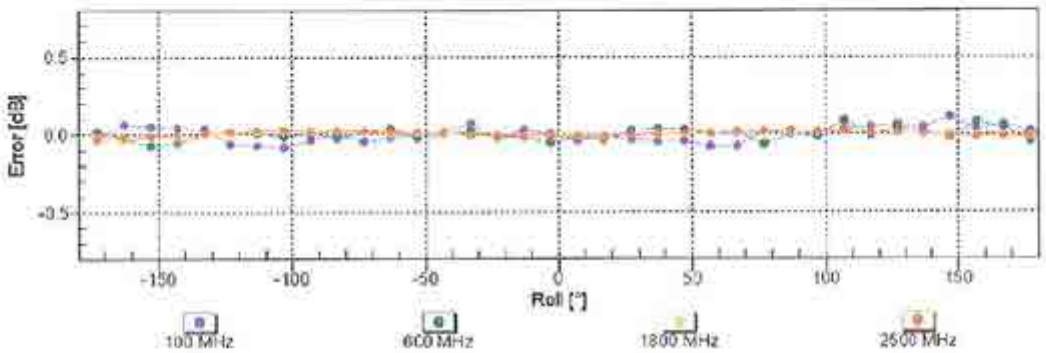


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

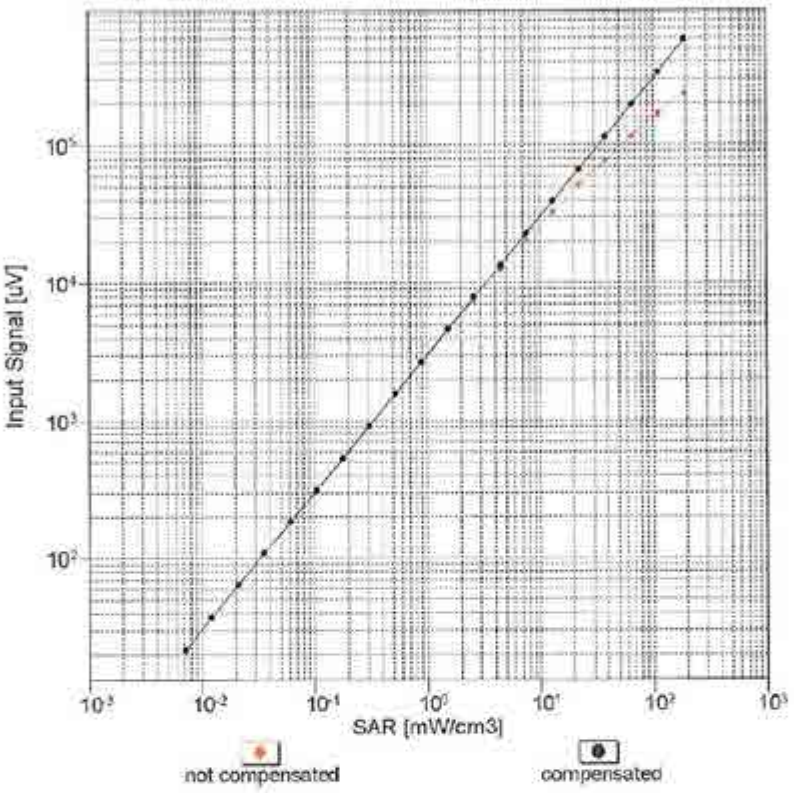
f=600 MHz,TEM

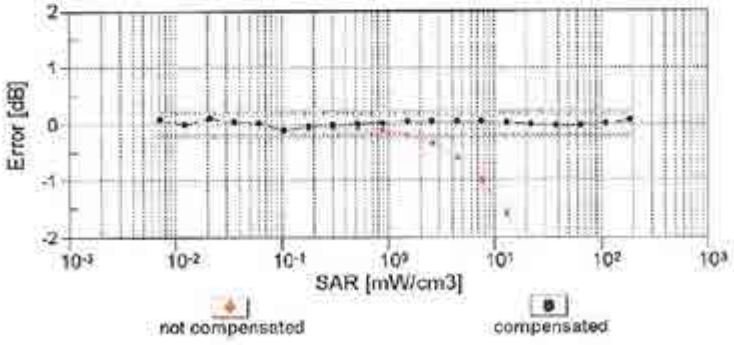
f=1800 MHz,R22



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

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

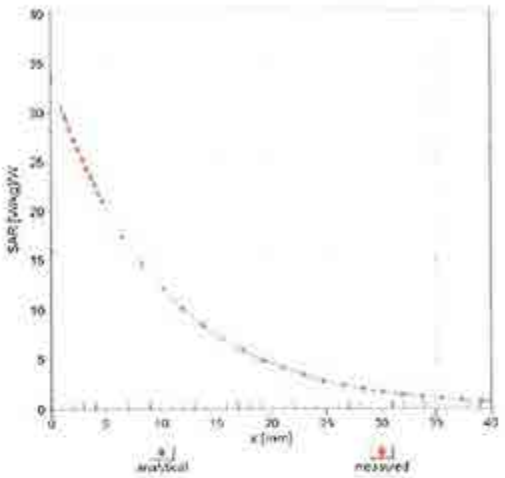




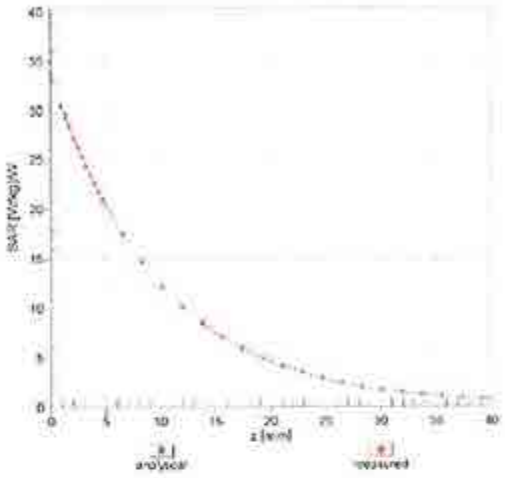
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 2450 MHz,WGLS R22 (H_convF)

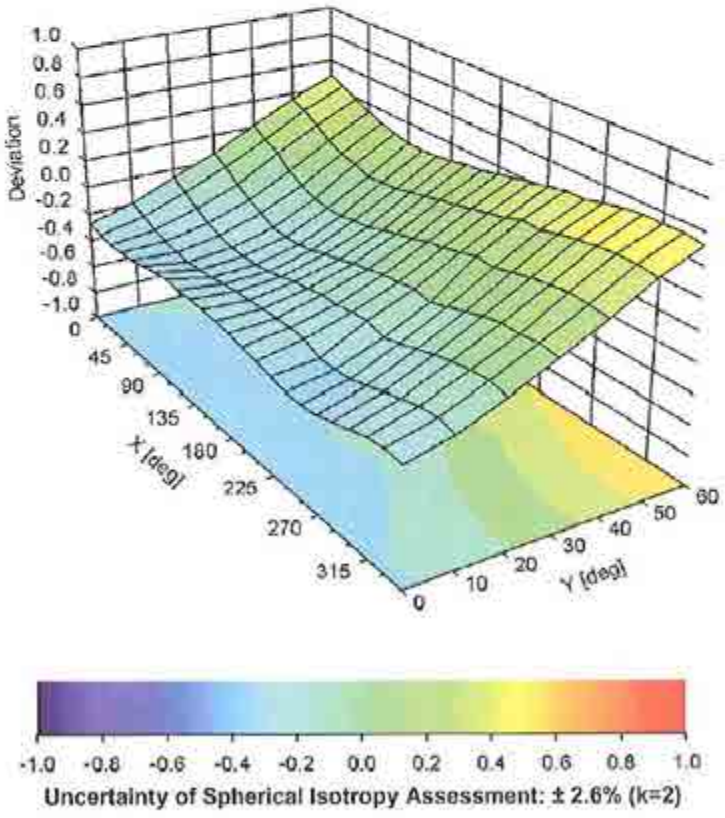


f = 2450 MHz,WGLS R22 (M_convF)



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:3612

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	77
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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

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

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

Accreditation No.: **SCS 0108**

Client **Motorola EME**

Certificate No: **ES3-3291_Jul15**

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3291

Calibration procedure(s) QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date July 21, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: July 21, 2015

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) Accreditation No.: **SCS 0108**

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3291

Manufactured: July 6, 2010
Calibrated: July 21, 2015

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.86	1.38	0.82	± 10.1 %
DCP (mV)[B]	105.8	100.2	105.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	197.8	±3.5 %
		Y	0.0	0.0	1.0		193.1	
		Z	0.0	0.0	1.0		178.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.16	66.8	19.3	5.67	126.3	±1.7 %
		Y	6.41	67.4	19.6		147.1	
		Z	6.17	67.0	19.4		132.5	
10101-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	7.26	67.3	19.8	6.42	135.5	±1.7 %
		Y	7.24	66.9	19.6		133.0	
		Z	7.27	67.5	19.9		142.1	
10102-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	7.49	67.4	19.9	6.60	135.8	±1.7 %
		Y	7.54	67.2	19.9		135.7	
		Z	7.54	67.7	20.1		145.1	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.30	67.4	19.7	5.80	145.4	±1.7 %
		Y	6.29	67.0	19.5		145.9	
		Z	6.05	66.7	19.4		130.9	
10109-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	6.96	66.9	19.7	6.43	128.8	±1.4 %
		Y	7.02	66.7	19.6		129.6	
		Z	6.99	67.2	19.9		137.8	
10110-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.99	67.0	19.6	5.75	142.6	±1.7 %
		Y	5.98	66.5	19.3		142.0	
		Z	5.93	67.1	19.7		149.1	
10111-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	6.75	66.9	19.8	6.44	129.2	±1.4 %
		Y	6.75	66.4	19.5		126.1	
		Z	6.67	67.0	19.8		132.1	
10112-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	7.25	67.2	19.9	6.59	136.4	±1.7 %
		Y	7.24	66.8	19.7		130.7	
		Z	7.20	67.4	20.0		137.7	
10113-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	6.98	67.1	19.9	6.62	130.9	±1.4 %
		Y	6.99	66.6	19.7		127.3	
		Z	6.91	67.2	20.0		133.1	
10140-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	7.51	67.8	20.2	6.49	138.7	±1.9 %
		Y	7.42	67.1	19.7		134.2	
		Z	7.43	67.7	20.1		142.6	
10141-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	X	7.65	67.8	20.2	6.53	141.3	±1.7 %
		Y	7.59	67.3	19.9		136.6	
		Z	7.57	67.8	20.1		145.3	

10142-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	5.84	67.1	19.7	5.73	143.3	±1.9 %
		Y	5.78	66.2	19.2		139.6	
		Z	5.71	66.9	19.6		144.8	
10143-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	6.76	67.9	20.3	6.35	149.3	±1.7 %
		Y	6.76	67.3	20.0		145.3	
		Z	6.65	67.9	20.3		149.7	
10144-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	X	6.81	67.2	20.0	6.65	126.0	±1.7 %
		Y	7.07	67.5	20.2		146.6	
		Z	6.69	67.2	20.0		127.6	
10145-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	5.47	66.6	19.5	5.76	131.6	±1.2 %
		Y	5.51	66.0	19.1		133.3	
		Z	5.45	66.9	19.6		138.4	
10146-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	6.39	67.9	20.3	6.41	139.0	±1.4 %
		Y	6.39	67.0	19.8		136.4	
		Z	6.28	67.9	20.3		141.8	
10147-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	X	6.63	67.9	20.5	6.72	139.3	±1.4 %
		Y	6.67	67.2	20.1		136.9	
		Z	6.53	68.1	20.6		141.1	
10149-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.04	67.2	19.9	6.42	132.6	±1.4 %
		Y	7.00	66.6	19.6		128.3	
		Z	6.96	67.2	19.8		135.3	
10150-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	X	7.28	67.4	20.1	6.60	134.7	±1.7 %
		Y	7.25	66.9	19.8		130.8	
		Z	7.22	67.5	20.1		137.9	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.98	67.0	19.6	5.75	145.4	±1.4 %
		Y	5.97	66.5	19.3		140.9	
		Z	5.94	67.1	19.7		148.5	
10155-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	6.73	66.9	19.7	6.43	128.4	±1.7 %
		Y	7.00	67.3	20.0		148.4	
		Z	6.66	67.0	19.8		131.1	
10156-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.75	66.8	19.6	5.79	141.2	±1.4 %
		Y	5.73	66.1	19.2		136.6	
		Z	5.66	66.8	19.6		143.7	
10157-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	6.72	67.8	20.3	6.49	146.3	±1.7 %
		Y	6.71	67.1	19.9		142.6	
		Z	6.62	67.9	20.4		147.2	
10158-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	6.97	67.1	19.9	6.62	128.9	±1.9 %
		Y	7.25	67.6	20.2		149.9	
		Z	6.87	67.1	19.9		131.3	
10159-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	6.83	68.0	20.4	6.56	147.2	±1.7 %
		Y	6.71	66.8	19.8		135.8	
		Z	6.71	68.0	20.4		147.6	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.18	66.7	19.4	5.82	127.1	±1.4 %
		Y	6.32	66.7	19.4		139.0	
		Z	6.09	66.5	19.3		129.0	

10161-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	7.06	67.2	19.9	6.43	134.1	±1.7 %
		Y	7.25	67.4	20.0		147.2	
		Z	6.99	67.3	19.9		135.6	
10162-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	X	7.27	67.4	20.0	6.58	135.3	±1.9 %
		Y	7.47	67.6	20.1		148.9	
		Z	7.17	67.4	20.0		137.3	
10166-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	4.92	66.6	19.4	5.46	131.3	±1.4 %
		Y	4.98	66.0	19.0		141.1	
		Z	4.84	66.6	19.4		132.0	
10167-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	5.71	67.5	20.1	6.21	130.4	±1.7 %
		Y	5.92	67.4	20.0		145.8	
		Z	5.61	67.6	20.1		132.6	
10168-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	X	6.17	67.8	20.6	6.79	130.7	±1.7 %
		Y	6.41	67.7	20.5		145.3	
		Z	6.02	67.6	20.5		131.0	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.86	67.5	20.2	5.73	145.1	±1.2 %
		Y	4.79	66.1	19.3		132.8	
		Z	4.81	67.4	20.1		146.1	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.45	68.0	20.8	6.52	142.7	±1.9 %
		Y	5.49	67.0	20.2		132.6	
		Z	5.41	68.2	20.9		144.5	
10171-AAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	5.46	68.2	20.9	6.49	143.1	±1.7 %
		Y	5.48	67.1	20.2		132.1	
		Z	5.35	68.1	20.8		143.3	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.82	67.2	20.0	5.72	143.7	±1.2 %
		Y	4.79	66.1	19.3		131.6	
		Z	4.73	67.0	19.9		144.7	
10176-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.45	68.0	20.8	6.52	142.0	±1.7 %
		Y	5.48	67.0	20.1		131.5	
		Z	5.31	67.7	20.7		143.4	
10177-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.81	67.1	20.0	5.73	143.6	±1.4 %
		Y	4.83	66.2	19.4		132.1	
		Z	4.73	67.1	20.0		144.1	
10178-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.45	68.0	20.8	6.52	142.5	±1.7 %
		Y	5.54	67.3	20.3		132.7	
		Z	5.33	67.8	20.7		143.2	
10179-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	5.45	68.1	20.9	6.50	142.1	±1.7 %
		Y	5.45	67.0	20.1		131.2	
		Z	5.34	68.0	20.8		143.0	
10180-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	5.45	68.1	20.8	6.50	142.4	±1.4 %
		Y	5.46	67.0	20.1		131.0	
		Z	5.29	67.7	20.6		141.9	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.81	67.2	20.0	5.72	143.2	±1.4 %
		Y	4.76	65.9	19.2		131.3	
		Z	4.74	67.1	20.0		143.7	

10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.44	68.0	20.8	6.52	142.5	±1.7 %
		Y	5.44	66.8	20.0		131.4	
		Z	5.32	67.7	20.7		142.2	
10183-AAA	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	X	5.43	68.1	20.8	6.50	142.3	±1.7 %
		Y	5.47	67.1	20.2		131.2	
		Z	5.30	67.8	20.7		141.5	
10184-CAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	4.83	67.2	20.0	5.73	143.4	±1.4 %
		Y	4.77	65.9	19.2		131.8	
		Z	4.76	67.2	20.0		143.3	
10185-CAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.45	68.1	20.8	6.51	142.1	±1.7 %
		Y	5.47	67.0	20.1		131.7	
		Z	5.31	67.8	20.7		141.8	
10186-AAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	X	5.43	68.0	20.8	6.50	141.9	±1.7 %
		Y	5.47	67.0	20.1		131.8	
		Z	5.30	67.8	20.6		140.8	
10187-CAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	4.83	67.2	20.0	5.73	143.5	±1.4 %
		Y	4.77	66.0	19.2		132.0	
		Z	4.74	67.1	20.0		143.2	
10188-CAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.43	67.9	20.7	6.52	141.7	±1.7 %
		Y	5.47	67.0	20.1		131.9	
		Z	5.31	67.7	20.6		141.2	
10189-AAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	X	5.43	68.1	20.8	6.50	141.1	±1.7 %
		Y	5.46	67.0	20.1		131.2	
		Z	5.29	67.7	20.6		141.2	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.29	67.4	19.8	5.81	146.3	±1.4 %
		Y	6.15	66.4	19.2		134.0	
		Z	6.22	67.3	19.8		147.3	
10298-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	X	5.57	66.7	19.5	5.72	137.0	±1.7 %
		Y	5.68	66.5	19.4		148.7	
		Z	5.47	66.7	19.5		138.0	
10299-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	X	6.47	67.8	20.2	6.39	141.2	±1.4 %
		Y	6.40	66.7	19.6		130.8	
		Z	6.33	67.7	20.2		139.4	
10300-AAB	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM)	X	6.62	67.8	20.3	6.60	139.7	±1.4 %
		Y	6.60	66.9	19.9		131.5	
		Z	6.52	67.9	20.4		139.3	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.58	67.0	19.6	6.06	127.9	±1.7 %
		Y	6.76	67.2	19.7		140.4	
		Z	6.51	66.9	19.5		129.5	

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 Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 8 and 9).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	7.74	7.74	7.74	0.05	1.60	± 13.3 %
220	49.0	0.81	7.43	7.43	7.43	0.05	1.80	± 13.3 %
300	45.3	0.87	7.49	7.49	7.49	0.15	1.20	± 13.3 %
450	43.5	0.87	7.13	7.13	7.13	0.20	2.00	± 13.3 %
750	41.9	0.89	6.51	6.51	6.51	0.29	1.98	± 12.0 %
900	41.5	0.97	6.25	6.25	6.25	0.52	1.38	± 12.0 %
1810	40.0	1.40	5.18	5.18	5.18	0.74	1.19	± 12.0 %
1950	40.0	1.40	4.96	4.96	4.96	0.80	1.19	± 12.0 %
2300	39.5	1.67	4.81	4.81	4.81	0.80	1.23	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.71	1.34	± 12.0 %
2600	39.0	1.96	4.37	4.37	4.37	0.80	1.28	± 12.0 %
3500	37.9	2.91	4.26	4.26	4.26	0.68	1.40	± 13.1 %
3700	37.7	3.12	3.96	3.96	3.96	0.80	1.30	± 13.1 %

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

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

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	7.43	7.43	7.43	0.05	1.50	± 13.3 %
220	60.2	0.86	7.14	7.14	7.14	0.05	1.50	± 13.3 %
300	58.2	0.92	7.20	7.20	7.20	0.13	1.50	± 13.3 %
450	56.7	0.94	7.23	7.23	7.23	0.14	1.20	± 13.3 %
750	55.5	0.96	6.22	6.22	6.22	0.36	1.72	± 12.0 %
900	55.0	1.05	6.12	6.12	6.12	0.62	1.35	± 12.0 %
1810	53.3	1.52	4.88	4.88	4.88	0.55	1.40	± 12.0 %
1950	53.3	1.52	4.91	4.91	4.91	0.50	1.62	± 12.0 %
2300	52.9	1.81	4.53	4.53	4.53	0.80	1.25	± 12.0 %
2450	52.7	1.95	4.27	4.27	4.27	0.80	1.27	± 12.0 %
2600	52.5	2.16	4.12	4.12	4.12	0.70	1.20	± 12.0 %
3500	51.3	3.31	3.75	3.75	3.75	0.90	1.25	± 13.1 %
3700	51.0	3.55	3.64	3.64	3.64	0.90	1.35	± 13.1 %

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

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

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

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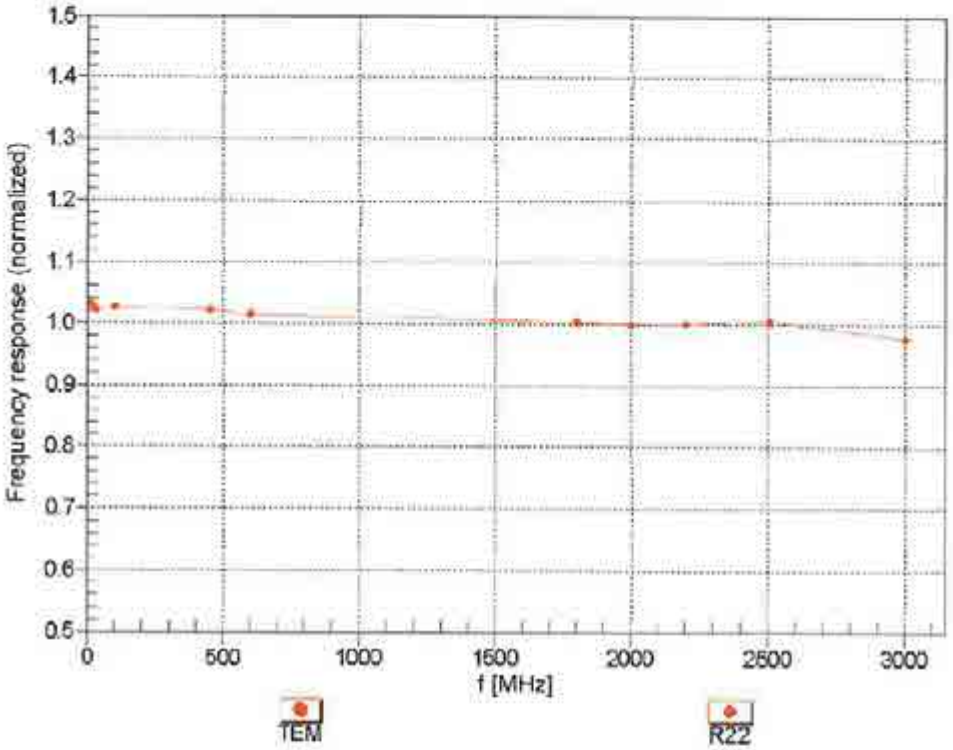
Frequency Response of E-Field

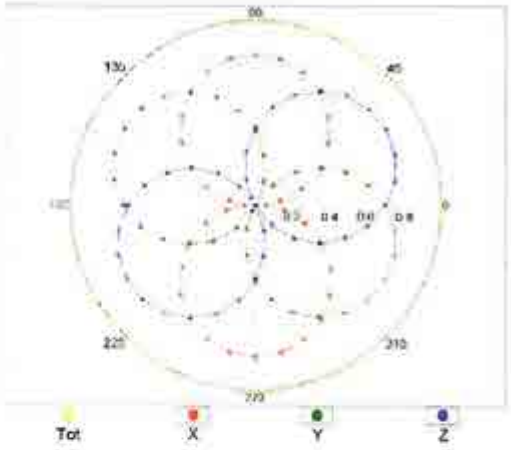
(TEM-Cell:ifi110 EXX, Waveguide: R22)



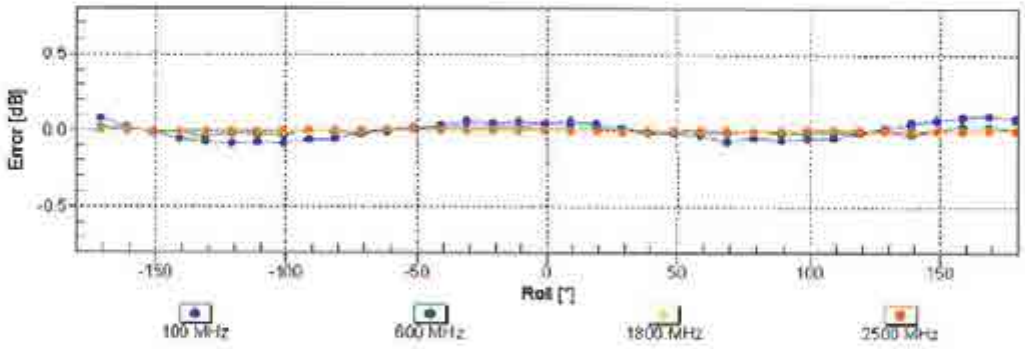
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM

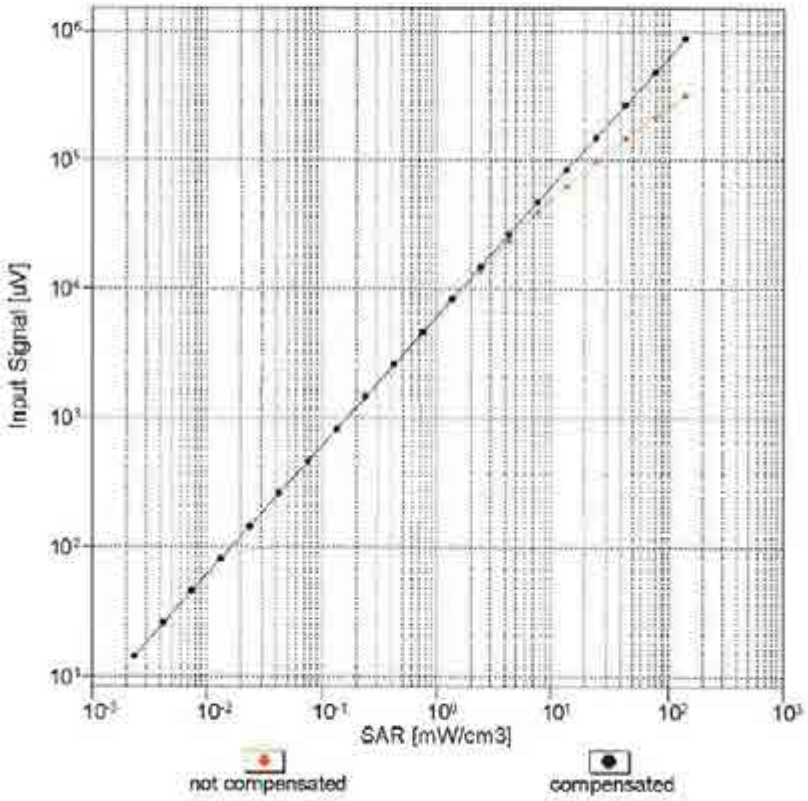


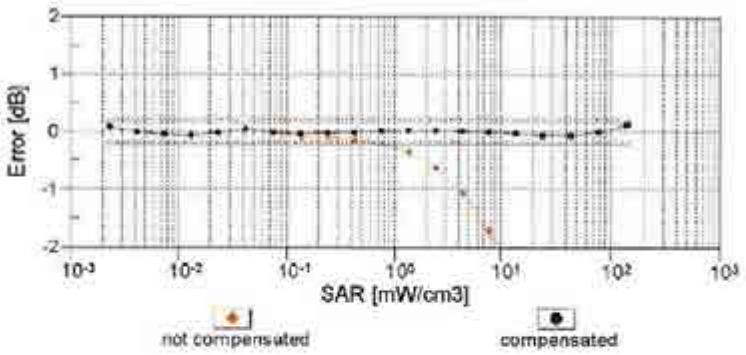
f=1800 MHz,R22



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

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

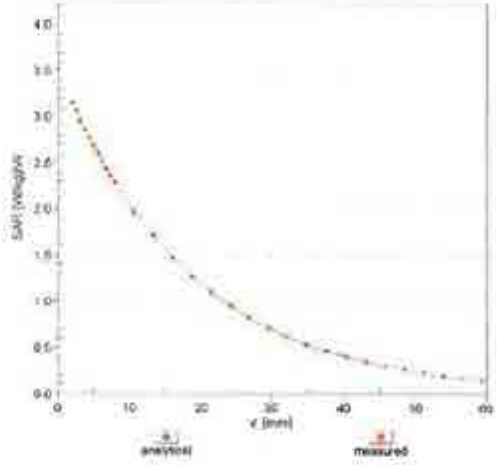




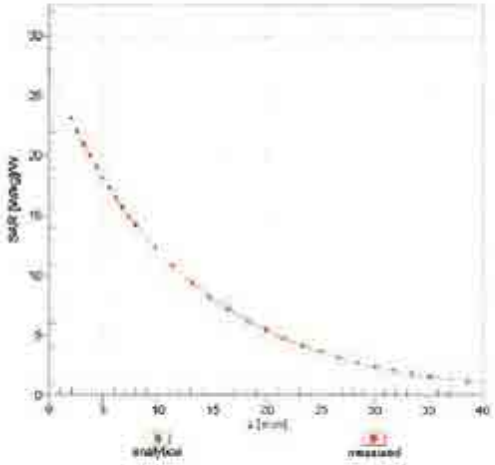
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

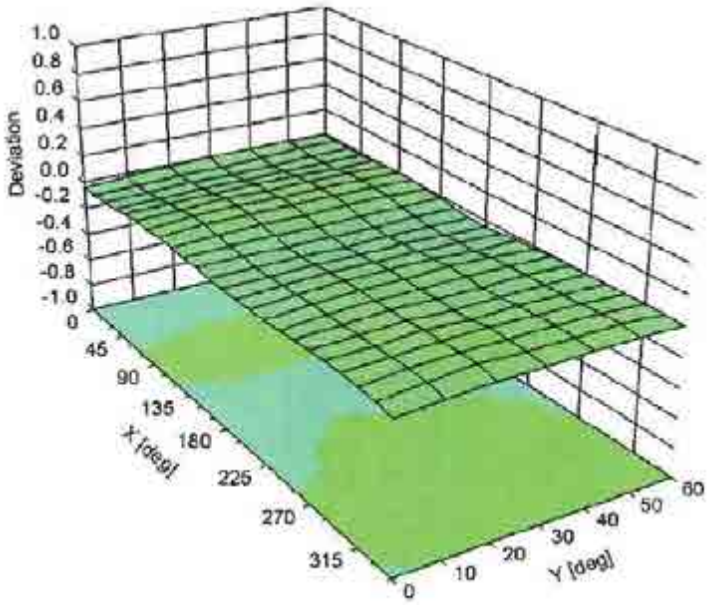


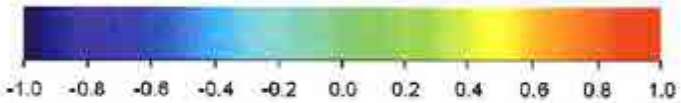
f = 1810 MHz,WGLS R22 (H_convF)



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:3291

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	118.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Appendix (Additional assessments outside the scope of SCS 0108)

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [X]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unc (k=2) [X]
6	55.5	0.75	7.20	7.20	7.20	0.00	1.00	± 13.3 %

[X] Calibration procedure for frequencies below 30 MHz is pending accreditation. Frequency validity for ConvF assessments at 6 MHz is 4-9 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values.