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SAR EVALUATION REPORT

Applicant Name:
Samsung Electronics, Co. Ltd.
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Gyeonggi-do 16677, Korea

Date of Testing:
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Test Site/Location:
PCTEST Lab, Columbia, MD, USA
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FCC ID: A3LSMT377W

APPLICANT: SAMSUNG ELECTRONICS, CO. LTD.

DUT Type: Portable Tablet
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): SM-T377W

Equipment Class	Band & Mode	Tx Frequency	SAR 1 gm Body (W/kg)
PCB	UMTS 850	826.40 - 846.60 MHz	0.77
PCB	UMTS 1750	1712.4 - 1752.6 MHz	0.63
PCB	UMTS 1900	1852.4 - 1907.6 MHz	0.71
PCB	LTE Band 12	699.7 - 715.3 MHz	0.53
PCB	LTE Band 17	706.5 - 713.5 MHz	N/A
PCB	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.82
PCB	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.82
PCB	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.69
PCB	LTE Band 30	2307.5 - 2312.5 MHz	0.97
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.92
DTS	Bluetooth LE	2402 - 2480 MHz	N/A
NII	U-NII-1	5180 - 5240 MHz	N/A
NII	U-NII-2A	5260 - 5320 MHz	0.97
NII	U-NII-2C	5500 - 5720 MHz	0.89
NII	U-NII-3	5745 - 5825 MHz	0.56
DSS	Bluetooth	2402 - 2480 MHz	0.14
Simultaneous SAR per KDB 690783 D01v01r03:			1.59

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.7 of this report; for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

Randy Ortanez
President

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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
UMTS 850	Data	826.40 - 846.60 MHz
UMTS 1750	Data	1712.4 - 1752.6 MHz
UMTS 1900	Data	1852.4 - 1907.6 MHz
LTE Band 12	Data	699.7 - 715.3 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
LTE Band 30	Data	2307.5 - 2312.5 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
U-NII-1	Data	5180 - 5240 MHz
U-NII-2A	Data	5260 - 5320 MHz
U-NII-2C	Data	5500 - 5720 MHz
U-NII-3	Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses a power reduction mechanism for PCB SAR compliance. The power reduction mechanism is activated when the device is used in close proximity to the user's body. FCC KDB Publication 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device.

1.3 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05.

Maximum Output Powers

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	*3GPP HSDPA*	*3GPP HSUPA*	*3GPP DC-HSDPA*
UMTS Band 5 (850 MHz)	Maximum	**24.0**	**24.0**	**24.0**	**24.0**
	Nominal	**23.5**	**23.5**	**23.5**	**23.5**
UMTS Band 4 (1750 MHz)	Maximum	**23.5**	**23.5**	**23.5**	**23.5**
	Nominal	**23.0**	**23.0**	**23.0**	**23.0**
UMTS Band 2 (1900 MHz)	Maximum	**24.0**	**24.0**	**24.0**	**24.0**
	Nominal	**23.5**	**23.5**	**23.5**	**23.5**

Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	**24.5**
	Nominal	**24.0**
LTE Band 17	Maximum	**24.5**
	Nominal	**24.0**
LTE Band 5 (Cell)	Maximum	**24.5**
	Nominal	**24.0**
LTE Band 4 (AWS)	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 2 (PCS)	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 30	Maximum	**22.5**
	Nominal	**22.0**

Mode / Band		Modulated Average - Single Tx Chain (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11g (2.4 GHz)	Maximum	**12.5**
	Nominal	**12.0**
IEEE 802.11n (2.4 GHz)	Maximum	**11.5**
	Nominal	**11.0**
Bluetooth	Maximum	**9.5**
	Nominal	**9.0**
Bluetooth LE	Maximum	**7.5**
	Nominal	**7.0**

Mode / Band		Modulated Average - Single Tx Chain (dBm)	
		20 MHz Bandwidth	40 MHz Bandwidth
IEEE 802.11a (5 GHz)	Maximum	**11.5**	
	Nominal	**11.0**	
IEEE 802.11n (5 GHz)	Maximum	**11.5**	**11.5**
	Nominal	**11.0**	**11.0**

Reduced Output Powers

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	*3GPP HSDPA*	*3GPP HSUPA*	*3GPP DC-HSDPA*
UMTS Band 5 (850 MHz)	Maximum	**19.0**	**19.0**	**19.0**	**19.0**
	Nominal	**18.5**	**18.5**	**18.5**	**18.5**
UMTS Band 4 (1750 MHz)	Maximum	**12.0**	**12.0**	**12.0**	**12.0**
	Nominal	**11.5**	**11.5**	**11.5**	**11.5**
UMTS Band 2 (1900 MHz)	Maximum	**13.0**	**13.0**	**13.0**	**13.0**
	Nominal	**12.5**	**12.5**	**12.5**	**12.5**

Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	**20.5**
	Nominal	**20.0**
LTE Band 17	Maximum	**20.0**
	Nominal	**19.5**
LTE Band 5 (Cell)	Maximum	**19.5**
	Nominal	**19.0**
LTE Band 4 (AWS)	Maximum	**12.5**
	Nominal	**12.0**
LTE Band 2 (PCS)	Maximum	**12.5**
	Nominal	**12.0**
LTE Band 30	Maximum	**13.5**
	Nominal	**13.0**

1.4 DUT Antenna Locations

The overall diagonal dimension of the device is > 200 mm. A diagram showing the locations of the device antennas can be found in Appendix F. Exact antenna dimensions and separation distances are shown in the Technical Descriptions document.

Table 1-1
Sides for SAR Testing

Device Sides/Edges for SAR Testing					
Mode	Back	Top	Bottom	Right	Left
UMTS 850	Yes	Yes	Yes	Yes	Yes
UMTS 1750	Yes	Yes	No	No	Yes
UMTS 1900	Yes	Yes	No	No	Yes
LTE Band 12	Yes	Yes	Yes	Yes	Yes
LTE Band 5 (Cell)	Yes	Yes	Yes	Yes	Yes
LTE Band 4 (AWS)	Yes	Yes	No	No	Yes
LTE Band 2 (PCS)	Yes	Yes	No	No	Yes
LTE Band 30	Yes	Yes	No	No	Yes
2.4 GHz WLAN	Yes	Yes	No	No	No
5 GHz WLAN	Yes	Yes	No	No	No
Bluetooth	Yes	Yes	No	No	No

Note: Per FCC KDB 616217 D04v01r01, particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01v05r01.

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-1 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

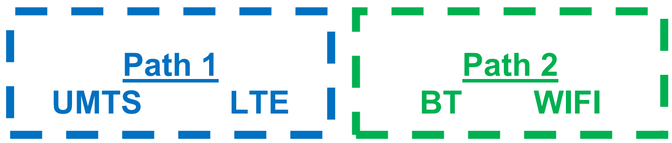


Figure 1-1
Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05 3) procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Body
1	UMTS + 2.4 GHz WI-FI	Yes
2	UMTS + 5 GHz WI-FI	Yes
3	UMTS + 2.4 GHz Bluetooth	Yes
4	LTE + 2.4 GHz WI-FI	Yes
5	LTE + 5 GHz WI-FI	Yes
6	LTE + 2.4 GHz Bluetooth	Yes

1. 2.4 GHz WLAN, 5 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
2. All licensed modes share the same antenna path and cannot transmit simultaneously.

1.6 Miscellaneous SAR Test Considerations

(A) WIFI/BT

Since U-NII-1 and U-NII-2A bands have the same maximum output power and the highest reported SAR for U-NII-2A is less than 1.2 W/kg, SAR is not required for U-NII-1 band according to FCC KDB 248227 D01v02.

(B) Licensed Transmitter(s)

This device is only capable of QPSK HSUPA in the uplink. Therefore, no additional SAR tests are required beyond that described for devices with HSUPA in KDB 941225 D01v03.

This device supports both LTE Band 12 and LTE Band 17. Since the supported frequency span for LTE Band 17 falls completely within the supported frequency span for LTE Band 12, LTE Band 17 target power is less than or equal to LTE Band 12 target power, and both LTE bands share the same transmission path, SAR was only assessed for LTE Band 12.

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r03.

1.7 Guidance Applied

- FCC KDB Publication 941225 D01v03, D05v02r03 (3G/4G)
- FCC KDB Publication 248227 D01v02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r03, D02v01r01 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04v01r01 (Tablet SAR Considerations)

1.8 Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.

	Max Power Serial Number	Reduced Power Serial Number
UMTS 850	7896	7938
UMTS 1750	02726	02676
UMTS 1900	7896	02700
LTE Band 12	7904	8159
LTE Band 5 (Cell)	7896	02684
LTE Band 4 (AWS)	8142	02676
LTE Band 2 (PCS)	7938	8142
LTE Band 30	02700	24321
2.4 GHz WLAN	8019	-
5 GHz WLAN	8159	-
Bluetooth	02684	-

2 LTE INFORMATION

LTE Information			
FCC ID	**A3LSMT377W**		
Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz)		
	LTE Band 17 (706.5 - 713.5 MHz)		
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)		
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)		
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
	LTE Band 30 (2307.5 - 2312.5 MHz)		
Channel Bandwidths	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
	LTE Band 17: 5 MHz, 10 MHz		
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 30: 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 12: 1.4 MHz	699.7 (23017)	707.5 (23095)	715.3 (23173)
LTE Band 12: 3 MHz	700.5 (23025)	707.5 (23095)	714.5 (23165)
LTE Band 12: 5 MHz	701.5 (23035)	707.5 (23095)	713.5 (23155)
LTE Band 12: 10 MHz	704 (23060)	707.5 (23095)	711 (23130)
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)
LTE Band 30: 5 MHz	2307.5 (27685)	2310 (27710)	2312.5 (27735)
LTE Band 30: 10 MHz	N/A	2310 (27710)	N/A
UE Category	4		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		
LTE Carrier Aggregation Possible Combinations	N/A		
LTE Release 10 Additional Information	This device does not support full CA features on 3GPP Release 10. The following LTE Release 10 Features are not supported: Carrier Aggregation, Relay, HetNet, Enhanced MIMO, eICI, WIFI Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.		

3 INTRODUCTION

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

3.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 3-1).

Equation 3-1
SAR Mathematical Equation

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01 and IEEE 1528-2013:

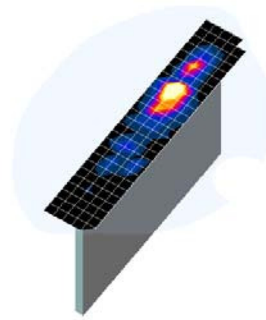


Figure 4-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Table 4-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01*

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)$*	$\Delta z_{zoom}(n>1)$*	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

5 SAR TESTING PROCEDURES

5.1 SAR Testing for Tablet per KDB Publication 616217 D04v01

Per FCC KDB Publication 616217 D04, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v05 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

5.2 Proximity Sensor Considerations

This device uses a power reduction mechanism to reduce output powers in certain use conditions when the device is used close the user's body.

When the device's antenna is within a certain distance of the user, the sensor activates and reduces the maximum allowed output power. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, additional evaluation is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level. FCC KDB Publication 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional test positions. Sensor triggering distance summary data is included in Appendix G.

The sensor is designed to support sufficient detection range and sensitivity to cover regions of the sensors in all applicable directions since the sensor entirely covers the antennas.

6 RF EXPOSURE LIMITS

6.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

6.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 6-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT *General Population* (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

7 FCC MEASUREMENT PROCEDURES

Power measurements for licensed transmitters are performed using a base station simulator under digital average power.

7.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r02.

7.2 3G SAR Test Reduction Procedure

In FCC KDB Publication 941225 D01v03, certain transmission modes within a frequency band and wireless mode evaluated for SAR are defined as primary modes. The equivalent modes considered for SAR test reduction are denoted as secondary modes. When the maximum output power including tune-up tolerance specified for production units in a secondary mode is $\leq$ 0.25 dB higher than the primary mode or when the highest reported SAR of the primary mode, scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode, is $\leq$ 1.2 W/kg, SAR measurements are not required for the secondary mode. These criteria are referred to as the 3G SAR test reduction procedure. When the 3G SAR test reduction procedure is not satisfied, SAR measurements are additionally required for the secondary mode.

7.3 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03 “3G SAR Measurement Procedures.”

The device is placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test are evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device is tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviates by more than 5%, the SAR test and drift measurements are repeated.

7.4 SAR Measurement Conditions for UMTS

7.4.1 Output Power Verification

Maximum output power is verified on the High, Middle and Low channels according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC with TPC (transmit power control) set to all “1s” or applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH etc) are tabulated in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

7.4.2 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all "1s". The 3G SAR test reduction procedure is applied to other spreading codes and multiple $DPDCH_n$ configurations supported by the handset with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured using an applicable RMC configuration with the corresponding spreading code or $DPDCH_n$, for the highest reported SAR configuration in 12.2 kbps RMC.

7.4.3 SAR Measurements with Rel 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body configurations with 12.2 kbps RMC as the primary mode. Otherwise, Body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, for the highest reported SAR configuration in 12.2 kbps RMC without HSDPA. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

7.4.4 SAR Measurements with Rel 6 HSUPA

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body configurations with 12.2 kbps RMC as the primary mode. Otherwise, Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 and power control algorithm 2, according to the highest reported body SAR configuration in 12.2 kbps RMC without HSPA.

When VOIP applies to head exposure, the 3G SAR test reduction procedure is applied with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body SAR measurements are applied to head exposure testing.

7.4.5 SAR Measurement Conditions for DC-HSDPA

SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

7.5 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r03 publication. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 or Anritsu MT8820C simulators are used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

7.5.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

7.5.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

7.5.3 A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

7.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r03:

a. Per Section 4.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
   i. The required channel and offset combination with the highest maximum output power is required for SAR.
   ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
   iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 4.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 4.2.1.
c. Per Section 4.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
d. Per Section 4.2.4 and 4.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 4.2.1 through 4.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

7.6 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01 DR02-41929 for more details.

7.6.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

7.6.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers are specified for the bands, SAR measurement for the U-NII band with the lower maximum output power is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg.

7.6.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, SAR must be considered for these channels. When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

7.6.4 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

7.6.5 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

7.6.6 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 7.6.5).

7.6.7 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required.

8 RF CONDUCTED POWERS

8.1 UMTS Conducted Powers

Table 8-1
Maximum Average RF Output Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.00	23.02	23.08	22.60	22.73	23.07	23.35	23.45	23.75	-
6	HSDPA	Subtest 1	22.88	22.90	22.75	22.80	22.66	22.40	23.31	23.48	23.80	0
6		Subtest 2	20.97	21.02	20.83	22.54	22.73	22.22	21.21	21.43	21.71	0
6		Subtest 3	21.43	21.47	21.28	21.79	21.91	22.16	21.56	21.59	21.92	0.5
6		Subtest 4	20.40	20.37	20.31	21.66	21.85	22.00	20.95	20.98	21.19	0.5
6	HSUPA	Subtest 1	21.83	21.78	21.63	22.00	21.84	21.50	22.32	22.45	22.80	0
6		Subtest 2	20.96	21.02	20.84	20.68	20.80	21.00	20.95	20.90	21.23	2
6		Subtest 3	21.47	21.50	21.42	21.63	21.92	21.19	21.92	22.02	22.30	1
6		Subtest 4	20.48	20.52	20.30	20.69	20.76	21.00	20.94	21.04	21.38	2
6		Subtest 5	20.47	20.51	20.31	21.00	21.02	21.08	20.81	21.08	21.41	0
8	DC-HSDPA	Subtest 1	23.22	23.30	23.35	22.73	22.30	21.66	23.08	22.59	23.00	0
8		Subtest 2	22.52	22.37	22.34	22.44	22.24	21.71	22.17	22.14	22.39	0
8		Subtest 3	21.40	21.81	22.00	21.94	21.43	21.63	21.40	21.23	21.22	0.5
8		Subtest 4	21.17	21.14	21.06	21.44	21.45	21.61	21.03	21.00	21.28	0.5

Table 8-2
Reduced Average RF Output Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	18.59	18.52	18.41	11.50	11.30	11.21	12.40	12.50	12.89	-
6	HSDPA	Subtest 1	18.55	18.61	18.44	11.31	11.06	10.60	12.23	11.51	11.50	0
6		Subtest 2	18.54	18.59	18.42	11.08	11.01	10.34	12.32	11.17	11.23	0
6		Subtest 3	18.59	18.66	18.43	10.95	10.86	10.20	12.23	10.50	10.54	0.5
6		Subtest 4	18.49	18.56	18.42	10.97	10.85	10.41	12.28	10.50	10.54	0.5
6	HSUPA	Subtest 1	17.13	17.20	17.10	11.47	11.28	10.66	11.11	11.82	11.40	0
6		Subtest 2	17.13	17.21	17.03	11.45	11.35	10.78	12.30	11.91	12.40	2
6		Subtest 3	17.16	17.22	17.02	11.50	11.38	10.65	12.35	11.82	12.48	1
6		Subtest 4	17.14	17.18	17.02	11.48	11.23	10.57	12.23	11.81	12.41	2
6		Subtest 5	18.14	18.15	18.03	11.47	11.30	10.60	12.11	11.71	12.33	0
8	DC-HSDPA	Subtest 1	18.25	18.29	18.20	10.77	10.70	10.70	12.13	11.26	11.10	0
8		Subtest 2	18.20	18.27	18.27	10.44	10.60	9.90	12.02	11.02	11.00	0
8		Subtest 3	18.10	18.33	18.16	10.55	10.49	9.72	11.75	10.88	10.70	0.5
8		Subtest 4	18.12	18.33	18.28	10.60	10.43	9.81	11.75	10.79	10.53	0.5

DC-HSDPA consideration

- 3GPP Specification 34.121-1 Release 8 Ver 8.10.0 was used for DC-HSDPA guidance
- H-Set 12 (QPSK) was confirmed to be used during DC-HSDPA measurements
- The DUT supports UE category 24 for HSDPA

It is expected by the manufacturer that MPR for some HSPA subtests may be up to 2 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.

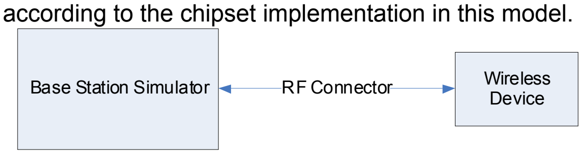


Figure 8-1
Power Measurement Setup

8.2 LTE Conducted Powers

8.2.1 LTE Band 12

Table 8-3
LTE Band 12 Conducted Powers - 10 MHz Bandwidth Maximum Power

LTE Band 12 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23095 (707.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	**23.94**	0	0
	1	25	23.89		0
	1	49	23.84		0
	25	0	**22.55**	0-1	1
	25	12	22.50		1
	25	25	22.42		1
	50	0	22.51		1
16QAM	1	0	22.99	0-1	1
	1	25	22.89		1
	1	49	22.92		1
	25	0	21.53	0-2	2
	25	12	21.55		2
	25	25	21.48		2
	50	0	21.52		2

Note: LTE Band 12 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-4
LTE Band 12 Conducted Powers - 5 MHz Bandwidth Maximum Power

LTE Band 12 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23035 (701.5 MHz) Conducted Power [dBm]	Mid Channel 23095 (707.5 MHz) Conducted Power [dBm]	High Channel 23155 (713.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	24.28	24.08	23.90	0	0
	1	12	24.10	24.06	23.80		0
	1	24	24.39	24.06	23.79		0
	12	0	22.76	22.55	22.38	0-1	1
	12	6	22.72	22.47	22.36		1
	12	13	22.76	22.47	22.37		1
	25	0	22.77	22.50	22.37		1
16QAM	1	0	23.15	22.80	22.53	0-1	1
	1	12	23.11	22.77	22.95		1
	1	24	23.22	22.85	22.72		1
	12	0	21.69	21.43	21.24	0-2	2
	12	6	21.68	21.39	21.29		2
	12	13	21.71	21.44	21.28		2
	25	0	21.80	21.49	21.38		2

Table 8-5
LTE Band 12 Conducted Powers - 3 MHz Bandwidth Maximum Power

LTE Band 12 3 MHz Bandwidth							
			Low Channel	Mid Channel	High Channel		
Modulation	RB Size	RB Offset	23025 (700.5 MHz)	23095 (707.5 MHz)	23165 (714.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	24.33	24.06	23.87	0	0
	1	7	24.31	24.01	23.84		0
	1	14	24.32	24.05	23.78		0
	8	0	22.84	22.50	22.39	0-1	1
	8	4	22.76	22.49	22.38		1
	8	7	22.79	22.47	22.36		1
	15	0	22.84	22.49	22.38		1
16QAM	1	0	23.29	22.95	22.64	0-1	1
	1	7	23.30	23.07	22.76		1
	1	14	23.11	22.93	22.65		1
	8	0	21.84	21.58	21.41	0-2	2
	8	4	21.73	21.53	21.41		2
	8	7	21.70	21.53	21.27		2
	15	0	21.70	21.43	21.32		2

Table 8-6
LTE Band 12 Conducted Powers – 1.4 MHz Bandwidth Maximum Power

LTE Band 12 1.4 MHz Bandwidth							
			Low Channel	Mid Channel	High Channel		
Modulation	RB Size	RB Offset	23017 (699.7 MHz)	23095 (707.5 MHz)	23173 (715.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	24.29	24.07	23.86	0	0
	1	2	24.36	24.10	23.85		0
	1	5	24.34	24.02	23.78		0
	3	0	23.97	23.69	23.50		0
	3	2	23.96	23.71	23.48		0
	3	3	23.98	23.74	23.49		0
	6	0	22.69	22.50	22.38	0-1	1
16QAM	1	0	23.25	23.14	23.00	0-1	1
	1	2	23.21	23.25	22.96		1
	1	5	23.39	23.09	22.75		1
	3	0	22.85	22.71	22.58		1
	3	2	22.86	22.68	22.48		1
	3	3	23.03	22.57	22.47		1
	6	0	21.70	21.54	21.40	0-2	2

Table 8-7
LTE Band 12 Conducted Powers - 10 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 12 10 MHz Bandwidth					
			Mid Channel		
Modulation	RB Size	RB Offset	23095 (707.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]		
QPSK	1	0	20.43	0	0
	1	25	20.43		0
	1	49	**20.44**		0
	25	0	19.28	0-1	1
	25	12	19.33		1
	25	25	**19.43**		1
	50	0	19.34		1
16QAM	1	0	18.50	0-1	1
	1	25	18.49		1
	1	49	18.51		1
	25	0	17.71	0-2	2
	25	12	17.75		2
	25	25	17.70		2
	50	0	17.79		2

Note: LTE Band 12 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-8
LTE Band 12 Conducted Powers - 5 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 12 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23035 (701.5 MHz) Conducted Power [dBm]	Mid Channel 23095 (707.5 MHz) Conducted Power [dBm]	High Channel 23155 (713.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	20.40	20.26	19.99	0	0
	1	12	20.41	20.20	19.93		0
	1	24	20.35	20.17	20.05		0
	12	0	19.04	19.04	18.83	0-1	1
	12	6	19.09	19.02	18.75		1
	12	13	19.07	18.98	18.78		1
	25	0	19.06	19.08	18.76		1
16QAM	1	0	18.56	18.30	18.23	0-1	1
	1	12	18.46	18.26	18.17		1
	1	24	18.43	18.27	18.21		1
	12	0	17.79	17.87	17.66	0-2	2
	12	6	17.84	17.82	17.59		2
	12	13	17.79	17.79	17.67		2
	25	0	17.91	17.94	17.65		2

Table 8-9
LTE Band 12 Conducted Powers - 3 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 12 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23025 (700.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23165 (714.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.29	20.26	20.11	0	0
	1	7	20.26	20.27	20.08		0
	1	14	20.23	20.28	20.08		0
	8	0	19.33	19.30	19.09	0-1	1
	8	4	19.34	19.31	19.00		1
	8	7	19.38	19.23	19.06		1
	15	0	19.28	19.26	19.00		1
16QAM	1	0	18.63	18.53	18.21	0-1	1
	1	7	18.51	18.52	18.24		1
	1	14	18.55	18.43	18.26		1
	8	0	18.25	18.08	17.95	0-2	2
	8	4	18.18	18.07	17.87		2
	8	7	18.13	18.06	17.85		2
	15	0	18.18	18.14	17.84		2

Table 8-10
LTE Band 12 Conducted Powers – 1.4 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 12 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23017 (699.7 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23173 (715.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.30	20.24	20.08	0	0
	1	2	20.33	20.29	20.10		0
	1	5	20.31	20.23	20.13		0
	3	0	20.22	20.21	19.83		0
	3	2	20.26	20.18	19.84		0
	3	3	20.27	20.19	19.86		0
	6	0	19.36	19.35	19.01	0-1	1
16QAM	1	0	18.63	18.36	18.17	0-1	1
	1	2	18.58	18.37	18.18		1
	1	5	18.60	18.42	18.14		1
	3	0	18.47	18.37	18.16		1
	3	2	18.46	18.46	18.16		1
	3	3	18.47	18.39	18.14		1
	6	0	18.19	18.26	17.82	0-2	2

8.2.2 LTE Band 5 (Cell)

Table 8-11
LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth Maximum Power

LTE Band 5 (Cell) 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20525 (836.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	**23.91**	0	0
	1	25	23.83		0
	1	49	23.62		0
	25	0	**22.54**	0-1	1
	25	12	22.52		1
	25	25	22.50		1
	50	0	22.53		1
16QAM	1	0	22.77	0-1	1
	1	25	22.70		1
	1	49	22.78		1
	25	0	21.51	0-2	2
	25	12	21.50		2
	25	25	21.54		2
	50	0	21.55		2

Note: LTE Band 5 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-12
LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth Maximum Power

LTE Band 5 (Cell) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20425 (826.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20625 (846.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	24.00	24.00	23.89	0	0
	1	12	23.98	23.88	23.66		0
	1	24	23.94	23.91	23.03		0
	12	0	22.55	22.40	22.21	0-1	1
	12	6	22.55	22.36	22.21		1
	12	13	22.53	22.37	22.19		1
	25	0	22.54	22.38	22.21		1
16QAM	1	0	23.00	22.87	22.79	0-1	1
	1	12	22.95	22.63	22.68		1
	1	24	22.96	22.57	22.00		1
	12	0	21.35	21.22	21.18	0-2	2
	12	6	21.41	21.27	21.12		2
	12	13	21.36	21.24	21.10		2
	25	0	21.49	21.31	21.18		2

Table 8-13
LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth Maximum Power

LTE Band 5 (Cell) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20415 (825.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20635 (847.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	24.00	23.92	23.71	0	0
	1	7	23.98	23.89	23.24		0
	1	14	23.97	23.92	23.02		0
	8	0	22.52	22.40	22.31	0-1	1
	8	4	22.49	22.37	22.29		1
	8	7	22.49	22.40	22.03		1
	15	0	22.49	22.39	22.29		1
16QAM	1	0	22.92	22.77	22.86	0-1	1
	1	7	23.00	22.75	22.62		1
	1	14	22.94	22.81	22.00		1
	8	0	21.45	21.34	21.22	0-2	2
	8	4	21.53	21.26	21.25		2
	8	7	21.47	21.27	21.16		2
	15	0	21.40	21.25	21.15		2

Table 8-14
LTE Band 5 (Cell) Conducted Powers – 1.4 MHz Bandwidth Maximum Power

LTE Band 5 (Cell) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20407 (824.7 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20643 (848.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.95	23.99	23.05	0	0
	1	2	23.97	23.98	23.01		0
	1	5	23.98	23.89	23.00		0
	3	0	23.81	23.60	23.06		0
	3	2	23.72	23.57	23.00		0
	3	3	23.79	23.60	22.69		0
	6	0	22.48	22.39	22.00	0-1	1
16QAM	1	0	23.00	22.93	22.44	0-1	1
	1	2	22.99	22.85	22.41		1
	1	5	22.97	23.00	22.00		1
	3	0	22.62	22.61	22.28		1
	3	2	22.65	22.46	22.05		1
	3	3	22.57	22.60	22.01		1
	6	0	21.40	21.26	21.20	0-2	2

Table 8-15
LTE Band 5 Conducted Powers - 10 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 5 (Cell) 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20525 (836.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	18.18	0	0
	1	25	**18.20**		0
	1	49	18.18		0
	25	0	17.06	0-1	1
	25	12	**17.12**		1
	25	25	16.99		1
	50	0	17.06		1
16QAM	1	0	16.50	0-1	1
	1	25	16.56		1
	1	49	16.50		1
	25	0	15.75	0-2	2
	25	12	15.51		2
	25	25	15.50		2
	50	0	15.52		2

Note: LTE Band 5 at 10 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-16
LTE Band 5 Conducted Powers - 5 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 5 (Cell) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20425 (826.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20625 (846.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	17.96	18.03	18.27	0	0
	1	12	17.91	17.95	18.25		0
	1	24	17.93	17.99	17.99		0
	12	0	16.98	17.03	17.23	0-1	1
	12	6	16.95	16.93	17.13		1
	12	13	16.93	16.90	17.07		1
	25	0	16.90	16.97	17.21		1
16QAM	1	0	16.66	16.67	16.66	0-1	1
	1	12	16.65	16.59	16.61		1
	1	24	16.67	16.61	16.67		1
	12	0	16.05	16.11	16.22	0-2	2
	12	6	16.01	16.01	16.14		2
	12	13	15.99	16.02	16.17		2
	25	0	15.98	15.97	16.21		2

Table 8-17
LTE Band 5 Conducted Powers - 3 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 5 (Cell) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20415 (825.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20635 (847.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	18.02	17.98	18.30	0	0
	1	7	17.97	17.97	18.22		0
	1	14	18.06	17.98	18.02		0
	8	0	17.20	17.25	17.40	0-1	1
	8	4	17.11	17.20	17.29		1
	8	7	17.12	17.21	17.30		1
	15	0	17.10	17.21	17.33		1
16QAM	1	0	16.51	16.64	16.79	0-1	1
	1	7	16.50	16.59	16.70		1
	1	14	16.50	16.58	16.72		1
	8	0	16.26	16.18	16.39	0-2	2
	8	4	16.27	16.15	16.38		2
	8	7	16.28	16.10	16.43		2
	15	0	16.20	16.18	16.45		2

Table 8-18
LTE Band 5 Conducted Powers – 1.4 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 5 (Cell) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20407 (824.7 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20643 (848.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	18.14	18.12	18.37	0	0
	1	2	18.02	18.10	18.34		0
	1	5	18.09	18.07	18.19		0
	3	0	17.97	18.01	18.21		0
	3	2	17.98	18.02	18.17		0
	3	3	18.03	17.98	18.13		0
	6	0	17.20	17.25	17.41	0-1	1
16QAM	1	0	16.76	16.64	16.68	0-1	1
	1	2	16.80	16.63	16.62		1
	1	5	16.54	16.59	16.67		1
	3	0	16.53	16.50	16.56		1
	3	2	16.51	16.51	16.63		1
	3	3	16.54	16.50	16.59		1
	6	0	16.28	16.22	16.50	0-2	2

8.2.3 LTE Band 4 (AWS)

Table 8-19
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth Maximum Power

LTE Band 4 (AWS) 20 MHzBandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20175 (1732.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	23.53	0	0
	1	50	23.62		0
	1	99	**23.68**		0
	50	0	22.16	0-1	1
	50	25	22.18		1
	50	50	**22.19**		1
	100	0	22.18		1
16QAM	1	0	22.50	0-1	1
	1	50	22.55		1
	1	99	22.64		1
	50	0	21.10	0-2	2
	50	25	21.11		2
	50	50	21.15		2
	100	0	21.14		2

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-20
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth Maximum Power

LTE Band 4 (AWS) 15 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20025 (1717.5 MHz)	20175 (1732.5 MHz)	20325 (1747.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.60	23.67	23.95	0	0
	1	36	23.69	23.68	23.98		0
	1	74	23.64	23.71	23.98		0
	36	0	22.15	22.17	22.68	0-1	1
	36	18	22.20	22.18	22.63		1
	36	37	22.18	22.20	22.64		1
	75	0	22.15	22.19	22.61		1
16QAM	1	0	22.62	22.71	22.99	0-1	1
	1	36	22.65	22.71	22.92		1
	1	74	22.75	22.77	22.91		1
	36	0	21.15	21.12	21.53	0-2	2
	36	18	21.08	21.15	21.57		2
	36	37	21.10	21.13	21.58		2
	75	0	21.07	21.15	21.55		2

Table 8-21
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth Maximum Power

LTE Band 4 (AWS) 10 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20000 (1715.0 MHz)	20175 (1732.5 MHz)	20350 (1750.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.66	23.68	23.97	0	0
	1	25	23.69	23.65	23.98		0
	1	49	23.64	23.72	23.98		0
	25	0	22.21	22.15	22.69	0-1	1
	25	12	22.19	22.16	22.64		1
	25	25	22.16	22.16	22.65		1
	50	0	22.15	22.19	22.65		1
16QAM	1	0	22.51	22.60	22.99	0-1	1
	1	25	22.56	22.72	22.92		1
	1	49	22.75	22.77	22.94		1
	25	0	21.12	21.09	21.54	0-2	2
	25	12	21.11	21.14	21.57		2
	25	25	21.16	21.13	21.59		2
	50	0	21.07	21.12	21.56		2

Table 8-22
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth Maximum Power

LTE Band 4 (AWS) 5 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			19975 (1712.5 MHz)	20175 (1732.5 MHz)	20375 (1752.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.77	23.67	23.99	0	0
	1	12	23.77	23.67	23.88		0
	1	24	23.76	23.69	23.92		0
	12	0	22.18	22.12	22.72	0-1	1
	12	6	22.22	22.14	22.78		1
	12	13	22.24	22.15	22.72		1
	25	0	22.16	22.16	22.69		1
16QAM	1	0	22.72	22.55	22.93	0-1	1
	1	12	22.61	22.58	22.92		1
	1	24	22.62	22.87	22.92		1
	12	0	21.12	21.06	21.59	0-2	2
	12	6	21.17	21.06	21.55		2
	12	13	21.15	21.08	21.61		2
	25	0	21.28	21.15	21.71		2

Table 8-23
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth Maximum Power

LTE Band 4 (AWS) 3 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 19965 (1711.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20385 (1753.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.88	23.68	23.95	0	0
	1	7	23.85	23.71	23.98		0
	1	14	23.96	23.75	24.00		0
	8	0	22.34	22.16	22.67	0-1	1
	8	4	22.38	22.14	22.70		1
	8	7	22.37	22.16	22.67		1
	15	0	22.38	22.16	22.66		1
16QAM	1	0	23.00	22.71	22.98	0-1	1
	1	7	22.69	22.72	22.99		1
	1	14	22.81	22.56	22.94		1
	8	0	21.22	21.11	21.66	0-2	2
	8	4	21.22	21.13	21.66		2
	8	7	21.19	21.24	21.56		2
	15	0	21.18	21.08	21.63		2

Table 8-24
LTE Band 4 (AWS) Conducted Powers - 1.4 MHz Bandwidth Maximum Power

LTE Band 4 (AWS) 1.4 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 19957 (1710.7 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20393 (1754.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.94	23.75	24.00	0	0
	1	2	23.96	23.75	24.00		0
	1	5	24.00	23.78	23.99		0
	3	0	23.61	23.41	23.93		0
	3	2	23.56	23.40	23.93		0
	3	3	23.66	23.45	23.96		0
	6	0	22.37	22.16	22.74	0-1	1
16QAM	1	0	22.82	22.68	23.00	0-1	1
	1	2	22.79	22.71	22.99		1
	1	5	22.95	22.68	22.98		1
	3	0	22.45	22.37	22.87		1
	3	2	22.54	22.40	22.72		1
	3	3	22.52	22.30	22.81		1
	6	0	21.25	21.11	21.76	0-2	2

Table 8-25
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 4 (AWS) 20 MHzBandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20175 (1732.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	12.07	0	0
	1	50	12.10		0
	1	99	**12.28**		0
	50	0	**12.18**	0-1	0
	50	25	12.04		0
	50	50	11.99		0
	100	0	12.12		0
16QAM	1	0	12.12	0-1	0
	1	50	12.04		0
	1	99	12.24		0
	50	0	12.00	0-2	0
	50	25	12.01		0
	50	50	11.97		0
	100	0	12.01		0

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-26
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 4 (AWS) 15 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 20025 (1717.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20325 (1747.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	12.02	12.25	11.86	0	0
	1	36	12.00	12.31	11.90		0
	1	74	12.07	12.30	11.93		0
	36	0	12.08	12.15	11.78	0-1	0
	36	18	12.14	12.20	11.80		0
	36	37	12.08	12.16	11.83		0
	75	0	12.09	12.19	11.74		0
16QAM	1	0	12.22	12.26	11.68	0-1	0
	1	36	12.20	12.27	11.77		0
	1	74	12.21	12.26	11.78		0
	36	0	12.19	12.13	11.74	0-2	0
	36	18	12.23	12.17	11.78		0
	36	37	12.16	12.07	11.59		0
	75	0	12.11	12.06	11.68		0

Table 8-27
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 4 (AWS) 10 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 20000 (1715.0 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20350 (1750.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	12.28	12.26	11.76	0	0
	1	25	12.39	12.24	11.99		0
	1	49	12.35	12.20	11.93		0
	25	0	12.23	11.97	11.75	0-1	0
	25	12	12.27	11.97	11.80		0
	25	25	12.30	12.02	11.76		0
	50	0	12.25	12.03	11.75		0
16QAM	1	0	12.33	12.06	11.81	0-1	0
	1	25	12.36	12.05	11.90		0
	1	49	12.38	12.06	11.94		0
	25	0	12.36	12.11	11.77	0-2	0
	25	12	12.38	12.14	11.82		0
	25	25	12.33	12.18	11.79		0
	50	0	12.23	12.13	11.78		0

Table 8-28
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 4 (AWS) 5 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 19975 (1712.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20375 (1752.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	12.20	12.12	11.68	0	0
	1	12	12.26	12.07	11.75		0
	1	24	12.28	12.18	11.75		0
	12	0	12.27	12.10	11.72	0-1	0
	12	6	12.22	12.10	11.65		0
	12	13	12.26	12.12	11.75		0
	25	0	12.28	12.09	11.78		0
16QAM	1	0	12.40	11.86	11.84	0-1	0
	1	12	12.30	11.80	11.81		0
	1	24	12.46	11.86	11.89		0
	12	0	12.23	11.99	11.81	0-2	0
	12	6	12.22	11.97	11.85		0
	12	13	12.26	12.04	11.81		0
	25	0	12.23	12.14	11.69		0

Table 8-29
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 4 (AWS) 3 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 19965 (1711.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20385 (1753.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	12.49	11.93	11.70	0	0
	1	7	12.42	11.93	11.66		0
	1	14	12.43	11.97	11.74		0
	8	0	12.24	12.11	11.77	0-1	0
	8	4	12.26	12.09	11.65		0
	8	7	12.27	12.11	11.75		0
	15	0	12.27	12.11	11.68		0
16QAM	1	0	12.29	12.10	11.43	0-1	0
	1	7	12.28	12.12	11.43		0
	1	14	12.25	12.09	11.52		0
	8	0	12.21	12.25	11.60	0-2	0
	8	4	12.25	12.03	11.66		0
	8	7	12.19	12.04	11.69		0
	15	0	12.24	12.04	11.65		0

Table 8-30
LTE Band 4 (AWS) Conducted Powers – 1.4 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 4 (AWS) 1.4 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 19957 (1710.7 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20393 (1754.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	12.29	12.30	11.50	0	0
	1	2	12.27	12.25	11.50		0
	1	5	12.31	12.32	11.54		0
	3	0	12.18	12.16	11.60		0
	3	2	12.21	12.09	11.65		0
	3	3	12.21	12.04	11.69		0
	6	0	12.17	12.08	11.63	0-1	0
16QAM	1	0	11.97	12.01	11.58	0-1	0
	1	2	11.98	12.02	11.55		0
	1	5	11.97	12.04	11.50		0
	3	0	12.11	12.05	11.44		0
	3	2	12.09	12.00	11.45		0
	3	3	12.13	12.11	11.47		0
	6	0	12.02	11.88	11.51	0-2	0

8.2.4 LTE Band 2 (PCS)

Table 8-31
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth Maximum Power

LTE Band 2 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.52	23.70	23.86	0	0
	1	50	23.58	23.86	23.93		0
	1	99	23.68	23.89	**23.94**		0
	50	0	22.11	22.39	22.52	0-1	1
	50	25	22.13	22.42	22.54		1
	50	50	22.18	22.47	**22.60**		1
	100	0	22.14	22.44	22.53		1
16QAM	1	0	22.50	22.88	22.90	0-1	1
	1	50	22.70	22.80	22.99		1
	1	99	22.83	22.93	22.99		1
	50	0	21.08	21.31	21.54	0-2	2
	50	25	21.16	21.37	21.54		2
	50	50	21.15	21.40	21.56		2
	100	0	21.14	21.37	21.54		2

Table 8-32
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth Maximum Power

LTE Band 2 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.62	23.79	23.87	0	0
	1	36	23.70	23.84	23.93		0
	1	74	23.73	23.92	23.96		0
	36	0	22.18	22.39	22.44	0-1	1
	36	18	22.20	22.42	22.48		1
	36	37	22.23	22.45	22.51		1
	75	0	22.21	22.43	22.49		1
16QAM	1	0	22.81	23.00	22.99	0-1	1
	1	36	22.65	22.96	22.84		1
	1	74	22.89	22.88	22.98		1
	36	0	21.15	21.30	21.47	0-2	2
	36	18	21.19	21.32	21.42		2
	36	37	21.23	21.39	21.45		2
	75	0	21.21	21.33	21.43		2

Table 8-33
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth Maximum Power

LTE Band 2 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.63	23.75	23.86	0	0
	1	25	23.81	23.90	23.91		0
	1	49	23.87	23.90	23.97		0
	25	0	22.18	22.39	22.44	0-1	1
	25	12	22.19	22.39	22.45		1
	25	25	22.23	22.43	22.48		1
	50	0	22.22	22.43	22.48		1
16QAM	1	0	22.81	22.95	22.99	0-1	1
	1	25	22.75	22.96	22.74		1
	1	49	22.89	22.86	22.93		1
	25	0	21.19	21.32	21.47	0-2	2
	25	12	21.20	21.30	21.44		2
	25	25	21.23	21.38	21.45		2
	50	0	21.21	21.35	21.43		2

Table 8-34
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth Maximum Power

LTE Band 2 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.69	23.82	23.89	0	0
	1	12	23.67	23.82	23.92		0
	1	24	23.72	23.84	23.91		0
	12	0	22.14	22.38	22.47	0-1	1
	12	6	22.17	22.40	22.47		1
	12	13	22.18	22.39	22.48		1
	25	0	22.18	22.39	22.48		1
16QAM	1	0	22.53	22.77	22.79	0-1	1
	1	12	22.59	22.86	22.88		1
	1	24	22.80	22.96	22.86		1
	12	0	21.14	21.29	21.39	0-2	2
	12	6	21.09	21.24	21.36		2
	12	13	21.07	21.33	21.36		2
	25	0	21.18	21.40	21.43		2

Table 8-35
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth Maximum Power

LTE Band 2 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18615 (1851.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19185 (1908.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.72	23.90	23.95	0	0
	1	7	23.71	23.85	23.92		0
	1	14	23.77	23.90	23.97		0
	8	0	22.15	22.41	22.43	0-1	1
	8	4	22.15	22.38	22.42		1
	8	7	22.15	22.42	22.45		1
	15	0	22.18	22.41	22.45		1
16QAM	1	0	22.60	22.87	22.97	0-1	1
	1	7	22.60	22.86	22.82		1
	1	14	22.65	22.92	22.90		1
	8	0	21.10	21.29	21.45	0-2	2
	8	4	21.16	21.41	21.33		2
	8	7	21.16	21.39	21.40		2
	15	0	21.18	21.31	21.38		2

Table 8-36
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth Maximum Power

LTE Band 2 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19193 (1909.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.78	23.96	23.86	0	0
	1	2	23.71	23.85	23.84		0
	1	5	23.77	23.88	23.87		0
	3	0	23.39	23.58	23.54		0
	3	2	23.38	23.59	23.58		0
	3	3	23.44	23.61	23.60		0
	6	0	22.22	22.38	22.38	0-1	1
16QAM	1	0	22.75	22.76	22.78	0-1	1
	1	2	22.87	22.92	22.80		1
	1	5	22.84	22.81	22.91		1
	3	0	22.30	22.40	22.61		1
	3	2	22.26	22.46	22.49		1
	3	3	22.32	22.52	22.41		1
	6	0	21.21	21.42	21.41	0-2	2

Table 8-37
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 2 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	11.71	12.02	12.25	0	0
	1	50	11.82	12.11	12.39		0
	1	99	11.88	12.14	**12.46**		0
	50	0	11.78	11.95	**12.35**	0-1	0
	50	25	11.76	12.06	12.33		0
	50	50	11.90	12.05	12.31		0
	100	0	11.84	11.97	12.34		0
16QAM	1	0	11.71	11.92	12.30	0-1	0
	1	50	11.88	12.07	12.34		0
	1	99	11.86	12.23	12.40		0
	50	0	11.81	12.02	12.35	0-2	0
	50	25	11.88	12.04	12.34		0
	50	50	11.89	12.08	12.33		0
	100	0	11.81	12.03	12.37		0

Table 8-38
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 2 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	11.85	11.28	12.05	0	0
	1	36	11.79	11.60	11.57		0
	1	74	11.54	11.97	11.41		0
	36	0	11.88	11.38	12.03	0-1	0
	36	18	11.71	11.60	11.60		0
	36	37	11.63	11.86	11.42		0
	75	0	11.75	11.55	11.54		0
16QAM	1	0	11.77	11.22	12.07	0-1	0
	1	36	11.74	11.55	11.50		0
	1	74	11.59	11.90	11.42		0
	36	0	11.85	11.24	11.88	0-2	0
	36	18	11.72	11.47	11.47		0
	36	37	11.62	11.71	11.33		0
	75	0	11.72	11.39	11.38		0

Table 8-39
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 2 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	11.85	11.32	11.93	0	0
	1	25	11.88	11.60	11.39		0
	1	49	11.76	11.92	11.32		0
	25	0	11.84	11.42	11.65	0-1	0
	25	12	11.79	11.60	11.47		0
	25	25	11.64	11.72	11.35		0
	50	0	11.68	11.49	11.43		0
16QAM	1	0	11.67	11.31	11.88	0-1	0
	1	25	11.78	11.56	11.33		0
	1	49	11.64	11.87	11.34		0
	25	0	11.82	11.28	11.51	0-2	0
	25	12	11.79	11.47	11.35		0
	25	25	11.65	11.57	11.31		0
	50	0	11.66	11.33	11.37		0

Table 8-40
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 2 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	11.74	11.45	11.52	0	0
	1	12	11.79	11.61	11.49		0
	1	24	11.78	11.72	11.57		0
	12	0	11.82	11.51	11.50	0-1	0
	12	6	11.81	11.62	11.53		0
	12	13	11.78	11.67	11.53		0
	25	0	11.73	11.51	11.44		0
16QAM	1	0	11.67	11.41	11.46	0-1	0
	1	12	11.70	11.55	11.42		0
	1	24	11.65	11.66	11.48		0
	12	0	11.65	11.38	11.46	0-2	0
	12	6	11.68	11.51	11.40		0
	12	13	11.63	11.54	11.48		0
	25	0	11.57	11.37	11.41		0

Table 8-41
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 2 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18615 (1851.5 MHz)	18900 (1880.0 MHz)	19185 (1908.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.80	11.77	11.41	0	0
	1	7	11.69	11.79	11.40		0
	1	14	11.84	11.92	11.44		0
	8	0	11.80	11.89	11.46	0-1	0
	8	4	11.83	11.94	11.50		0
	8	7	11.84	11.97	11.51		0
	15	0	11.86	11.92	11.48		0
16QAM	1	0	11.73	11.81	11.45	0-1	0
	1	7	11.78	11.85	11.46		0
	1	14	11.80	11.93	11.47		0
	8	0	11.71	11.82	11.45	0-2	0
	8	4	11.70	11.83	11.49		0
	8	7	11.72	11.86	11.42		0
	15	0	11.71	11.81	11.48		0

Table 8-42
LTE Band 2 (PCS) Conducted Powers – 1.4 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 2 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18607 (1850.7 MHz)	18900 (1880.0 MHz)	19193 (1909.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.73	11.80	11.46	0	0
	1	2	11.76	11.71	11.41		0
	1	5	11.78	11.74	11.51		0
	3	0	11.76	11.85	11.46		0
	3	2	11.79	11.89	11.47		0
	3	3	11.78	11.91	11.48		0
	6	0	11.66	11.76	11.40	0-1	0
16QAM	1	0	11.69	11.72	11.49	0-1	0
	1	2	11.72	11.66	11.48		0
	1	5	11.71	11.68	11.43		0
	3	0	11.76	11.72	11.42		0
	3	2	11.78	11.75	11.44		0
	3	3	11.77	11.76	11.44		0
	6	0	11.62	11.62	11.41	0-2	0

8.2.5 LTE Band 30

Table 8-43
LTE Band 30 Conducted Powers - 10 MHz Bandwidth Maximum Power

LTE Band 30 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			27710 (2310.0 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	22.43	0	0
		25	22.48		0
		49	**22.50**		0
	25	0	21.19	0-1	1
		12	**21.25**		1
		25	21.17		1
	50	0	21.24		1
16QAM	1	0	21.44	0-1	1
		25	21.45		1
		49	21.42		1
	25	0	20.46	0-2	2
		12	20.48		2
		25	20.43		2
	50	0	20.45		2

Table 8-44
LTE Band 30 Conducted Powers - 5 MHz Bandwidth Maximum Power

LTE Band 30 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 27710 (2310.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.45	0	0
		12	22.47		0
		24	22.42		0
	12	0	21.09	0-1	1
		6	21.14		1
		13	20.98		1
	25	0	21.00		1
16QAM	1	0	20.98	0-1	1
		12	21.00		1
		24	21.04		1
	12	0	20.20	0-2	2
		6	20.22		2
		13	20.14		2
	25	0	20.17		2

Note: LTE Band 30 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Table 8-45
LTE Band 30 Conducted Powers – 10 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 30 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 27710 (2310.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	13.19	0	0
		25	13.23		0
		49	**13.28**		0
	25	0	**13.24**	0-1	0
		12	13.12		0
		25	13.10		0
	50	0	13.16		0
16QAM	1	0	13.03	0-1	0
		25	13.03		0
		49	13.05		0
	25	0	13.11	0-2	0
		12	13.13		0
		25	13.09		0
	50	0	13.18		0

Table 8-46
LTE Band 30 Conducted Powers – 5 MHz Bandwidth Reduced Average RF Output Powers

LTE Band 30 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 27710 (2310.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	13.48	0	0
		12	13.49		0
		24	13.46		0
	12	0	13.36	0-1	0
		6	13.35		0
		13	13.42		0
	25	0	13.42		0
16QAM	1	0	13.40	0-1	0
		12	13.48		0
		24	13.47		0
	12	0	13.39	0-2	0
		6	13.37		0
		13	13.35		0
	25	0	13.42		0

Note: LTE Band 30 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

8.3 WLAN Conducted Powers

Table 8-47
2.4 GHz Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm] IEEE Transmission Mode	
		802.11b	802.11g
2412	1	**13.43**	12.48
2437	6	13.33	12.22
2462	11	13.34	12.30

Table 8-48
5 GHz (40 MHz Bandwidth) Average RF Power

Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm] IEEE 802.11n
5190	38	11.07
5230	46	11.11
5270	54	**11.31**
5310	62	**11.11**
5510	102	**11.49**
5590	118	10.50
5630	126	10.42
5710	142	**10.71**
5755	151	11.41
5795	159	**11.47**

Justification for test configurations for WLAN per KDB Publication 248227 D01v02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.
- The bolded data rate and channel above were tested for SAR.

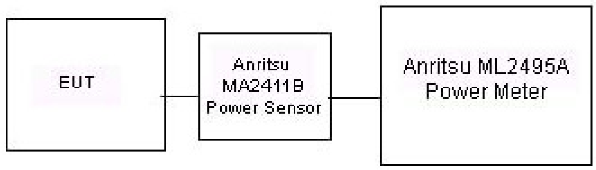


Figure 8-2
Power Measurement Setup

8.4 Bluetooth Conducted Powers

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1.0	0	9.03	7.991
2441	1.0	39	9.05	8.029
2480	1.0	78	7.68	5.866
2402	2.0	0	4.35	2.725
2441	2.0	39	4.04	2.534
2480	2.0	78	2.98	1.985
2402	3.0	0	4.18	2.619
2441	3.0	39	4.28	2.677
2480	3.0	78	3.24	2.109

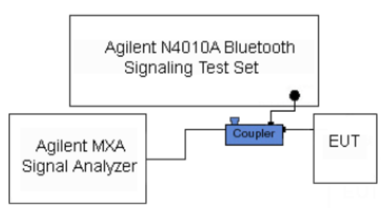


Figure 8-5
Power Measurement Setup

9 SYSTEM VERIFICATION

9.1 Tissue Verification

Table 9-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (˚C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
8/4/2015	750B	22.1	700	0.925	55.802	0.959	55.726	-3.55%	0.14%
			710	0.932	55.678	0.960	55.687	-2.92%	-0.02%
			740	0.961	55.355	0.963	55.570	-0.21%	-0.39%
			755	0.976	55.246	0.964	55.512	1.24%	-0.48%
8/10/2015	835B	21.7	820	0.990	53.760	0.969	55.258	2.17%	-2.71%
			835	1.005	53.595	0.970	55.200	3.61%	-2.91%
			850	1.020	53.423	0.988	55.154	3.24%	-3.14%
3/14/2016	835B	22.7	820	0.973	54.577	0.969	55.258	0.41%	-1.23%
			835	0.984	54.471	0.970	55.200	1.44%	-1.32%
			850	1.003	54.308	0.988	55.154	1.52%	-1.53%
3/21/2016	1750B	22.8	1710	1.449	51.053	1.463	53.537	-0.96%	-4.64%
			1750	1.494	50.921	1.488	53.432	0.40%	-4.70%
			1790	1.537	50.727	1.514	53.33	1.52%	-4.87%
8/5/2015	1900B	22.6	1850	1.487	51.230	1.520	53.300	-2.17%	-3.88%
			1880	1.519	51.153	1.520	53.300	-0.07%	-4.03%
			1910	1.555	51.069	1.520	53.300	2.30%	-4.19%
3/9/2016	1900B	22.6	1850	1.462	52.959	1.520	53.300	-3.82%	-0.64%
			1880	1.493	52.888	1.520	53.300	-1.78%	-0.77%
			1910	1.527	52.771	1.520	53.300	0.46%	-0.99%
8/7/2015	2450B	22.0	2400	1.966	51.361	1.902	52.767	3.36%	-2.66%
			2450	2.035	51.219	1.950	52.700	4.36%	-2.81%
			2500	2.095	51.043	2.021	52.636	3.66%	-3.03%
3/10/2016	2450B	22.2	2400	1.956	54.184	1.902	52.767	2.84%	2.69%
			2450	2.014	53.983	1.950	52.700	3.28%	2.43%
			2500	2.100	53.793	2.021	52.636	3.91%	2.20%
3/22/2016	2450B	23.5	2300	1.770	53.170	1.809	52.900	-2.16%	0.51%
			2310	1.782	53.142	1.816	52.887	-1.87%	0.48%
			2320	1.795	53.106	1.826	52.873	-1.70%	0.44%
08/03/2015	5200B - 5800B	22.8	5260	5.374	46.966	5.369	48.933	0.09%	-4.02%
			5280	5.399	47.135	5.393	48.906	0.11%	-3.62%
			5300	5.436	46.955	5.416	48.879	0.37%	-3.94%
			5320	5.452	46.867	5.439	48.851	0.24%	-4.06%
			5500	5.672	46.417	5.650	48.607	0.39%	-4.51%
			5520	5.692	46.411	5.673	48.580	0.33%	-4.46%
			5700	5.922	46.264	5.883	48.336	0.66%	-4.29%
			5745	5.969	46.155	5.936	48.275	0.56%	-4.39%
			5785	6.080	46.180	5.982	48.220	1.64%	-4.23%
			5800	6.109	46.184	6.000	48.200	1.82%	-4.18%

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

9.2 Test System Verification

Prior to SAR assessment, the system is verified to ±10% of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix E.

Table 9-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
C	750	BODY	08/04/2015	21.5	22.0	0.200	1046	3333	1.750	8.290	8.750	5.55%
J	835	BODY	08/10/2015	20.9	21.7	0.200	4d119	3319	1.960	9.200	9.800	6.52%
I	835	BODY	03/14/2016	23.2	22.7	0.200	4d119	3333	1.980	9.200	9.900	7.61%
C	1750	BODY	03/21/2016	24.1	22.8	0.100	1008	3288	3.840	38.000	38.400	1.05%
I	1900	BODY	08/05/2015	23.0	22.6	0.100	5d141	3213	4.020	40.000	40.200	0.50%
G	1900	BODY	03/09/2016	21.4	21.9	0.100	5d149	3334	4.030	40.400	40.300	-0.25%
E	2300	BODY	03/22/2016	23.5	22.0	0.100	1064	3351	4.680	45.500	46.800	2.86%
E	2450	BODY	08/07/2015	22.1	21.9	0.100	719	3332	4.970	51.800	49.700	-4.05%
E	2450	BODY	03/10/2016	22.8	22.2	0.100	719	3351	5.020	51.900	50.200	-3.28%
A	5300	BODY	08/03/2015	24.5	23.4	0.050	1191	3914	4.140	79.900	82.800	3.63%
A	5500	BODY	08/03/2015	24.5	23.4	0.050	1191	3914	4.330	83.100	86.600	4.21%
A	5800	BODY	08/03/2015	24.5	23.4	0.050	1191	3914	4.050	78.000	81.000	3.85%

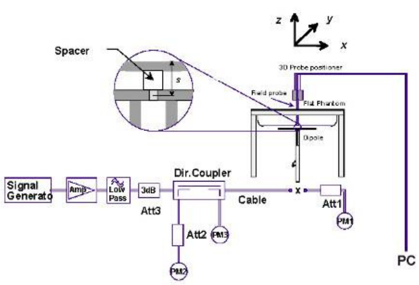


Figure 9-1
System Verification Setup Diagram

Figure 9-2
System Verification Setup Photo

10 SAR DATA SUMMARY

10.1 Standalone Body SAR Data

Table 10-1
UMTS Body SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	19.0	18.52	-0.03	0 mm	7938	1:1	back	0.692	1.117	0.773	A1
836.60	4183	UMTS 850	RMC	19.0	18.52	0.02	0 mm	7938	1:1	top	0.245	1.117	0.274	
836.60	4183	UMTS 850	RMC	19.0	18.52	-0.10	0 mm	7938	1:1	left	0.318	1.117	0.355	
836.60	4183	UMTS 850	RMC	24.0	23.02	0.02	17 mm	7896	1:1	back	0.275	1.253	0.345	
836.60	4183	UMTS 850	RMC	24.0	23.02	0.04	13 mm	7896	1:1	top	0.210	1.253	0.263	
836.60	4183	UMTS 850	RMC	24.0	23.02	-0.04	0 mm	7896	1:1	bottom	0.037	1.253	0.046	
836.60	4183	UMTS 850	RMC	24.0	23.02	-0.02	0 mm	7896	1:1	right	0.105	1.253	0.132	
836.60	4183	UMTS 850	RMC	24.0	23.02	-0.04	6 mm	7896	1:1	left	0.374	1.253	0.469	
1732.40	1412	UMTS 1750	RMC	12.0	11.30	-0.10	0 mm	02676	1:1	back	0.538	1.175	0.632	A2
1732.40	1412	UMTS 1750	RMC	12.0	11.30	0.01	0 mm	02676	1:1	top	0.258	1.175	0.303	
1732.40	1412	UMTS 1750	RMC	12.0	11.30	0.06	0 mm	02676	1:1	left	0.044	1.175	0.052	
1732.40	1412	UMTS 1750	RMC	23.5	22.73	-0.01	17 mm	02726	1:1	back	0.448	1.194	0.535	
1732.40	1412	UMTS 1750	RMC	23.5	22.73	0.02	13 mm	02726	1:1	top	0.423	1.194	0.505	
1732.40	1412	UMTS 1750	RMC	23.5	22.73	0.01	6 mm	02726	1:1	left	0.216	1.194	0.258	
1880.00	9400	UMTS 1900	RMC	13.0	12.50	-0.07	0 mm	02700	1:1	back	0.633	1.122	0.710	A3
1880.00	9400	UMTS 1900	RMC	13.0	12.50	-0.03	0 mm	02700	1:1	top	0.343	1.122	0.385	
1880.00	9400	UMTS 1900	RMC	13.0	12.50	0.08	0 mm	02700	1:1	left	0.053	1.122	0.059	
1880.00	9400	UMTS 1900	RMC	24.0	23.45	0.01	17 mm	7896	1:1	back	0.559	1.135	0.634	
1880.00	9400	UMTS 1900	RMC	24.0	23.45	0.04	13 mm	7896	1:1	top	0.621	1.135	0.705	
1880.00	9400	UMTS 1900	RMC	24.0	23.45	0.02	6 mm	7896	1:1	left	0.322	1.135	0.365	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram							

Table 10-2
LTE Band 12 Body SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	24.5	23.94	0.00	0	7904	QPSK	1	0	17 mm	back	1:1	0.275	1.138	0.313	
707.50	23095	Mid	LTE Band 12	10	23.5	22.55	-0.03	1	7904	QPSK	25	0	17 mm	back	1:1	0.205	1.245	0.255	
707.50	23095	Mid	LTE Band 12	10	24.5	23.94	-0.01	0	7904	QPSK	1	0	13 mm	top	1:1	0.184	1.138	0.209	
707.50	23095	Mid	LTE Band 12	10	23.5	22.55	-0.02	1	7904	QPSK	25	0	13 mm	top	1:1	0.130	1.245	0.162	
707.50	23095	Mid	LTE Band 12	10	24.5	23.94	-0.15	0	7904	QPSK	1	0	0 mm	bottom	1:1	0.081	1.138	0.092	
707.50	23095	Mid	LTE Band 12	10	23.5	22.55	0.15	1	7904	QPSK	25	0	0 mm	bottom	1:1	0.063	1.245	0.078	
707.50	23095	Mid	LTE Band 12	10	24.5	23.94	0.06	0	7904	QPSK	1	0	0 mm	right	1:1	0.097	1.138	0.110	
707.50	23095	Mid	LTE Band 12	10	23.5	22.55	0.02	1	7904	QPSK	25	0	0 mm	right	1:1	0.077	1.245	0.096	
707.50	23095	Mid	LTE Band 12	10	24.5	23.94	0.05	0	7904	QPSK	1	0	6 mm	left	1:1	0.187	1.138	0.213	
707.50	23095	Mid	LTE Band 12	10	23.5	22.55	-0.06	1	7904	QPSK	25	0	6 mm	left	1:1	0.137	1.245	0.171	
707.50	23095	Mid	LTE Band 12	10	20.5	20.44	-0.02	0	8159	QPSK	1	49	0 mm	back	1:1	0.523	1.014	0.530	A4
707.50	23095	Mid	LTE Band 12	10	19.5	19.43	0.03	1	8159	QPSK	25	25	0 mm	back	1:1	0.497	1.016	0.505	
707.50	23095	Mid	LTE Band 12	10	20.5	20.44	0.00	0	8159	QPSK	1	49	0 mm	top	1:1	0.349	1.014	0.354	
707.50	23095	Mid	LTE Band 12	10	19.5	19.43	-0.08	1	8159	QPSK	25	25	0 mm	top	1:1	0.354	1.016	0.360	
707.50	23095	Mid	LTE Band 12	10	20.5	20.44	-0.03	0	8159	QPSK	1	49	0 mm	left	1:1	0.297	1.014	0.301	
707.50	23095	Mid	LTE Band 12	10	19.5	19.43	0.03	1	8159	QPSK	25	25	0 mm	left	1:1	0.261	1.016	0.265	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Table 10-3
LTE Band 5 (Cell) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.91	0.08	0	7896	QPSK	1	0	17 mm	back	1:1	0.351	1.146	0.402	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.54	-0.06	1	7896	QPSK	25	0	17 mm	back	1:1	0.252	1.247	0.314	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.91	0.11	0	7896	QPSK	1	0	13 mm	top	1:1	0.281	1.146	0.322	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.54	0.04	1	7896	QPSK	25	0	13 mm	top	1:1	0.187	1.247	0.233	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.91	0.05	0	7896	QPSK	1	0	0 mm	bottom	1:1	0.075	1.146	0.086	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.54	0.05	1	7896	QPSK	25	0	0 mm	bottom	1:1	0.051	1.247	0.064	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.91	0.11	0	7896	QPSK	1	0	0 mm	right	1:1	0.161	1.146	0.185	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.54	0.08	1	7896	QPSK	25	0	0 mm	right	1:1	0.121	1.247	0.151	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.91	0.06	0	7896	QPSK	1	0	6 mm	left	1:1	0.407	1.146	0.466	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.54	0.09	1	7896	QPSK	25	0	6 mm	left	1:1	0.291	1.247	0.363	
836.50	20525	Mid	LTE Band 5 (Cell)	10	19.5	18.20	-0.14	0	02684	QPSK	1	25	0 mm	back	1:1	0.607	1.349	0.819	A5
836.50	20525	Mid	LTE Band 5 (Cell)	10	18.5	17.12	0.09	1	02684	QPSK	25	12	0 mm	back	1:1	0.487	1.374	0.669	
836.50	20525	Mid	LTE Band 5 (Cell)	10	18.5	17.06	0.07	1	02684	QPSK	50	0	0 mm	back	1:1	0.482	1.393	0.671	
836.50	20525	Mid	LTE Band 5 (Cell)	10	19.5	18.20	-0.06	0	02684	QPSK	1	25	0 mm	top	1:1	0.340	1.349	0.459	
836.50	20525	Mid	LTE Band 5 (Cell)	10	18.5	17.12	0.05	1	02684	QPSK	25	12	0 mm	top	1:1	0.323	1.374	0.444	
836.50	20525	Mid	LTE Band 5 (Cell)	10	19.5	18.20	0.05	0	02684	QPSK	1	25	0 mm	left	1:1	0.429	1.349	0.579	
836.50	20525	Mid	LTE Band 5 (Cell)	10	18.5	17.12	-0.05	1	02684	QPSK	25	12	0 mm	left	1:1	0.414	1.374	0.569	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Table 10-4
LTE Band 4 (AWS) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.68	-0.03	0	8142	QPSK	1	99	17 mm	back	1:1	0.766	1.076	0.824	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.19	-0.02	1	8142	QPSK	50	50	17 mm	back	1:1	0.554	1.205	0.668	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.18	0.03	1	8142	QPSK	100	0	17 mm	back	1:1	0.564	1.208	0.681	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.68	-0.01	0	8142	QPSK	1	99	13 mm	top	1:1	0.601	1.076	0.647	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.19	-0.04	1	8142	QPSK	50	50	13 mm	top	1:1	0.434	1.205	0.523	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.68	-0.03	0	8142	QPSK	1	99	6 mm	left	1:1	0.635	1.076	0.683	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.19	-0.04	1	8142	QPSK	50	50	6 mm	left	1:1	0.463	1.205	0.558	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.28	-0.04	0	02676	QPSK	1	99	0 mm	back	1:1	0.769	1.052	0.809	A6
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.18	0.16	0	02676	QPSK	50	0	0 mm	back	1:1	0.746	1.076	0.803	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.12	-0.04	0	02676	QPSK	100	0	0 mm	back	1:1	0.736	1.091	0.803	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.28	0.06	0	02676	QPSK	1	99	0 mm	top	1:1	0.275	1.052	0.289	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.18	0.14	0	02676	QPSK	50	0	0 mm	top	1:1	0.257	1.076	0.277	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.28	0.02	0	02676	QPSK	1	99	0 mm	left	1:1	0.089	1.052	0.094	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.18	0.01	0	02676	QPSK	50	0	0 mm	left	1:1	0.088	1.076	0.095	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Table 10-5
LTE Band 2 (PCS) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.94	-0.01	0	7938	QPSK	1	99	17 mm	back	1:1	0.528	1.014	0.535	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.60	-0.03	1	7938	QPSK	50	50	17 mm	back	1:1	0.507	1.096	0.556	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.94	-0.04	0	7938	QPSK	1	99	13 mm	top	1:1	0.573	1.014	0.581	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.60	0.06	1	7938	QPSK	50	50	13 mm	top	1:1	0.527	1.096	0.578	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.94	-0.01	0	7938	QPSK	1	99	6 mm	left	1:1	0.297	1.014	0.301	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.60	-0.18	1	7938	QPSK	50	50	6 mm	left	1:1	0.258	1.096	0.283	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.46	-0.11	0	8142	QPSK	1	99	0 mm	back	1:1	0.688	1.009	0.694	A7
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.35	-0.19	0	8142	QPSK	50	0	0 mm	back	1:1	0.625	1.035	0.647	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.46	-0.18	0	8142	QPSK	1	99	0 mm	top	1:1	0.320	1.009	0.323	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.35	0.04	0	8142	QPSK	50	0	0 mm	top	1:1	0.307	1.035	0.318	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.46	0.13	0	8142	QPSK	1	99	0 mm	left	1:1	0.034	1.009	0.034	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.35	0.19	0	8142	QPSK	50	0	0 mm	left	1:1	0.033	1.035	0.034	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Table 10-6
LTE Band 30 Body SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
2310.00	27710	Mid	LTE Band 30	10	22.5	22.50	0.14	0	02700	QPSK	1	49	10 mm	back	1:1	0.952	1.000	0.952	A8
2310.00	27710	Mid	LTE Band 30	10	21.5	21.25	0.05	1	02700	QPSK	25	12	10 mm	back	1:1	0.677	1.059	0.717	
2310.00	27710	Mid	LTE Band 30	10	21.5	21.24	0.01	1	02700	QPSK	50	0	10 mm	back	1:1	0.664	1.062	0.705	
2310.00	27710	Mid	LTE Band 30	10	22.5	22.50	0.02	0	02700	QPSK	1	49	0 mm	top	1:1	0.280	1.000	0.280	
2310.00	27710	Mid	LTE Band 30	10	21.5	21.25	-0.01	1	02700	QPSK	25	12	0 mm	top	1:1	0.199	1.059	0.211	
2310.00	27710	Mid	LTE Band 30	10	22.5	22.50	-0.02	0	02700	QPSK	1	49	5 mm	left	1:1	0.827	1.000	0.827	
2310.00	27710	Mid	LTE Band 30	10	21.5	21.25	0.03	1	02700	QPSK	25	12	5 mm	left	1:1	0.606	1.059	0.642	
2310.00	27710	Mid	LTE Band 30	10	21.5	21.24	0.00	1	02700	QPSK	50	0	5 mm	left	1:1	0.598	1.062	0.635	
2310.00	27710	Mid	LTE Band 30	10	13.5	13.28	0.15	0	24321	QPSK	1	49	0 mm	back	1:1	0.926	1.052	0.974	
2310.00	27710	Mid	LTE Band 30	10	13.5	13.24	0.14	0	24321	QPSK	25	0	0 mm	back	1:1	0.917	1.062	0.974	
2310.00	27710	Mid	LTE Band 30	10	13.5	13.16	0.13	0	24321	QPSK	50	0	0 mm	back	1:1	0.900	1.081	0.973	
2310.00	27710	Mid	LTE Band 30	10	13.5	13.28	-0.18	0	24321	QPSK	1	49	0 mm	left	1:1	0.363	1.052	0.382	
2310.00	27710	Mid	LTE Band 30	10	13.5	13.24	-0.20	0	24321	QPSK	25	0	0 mm	left	1:1	0.358	1.062	0.380	
2310.00	27710	Mid	LTE Band 30	10	22.5	22.50	-0.02	0	02700	QPSK	1	49	10 mm	back	1:1	0.944	1.000	0.944	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram									

Note: Variability data is highlighted blue in the table above.

Table 10-7
WLAN Body SAR

MEASUREMENT RESULTS																	
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	13.5	13.43	-0.05	0 mm	8019	1	back	99.7	0.897	1.016	1.004	0.915	A9
2462	11	802.11b	DSSS	22	13.5	13.34	-0.03	0 mm	8019	1	back	99.7	0.865	1.038	1.004	0.902	
2412	1	802.11b	DSSS	22	13.5	13.43	-0.03	0 mm	8019	1	top	99.7	0.357	1.016	1.004	0.364	
2412	1	802.11b	DSSS	22	13.5	13.43	0.02	0 mm	8019	1	back	99.7	0.851	1.016	1.004	0.868	
5270	54	802.11n	OFDM	40	11.5	11.31	0.19	0 mm	8159	13.5	back	96.8	0.898	1.045	1.033	0.969	A10
5310	62	802.11n	OFDM	40	11.5	11.11	-0.16	0 mm	8159	13.5	back	96.8	0.853	1.094	1.033	0.964	
5270	54	802.11n	OFDM	40	11.5	11.31	0.12	0 mm	8159	13.5	top	96.8	0.712	1.045	1.033	0.769	
5270	54	802.11n	OFDM	40	11.5	11.31	0.12	0 mm	8159	13.5	back	96.8	0.854	1.045	1.033	0.921	
5510	102	802.11n	OFDM	40	11.5	11.49	-0.05	0 mm	8159	13.5	back	96.8	0.837	1.002	1.033	0.867	
5710	142	802.11n	OFDM	40	11.5	10.71	0.10	0 mm	8159	13.5	back	96.8	0.665	1.199	1.033	0.823	
5510	102	802.11n	OFDM	40	11.5	11.49	0.19	0 mm	8159	13.5	top	96.8	0.859	1.002	1.033	0.889	
5710	142	802.11n	OFDM	40	11.5	10.71	0.13	0 mm	8159	13.5	top	96.8	0.394	1.199	1.033	0.488	
5510	102	802.11n	OFDM	40	11.5	11.49	0.05	0 mm	8159	13.5	top	96.8	0.841	1.002	1.033	0.871	
5795	159	802.11n	OFDM	40	11.5	11.47	0.12	0 mm	8159	13.5	back	96.8	0.534	1.007	1.033	0.556	
5795	159	802.11n	OFDM	40	11.5	11.47	0.13	0 mm	8159	13.5	top	96.8	0.353	1.007	1.033	0.367	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram								

Note: Variability data is highlighted blue in the table above.

Table 10-8
Bluetooth Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2441	39	Bluetooth	FHSS	9.5	9.05	-0.02	0 mm	02684	1	back	1:1	0.124	1.109	0.138	A11
2441	39	Bluetooth	FHSS	9.5	9.05	0.12	0 mm	02684	1	top	1:1	0.045	1.109	0.050	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

10.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04v01r01 and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 12 for variability analysis.
7. FCC KDB Publication 616217 D04 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v05 was applied to determine SAR test exclusion for adjacent edge configurations.

UMTS Notes:

1. UMTS mode was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03. HSPA SAR was not required per 3G Test Reduction Procedures.
2. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r03. The general test procedures used for testing can be found in Section 7.5.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02 for 2.4 GHz WIFI operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 7.6.4 for more information.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02 for 5 GHz WIFI operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 7.6.5 for more information.
3. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.

11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05r02 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

11.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

11.3 Body SAR Simultaneous Transmission Analysis

Table 11-1
Simultaneous Transmission Scenario with 2.4 GHz WLAN

Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	UMTS 1750 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.773	0.915	See Note 1	0.04	Back	0.632	0.915	**1.547**	N/A
Top	0.274	0.364	0.638	N/A	Top	0.505	0.364	0.869	N/A
Bottom	0.046	0.400	0.446	N/A	Bottom	0.400	0.400	0.800	N/A
Right	0.132	0.400	0.532	N/A	Right	0.400	0.400	0.800	N/A
Left	0.469	0.400	**0.869**	N/A	Left	0.258	0.400	0.658	N/A
Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.710	0.915	See Note 1	0.04	Back	0.530	0.915	**1.445**	N/A
Top	0.705	0.364	**1.069**	N/A	Top	0.360	0.364	0.724	N/A
Bottom	0.400	0.400	0.800	N/A	Bottom	0.092	0.400	0.492	N/A
Right	0.400	0.400	0.800	N/A	Right	0.110	0.400	0.510	N/A
Left	0.365	0.400	0.765	N/A	Left	0.301	0.400	0.701	N/A
Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.819	0.915	See Note 1	0.03	Back	0.824	0.915	See Note 1	0.04
Top	0.459	0.364	0.823	N/A	Top	0.647	0.364	1.011	N/A
Bottom	0.086	0.400	0.486	N/A	Bottom	0.400	0.400	0.800	N/A
Right	0.185	0.400	0.585	N/A	Right	0.400	0.400	0.800	N/A
Left	0.579	0.400	**0.979**	N/A	Left	0.683	0.400	**1.083**	N/A
Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	LTE Band 30 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.694	0.915	See Note 1	0.04	Back	0.974	0.915	See Note 1	0.03
Top	0.581	0.364	**0.945**	N/A	Top	0.280	0.364	0.644	N/A
Bottom	0.400	0.400	0.800	N/A	Bottom	0.400	0.400	0.800	N/A
Right	0.400	0.400	0.800	N/A	Right	0.400	0.400	0.800	N/A
Left	0.301	0.400	0.701	N/A	Left	0.827	0.400	**1.227**	N/A

Table 11-2
Simultaneous Transmission Scenario with 5 GHz WLAN

Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.773	0.969	See Note 1	0.04
Top	0.274	0.889	**1.163**	N/A
Bottom	0.046	0.400	0.446	N/A
Right	0.132	0.400	0.532	N/A
Left	0.469	0.400	0.869	N/A

Configuration	UMTS 1750 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.632	0.969	See Note 1	0.04
Top	0.505	0.889	**1.394**	N/A
Bottom	0.400	0.400	0.800	N/A
Right	0.400	0.400	0.800	N/A
Left	0.258	0.400	0.658	N/A

Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.710	0.969	See Note 1	0.04
Top	0.705	0.889	**1.594**	N/A
Bottom	0.400	0.400	0.800	N/A
Right	0.400	0.400	0.800	N/A
Left	0.365	0.400	0.765	N/A

Configuration	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.530	0.969	**1.499**	N/A
Top	0.360	0.889	1.249	N/A
Bottom	0.092	0.400	0.492	N/A
Right	0.110	0.400	0.510	N/A
Left	0.301	0.400	0.701	N/A

Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.819	0.969	See Note 1	0.04
Top	0.459	0.889	**1.348**	N/A
Bottom	0.086	0.400	0.486	N/A
Right	0.185	0.400	0.585	N/A
Left	0.579	0.400	0.979	N/A

Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.824	0.969	See Note 1	0.04
Top	0.647	0.889	**1.536**	N/A
Bottom	0.400	0.400	0.800	N/A
Right	0.400	0.400	0.800	N/A
Left	0.683	0.400	1.083	N/A

Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.694	0.969	See Note 1	0.04
Top	0.581	0.889	**1.470**	N/A
Bottom	0.400	0.400	0.800	N/A
Right	0.400	0.400	0.800	N/A
Left	0.301	0.400	0.701	N/A

Configuration	LTE Band 30 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.974	0.969	See Note 1	0.03
Top	0.280	0.889	1.169	N/A
Bottom	0.400	0.400	0.800	N/A
Right	0.400	0.400	0.800	N/A
Left	0.827	0.400	**1.227**	N/A

Table 11-3
Simultaneous Transmission Scenario with Bluetooth

Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Configuration	UMTS 1750 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back	0.773	0.138	**0.911**	Back	0.632	0.138	0.770
Top	0.274	0.050	0.324	Top	0.505	0.050	0.555
Bottom	0.046	0.400	0.446	Bottom	0.400	0.400	**0.800**
Right	0.132	0.400	0.532	Right	0.400	0.400	**0.800**
Left	0.469	0.400	0.869	Left	0.258	0.400	0.658
Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Configuration	LTE Band 12 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back	0.710	0.138	**0.848**	Back	0.530	0.138	0.668
Top	0.705	0.050	0.755	Top	0.360	0.050	0.410
Bottom	0.400	0.400	0.800	Bottom	0.092	0.400	0.492
Right	0.400	0.400	0.800	Right	0.110	0.400	0.510
Left	0.365	0.400	0.765	Left	0.301	0.400	0.701
Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Configuration	LTE Band 4 (AWS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back	0.819	0.138	0.957	Back	0.824	0.138	0.962
Top	0.459	0.050	0.509	Top	0.647	0.050	0.697
Bottom	0.086	0.400	0.486	Bottom	0.400	0.400	0.800
Right	0.185	0.400	0.585	Right	0.400	0.400	0.800
Left	0.579	0.400	**0.979**	Left	0.683	0.400	**1.083**
Configuration	LTE Band 2 (PCS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Configuration	LTE Band 30 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back	0.694	0.138	**0.832**	Back	0.974	0.138	1.112
Top	0.581	0.050	0.631	Top	0.280	0.050	0.330
Bottom	0.400	0.400	0.800	Bottom	0.400	0.400	0.800
Right	0.400	0.400	0.800	Right	0.400	0.400	0.800
Left	0.301	0.400	0.701	Left	0.827	0.400	**1.227**

Notes:
1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not greater than 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.
2. For SAR summation the highest reported SAR across all test distances was used as the most conservative evaluation for simultaneous transmission analysis for each device edge.
3. When the antenna separation distance was > 50 mm, an estimated SAR of 0.4 W/kg was used to determine the simultaneous transmission SAR exclusion, for configurations excluded per FCC KDB Publication 447498 D01v05.

11.4 SPLSR Evaluation and Analysis

Per FCC KDB Publication 447498 D01v05, when the sum of the standalone transmitters is more than 1.6 W/kg, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04, simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

$$\text{Distance}_{Tx1 - Tx2} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

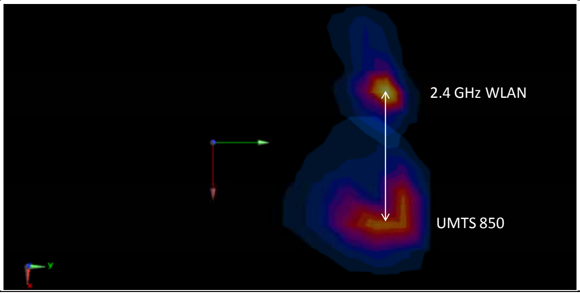
$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$

Table 11-4
Peak SAR Locations for Body Back Side

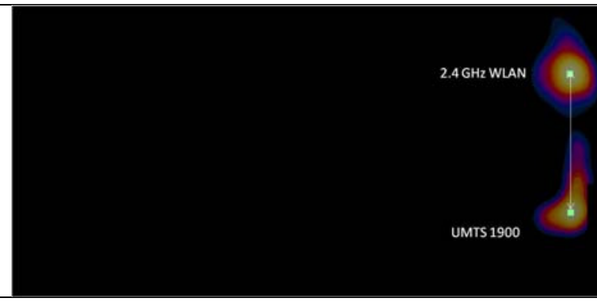
Mode/Band	x (mm)	y (mm)	Reported SAR (W/kg)
2.4 GHz WLAN	-28.00	93.60	0.915
5 GHz WLAN	-27.00	94.00	0.969
UMTS 850	25.00	84.50	0.773
UMTS 1750	26.51	85.01	0.632
UMTS 1900	23.50	94.00	0.710
LTE Band 5	37.00	76.00	0.819
LTE Band 4	23.50	75.00	0.824
LTE Band 2	27.50	83.50	0.694
LTE Band 30	38.22	37.20	0.974

Table 11-5
SAR Sum to Peak Location Separation Ratio Calculations

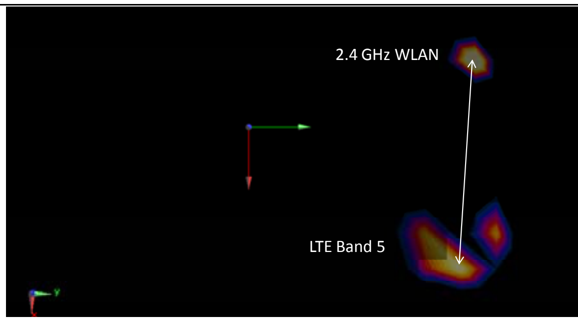
Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio	Plot Number
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$	
UMTS 850	2.4 GHz WLAN	0.773	0.915	1.688	53.78	0.04	1
UMTS 1900	2.4 GHz WLAN	0.710	0.915	1.625	51.50	0.04	2
LTE Band 5	2.4 GHz WLAN	0.819	0.915	1.734	67.34	0.03	3
LTE Band 4	2.4 GHz WLAN	0.824	0.915	1.739	54.76	0.04	4
LTE Band 2	2.4 GHz WLAN	0.694	0.915	1.609	56.41	0.04	5
LTE Band 30	2.4 GHz WLAN	0.974	0.915	1.889	86.98	0.03	6
UMTS 850	5 GHz WLAN	0.773	0.969	1.742	52.86	0.04	7
UMTS 1750	5 GHz WLAN	0.632	0.969	1.601	54.26	0.04	8
UMTS 1900	5 GHz WLAN	0.710	0.969	1.679	50.50	0.04	9
LTE Band 5	5 GHz WLAN	0.819	0.969	1.788	66.48	0.04	10
LTE Band 4	5 GHz WLAN	0.824	0.969	1.793	53.96	0.04	11
LTE Band 2	5 GHz WLAN	0.694	0.969	1.663	55.50	0.04	12
LTE Band 30	5 GHz WLAN	0.974	0.969	1.943	86.49	0.03	13


2.4 GHz WLAN
UMTS 850

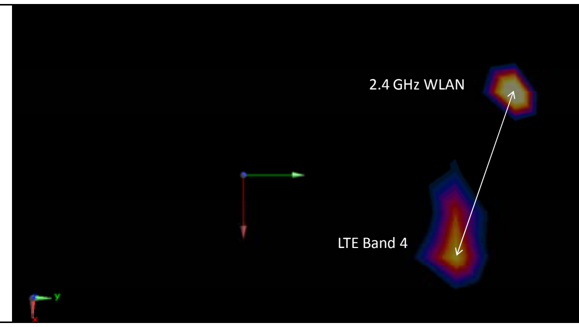
1


2.4 GHz WLAN
UMTS 1900

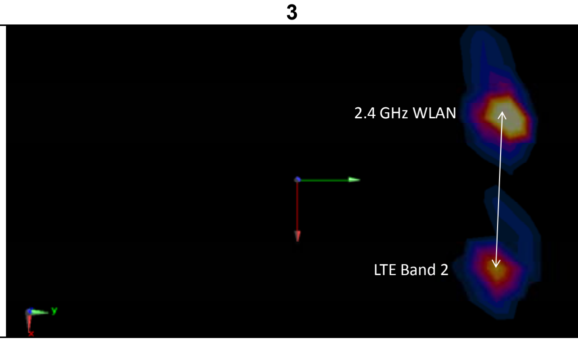
2


2.4 GHz WLAN
LTE Band 5

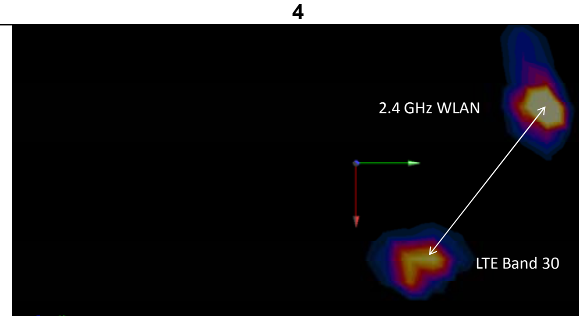
3


2.4 GHz WLAN
LTE Band 4

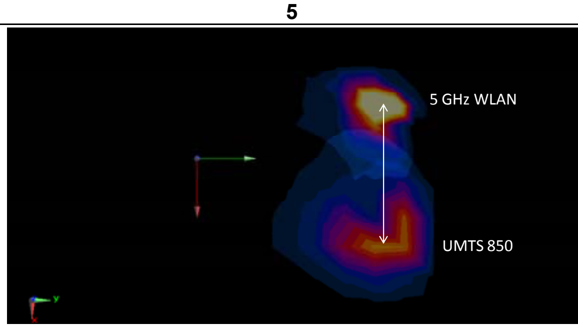
4


2.4 GHz WLAN
LTE Band 2

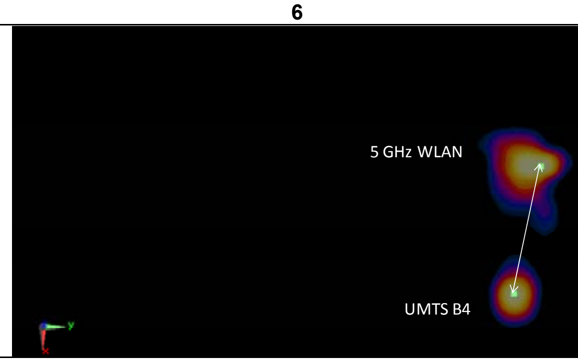
5


2.4 GHz WLAN
LTE Band 30

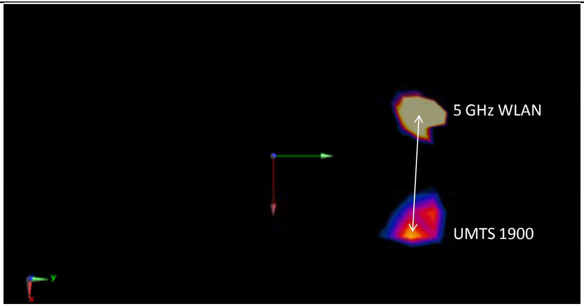
6


5 GHz WLAN
UMTS 850

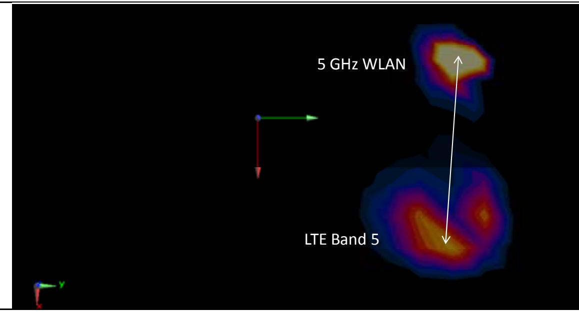
7


5 GHz WLAN
UMTS B4

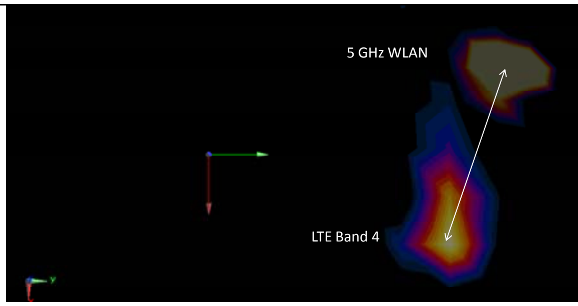
8



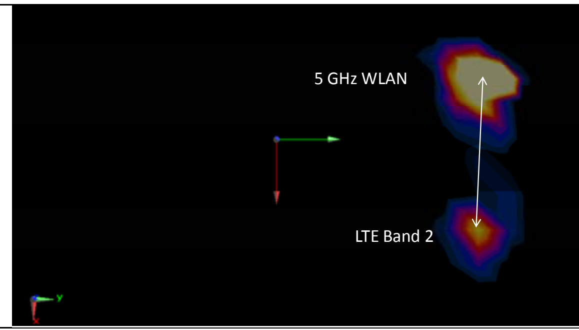
9



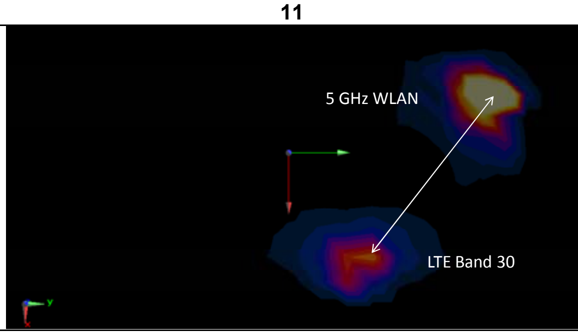
10



11



12



13

11.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results and SPLSR analysis are sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05 and IEEE 1528-2013 Section 6.3.4.1.2.

12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Table 12-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS																
Band	FREQUENCY		Mode	Service	# of Time Slots	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.							(W/kg)	(W/kg)		(W/kg)		(W/kg)	
2300	2310.00	27710	LTE Band 30, 10 MHz Bandwidth	QPSK, 1 RB, 49 RB Offset	N/A	N/A	back	10 mm	0.952	0.944	1.01	N/A	N/A	N/A	N/A
2450	2412.00	1	802.11b, 22 MHz Bandwidth	DSSS	N/A	1	back	0 mm	0.897	0.851	1.05	N/A	N/A	N/A	N/A
5300	5270.00	54	802.11n, 40 MHz Bandwidth	OFDM	N/A	13.5	back	0 mm	0.898	0.854	1.05	N/A	N/A	N/A	N/A
5500	5510.00	102	802.11n, 40 MHz Bandwidth	OFDM	N/A	13.5	top	0 mm	0.859	0.841	1.02	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram						

12.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01, the extended measurement uncertainty analysis per IEEE 1528-2003 was not required.

13 EQUIPMENT LIST

Applicable for 08/03/15 to 08/10/15

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
SPEAG	D1900V2	1900 MHz SAR Dipole	4/14/2015	Annual	4/14/2016	5d141
SPEAG	D2450V2	2450 MHz SAR Dipole	8/11/2014	Annual	8/11/2015	719
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/25/2014	Annual	9/25/2015	1191
SPEAG	D750V3	750 MHz Dipole	2/19/2015	Annual	2/19/2016	1046
SPEAG	D835V2	835 MHz SAR Dipole	4/13/2015	Annual	4/13/2016	4d119
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/31/2014	Annual	10/31/2015	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2014	Annual	9/17/2015	1323
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/13/2015	Annual	3/13/2016	1368
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/20/2015	Annual	4/20/2016	1407
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/23/2014	Annual	10/23/2015	1408
SPEAG	ES3DV3	SAR Probe	1/20/2015	Annual	1/20/2016	3213
SPEAG	ES3DV3	SAR Probe	3/19/2015	Annual	3/19/2016	3319
SPEAG	ES3DV3	SAR Probe	9/18/2014	Annual	9/18/2015	3332
SPEAG	ES3DV3	SAR Probe	10/24/2014	Annual	10/24/2015	3333
SPEAG	EX3DV4	SAR Probe	2/10/2015	Annual	2/10/2016	3914
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/15/2015	Annual	3/15/2016	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	12/30/2014	Annual	12/30/2015	JP38020182
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	3/15/2015	Annual	3/15/2016	3629U00687
Rohde & Schwarz	CMU200	Base Station Simulator	3/23/2015	Annual	3/23/2016	836371/0079
SPEAG	DAK-3.5	Dielectric Assessment Kit	10/21/2014	Annual	10/21/2015	1091
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/12/2015	Annual	5/12/2016	1070
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264165
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764551
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764558
Agilent	E4438C	ESG Vector Signal Generator	3/12/2015	Annual	3/12/2016	MY45090700
Agilent	E4438C	ESG Vector Signal Generator	3/13/2015	Annual	3/13/2016	MY42082385
Control Company	4052	Long Stem Thermometer	9/27/2013	Biennial	9/27/2015	130567447
Fisher Scientific	S407993	Long Stem Thermometer	11/4/2013	Biennial	11/4/2015	130671826
Agilent	N9020A	MXA Signal Analyzer	10/27/2014	Annual	10/27/2015	US46470561
Agilent	N5182A	MXG Vector Signal Generator	10/27/2014	Annual	10/27/2015	MY47420603
Agilent	N5182A	MXG Vector Signal Generator	3/16/2015	Annual	3/16/2016	MY47420800
Anritsu	ML2495A	Power Meter	10/31/2013	Biennial	10/31/2015	941001
Anritsu	ML2495A	Power Meter	10/31/2013	Biennial	10/31/2015	1039008
Anritsu	MA2411B	Pulse Power Sensor	11/17/2014	Annual	11/17/2015	1126066
Anritsu	MA2411B	Pulse Power Sensor	3/13/2015	Annual	3/13/2016	1207470
Anritsu	MT8820C	Radio Communication Analyzer	9/19/2014	Annual	9/19/2015	6201144418
Rohde & Schwarz	CMW500	Radio Communication Tester	5/28/2015	Annual	5/28/2016	102060
Rohde & Schwarz	CMW500	Radio Communication Tester	6/1/2015	Annual	6/1/2016	108843
Agilent	8753ES	S-Parameter Network Analyzer	1/20/2015	Annual	1/20/2016	US39170122
Agilent	8753ES	S-Parameter Network Analyzer	3/12/2015	Annual	3/12/2016	MY40000670
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
Anritsu	MA24106A	USB Power Sensor	3/2/2015	Annual	3/2/2016	1344555
Anritsu	MA24106A	USB Power Sensor	3/2/2015	Annual	3/2/2016	1344556
Agilent	E5515C	Wireless Communications Test Set	2/23/2015	Biennial	2/23/2017	GB41450275
Agilent	E5515C	Wireless Communications Test Set	5/16/2015	Biennial	5/16/2017	GB43304447
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A

Applicable for 03/09/16 to 03/22/16

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	11/4/2015	Annual	11/4/2016	US39170118
Agilent	8753ES	S-Parameter Network Analyzer	3/3/2016	Annual	3/3/2017	US39170122
Agilent	E4432B	ESG-D Series Signal Generator	3/5/2016	Annual	3/5/2017	US40053896
Agilent	E5515C	Wireless Communications Test Set	11/30/2015	Annual	11/30/2016	GB42361078
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Agilent	N5182A	MXG Vector Signal Generator	11/6/2015	Annual	11/6/2016	MY47420603
Agilent	N5182A	MXG Vector Signal Generator	2/27/2016	Annual	2/27/2017	MY47420651
Agilent	N9020A	MXA Signal Analyzer	11/5/2015	Annual	11/5/2016	US46470561
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Anritsu	MA24106A	USB Power Sensor	5/29/2015	Annual	5/29/2016	1231535
Anritsu	MA24106A	USB Power Sensor	5/29/2015	Annual	5/29/2016	1231538
Anritsu	MA24106A	USB Power Sensor	5/29/2015	Annual	5/29/2016	1244512
Anritsu	MA24106A	USB Power Sensor	5/29/2015	Annual	5/29/2016	1244515
Anritsu	MA2411B	Pulse Power Sensor	8/3/2015	Annual	8/3/2016	1126066
Anritsu	MA2411B	Pulse Power Sensor	12/7/2015	Annual	12/7/2016	1207364
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	941001
Anritsu	ML2496A	Power Meter	2/28/2016	Annual	2/28/2017	1306009
Anritsu	MT8820C	Radio Communication Analyzer	11/12/2015	Annual	11/12/2016	6201144418
Anritsu	MT8820C	Radio Communication Analyzer	9/1/2015	Annual	9/1/2016	6201144419
Control Company	4040	Digital Thermometer	3/18/2015	Biennial	3/18/2017	150194895
Control Company	4353	Long Stem Thermometer	1/22/2015	Biennial	1/22/2017	150053029
Gigatronics	80701A	(0.05-18GHz) Power Sensor	11/4/2015	Annual	11/4/2016	1833460
Gigatronics	8651A	Universal Power Meter	11/4/2015	Annual	11/4/2016	8650319
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	12/2/2015	Annual	12/2/2016	833855/0010
Rohde & Schwarz	CMW500	Radio Communication Tester	10/13/2015	Annual	10/13/2016	100976
Seekonk	NC-100	Torque Wrench	11/6/2015	Biennial	11/6/2017	22313
Seekonk	NC-100	Torque Wrench	11/6/2015	Biennial	11/6/2017	N/A
SPEAG	D1765V2	1765 MHz SAR Dipole	5/13/2015	Annual	5/13/2016	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	7/14/2015	Annual	7/14/2016	5d149
SPEAG	D2300V2	2300 MHz SAR Dipole	12/8/2015	Annual	12/8/2016	1064
SPEAG	D2450V2	2450 MHz SAR Dipole	8/20/2015	Annual	8/20/2016	719
SPEAG	D835V2	835 MHz SAR Dipole	4/13/2015	Annual	4/13/2016	4d119
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/24/2015	Annual	8/24/2016	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/27/2015	Annual	10/27/2016	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/18/2015	Annual	9/18/2016	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/11/2015	Annual	11/11/2016	1415
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/12/2015	Annual	5/12/2016	1070
SPEAG	DAK-3.5	Dielectric Assessment Kit	10/20/2015	Annual	10/20/2016	1091
SPEAG	ES3DV3	SAR Probe	9/18/2015	Annual	9/18/2016	3288
SPEAG	ES3DV3	SAR Probe	10/29/2015	Annual	10/29/2016	3333
SPEAG	ES3DV3	SAR Probe	11/17/2015	Annual	11/17/2016	3334
SPEAG	ES3DV3	SAR Probe	6/22/2015	Annual	6/22/2016	3351

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

14 MEASUREMENT UNCERTAINTIES

a	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 1gm	c_i 10 gms	1gm u_i (± %)	10gms u_i (± %)	v_i
Measurement System								
Probe Calibration	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	2.0	R	1.73	1.0	1.0	1.2	1.2	∞
Linearity	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	0.25	R	1.73	1.0	1.0	0.1	0.1	∞
Readout Electronics	0.3	N	1	1.0	1.0	0.3	0.3	∞
Response Time	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions - Noise	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
RF Ambient Conditions - Reflections	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	6.7	R	1.73	1.0	1.0	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	2.7	N	1	1.0	1.0	2.7	2.7	35
Device Holder Uncertainty	1.67	N	1	1.0	1.0	1.7	1.7	5
Output Power Variation - SAR drift measurement	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
SAR Scaling	0.0	R	1.73	1.0	1.0	0.0	0.0	∞
Phantom & Tissue Parameters								
Phantom Uncertainty (Shape & Thickness tolerances)	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	4.2	N	1	0.78	0.71	3.3	3.0	10
Liquid Permittivity - measurement uncertainty	4.1	N	1	0.23	0.26	1.0	1.1	10
Liquid Conductivity - Temperature Uncertainty	3.4	R	1.73	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	0.6	R	1.73	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)		RSS				11.5	11.3	60
Expanded Uncertainty (95% CONFIDENCE LEVEL)		k=2				23.0	22.6	

15 CONCLUSION

15.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Industry Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

16 REFERENCES

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, 2006.

[3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sept. 1992.

[4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.

[5] IEEE Standards Coordinating Committee 39 –Standards Coordinating Committee 34 – IEEE Std. 1528-2003, Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Measurement Techniques.

[6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

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APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 7938

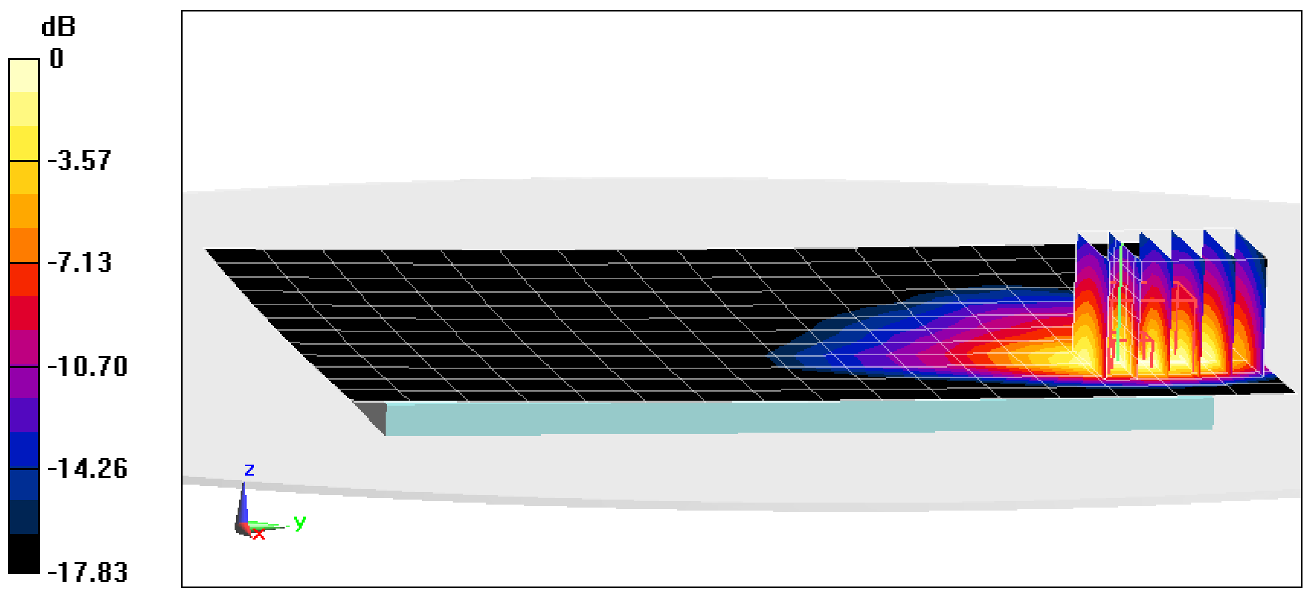
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Body; Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.007 S/m; ε_r = 53.577; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-10-2015; Ambient Temp: 20.9°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3319; ConvF(6.07, 6.07, 6.07); Calibrated: 3/19/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/13/2015
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 850, Body SAR, Back side, Mid.ch

Area Scan (13x17x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.80 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.37 W/kg
SAR(1 g) = 0.692 W/kg



0 dB = 0.855 W/kg = -0.68 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 02676

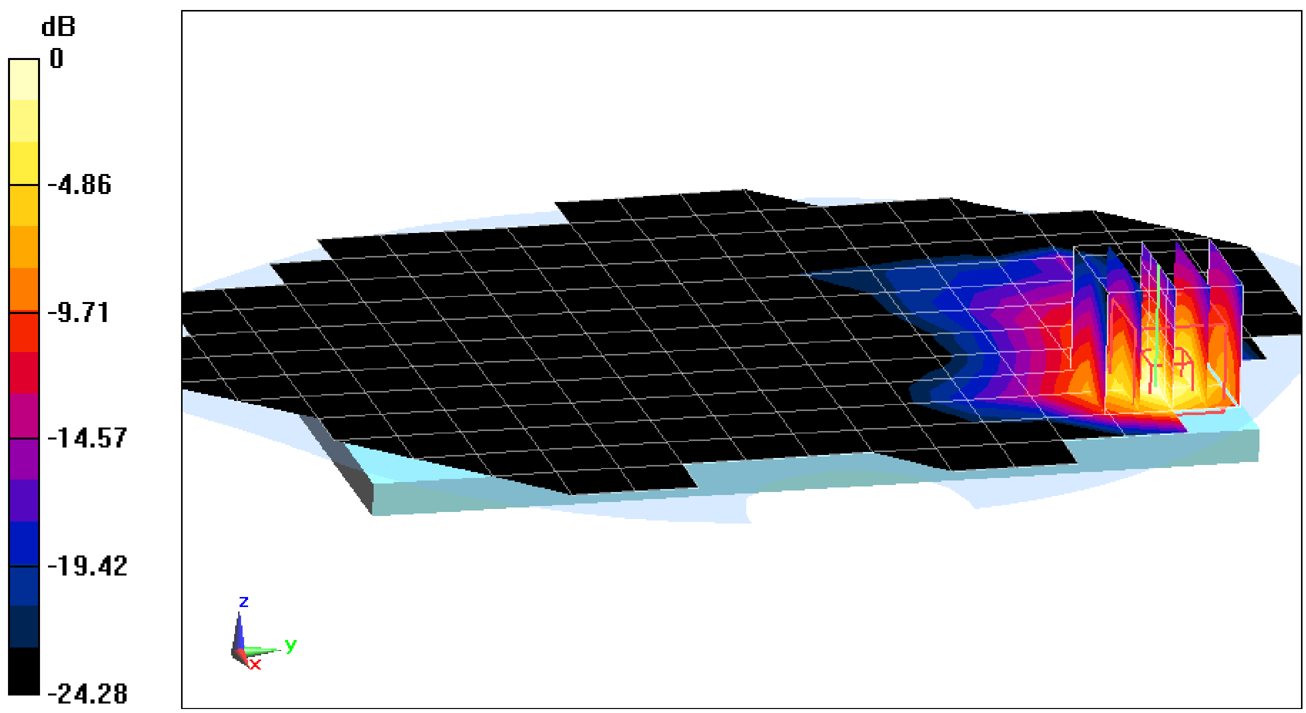
Communication System: UID 0, UMTS; Frequency: 1732.4 MHz;Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1732.4 MHz; σ = 1.474 S/m; ε_r = 50.979; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-21-2016; Ambient Temp: 24.1°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3288; ConvF(4.99, 4.99, 4.99); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2015
Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 1750, Body SAR, Back side, Mid.ch

Area Scan (15x19x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.20 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 1.08 W/kg
SAR(1 g) = 0.538 W/kg



0 dB = 0.676 W/kg = -1.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 02700

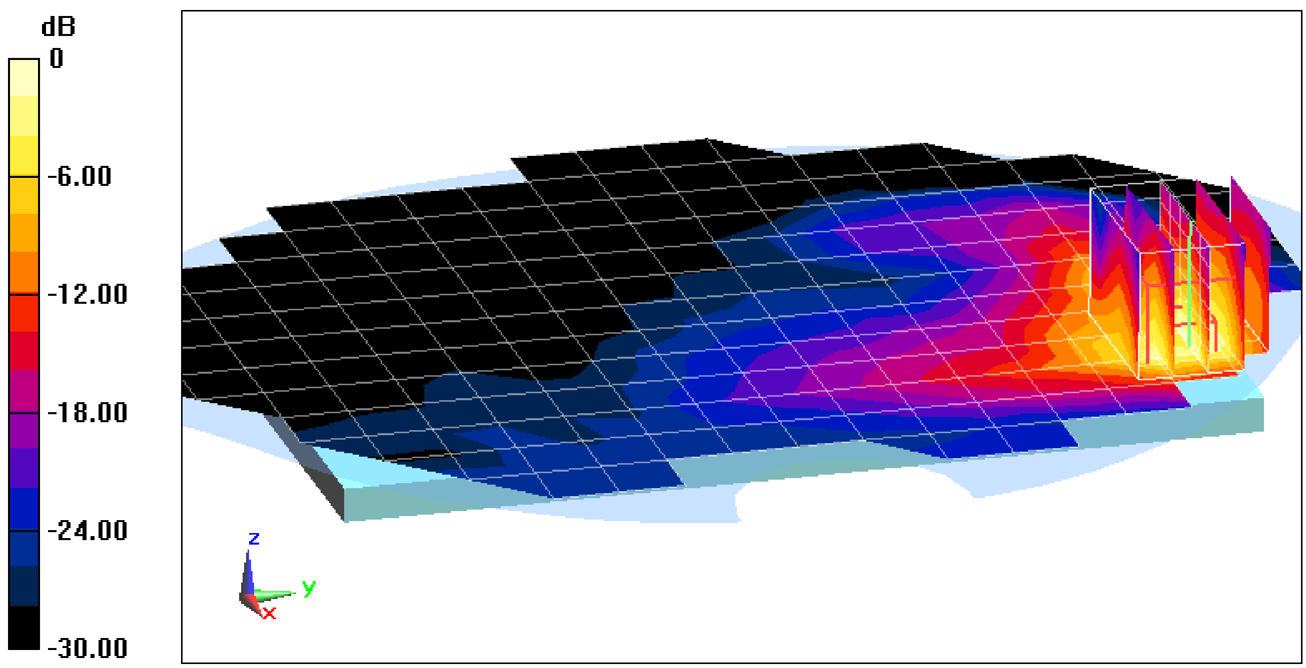
Communication System: UID 0, UMTS (0); Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.493 S/m; ε_r = 52.888; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-09-2016; Ambient Temp: 21.4°C; Tissue Temp: 21.9°C

Probe: ES3DV3 - SN3334; ConvF(4.84, 4.84, 4.84); Calibrated: 11/17/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1415; Calibrated: 11/11/2015
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: UMTS 1900, Body SAR, Back side, Mid.ch

Area Scan (15x19x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.82 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 1.36 W/kg
SAR(1 g) = 0.633 W/kg



0 dB = 0.913 W/kg = -0.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 8159

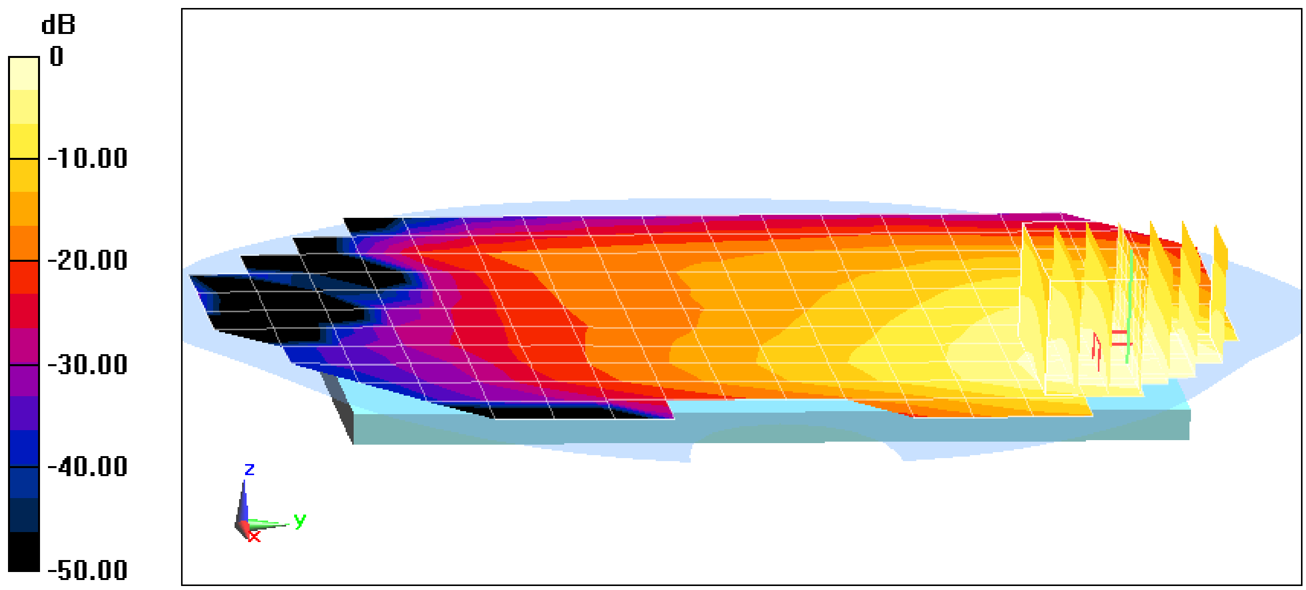
Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: 750 Body; Medium parameters used (interpolated):
f = 707.5 MHz; σ = 0.93 S/m; ε_r = 55.709; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-04-2015; Ambient Temp: 21.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3333; ConvF(6.14, 6.14, 6.14); Calibrated: 10/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 10/23/2014
Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 12, Body SAR, Back side, Mid.ch, 10 MHz Bandwidth
QPSK, 1 RB, 49 RB Offset

Area Scan (12x18x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.46 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.995 W/kg
SAR(1 g) = 0.523 W/kg



0 dB = 0.650 W/kg = -1.87 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 02684

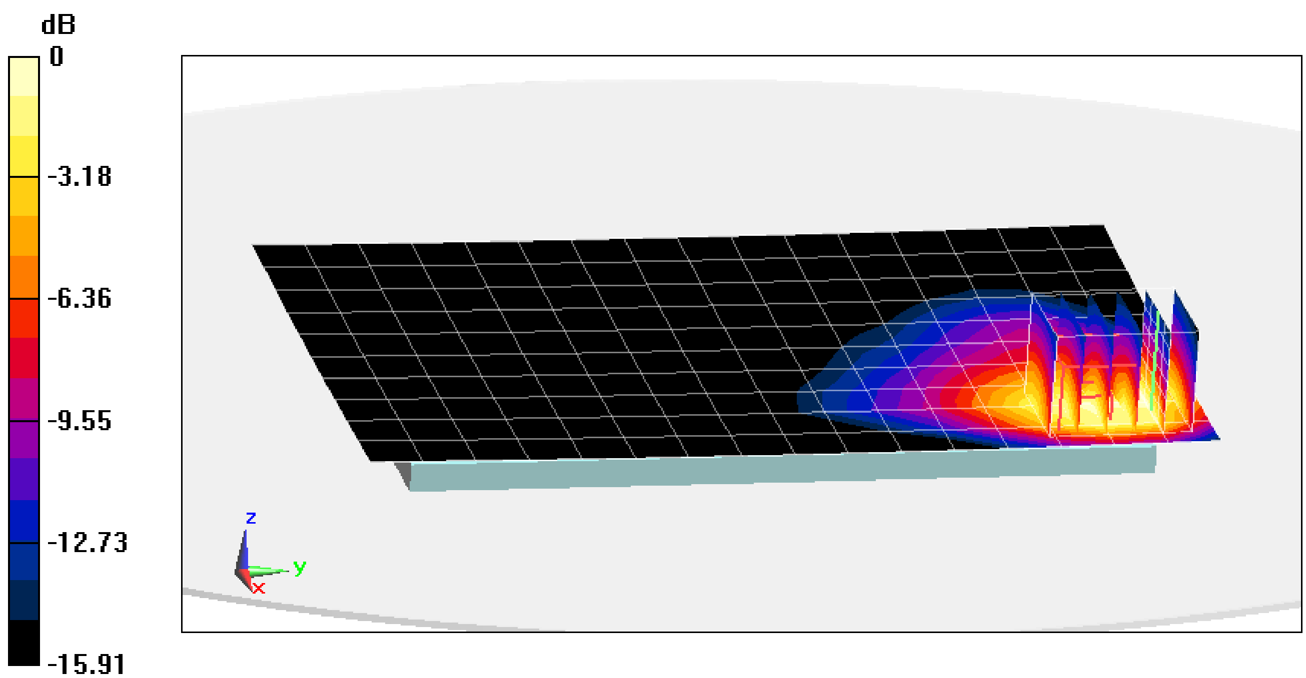
Communication System: UID 0, LTE Band 5; Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.986 S/m; ε_r = 54.455; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-14-2016; Ambient Temp: 23.2°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3333; ConvF(6.25, 6.25, 6.25); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/27/2015
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 5 (Cell.), Body SAR, Back side, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB,25 RB Offset

Area Scan (8x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.02 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 1.12 W/kg
SAR(1 g) = 0.607 W/kg



0 dB = 1.19 W/kg = 0.76 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 02676

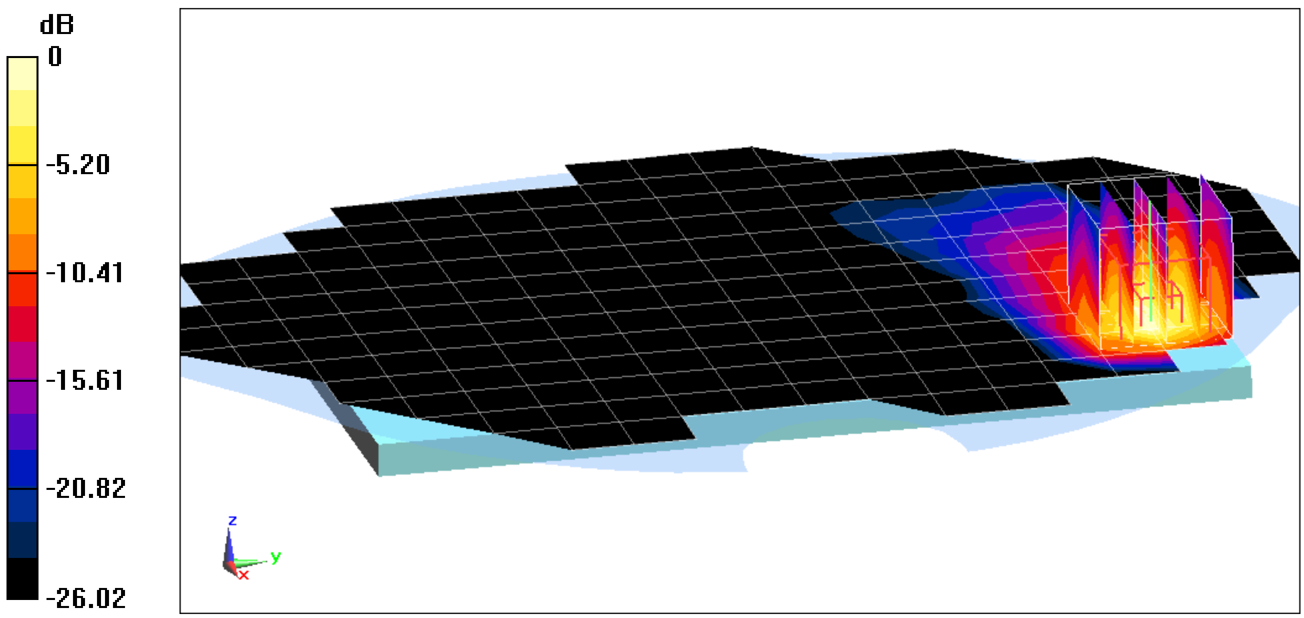
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.474 S/m; ε_r = 50.979; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-21-2016; Ambient Temp: 24.1°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3288; ConvF(4.99, 4.99, 4.99); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2015
Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Body SAR, Back side, Mid.ch
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (15x19x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.26 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.54 W/kg
SAR(1 g) = 0.769 W/kg



0 dB = 1.04 W/kg = 0.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 8142

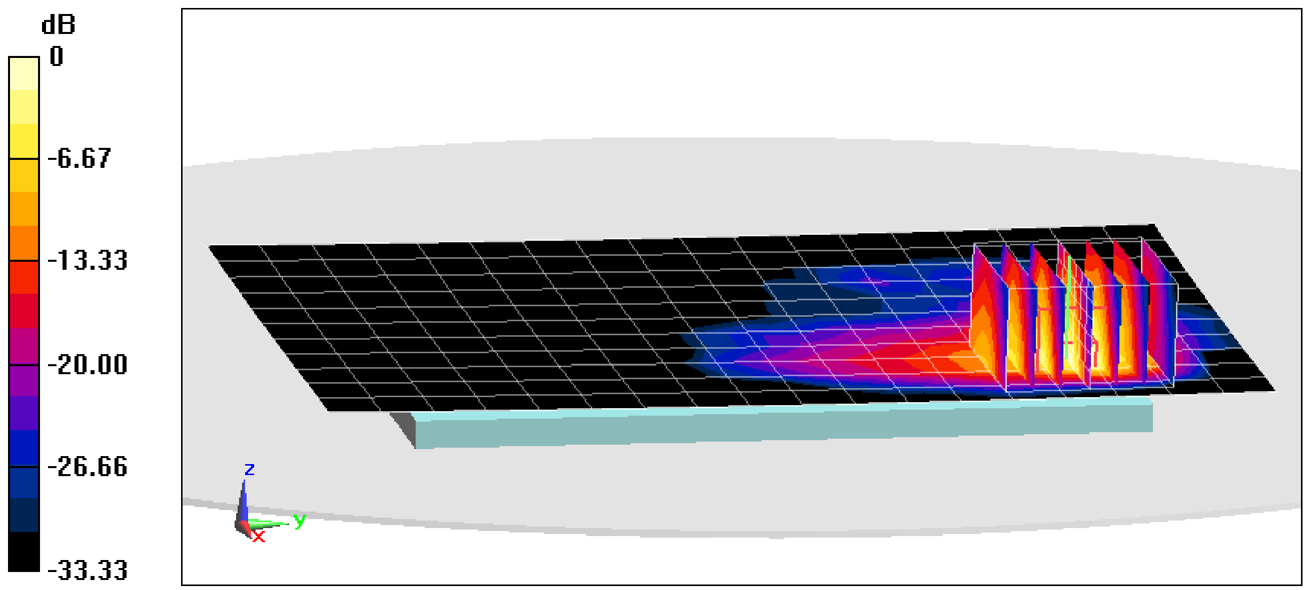
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.543 S/m; ε_r = 51.097; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-05-2015; Ambient Temp: 23.0°C; Tissue Temp: 22.6°C

Probe: ES3DV3 - SN3213; ConvF(4.72, 4.72, 4.72); Calibrated: 1/20/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1407; Calibrated: 4/20/2015
Phantom: ELI Left v6.0; Type: QDOVA001BB; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 2 (PCS), Body SAR, Back side, High.ch, 20 MHz Bandwidth QPSK, 1 RB, 99 RB Offset

Area Scan (12x19x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.18 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.688 W/kg



0 dB = 0.840 W/kg = -0.76 dBW/kg

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 02700

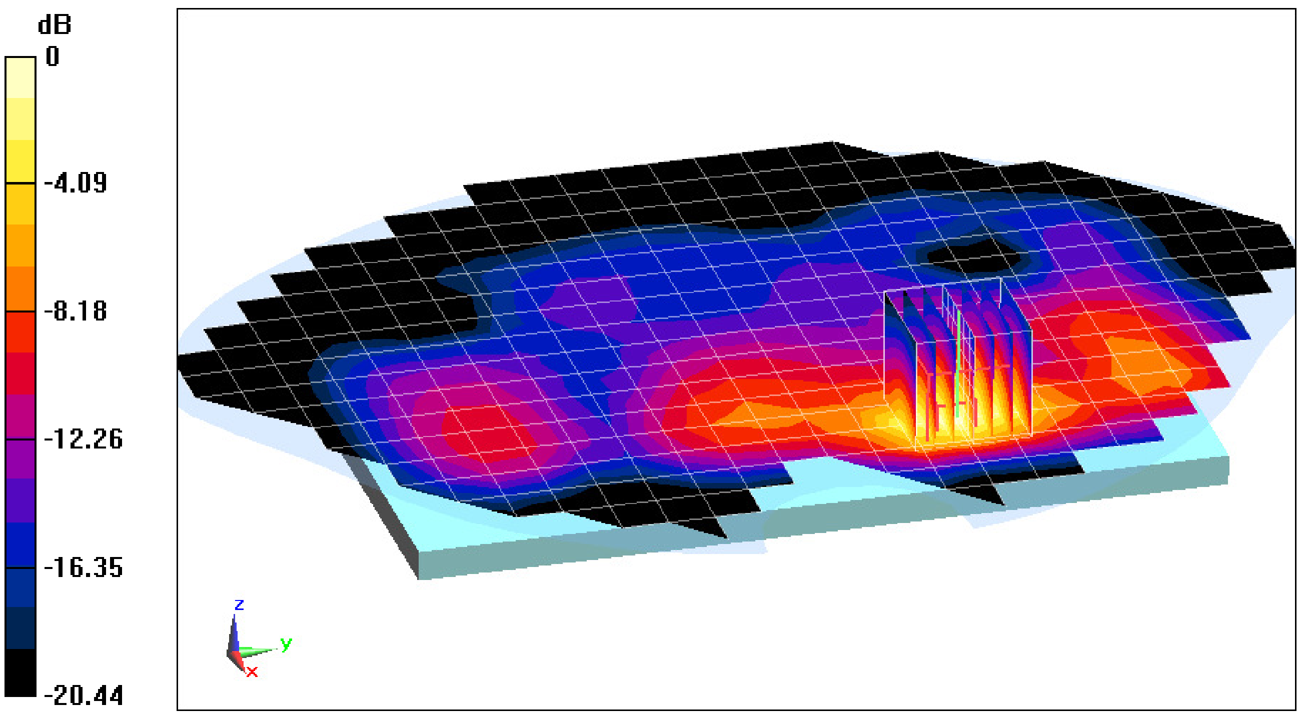
Communication System: UID 0, LTE Band 30 (0); Frequency: 2310 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2310 MHz; σ = 1.782 S/m; ε_r = 53.142; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-22-2016; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3351; ConvF(4.47, 4.47, 4.47); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 30, Body SAR, Back side, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset

Area Scan (18x25x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 24.90 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.89 W/kg
SAR(1 g) = 0.952 W/kg



0 dB = 1.21 W/kg = 0.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 8019

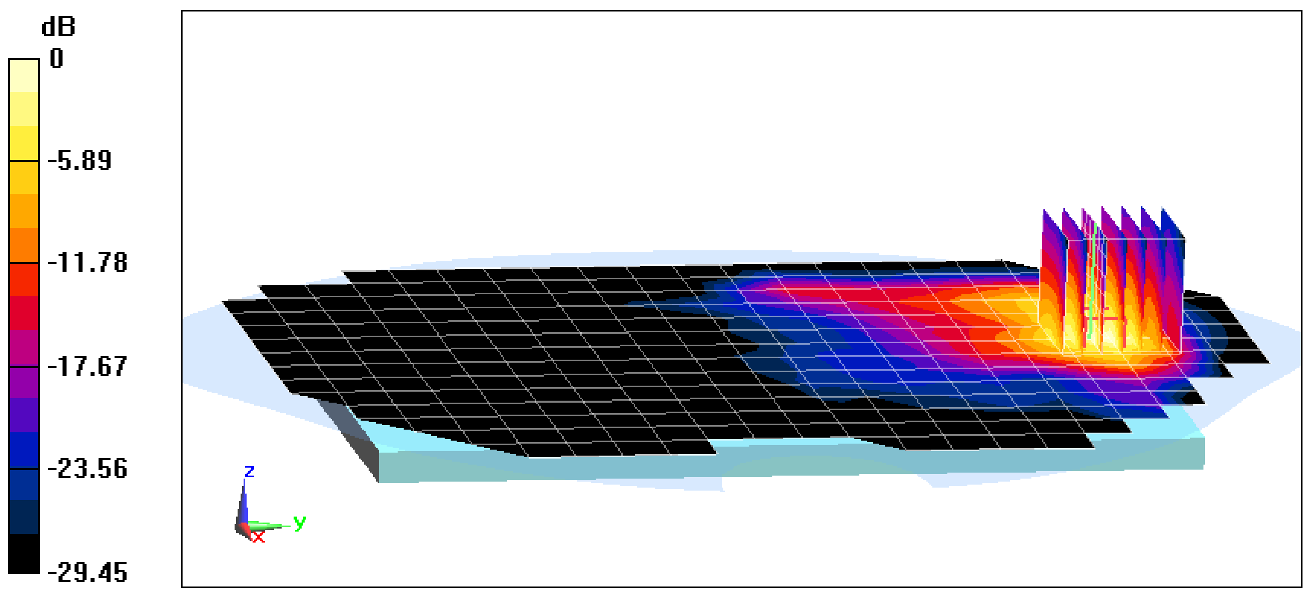
Communication System: UID 0, IEEE 802.11b; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium: 2450 Body; Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.983 S/m; ε_r = 51.327; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-07-2015; Ambient Temp: 22.1°C; Tissue Temp: 21.9°C

Probe: ES3DV3 - SN3332; ConvF(4.31, 4.31, 4.31); Calibrated: 9/18/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, 22 MHz Bandwidth, Body SAR, Ch 01, 1 Mbps, Back Side

Area Scan (15x22x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.13 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 2.40 W/kg
SAR(1 g) = 0.897 W/kg



0 dB = 1.23 W/kg = 0.90 dBW/kg

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 8159

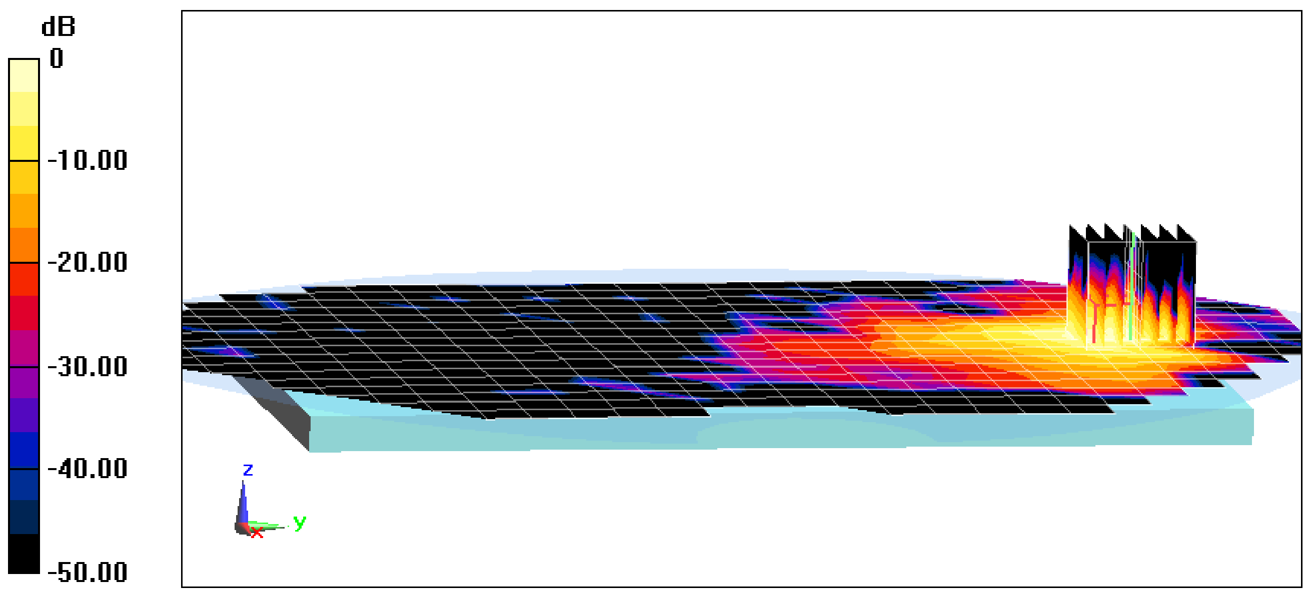
Communication System: UID 0, 802.11n 5.2-5.8 GHz Band; Frequency: 5270 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used (interpolated):
f = 5270 MHz; σ = 5.386 S/m; ε_r = 47.051; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-03-2015; Ambient Temp: 24.5°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(4.33, 4.33, 4.33); Calibrated: 2/10/2015;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/31/2014
Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode:IEEE 802.11n, U-NII-2A, 40 MHz Bandwidth, Body SAR, Ch 54, 13.5 Mbps, Back Side

Area Scan (18x27x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 13.61 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 4.46 W/kg
SAR(1 g) = 0.898 W/kg



0 dB = 2.17 W/kg = 3.36 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377W; Type: Portable Tablet; Serial: 02684

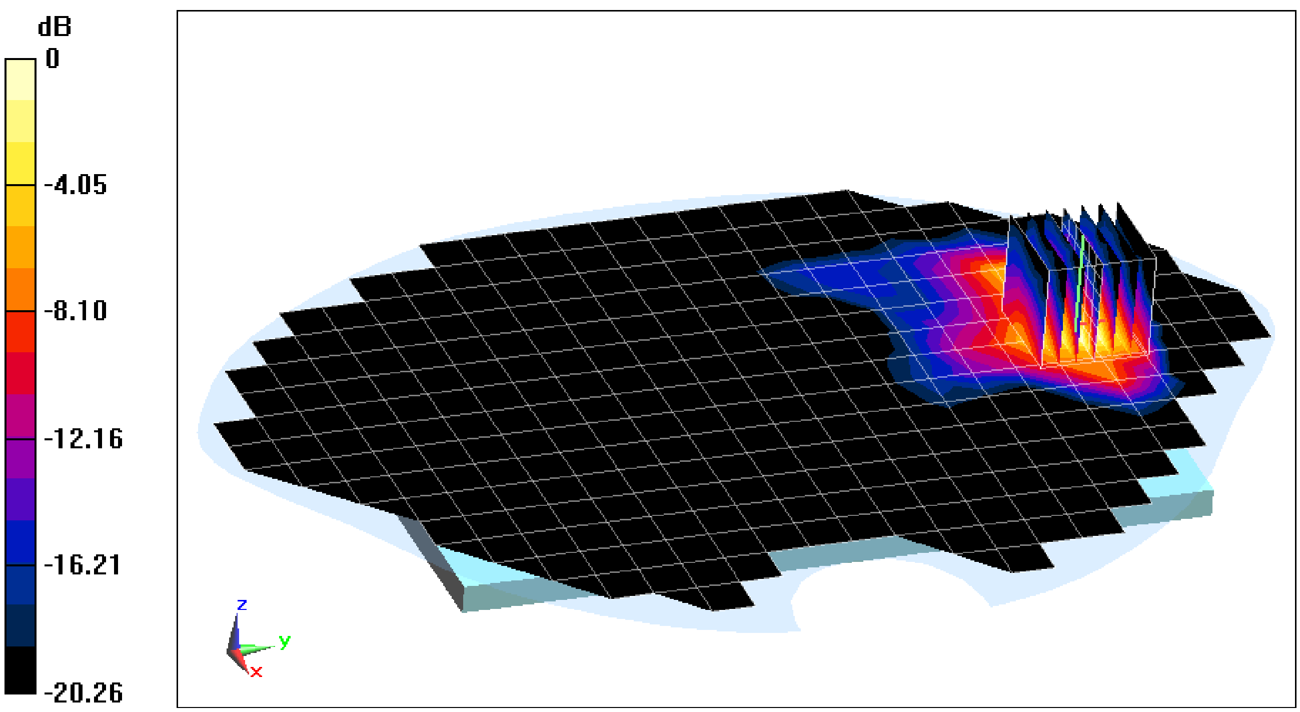
Communication System: UID 0, Bluetooth; Frequency: 2441 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2441 MHz; σ = 2.004 S/m; ε_r = 54.019; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-10-2016; Ambient Temp: 22.8°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3351; ConvF(4.3, 4.3, 4.3); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: Bluetooth, Body SAR, Ch 39, 1 Mbps, Back Side

Area Scan (21x25x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.622 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.320 W/kg
SAR(1 g) = 0.124 W/kg



0 dB = 0.167 W/kg = -7.77 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1046

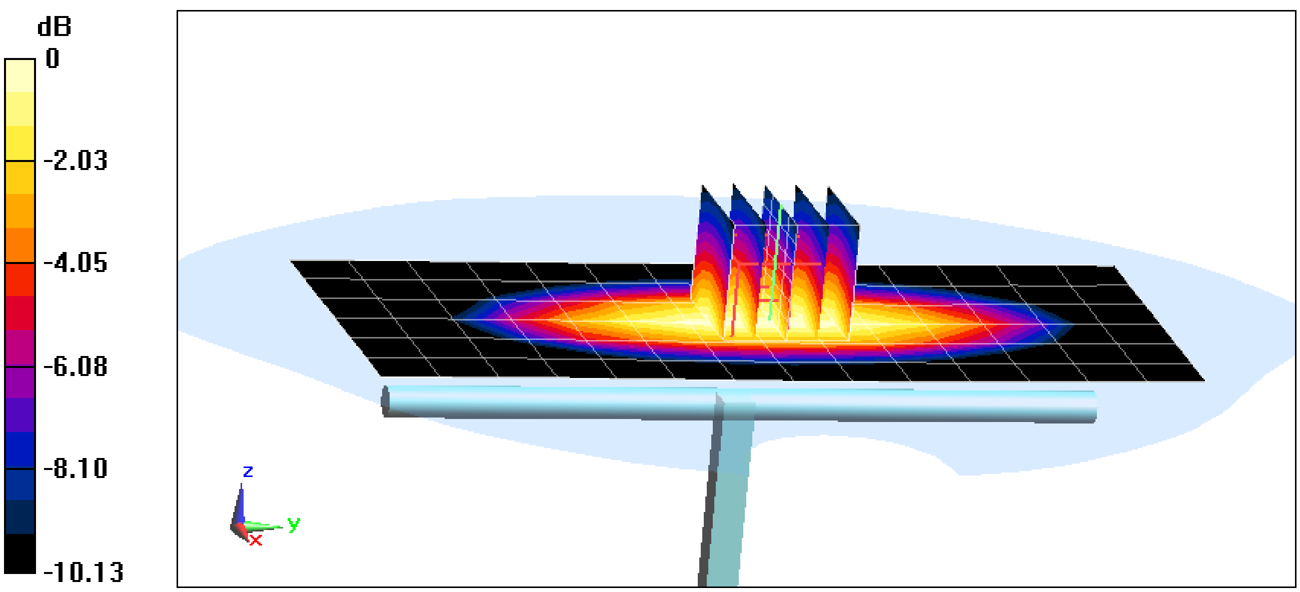
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Body; Medium parameters used (interpolated):
f = 750 MHz; σ = 0.971 S/m; ε_r = 55.282; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space = 1.5 cm

Test Date: 08-04-2015; Ambient Temp: 21.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3333; ConvF(6.14, 6.14, 6.14); Calibrated: 10/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 10/23/2014
Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.52 W/kg
SAR(1 g) = 1.75 W/kg
Deviation (1g) = 5.55 %



0 dB = 2.04 W/kg = 3.10 dBW/kg

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d119

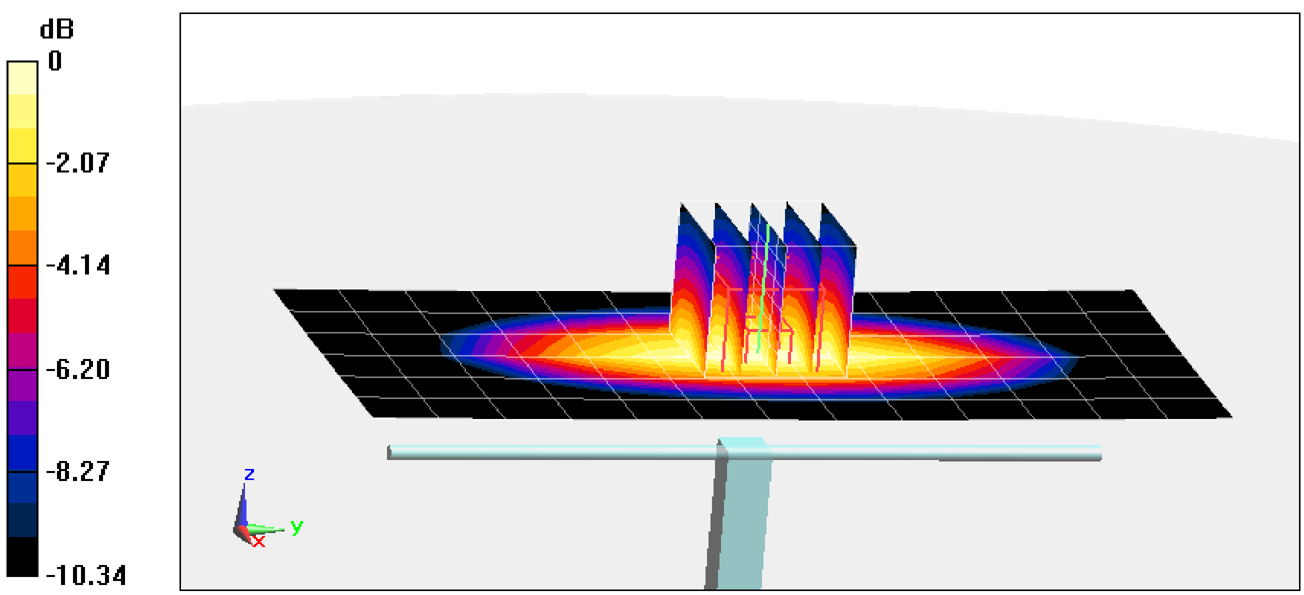
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body; Medium parameters used:
f = 835 MHz; σ = 1.005 S/m; ε_r = 53.595; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space = 1.5 cm

Test Date: 08-10-2015; Ambient Temp: 20.9°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3319; ConvF(6.07, 6.07, 6.07); Calibrated: 3/19/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/13/2015
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1226
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.84 W/kg
SAR(1 g) = 1.96 W/kg
Deviation (1g) = 6.52 %



0 dB = 2.29 W/kg = 3.60 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d119

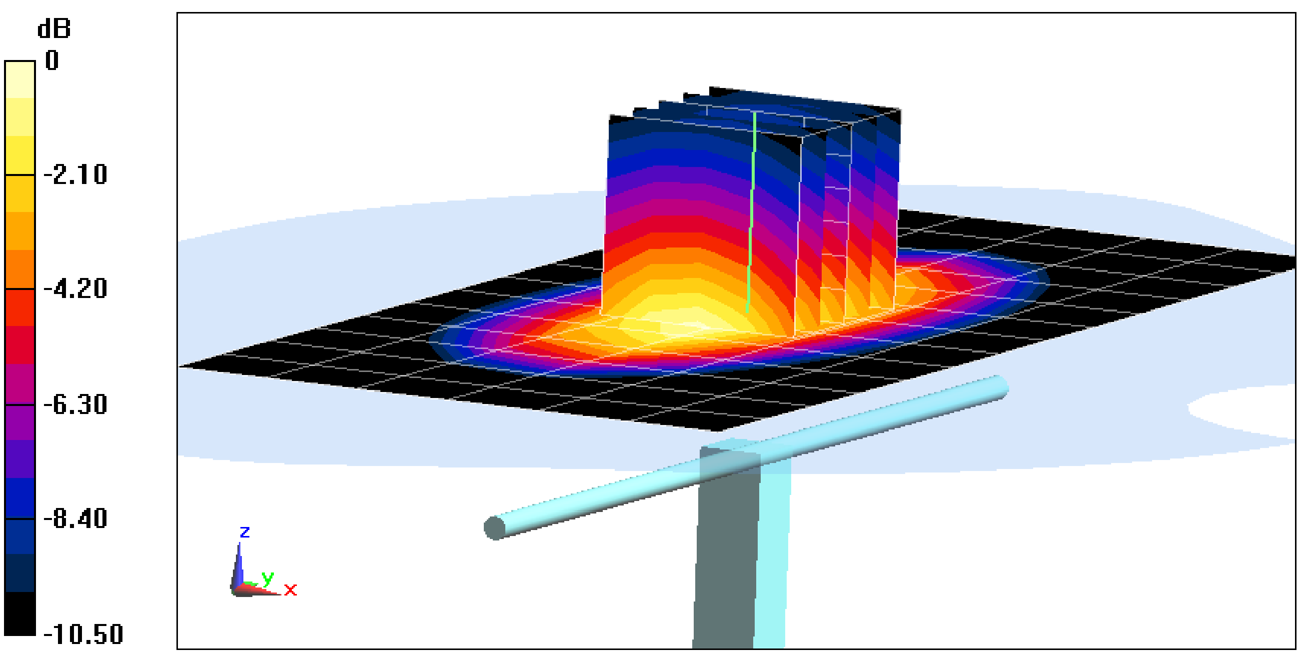
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 0.984 S/m; ε_r = 54.471; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 03-14-2016; Ambient Temp: 23.2°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3333; ConvF(6.25, 6.25, 6.25); Calibrated: 10/29/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/27/2015
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.89 W/kg
SAR(1 g) = 1.98 W/kg
Deviation(1 g) = 7.61%



0 dB = 2.31 W/kg = 3.64 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1765 MHz; Type: D1765V2; Serial: 1008

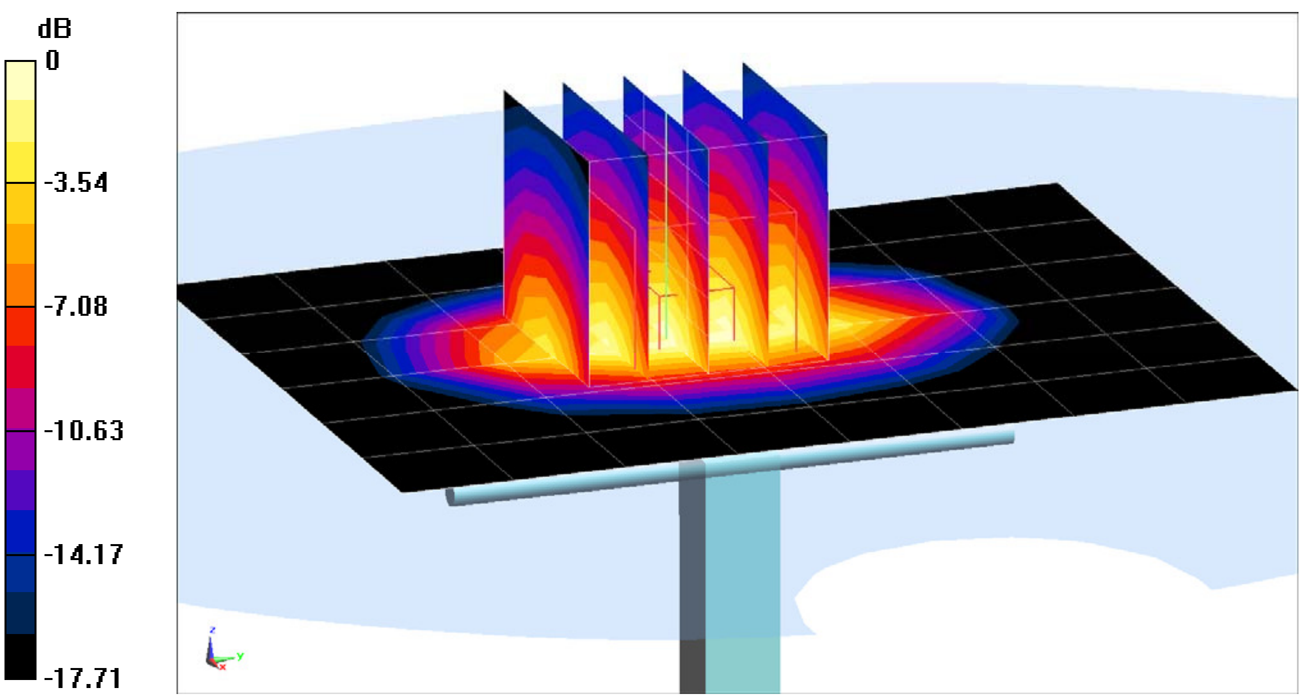
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used:
f = 1750 MHz; σ = 1.494 S/m; ε_r = 50.921; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 03-21-2016; Ambient Temp: 24.1°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3288; ConvF(4.99, 4.99, 4.99); Calibrated: 9/18/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2015
Phantom: Sub TWIN SAM; Type: QD000P40CC; Serial: TP-1357
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.75 W/kg
SAR(1 g) = 3.84 W/kg;
Deviation(1 g) = 1.05%;



0 dB = 4.84 W/kg = 6.85 dBW/kg

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d141

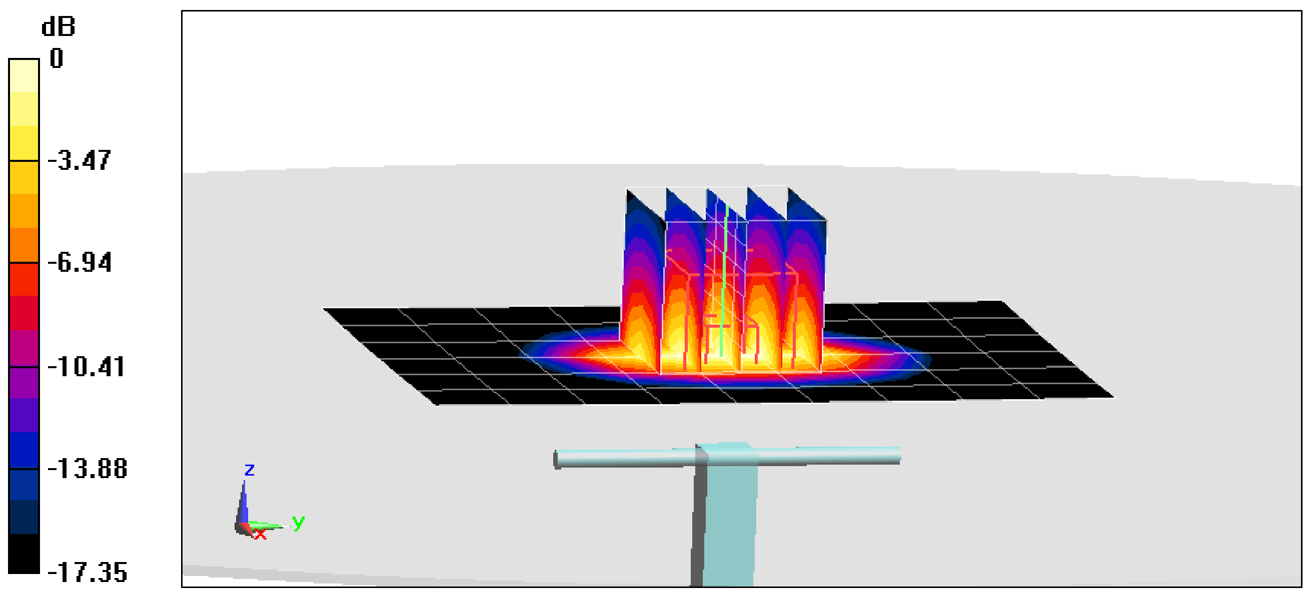
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.543 S/m; ε_r = 51.097; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space = 1.0 cm

Test Date: 08-05-2015; Ambient Temp: 23.0°C; Tissue Temp: 22.6°C

Probe: ES3DV3 - SN3213; ConvF(4.72, 4.72, 4.72); Calibrated: 1/20/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1407; Calibrated: 4/20/2015
Phantom: ELI Left v6.0; Type: QDOVA001BB; Serial: TP:1202
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.22 W/kg
SAR(1 g) = 4.02 W/kg
Deviation (1g) = 0.50 %



0 dB = 5.08 W/kg = 7.06 dBW/kg

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d149

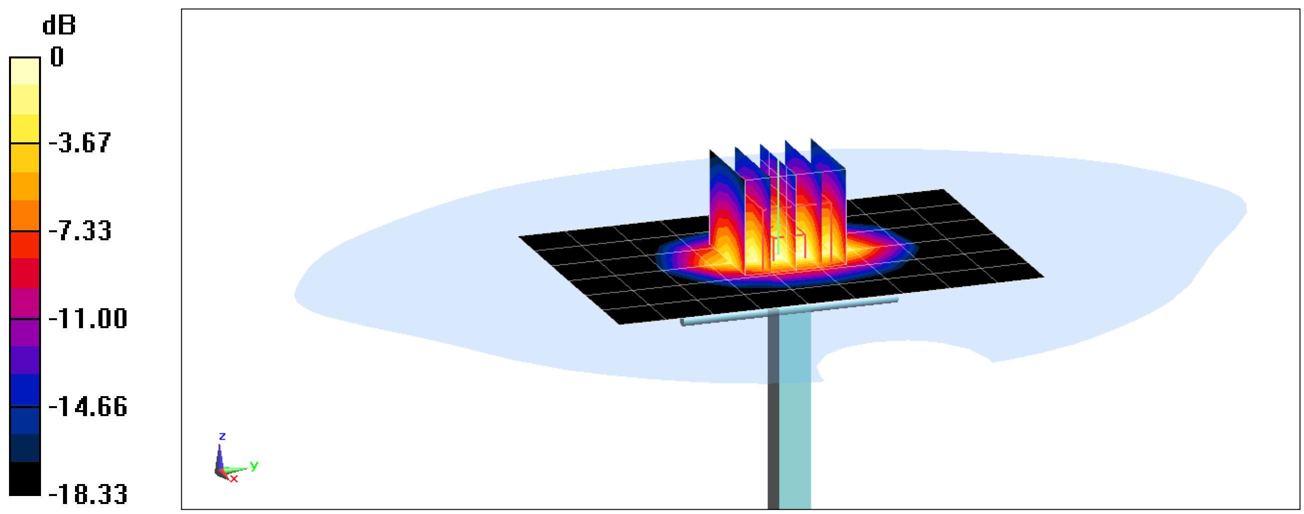
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; $\sigma = 1.516$ S/m; $\varepsilon_r = 52.81$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-09-2016; Ambient Temp: 21.4°C; Tissue Temp: 21.9°C

Probe: ES3DV3 - SN3334; ConvF(4.84, 4.84, 4.84); Calibrated: 11/17/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1415; Calibrated: 11/11/2015
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.20 W/kg
SAR(1 g) = 4.03 W/kg.
Deviation(1 g) = -0.25%



0 dB = 5.08 W/kg = 7.06 dBW/kg

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: 1064

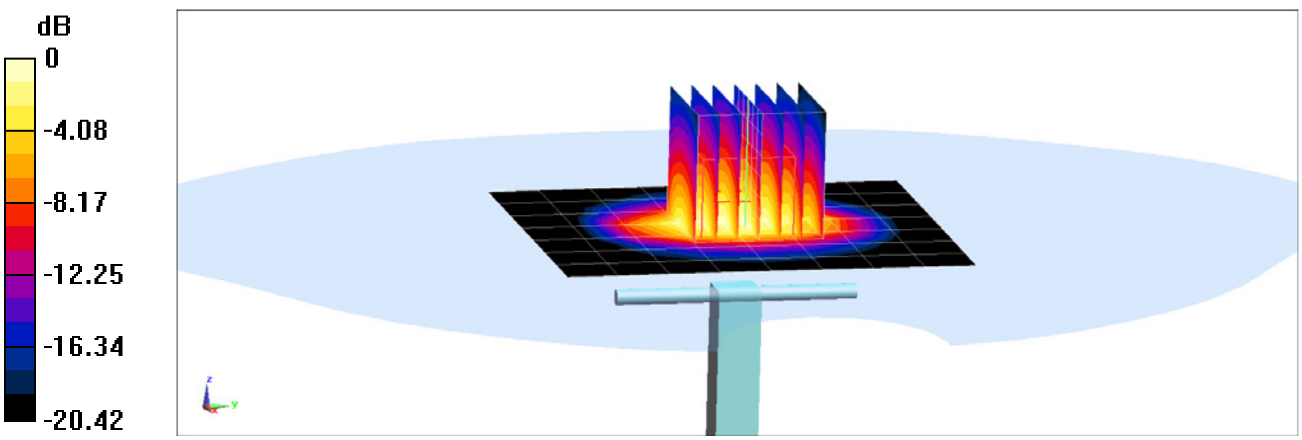
Communication System: UID 0, CW; Frequency: 2300 MHz; Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2300 MHz; σ = 1.77 S/m; ε_r = 53.17; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-22-2016; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3351; ConvF(4.47, 4.47, 4.47); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

2300 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 9.23 W/kg
SAR(1 g) = 4.68 W/kg
Deviation(1 g) = 2.86%



0 dB = 6.05 W/kg = 7.82 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 719

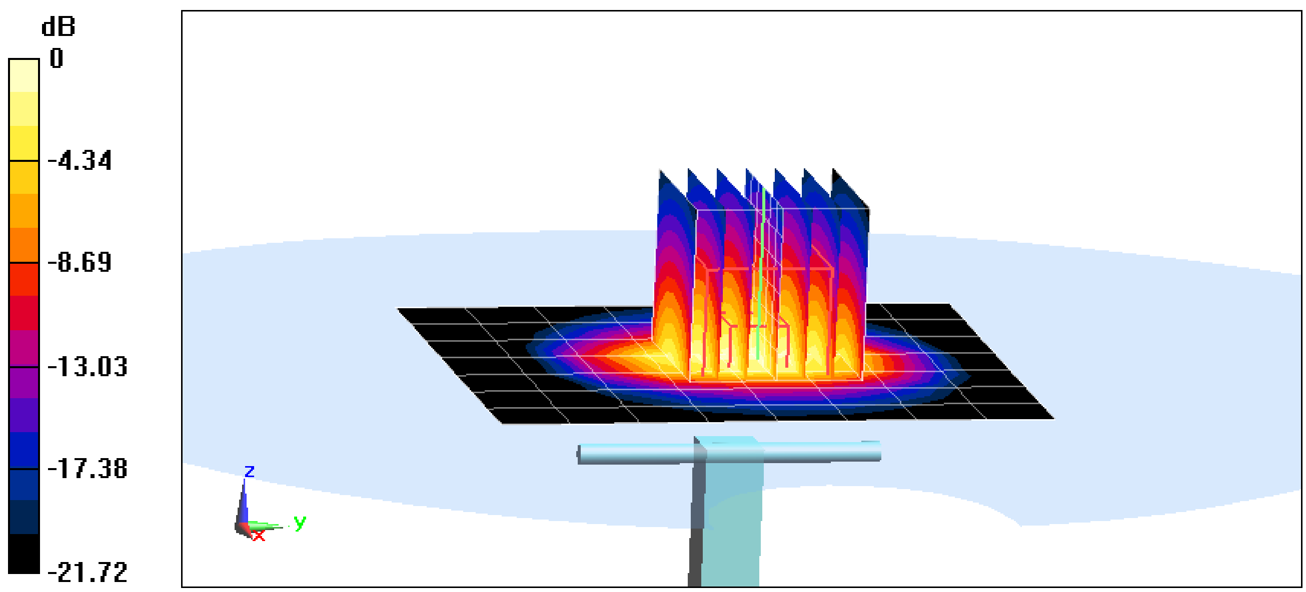
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body; Medium parameters used:
f = 2450 MHz; $\sigma = 2.035$ S/m; $\varepsilon_r = 51.219$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section; Space = 1.0 cm

Test Date: 08-07-2015; Ambient Temp: 22.1°C; Tissue Temp: 21.9°C

Probe: ES3DV3 - SN3332; ConvF(4.31, 4.31, 4.31); Calibrated: 9/18/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 10.3 W/kg
SAR(1 g) = 4.97 W/kg
Deviation (1g) = -4.05 %



0 dB = 6.57 W/kg = 8.18 dBW/kg

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 719

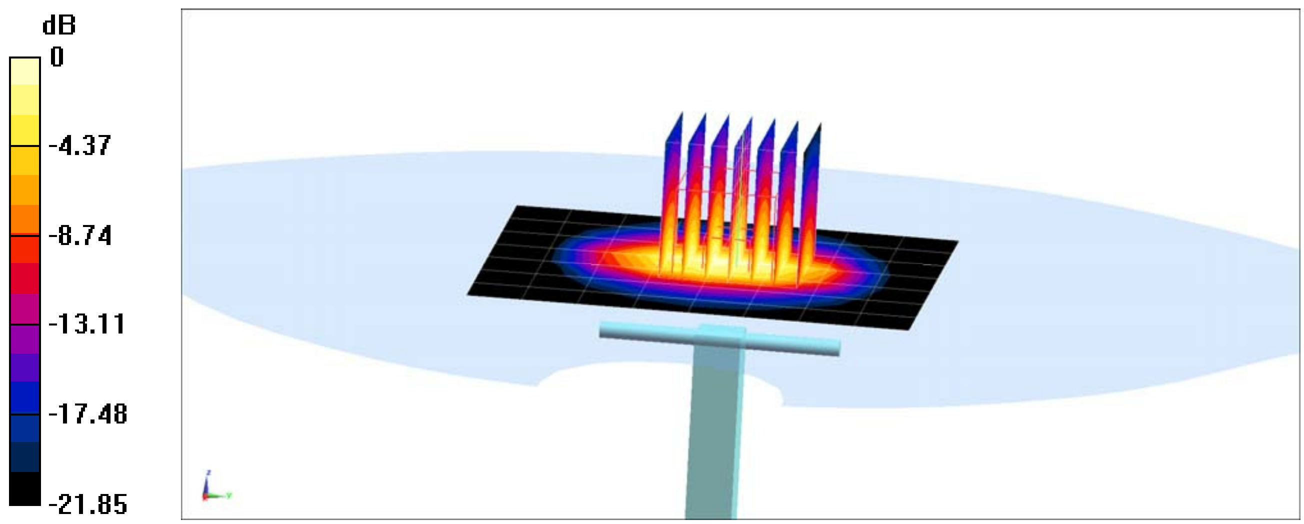
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2450 MHz; σ = 2.014 S/m; ε_r = 53.983; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-10-2016; Ambient Temp: 22.8°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3351; ConvF(4.3, 4.3, 4.3); Calibrated: 6/22/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2015
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 10.3 W/kg
SAR(1 g) = 5.02 W/kg
Deviation(1 g) = -3.28%



0 dB = 6.57 W/kg = 8.18 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 5 GHz; Type: D5GHzV2; Serial: 1191

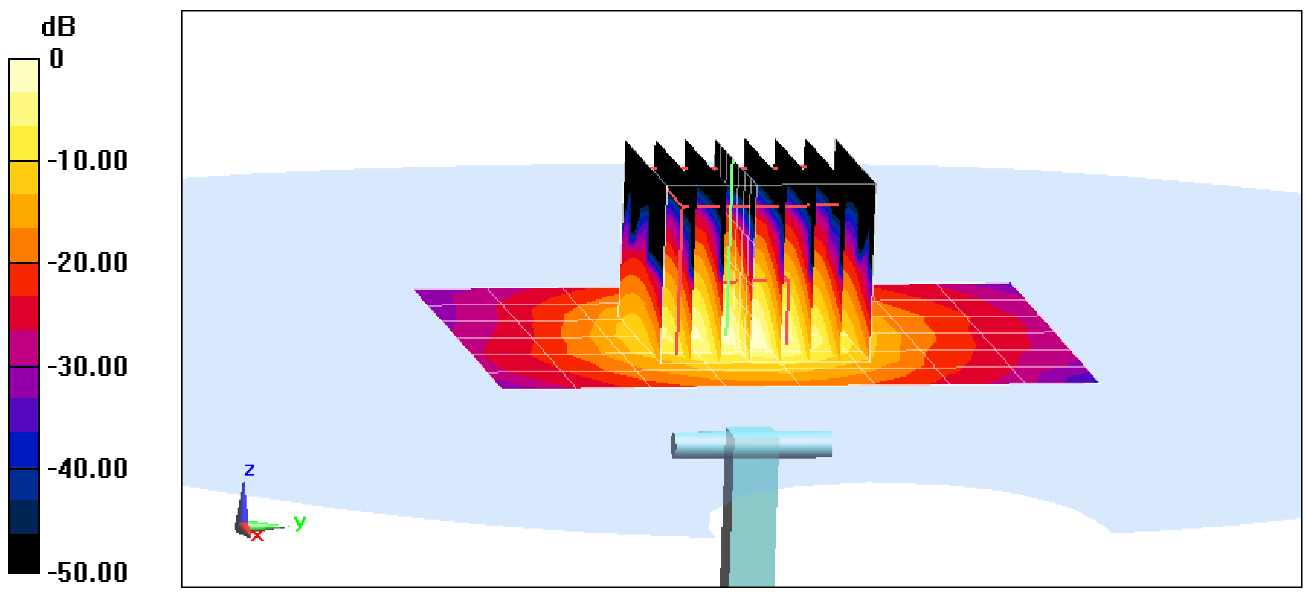
Communication System: UID 0, CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used:
f = 5300 MHz; σ = 5.436 S/m; ε_r = 46.955; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space = 1.0 cm

Test Date: 08-03-2015; Ambient Temp: 24.5°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(4.33, 4.33, 4.33); Calibrated: 2/10/2015;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/31/2014
Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5300 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 17.3 W/kg
SAR(1 g) = 4.14 W/kg
Deviation (1g) = 3.63 %



0 dB = 10.2 W/kg = 10.09 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 5 GHz; Type: D5GHzV2; Serial: 1191

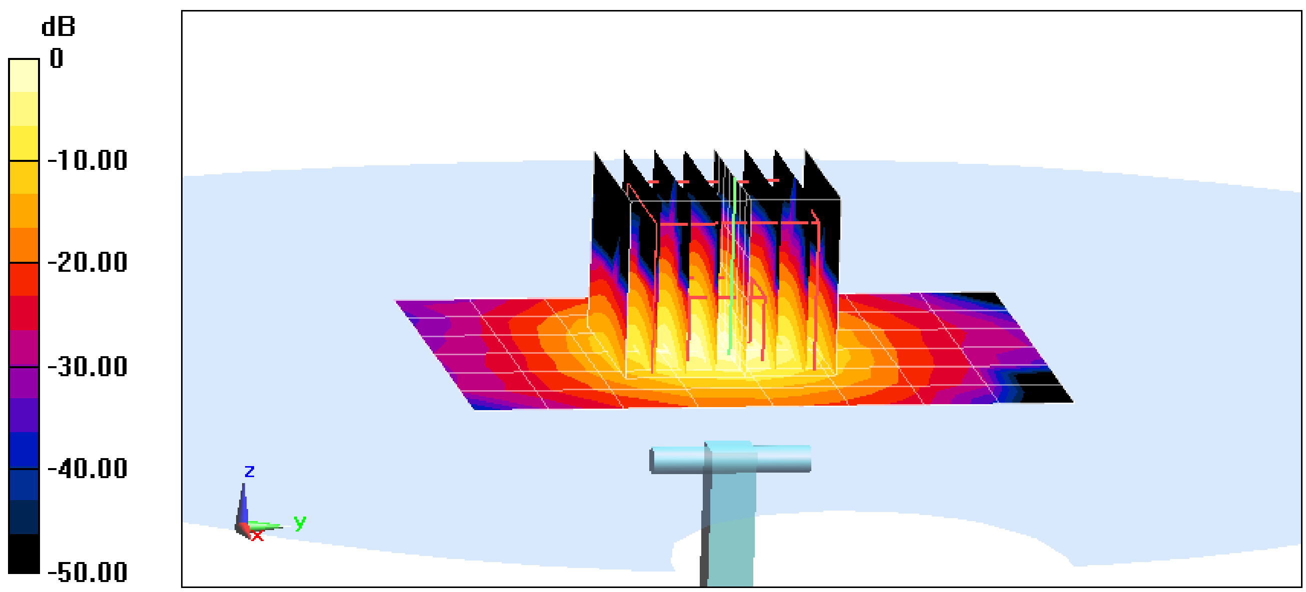
Communication System: UID 0, CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used:
f = 5500 MHz; σ = 5.672 S/m; ε_r = 46.417; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space = 1.0 cm

Test Date: 08-03-2015; Ambient Temp: 24.5°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(3.91, 3.91, 3.91); Calibrated: 2/10/2015;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/31/2014
Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5500 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 18.5 W/kg
SAR(1 g) = 4.33 W/kg
Deviation (1g) = 4.21 %



0 dB = 10.6 W/kg = 10.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 5 GHz; Type: D5GHzV2; Serial: 1191

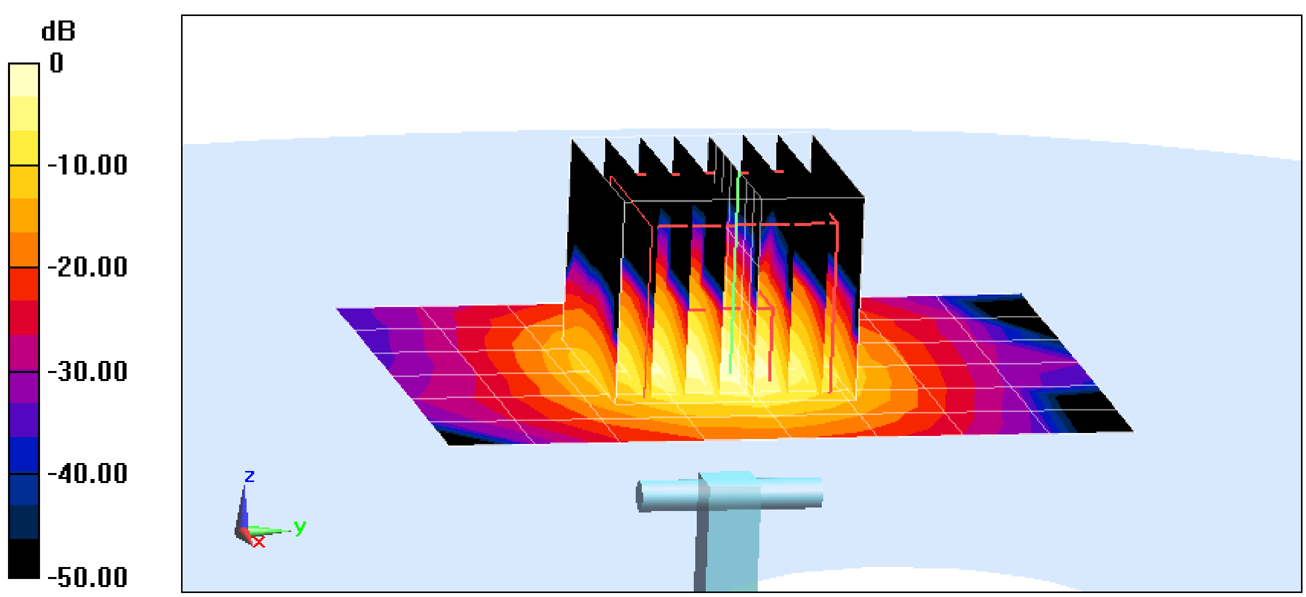
Communication System: UID 0, CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used:
f = 5800 MHz; σ = 6.109 S/m; ε_r = 46.184; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space = 1.0 cm

Test Date: 08-03-2015; Ambient Temp: 24.5°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(4.01, 4.01, 4.01); Calibrated: 2/10/2015;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 10/31/2014
Phantom: SAM Sub ; Type: QD000P40CC; Serial: TP:1357
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5800 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 4.05 W/kg
Deviation (1g) = 3.85 %



0 dB = 10.1 W/kg = 10.04 dBW/kg

APPENDIX C: PROBE CALIBRATION

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

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

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

Accreditation No.: SCS 0108

Client PC Test

Certificate No: D750V3-1046_Feb15

CALIBRATION CERTIFICATE

Object	D750V3 - SN: 1046
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	February 19, 2015

BN ✓ 3/6/2015

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 EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	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: February 19, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.6 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.04 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.28 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.9 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.29 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.47 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.8 Ω + 1.5 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.4 Ω - 1.3 jΩ
Return Loss	- 34.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.038 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 02, 2011

DASY5 Validation Report for Head TSL

Date: 18.02.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1046

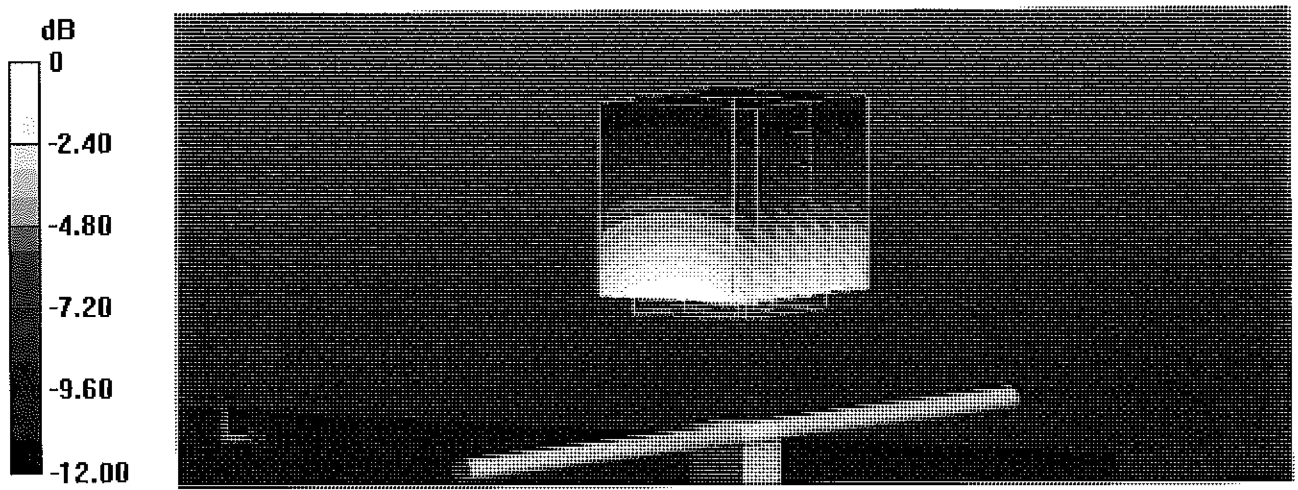
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; $\sigma = 0.9$ S/m; $\varepsilon_r = 41.6$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.44, 6.44, 6.44); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

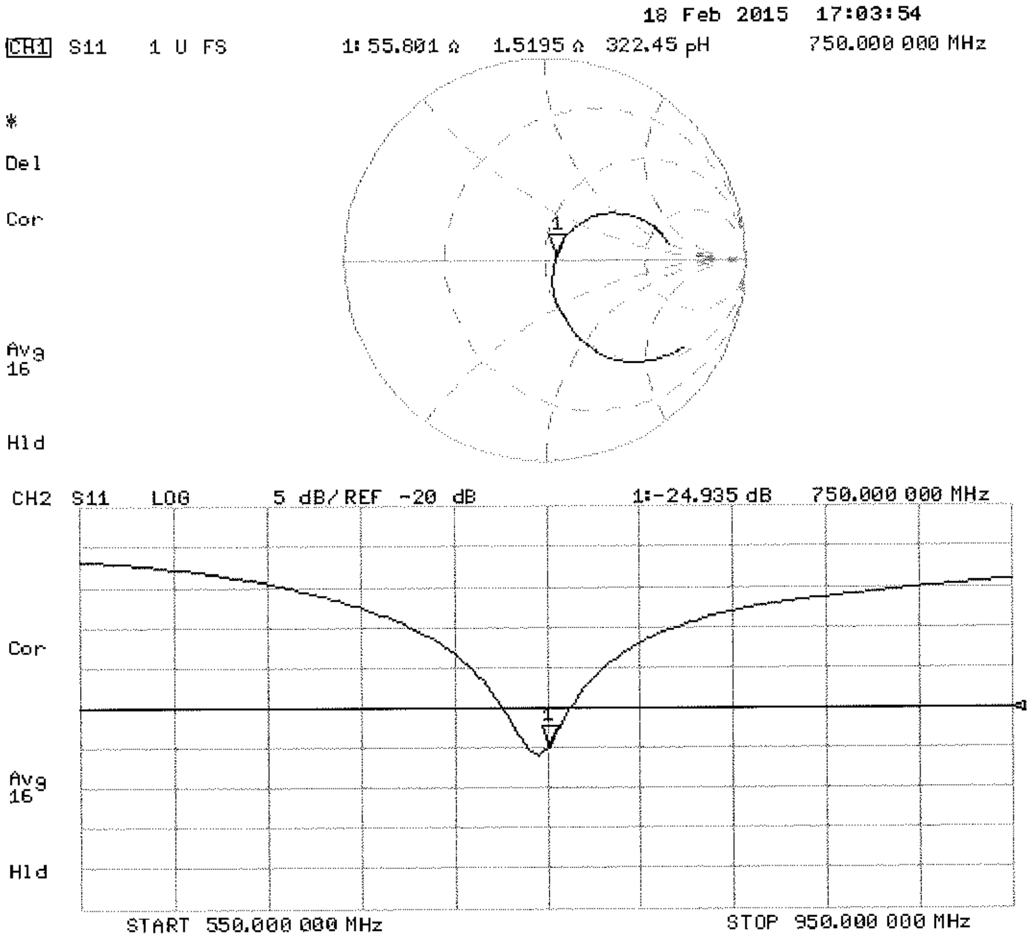
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.99 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.02 W/kg
SAR(1 g) = 2.03 W/kg; SAR(10 g) = 1.33 W/kg
Maximum value of SAR (measured) = 2.37 W/kg



0 dB = 2.37 W/kg = 3.75 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.02.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1046

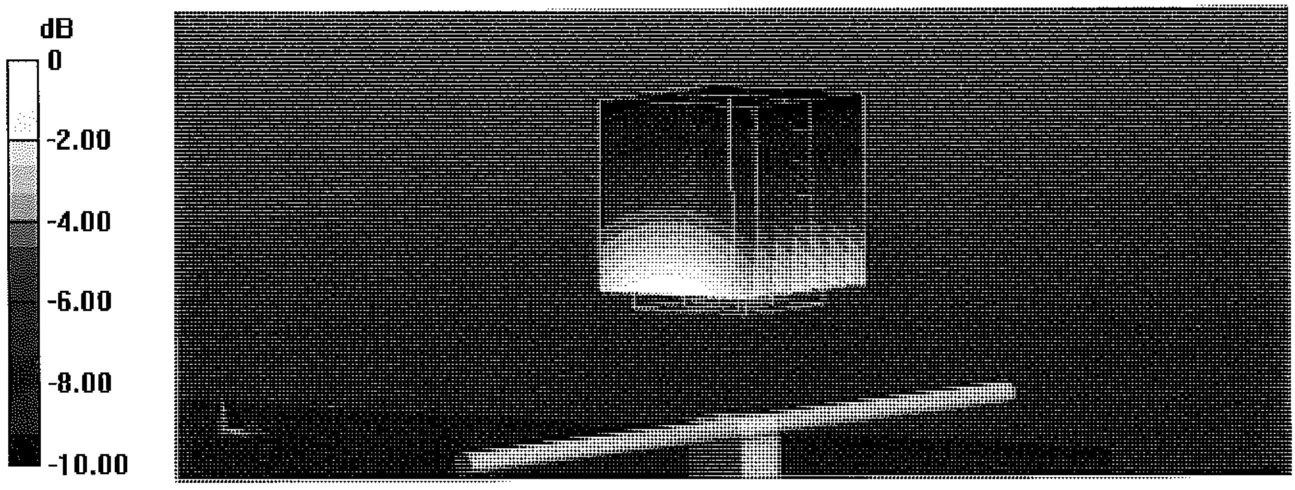
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; $\sigma = 0.98$ S/m; $\varepsilon_r = 53.9$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.21, 6.21, 6.21); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

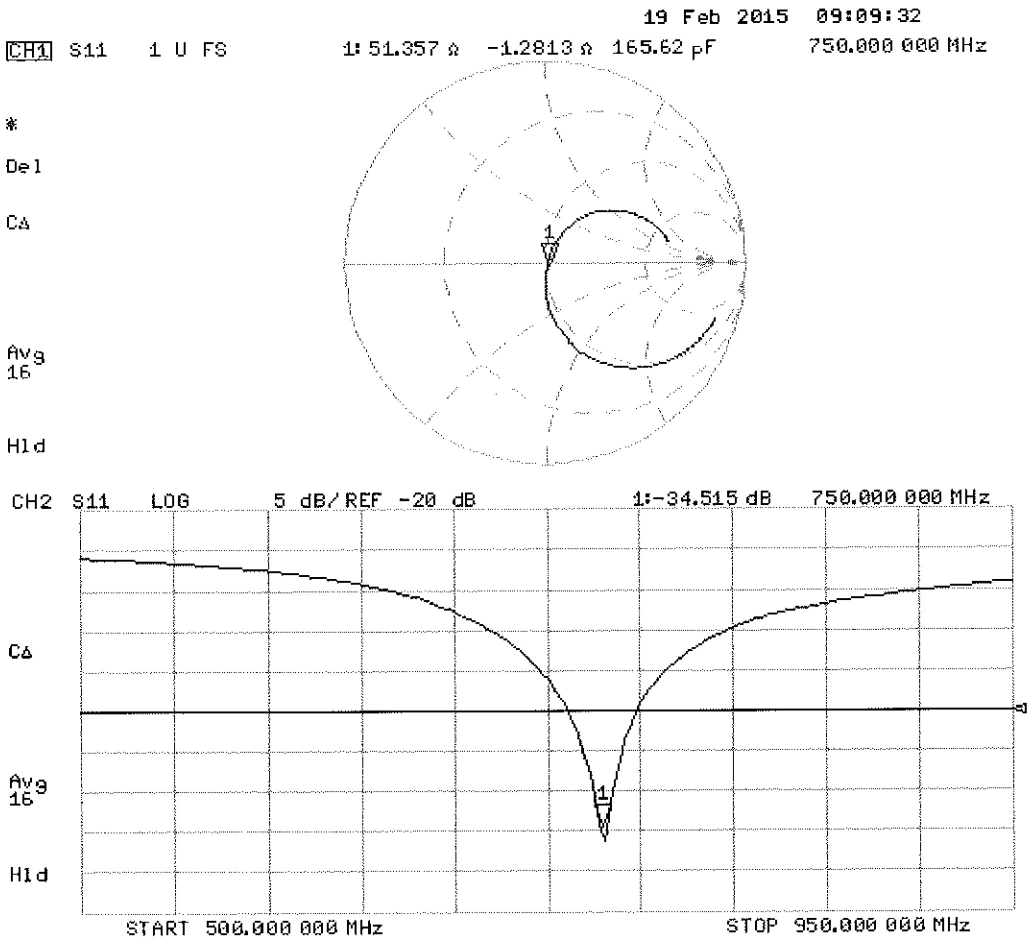
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.00 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 3.10 W/kg
SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.39 W/kg
Maximum value of SAR (measured) = 2.46 W/kg



0 dB = 2.46 W/kg = 3.91 dBW/kg

Impedance Measurement Plot for Body TSL



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Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 0108

Client PC Test

Certificate No: D835V2-4d119_Apr15

CALIBRATION CERTIFICATE

Object	D835V2 - SN:4d119
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 13, 2015

RN ✓ 4/29/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Israe Elnaouq	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: April 13, 2015

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

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Accreditation No.: SCS 0108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.38 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.11 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.4 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.20 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.55 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.06 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.2 Ω - 2.2 jΩ
Return Loss	- 33.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.7 Ω - 4.9 jΩ
Return Loss	- 25.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 13.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d119

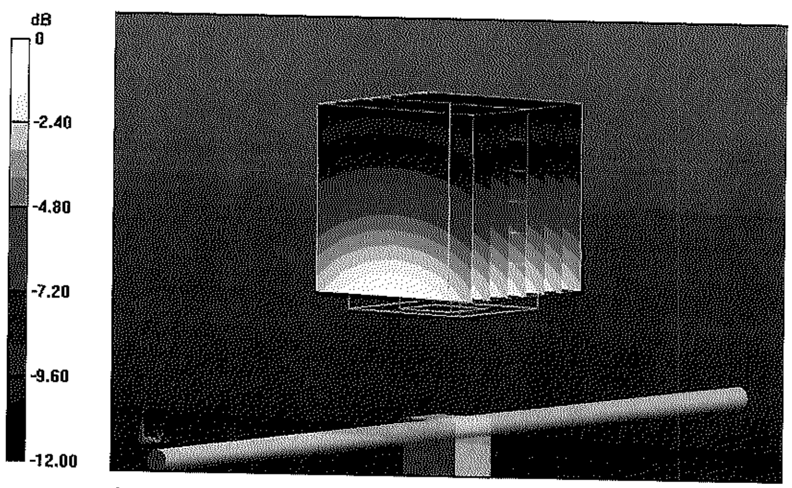
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.2, 6.2, 6.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

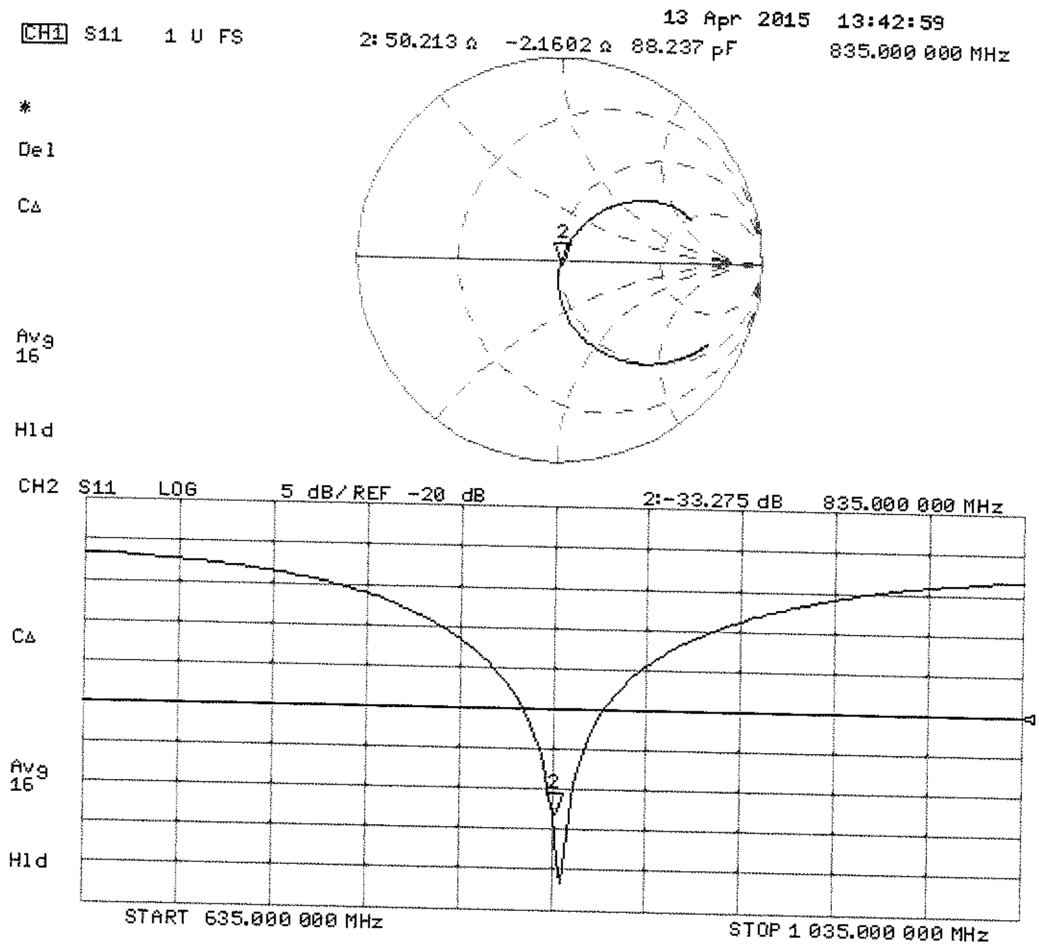
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.77 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.64 W/kg
SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 2.85 W/kg



0 dB = 2.85 W/kg = 4.55 dBW/kg

Impedance Measurement Plot for Head TSL



Date: 13.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

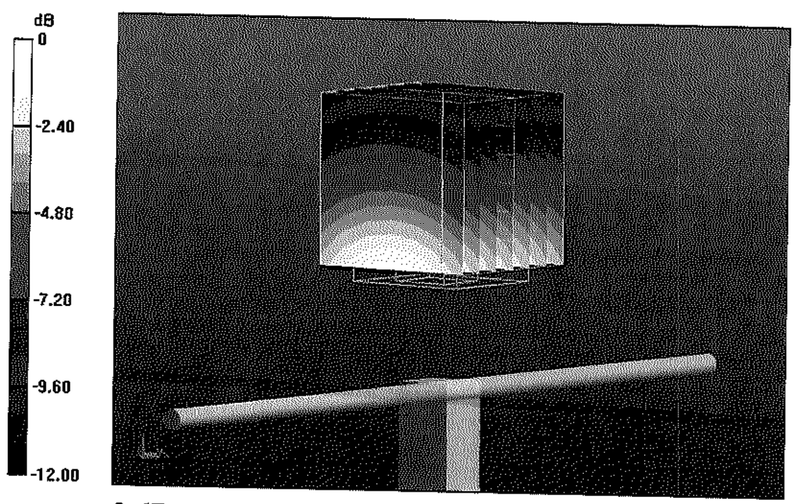
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d119

Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.01 S/m; ε_r = 55.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

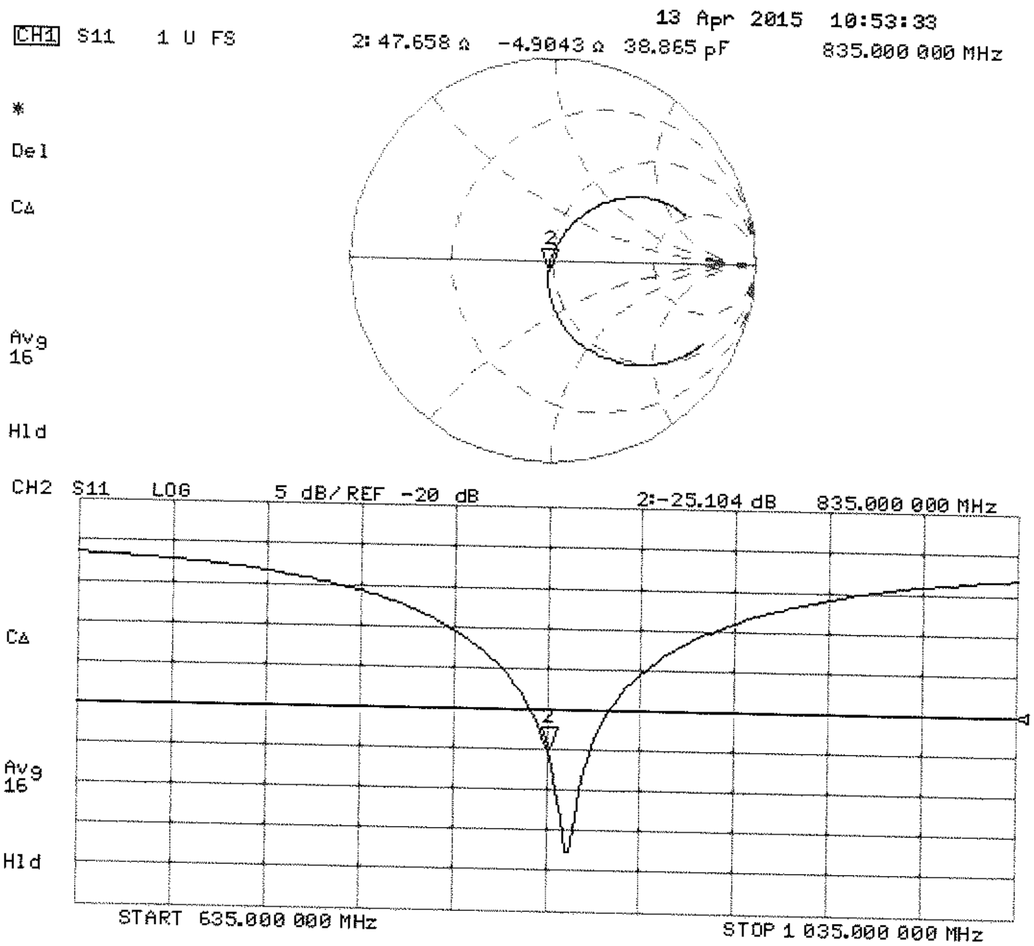
- Probe: ES3DV3 - SN3205; ConvF(6.17, 6.17, 6.17); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.44 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 3.52 W/kg
SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.55 W/kg
Maximum value of SAR (measured) = 2.77 W/kg



0 dB = 2.77 W/kg = 4.42 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1900V2-5d141_Apr15

CALIBRATION CERTIFICATE

Object	D1900V2 - SN:5d141
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 14, 2015

PM ✓
4/29/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: April 14, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.9 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.8 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.29 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.2 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 Ω + 4.6 jΩ
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2 Ω + 5.6 jΩ
Return Loss	- 24.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 14.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d141

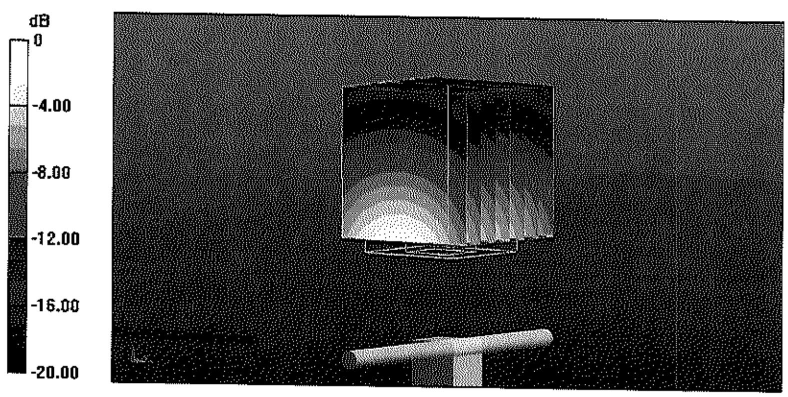
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.37 S/m; ε_r = 38.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

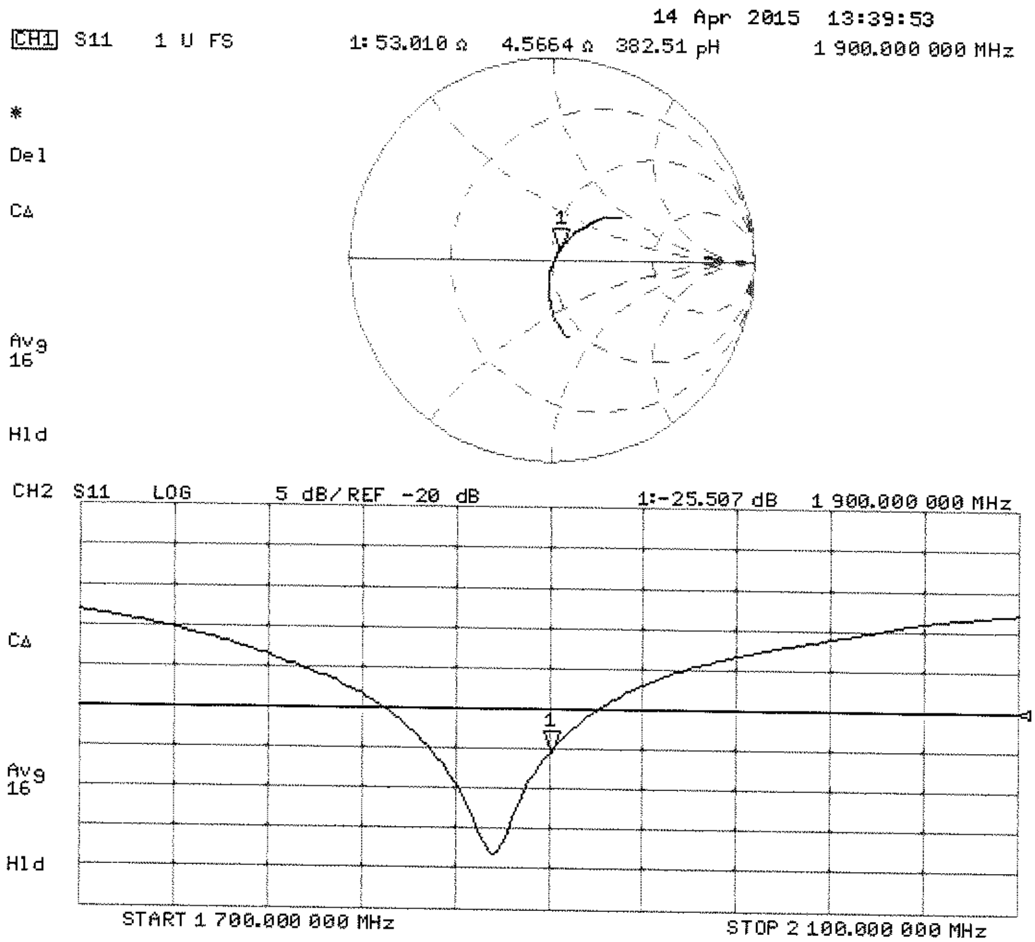
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.18 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.2 W/kg
Maximum value of SAR (measured) = 12.5 W/kg



0 dB = 12.5 W/kg = 10.97 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.04.2015

Test Laboratory: SPEAG, Zurich, Switzerland

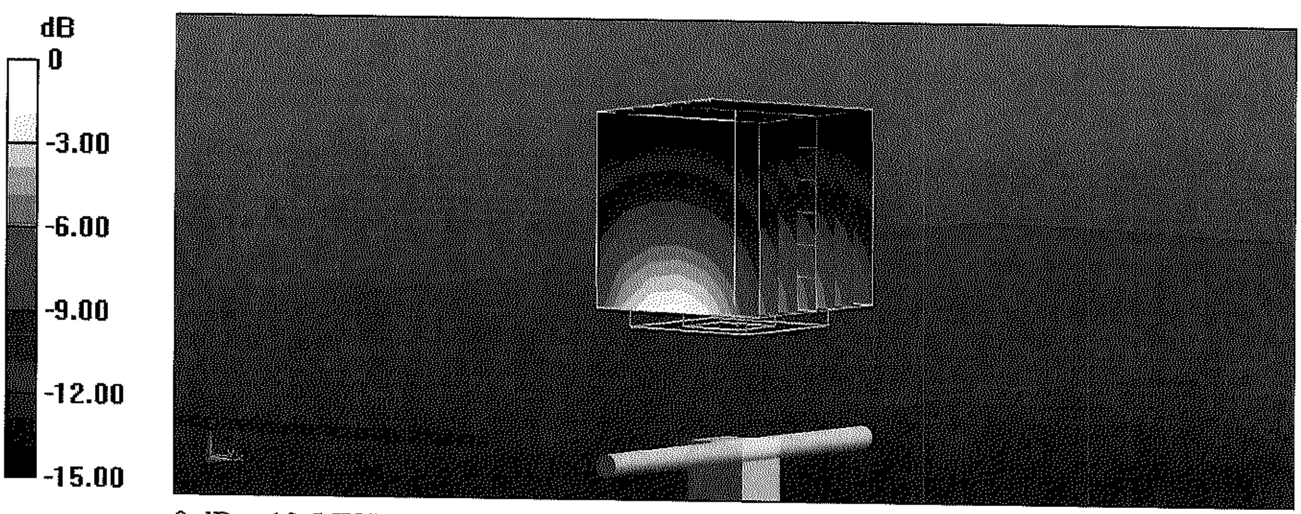
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d141

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.5 S/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

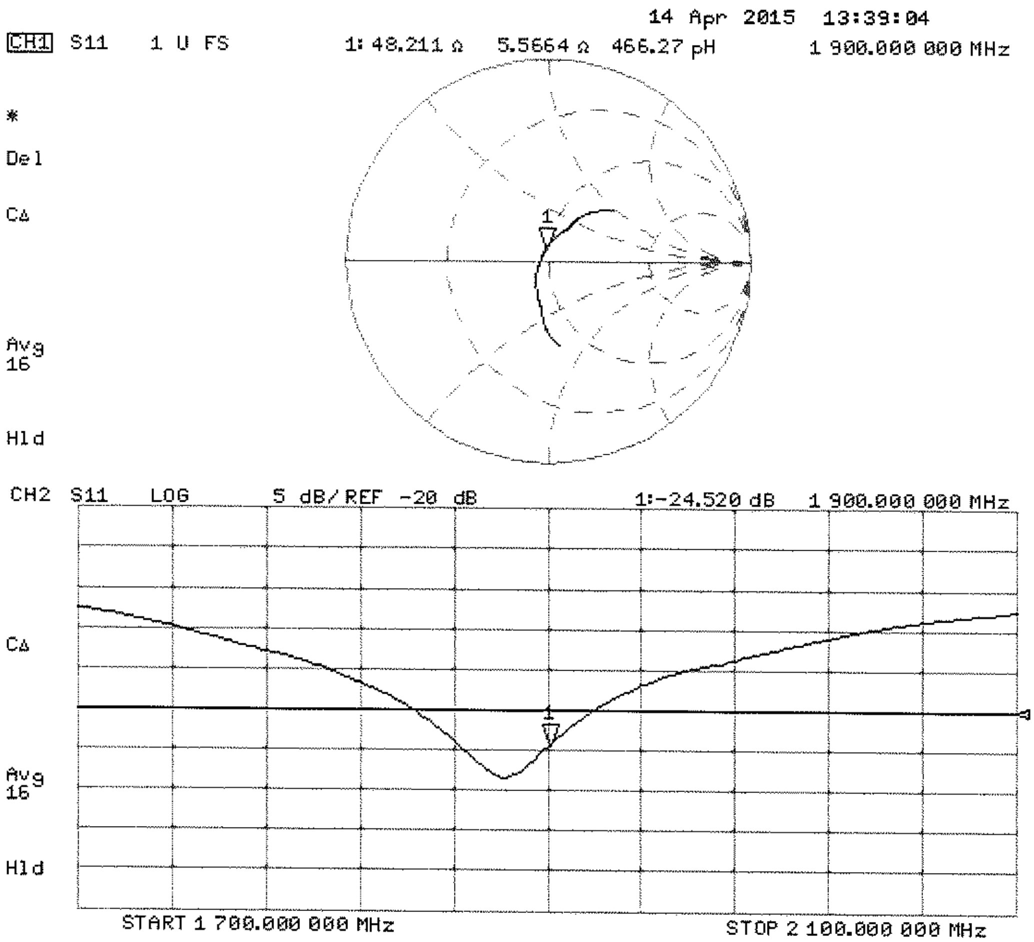
- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.73 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.9 W/kg
SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.29 W/kg
Maximum value of SAR (measured) = 12.5 W/kg



0 dB = 12.5 W/kg = 10.97 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2450V2-719_Aug14

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 719
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 11, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 12, 2014

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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S Swiss Calibration Service

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

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.0 ± 6 %	1.82 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.5 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.9 Ω + 3.0 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.9 Ω + 5.8 jΩ
Return Loss	- 24.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

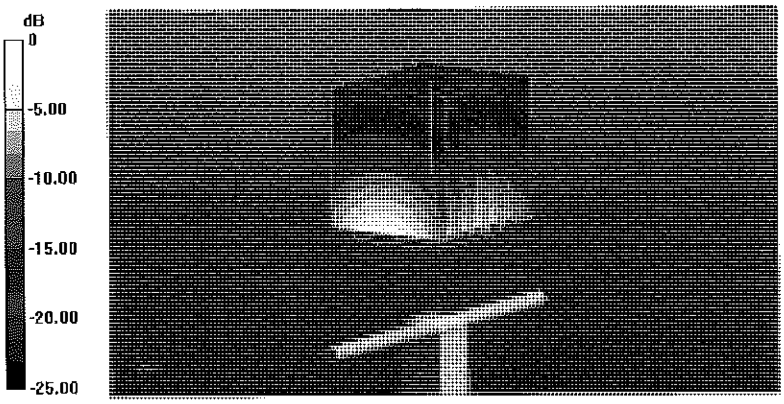
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 719

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.82 S/m; ε_r = 38; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

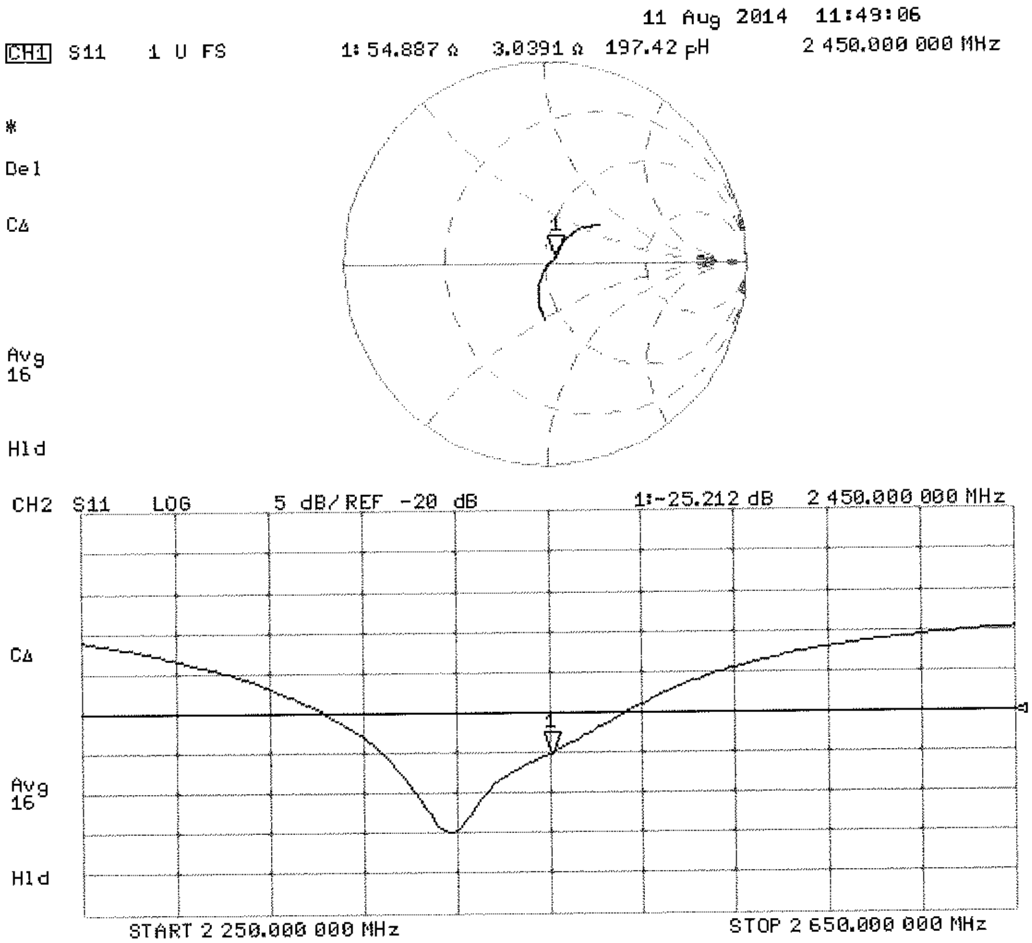
- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.6 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kg
Maximum value of SAR (measured) = 17.4 W/kg



0 dB = 17.4 W/kg = 12.41 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 719

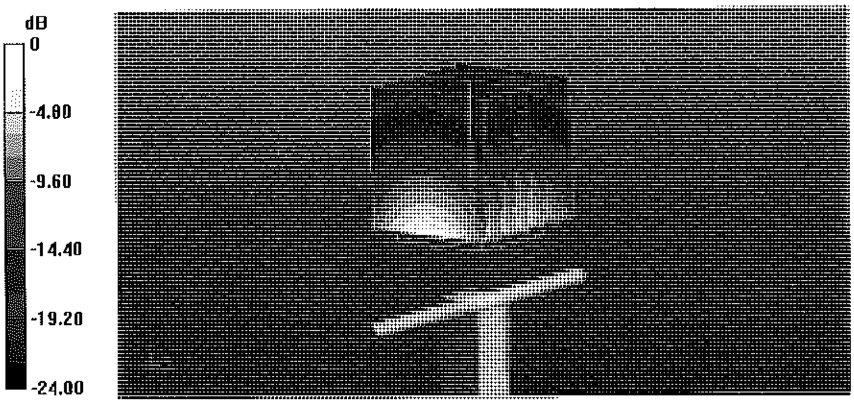
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 50.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

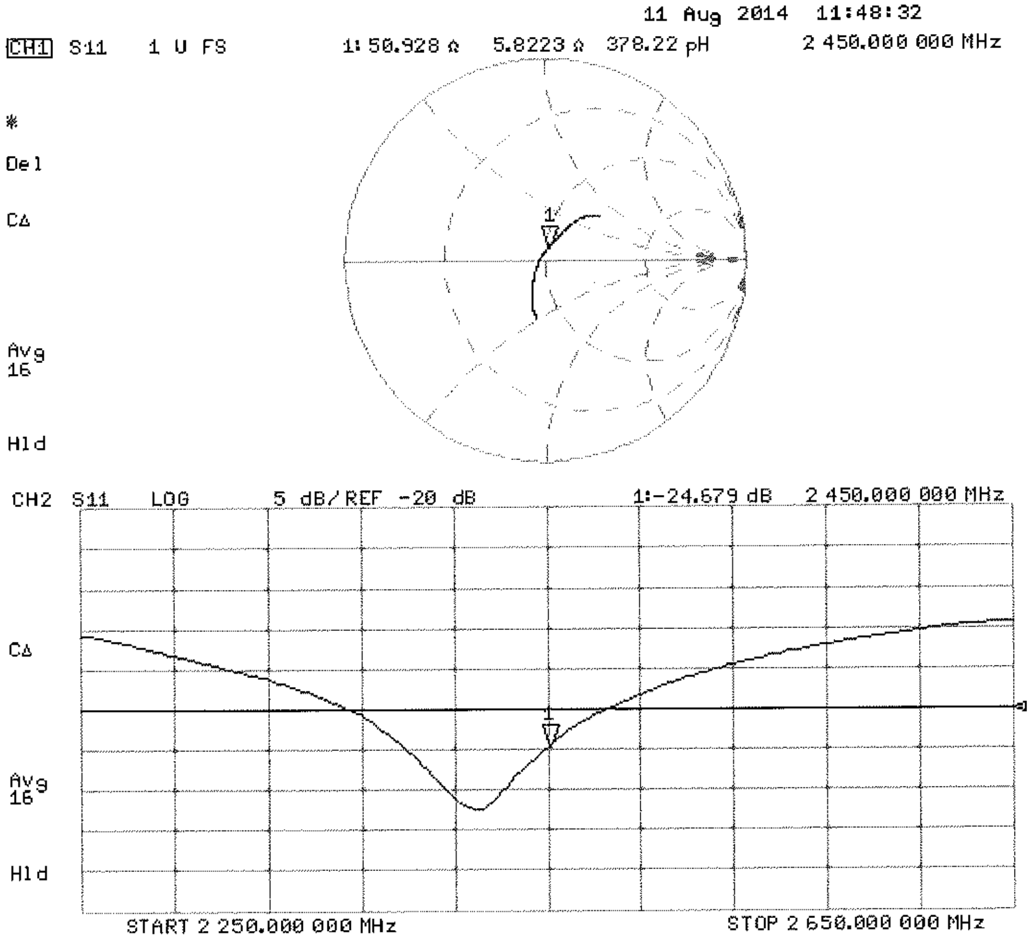
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.08 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.1 W/kg
Maximum value of SAR (measured) = 17.6 W/kg



0 dB = 17.6 W/kg = 12.46 dBW/kg

Impedance Measurement Plot for Body TSL



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D5GHzV2-1191_Sep14**

CALIBRATION CERTIFICATE

Object: D5GHzV2 - SN:1191

Calibration procedure(s): QA CAL-22.v2
Calibration procedure for dipole validation kits between 3-6 GHz

CC
11/6/14

Calibration date: September 25, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe EX3DV4	SN: 3503	30-Dec-13 (No. EX3-3503_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: September 25, 2014

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

Asset #81751

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
c) 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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.54 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.1 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.64 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.64 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**85.8 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**88.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.2 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**86.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.49 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.7 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.1 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**82.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.84 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.6 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**79.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.6 ± 6 %	5.79 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**83.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	5.93 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**84.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.1 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**78.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	51.8 Ω - 9.9 jΩ
Return Loss	- 20.1 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	54.5 Ω - 1.5 jΩ
Return Loss	- 26.8 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	49.6 Ω - 2.0 jΩ
Return Loss	- 33.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.5 Ω - 4.4 jΩ
Return Loss	- 22.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.6 Ω + 4.4 jΩ
Return Loss	- 22.6 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.9 Ω - 8.1 jΩ
Return Loss	- 21.8 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	54.5 Ω + 0.1 jΩ
Return Loss	- 27.3 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.2 Ω - 0.6 jΩ
Return Loss	- 43.8 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.5 Ω - 3.2 jΩ
Return Loss	- 22.4 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	57.2 Ω + 5.2 jΩ
Return Loss	- 21.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	April 01, 2014

DASY5 Validation Report for Head TSL

Date: 25.09.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; $\sigma = 4.54$ S/m; $\varepsilon_r = 34.9$; $\rho = 1000$ kg/m^3
Medium parameters used: f = 5300 MHz; $\sigma = 4.64$ S/m; $\varepsilon_r = 34.8$; $\rho = 1000$ kg/m^3
Medium parameters used: f = 5500 MHz; $\sigma = 4.83$ S/m; $\varepsilon_r = 34.5$; $\rho = 1000$ kg/m^3
Medium parameters used: f = 5600 MHz; $\sigma = 4.93$ S/m; $\varepsilon_r = 34.4$; $\rho = 1000$ kg/m^3
Medium parameters used: f = 5800 MHz; $\sigma = 5.14$ S/m; $\varepsilon_r = 34.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.52, 5.52, 5.52); Calibrated: 30.12.2013, ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2013, ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.86, 4.86, 4.86); Calibrated: 30.12.2013, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

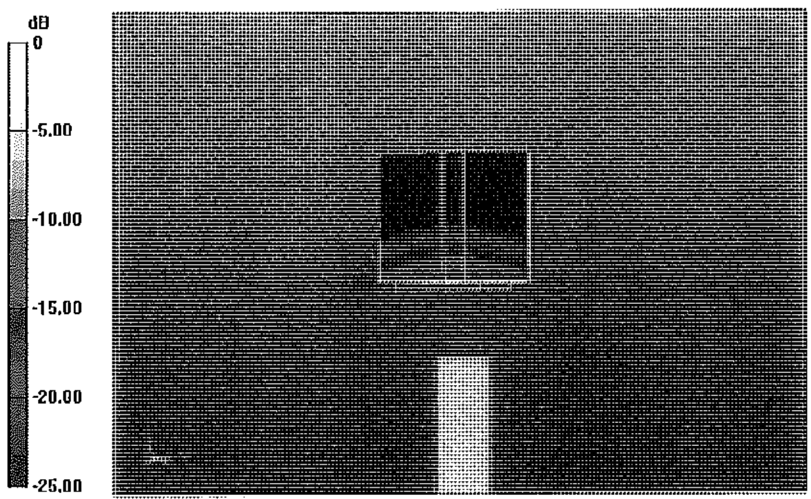
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.20 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 30.0 W/kg
SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.33 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.90 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 32.7 W/kg
SAR(1 g) = 8.64 W/kg; SAR(10 g) = 2.47 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.91 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 35.3 W/kg
SAR(1 g) = 8.93 W/kg; SAR(10 g) = 2.54 W/kg
Maximum value of SAR (measured) = 20.9 W/kg

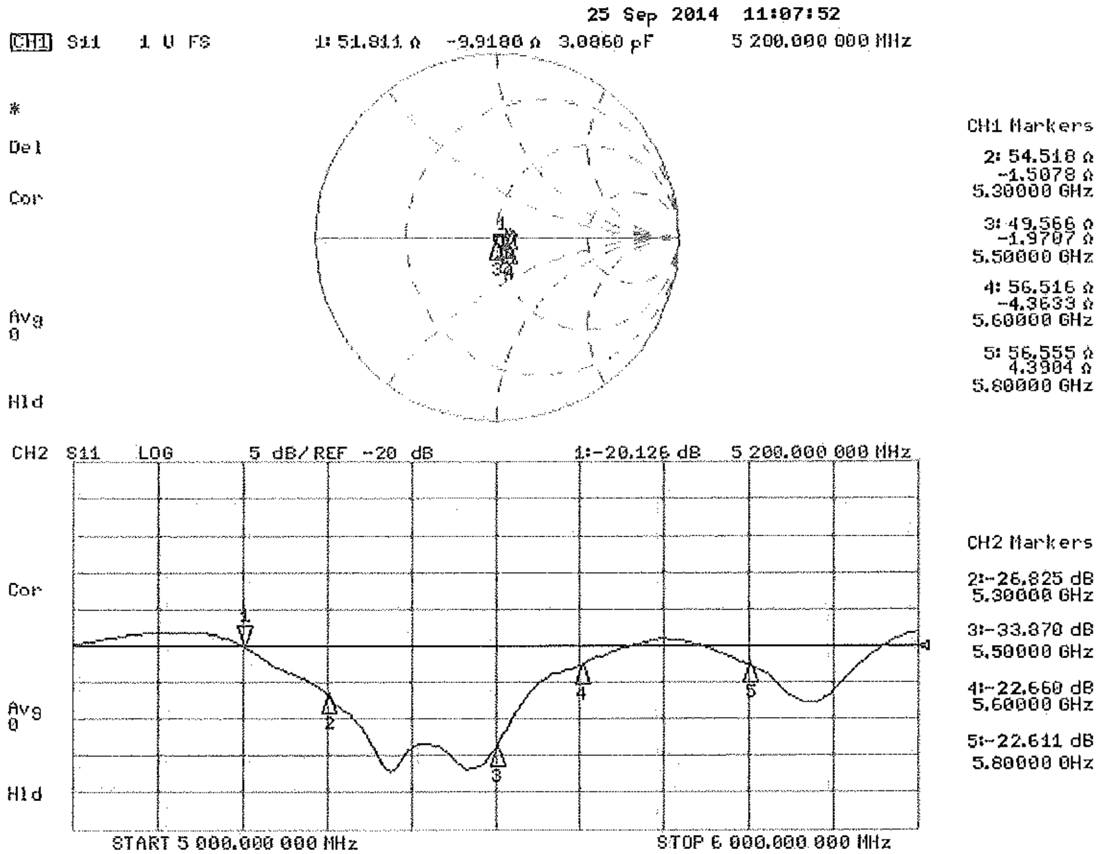
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.29 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 34.8 W/kg
SAR(1 g) = 8.76 W/kg; SAR(10 g) = 2.49 W/kg
Maximum value of SAR (measured) = 20.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.74 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 34.4 W/kg
SAR(1 g) = 8.3 W/kg; SAR(10 g) = 2.35 W/kg



0 dB = 19.8 W/kg = 12.97 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.09.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.4 S/m; ε_r = 47.1; ρ = 1000 kg/m^3
Medium parameters used: f = 5300 MHz; σ = 5.53 S/m; ε_r = 46.9; ρ = 1000 kg/m^3
Medium parameters used: f = 5500 MHz; σ = 5.79 S/m; ε_r = 46.6; ρ = 1000 kg/m^3
Medium parameters used: f = 5600 MHz; σ = 5.93 S/m; ε_r = 46.4; ρ = 1000 kg/m^3
Medium parameters used: f = 5800 MHz; σ = 6.21 S/m; ε_r = 46.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013, ConvF(4.52, 4.52, 4.52); Calibrated: 30.12.2013, ConvF(4.3, 4.3, 4.3); Calibrated: 30.12.2013, ConvF(4.47, 4.47, 4.47); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

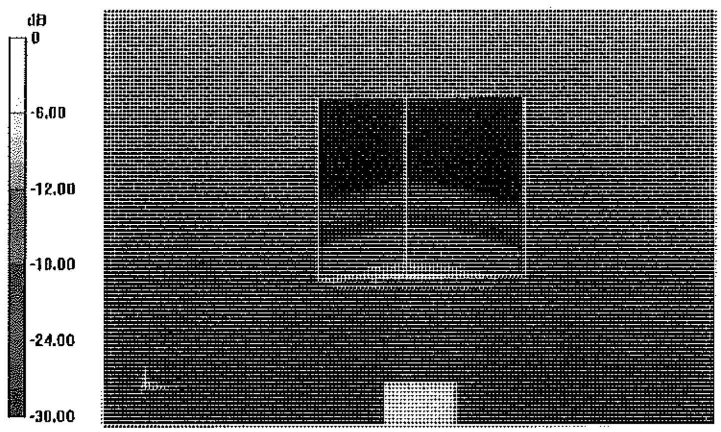
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.46 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 30.7 W/kg
SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.42 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.44 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 35.8 W/kg
SAR(1 g) = 8.37 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 20.4 W/kg

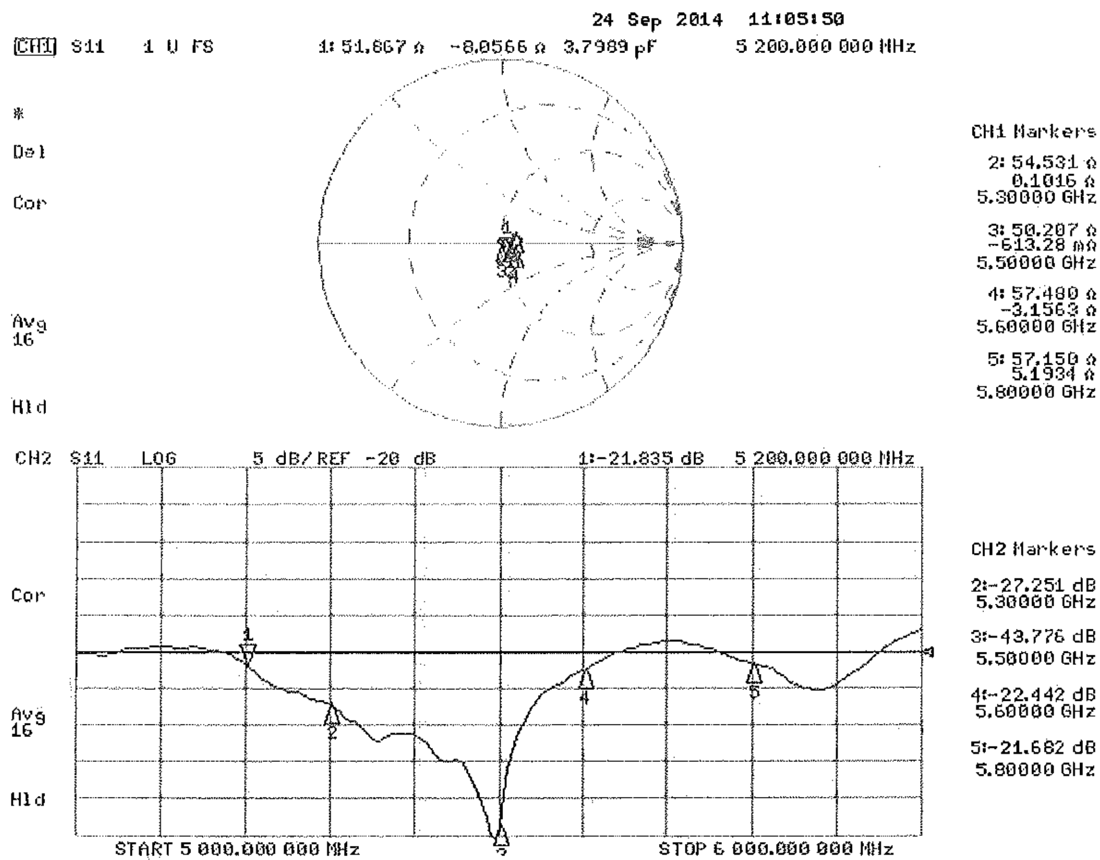
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.44 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 37.0 W/kg
SAR(1 g) = 8.48 W/kg; SAR(10 g) = 2.35 W/kg
Maximum value of SAR (measured) = 20.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 56.69 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 36.4 W/kg
SAR(1 g) = 7.86 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 19.7 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: **ES3-3213_Jan15**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3213

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

CC
1/30/15

Calibration date: January 20, 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	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-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:	Israe Elnaouq	Laboratory Technician	Israe Elnaouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 22, 2015

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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 ES3DV3

SN:3213

Manufactured: October 14, 2008
Calibrated: January 20, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3213

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)^A	1.49	1.37	1.34	± 10.1 %
DCP (mV)^B	99.9	101.8	101.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	169.8	±3.8 %
		Y	0.0	0.0	1.0		215.4	
		Z	0.0	0.0	1.0		214.5	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	1.84	57.8	10.2	10.00	47.4	±1.9 %
		Y	1.82	58.6	10.3		44.3	
		Z	1.65	57.3	9.2		44.2	
10011-CAB	UMTS-FDD (WCDMA)	X	3.32	66.8	18.5	2.91	135.8	±0.5 %
		Y	3.18	66.4	18.2		127.9	
		Z	3.21	66.5	18.2		128.1	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.90	68.1	18.4	1.87	137.2	±0.7 %
		Y	2.97	69.2	19.0		130.1	
		Z	2.80	68.0	18.4		129.9	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.40	71.2	23.7	9.46	135.1	±3.8 %
		Y	11.25	71.3	23.9		124.2	
		Z	10.96	70.3	23.2		124.8	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	18.25	96.6	27.2	9.39	140.4	±1.7 %
		Y	21.48	99.9	28.2		133.3	
		Z	11.76	89.4	24.5		127.3	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	13.12	91.7	26.0	9.57	126.4	±1.9 %
		Y	17.05	95.2	26.6		127.3	
		Z	8.91	85.2	23.3		118.8	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	34.78	100.0	25.2	6.56	116.4	±1.7 %
		Y	33.37	99.5	24.8		111.7	
		Z	34.11	99.5	24.6		110.5	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	37.18	99.7	24.0	4.80	131.2	±1.7 %
		Y	44.91	99.8	23.3		127.4	
		Z	41.51	99.7	23.2		125.0	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	48.95	99.5	22.4	3.55	140.9	±1.7 %
		Y	67.41	99.8	21.5		137.8	
		Z	56.45	100.0	21.9		135.0	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	20.23	99.3	22.1	1.16	111.3	±1.2 %
		Y	32.72	99.5	20.6		109.6	
		Z	48.57	100.0	20.0		108.8	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.60	67.9	20.0	5.67	144.6	±1.2 %
		Y	6.55	68.2	20.2		142.7	
		Z	6.50	67.8	19.9		141.5	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.34	75.7	26.2	9.29	133.2	±2.5 %
		Y	10.31	76.5	26.9		128.2	
		Z	9.74	74.5	25.6		127.1	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.50	67.6	20.0	5.80	142.8	±1.2 %
		Y	6.41	67.7	20.1		140.3	
		Z	6.41	67.6	19.9		140.2	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.36	69.2	21.6	8.07	132.8	±2.7 %
		Y	10.42	69.7	21.9		131.4	
		Z	10.22	69.1	21.4		130.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.65	74.6	25.8	9.28	127.9	±2.5 %
		Y	9.66	75.6	26.7		123.7	
		Z	9.14	73.6	25.3		122.7	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.14	66.9	19.6	5.75	139.3	±1.4 %
		Y	6.08	67.2	19.9		138.5	
		Z	6.05	66.9	19.6		137.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.58	67.5	19.9	5.82	144.3	±1.4 %
		Y	6.54	67.8	20.1		143.7	
		Z	6.50	67.5	19.8		142.1	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.93	66.1	19.3	5.73	120.6	±0.9 %
		Y	4.93	66.7	19.8		120.9	
		Z	4.85	66.3	19.5		118.9	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.93	79.5	28.6	9.21	140.8	±2.5 %
		Y	9.60	82.9	30.6		139.9	
		Z	8.30	78.2	27.9		136.6	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.90	66.0	19.3	5.72	118.8	±0.9 %
		Y	4.93	66.8	19.8		120.2	
		Z	4.81	66.1	19.3		116.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.92	66.1	19.3	5.72	119.0	±0.9 %
		Y	4.92	66.6	19.8		120.5	
		Z	4.77	65.8	19.2		115.8	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.93	68.7	21.4	8.10	125.0	±2.5 %
		Y	10.06	69.4	21.9		128.3	
		Z	9.78	68.5	21.2		120.5	
10225-CAB	UMTS-FDD (HSPA+)	X	6.66	65.7	18.8	5.97	106.5	±0.9 %
		Y	6.81	66.6	19.3		112.3	
		Z	6.64	66.0	18.9		108.0	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.91	79.4	28.5	9.21	141.4	±2.2 %
		Y	9.39	82.3	30.4		146.7	
		Z	8.40	78.5	28.2		141.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.84	73.3	25.2	9.24	119.1	±2.7 %
		Y	8.94	74.6	26.3		118.6	
		Z	8.39	72.4	24.7		114.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.62	74.6	25.8	9.30	126.2	±2.7 %
		Y	9.77	76.0	26.9		126.1	
		Z	9.10	73.4	25.2		121.4	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.43	66.4	18.5	3.96	132.5	±0.7 %
		Y	4.37	66.6	18.6		134.1	
		Z	4.40	66.7	18.6		130.5	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.63	66.4	18.4	3.46	122.5	±0.5 %
		Y	3.54	66.5	18.5		124.9	
		Z	3.55	66.3	18.3		121.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.49	65.9	18.1	3.39	125.1	±0.5 %
		Y	3.52	66.7	18.6		126.1	
		Z	3.51	66.5	18.4		123.8	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.49	67.6	19.9	5.81	143.1	±1.4 %
		Y	6.49	68.0	20.3		142.3	
		Z	6.42	67.6	19.9		144.3	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.06	68.1	20.2	6.06	147.6	±1.7 %
		Y	7.09	68.7	20.7		148.2	
		Z	7.03	68.3	20.4		149.8	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.66	67.4	18.4	3.76	135.3	±0.5 %
		Y	4.69	68.1	18.7		134.9	
		Z	4.72	68.2	18.7		136.5	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.58	67.4	18.3	3.77	133.4	±0.5 %
		Y	4.68	68.4	18.9		132.8	
		Z	4.58	67.9	18.5		135.4	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.41	65.7	17.2	1.54	131.4	±0.7 %
		Y	2.42	66.4	17.7		131.3	
		Z	2.59	67.7	18.2		134.1	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.06	68.9	21.5	8.23	127.6	±2.7 %
		Y	10.12	69.5	22.0		126.3	
		Z	10.04	69.1	21.7		129.7	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3213

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)
750	41.9	0.89	6.45	6.45	6.45	0.57	1.37	± 12.0 %
835	41.5	0.90	6.26	6.26	6.26	0.65	1.26	± 12.0 %
1750	40.1	1.37	5.22	5.22	5.22	0.47	1.47	± 12.0 %
1900	40.0	1.40	5.06	5.06	5.06	0.80	1.14	± 12.0 %
2450	39.2	1.80	4.54	4.54	4.54	0.78	1.22	± 12.0 %
2600	39.0	1.96	4.33	4.33	4.33	0.80	1.28	± 12.0 %

[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.

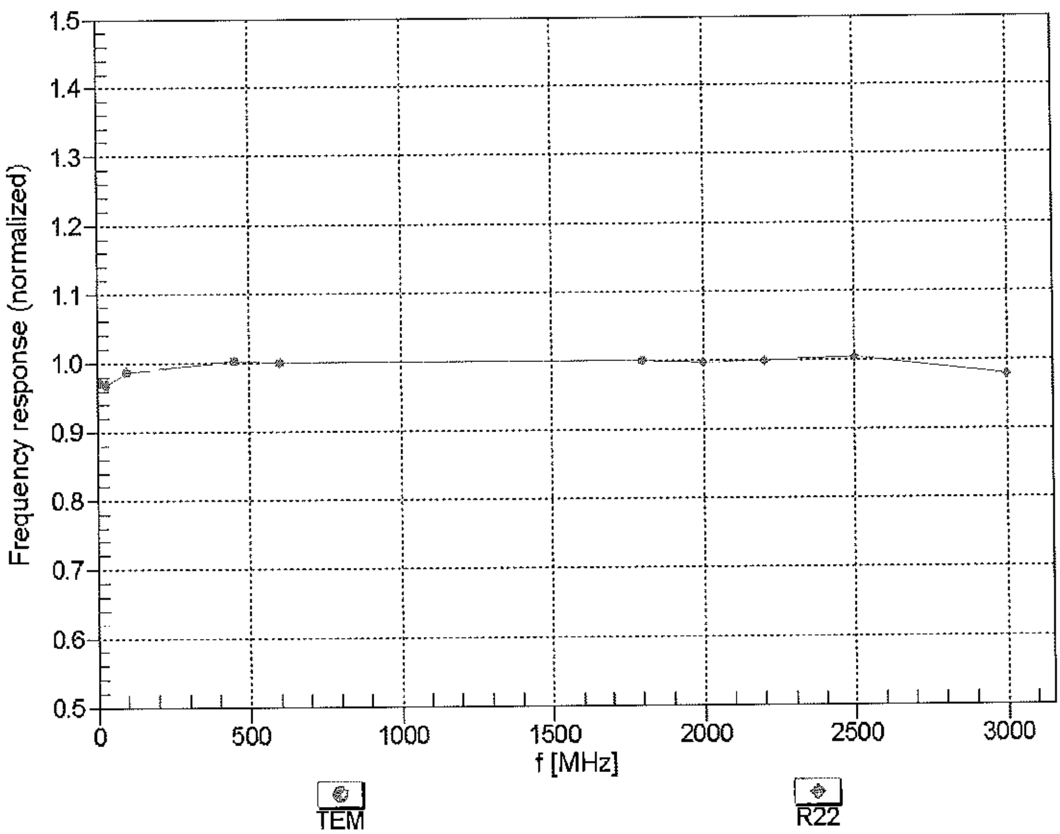
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3213

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)
750	55.5	0.96	6.11	6.11	6.11	0.71	1.24	± 12.0 %
835	55.2	0.97	6.07	6.07	6.07	0.35	1.86	± 12.0 %
1750	53.4	1.49	4.93	4.93	4.93	0.51	1.47	± 12.0 %
1900	53.3	1.52	4.72	4.72	4.72	0.80	1.20	± 12.0 %
2450	52.7	1.95	4.37	4.37	4.37	0.71	1.12	± 12.0 %
2600	52.5	2.16	4.20	4.20	4.20	0.66	0.95	± 12.0 %

[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.

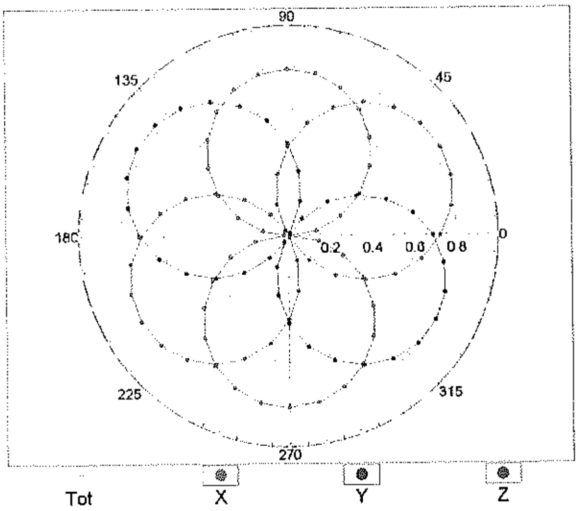
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



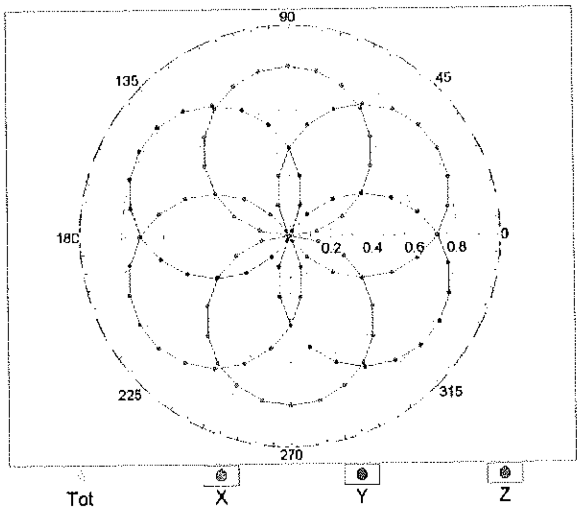
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

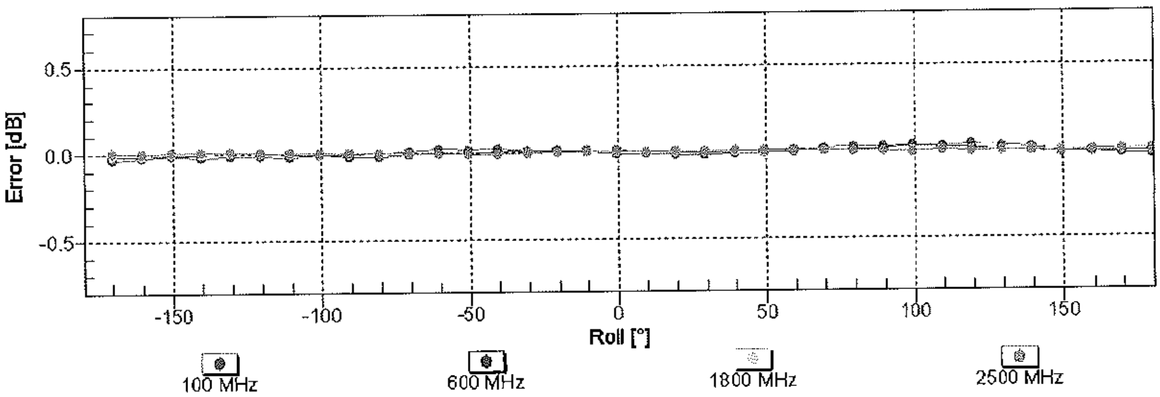
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



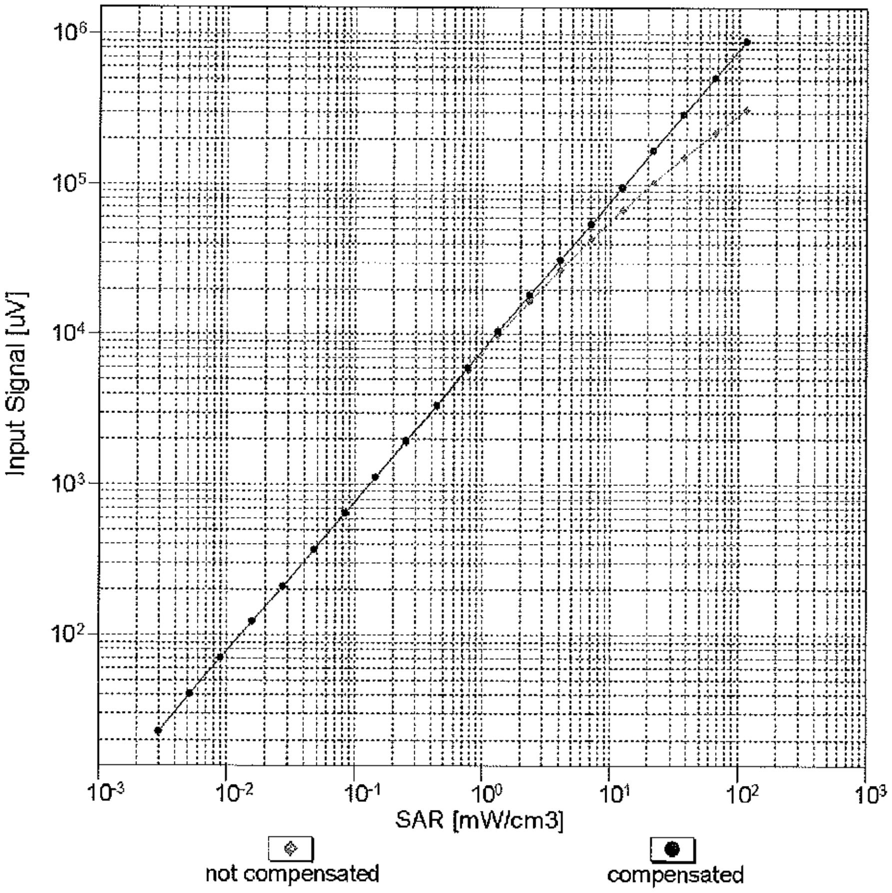
f=1800 MHz,R22

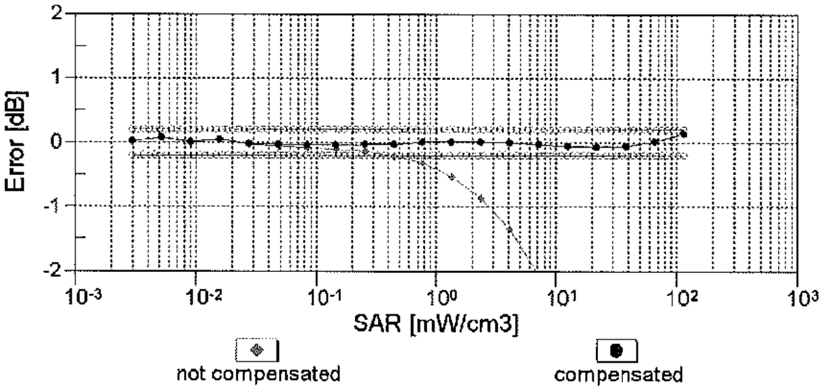




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

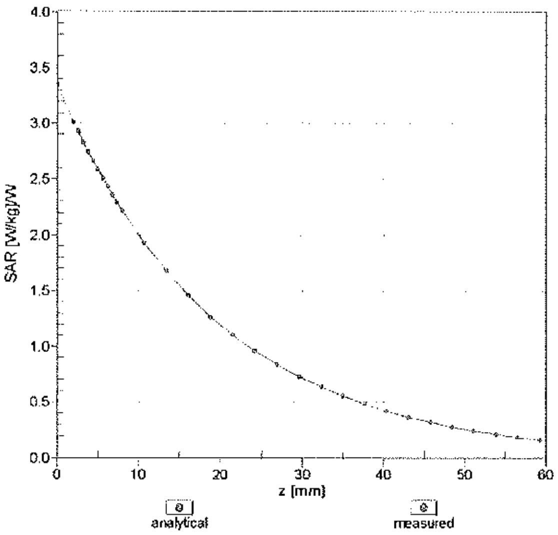




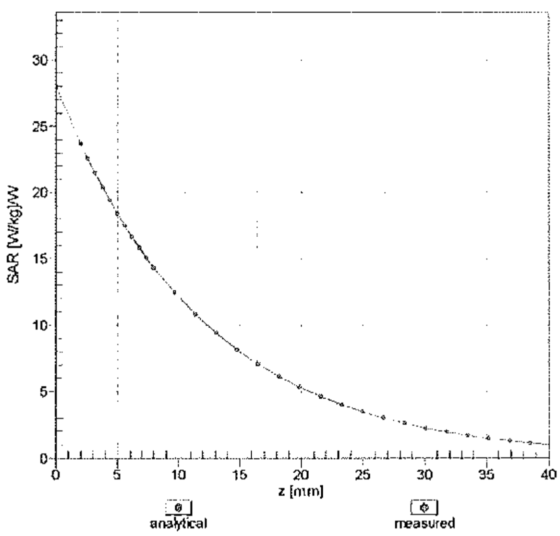
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

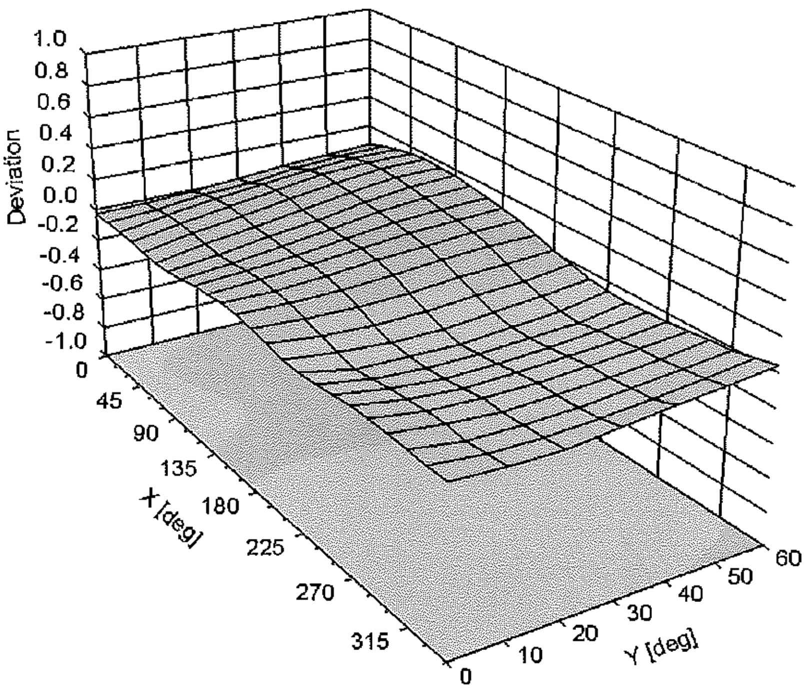


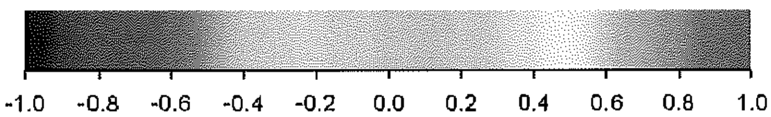
f = 1900 MHz,WGLS R22 (H_convF)



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:3213

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-70.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

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

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

Accreditation No.: SCS 0108

Client PC Test

Certificate No: ES3-3319_Mar15

CALIBRATION CERTIFICATE

PN √ 3/26/15

Object	ES3DV3 - SN:3319
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	March 19, 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	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-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:	Israe Elnaouq	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: March 19, 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 ES3DV3

SN:3319

Manufactured: January 10, 2012
Calibrated: March 19, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3319

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m)^2)[A]	1.12	1.08	1.15	± 10.1 %
DCP (mV)[B]	104.4	106.0	104.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	176.1	±3.3 %
		Y	0.0	0.0	1.0		192.7	
		Z	0.0	0.0	1.0		174.6	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	3.26	64.8	13.4	10.00	41.7	±1.9 %
		Y	2.66	62.2	11.7		39.5	
		Z	3.51	64.8	13.2		42.1	
10011-CAB	UMTS-FDD (WCDMA)	X	3.47	68.1	19.1	2.91	142.9	±0.5 %
		Y	3.37	67.9	19.1		133.0	
		Z	3.57	68.7	19.4		138.6	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.48	71.8	20.2	1.87	143.9	±0.7 %
		Y	3.23	70.9	19.9		134.6	
		Z	3.68	72.8	20.6		140.5	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.18	70.5	23.1	9.46	143.4	±3.3 %
		Y	10.98	70.5	23.2		129.9	
		Z	11.19	70.6	23.1		138.8	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	15.55	92.7	26.1	9.39	126.5	±1.7 %
		Y	21.21	98.0	27.2		142.0	
		Z	19.50	96.1	27.0		125.4	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	23.54	100.0	28.4	9.57	142.6	±2.2 %
		Y	23.24	99.9	28.0		137.4	
		Z	23.57	99.6	28.2		139.7	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	17.00	90.2	22.7	6.56	128.9	±2.2 %
		Y	35.20	99.7	24.9		148.2	
		Z	33.12	99.6	25.4		123.8	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	44.20	99.6	23.6	4.80	146.0	±1.9 %
		Y	49.99	99.9	23.0		136.6	
		Z	41.43	99.6	23.9		141.4	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	46.56	99.7	22.7	3.55	127.7	±2.2 %
		Y	58.11	99.8	21.9		145.3	
		Z	55.65	99.6	22.2		124.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	34.25	99.4	21.1	1.16	140.3	±1.7 %
		Y	40.72	100.0	20.6		135.7	
		Z	45.39	100.0	20.8		136.4	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.30	67.1	19.5	5.67	127.4	±1.4 %
		Y	6.58	68.4	20.3		149.0	
		Z	6.55	68.0	19.9		146.3	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.47	75.6	25.8	9.29	146.6	±3.0 %
		Y	10.18	75.8	26.3		136.2	
		Z	10.38	75.3	25.6		140.8	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.18	66.6	19.4	5.80	126.9	±1.4 %
		Y	6.40	67.8	20.1		147.0	
		Z	6.44	67.6	19.9		145.7	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.24	69.0	21.3	8.07	142.7	±2.5 %
		Y	10.25	69.2	21.5		136.7	
		Z	10.16	68.8	21.2		136.6	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.85	74.8	25.6	9.28	140.8	±3.0 %
		Y	9.49	74.7	25.9		130.5	
		Z	9.90	74.8	25.6		136.8	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.13	67.1	19.7	5.75	146.6	±1.4 %
		Y	6.11	67.4	19.9		147.7	
		Z	6.12	67.1	19.7		142.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.33	66.7	19.4	5.82	128.9	±1.4 %
		Y	6.33	67.1	19.7		128.7	
		Z	6.57	67.6	19.9		147.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.89	66.4	19.5	5.73	127.5	±1.2 %
		Y	4.99	67.5	20.2		149.3	
		Z	5.09	67.3	20.0		145.1	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.99	75.8	26.3	9.21	127.6	±2.7 %
		Y	9.29	81.7	29.6		149.8	
		Z	8.04	75.8	26.3		123.6	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.08	67.3	20.0	5.72	149.3	±1.4 %
		Y	5.00	67.6	20.3		145.0	
		Z	5.09	67.3	20.0		145.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.08	67.3	20.0	5.72	148.5	±1.4 %
		Y	5.06	67.9	20.4		147.1	
		Z	5.11	67.4	20.0		144.8	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.89	68.7	21.2	8.10	134.6	±2.2 %
		Y	9.84	68.9	21.4		130.4	
		Z	9.82	68.5	21.1		130.4	
10225-CAB	UMTS-FDD (HSPA+)	X	7.02	67.1	19.5	5.97	138.0	±1.4 %
		Y	6.88	67.0	19.5		133.2	
		Z	7.01	67.1	19.5		134.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.01	75.9	26.4	9.21	128.0	±2.7 %
		Y	9.39	82.1	29.9		149.7	
		Z	8.34	76.9	26.9		129.1	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.05	73.6	25.1	9.24	130.6	±3.0 %
		Y	8.76	73.7	25.5		123.6	
		Z	9.10	73.6	25.1		127.8	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.81	74.7	25.6	9.30	139.3	±3.0 %
		Y	9.50	74.8	25.9		130.7	
		Z	9.81	74.6	25.5		135.0	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.49	67.1	18.9	3.96	140.1	±0.7 %
		Y	4.46	67.2	19.0		137.6	
		Z	4.52	67.1	18.9		137.1	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.68	67.0	18.8	3.46	129.3	±0.7 %
		Y	3.64	67.3	19.0		130.3	
		Z	3.84	67.9	19.2		148.6	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.64	67.2	18.8	3.39	131.8	±0.5 %
		Y	3.60	67.4	19.1		128.2	
		Z	3.71	67.5	19.0		128.0	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.43	67.5	19.9	5.81	147.2	±1.7 %
		Y	6.39	67.7	20.0		145.4	
		Z	6.42	67.5	19.8		143.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.73	67.1	19.7	6.06	129.7	±1.4 %
		Y	6.75	67.5	19.9		130.8	
		Z	6.75	67.3	19.7		126.2	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.14	68.9	21.5	8.37	136.7	±2.5 %
		Y	10.23	69.5	22.0		136.5	
		Z	10.13	68.9	21.5		132.8	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.97	69.2	19.3	3.76	143.5	±0.5 %
		Y	4.87	69.3	19.4		141.0	
		Z	5.02	69.2	19.3		139.6	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.91	69.3	19.4	3.77	139.8	±0.7 %
		Y	4.67	68.9	19.1		138.9	
		Z	4.89	69.1	19.3		137.1	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.93	70.1	19.6	1.54	137.8	±0.7 %
		Y	2.84	69.8	19.6		138.2	
		Z	3.04	70.8	19.9		134.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.94	68.7	21.3	8.23	134.6	±2.2 %
		Y	10.00	69.1	21.7		134.1	
		Z	9.89	68.5	21.2		130.1	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3319

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)
750	41.9	0.89	6.69	6.69	6.69	0.40	1.70	± 12.0 %
835	41.5	0.90	6.41	6.41	6.41	0.43	1.62	± 12.0 %
1750	40.1	1.37	5.29	5.29	5.29	0.80	1.16	± 12.0 %
1900	40.0	1.40	5.10	5.10	5.10	0.80	1.24	± 12.0 %
2300	39.5	1.67	4.77	4.77	4.77	0.64	1.38	± 12.0 %
2450	39.2	1.80	4.55	4.55	4.55	0.80	1.29	± 12.0 %
2600	39.0	1.96	4.39	4.39	4.39	0.80	1.31	± 12.0 %

[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:3319

Calibration Parameter Determined in Body Tissue Simulating Media

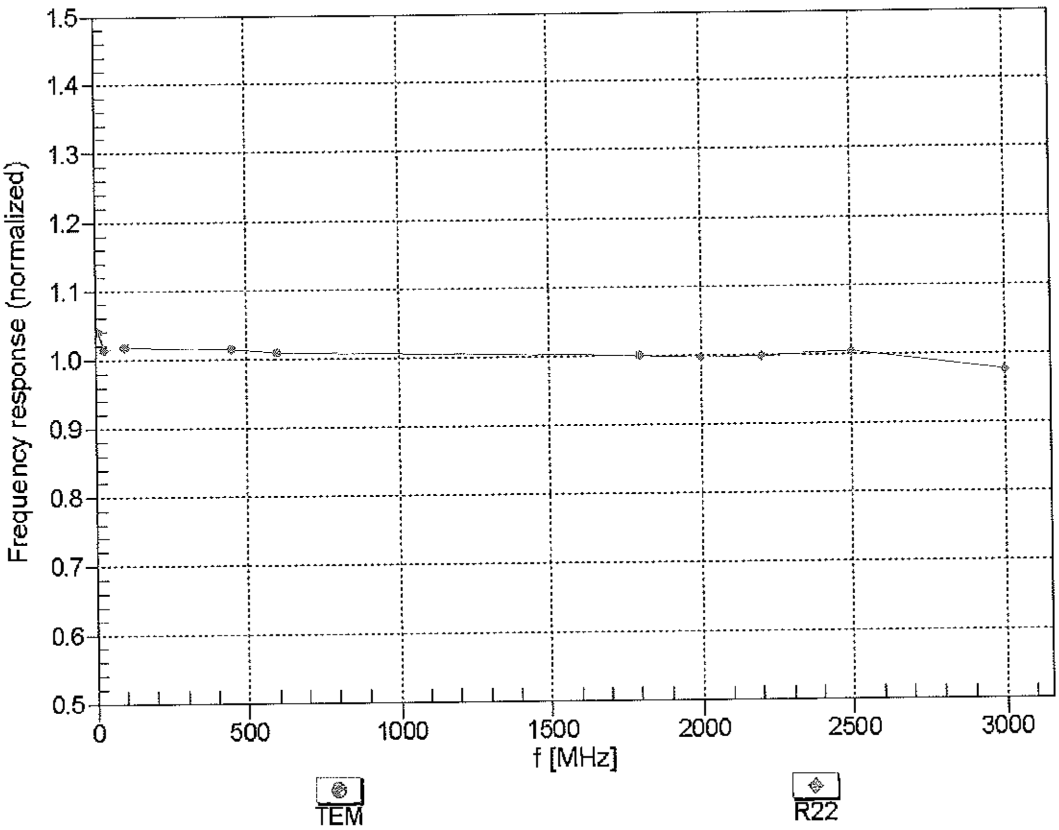
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.10	6.10	6.10	0.34	1.80	± 12.0 %
835	55.2	0.97	6.07	6.07	6.07	0.47	1.56	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.70	1.36	± 12.0 %
1900	53.3	1.52	4.53	4.53	4.53	0.71	1.39	± 12.0 %
2300	52.9	1.81	4.24	4.24	4.24	0.80	1.26	± 12.0 %
2450	52.7	1.95	4.11	4.11	4.11	0.80	1.10	± 12.0 %
2600	52.5	2.16	3.90	3.90	3.90	0.80	1.11	± 12.0 %

[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.

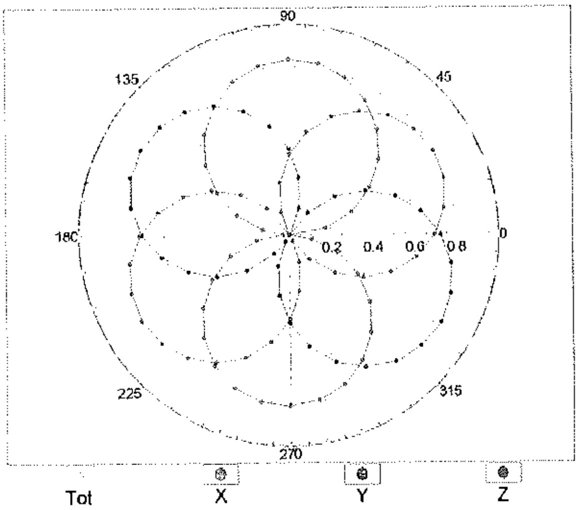
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



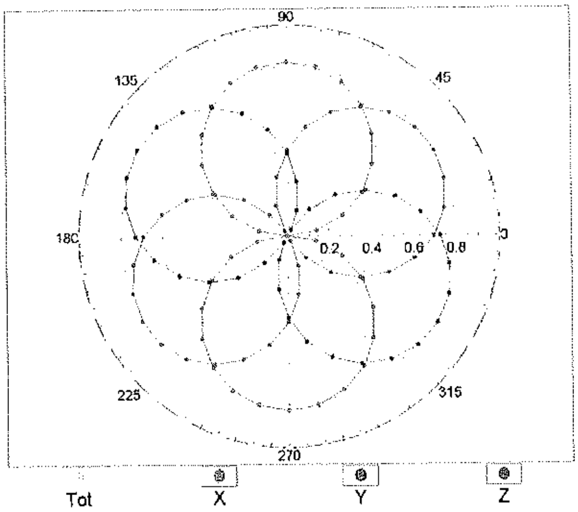
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

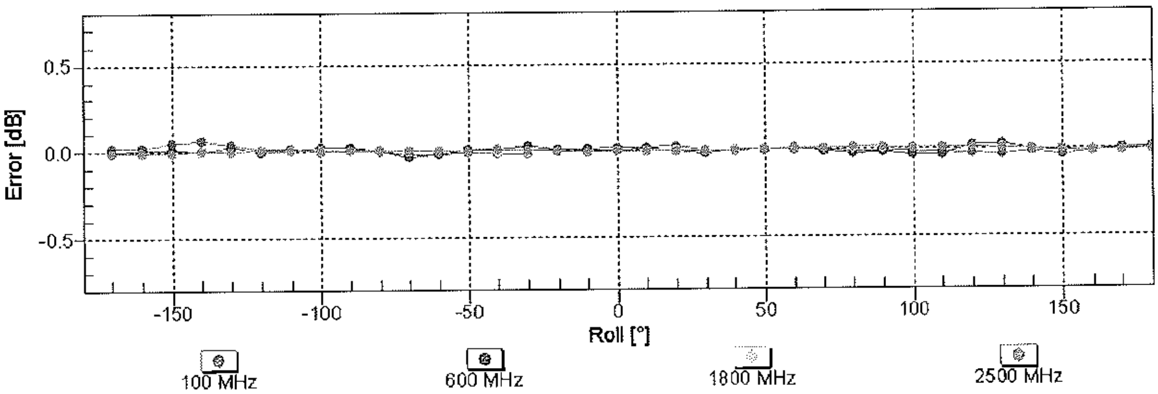
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



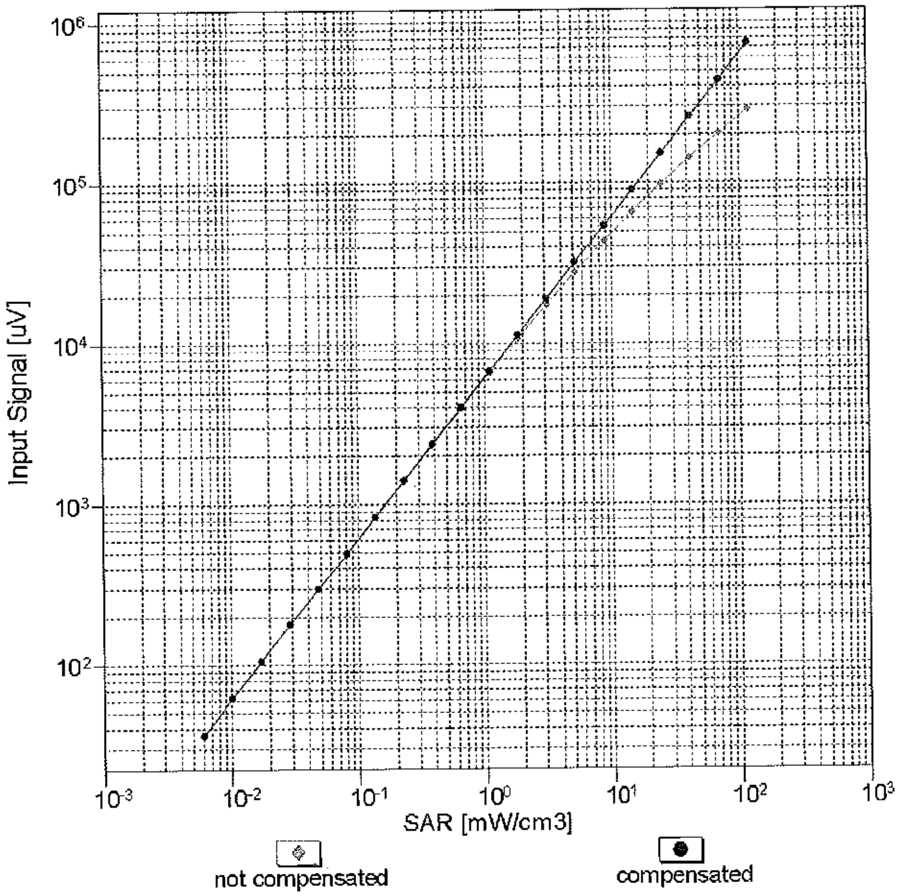
f=1800 MHz,R22

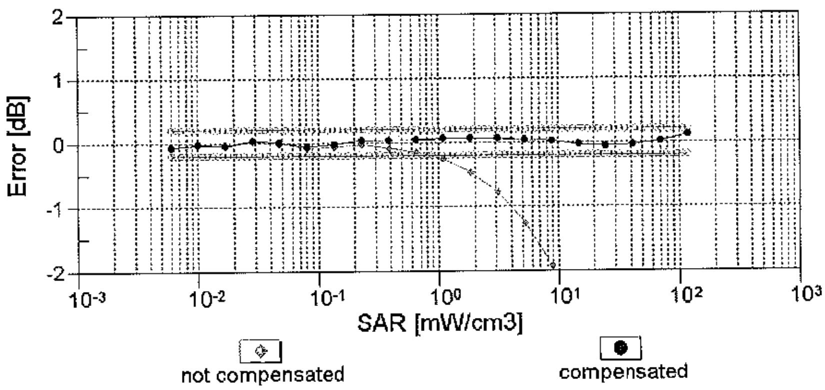




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

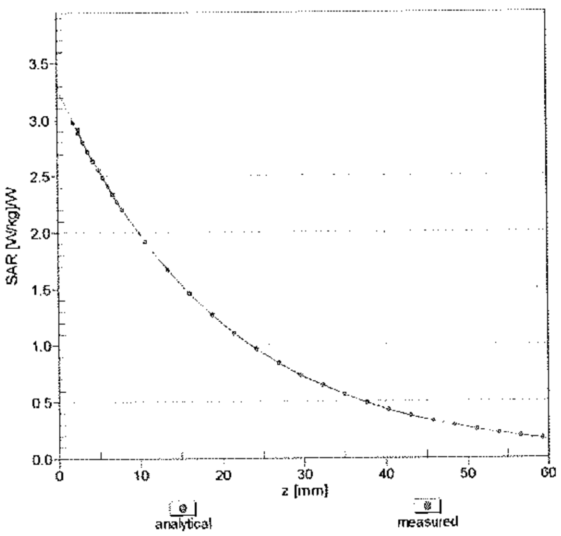




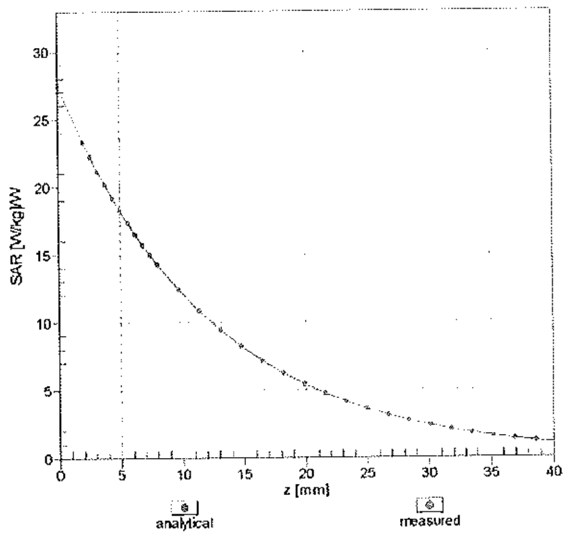
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

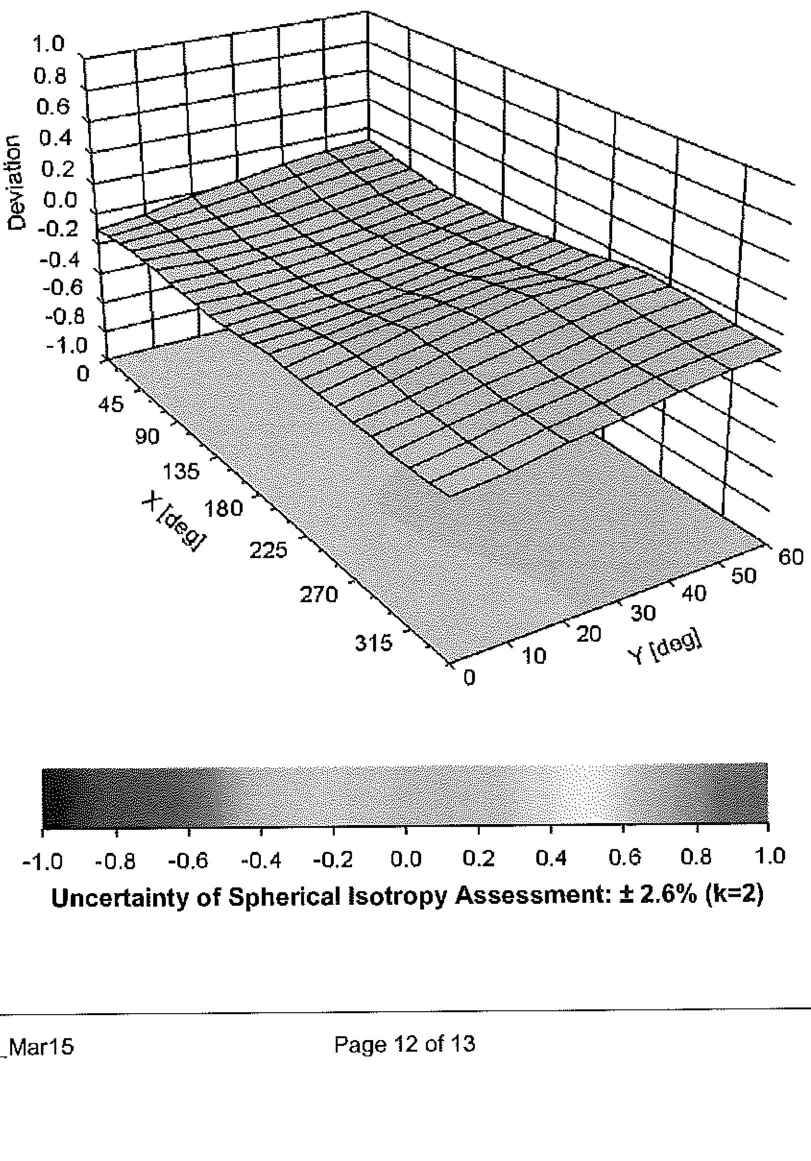


f = 1900 MHz,WGLS R22 (H_convF)



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:3319

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-120.2
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

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 **PC Test**

Certificate No: **ES3-3332_Sep14/2**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3332_Sep14)

Object: ES3DV3 - SN:3332

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

CC 12/12/14

Calibration date: September 18, 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:	Israe El-Naouq	Laboratory Technician	*(signature)*
Approved by:	Katja Pokovic	Technical Manager	*(signature)*

Issued: November 3, 2014

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 Paramaters:* 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:3332

Manufactured: January 24, 2012
Calibrated: September 18, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3332

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)²)^A	0.94	1.15	0.98	± 10.1 %
DCP (mV)^B	105.8	103.8	112.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	178.7	±3.0 %
		Y	0.0	0.0	1.0		199.5	
		Z	0.0	0.0	1.0		186.5	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	55.60	92.4	20.6	10.00	35.7	±1.7 %
		Y	2.80	61.2	11.6		42.9	
		Z	10.49	80.1	18.0		36.1	
10011-CAB	UMTS-FDD (WCDMA)	X	3.47	67.9	18.8	2.91	141.3	±0.7 %
		Y	3.29	67.0	18.4		138.2	
		Z	3.78	70.4	20.1		147.9	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.53	72.0	20.1	1.87	141.7	±0.7 %
		Y	3.03	69.1	18.8		141.1	
		Z	4.06	75.5	21.6		148.2	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.87	69.8	22.6	9.46	137.3	±3.5 %
		Y	11.63	71.7	23.9		141.9	
		Z	10.51	69.6	22.5		139.2	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	6.92	78.4	20.1	9.39	137.0	±2.5 %
		Y	26.20	99.6	27.8		141.5	
		Z	5.13	78.3	21.1		144.7	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	9.10	83.6	22.5	9.57	144.0	±2.5 %
		Y	26.31	100.0	28.1		136.7	
		Z	6.15	81.6	22.5		139.9	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	10.54	84.1	20.4	6.56	141.8	±2.5 %
		Y	40.55	99.6	24.9		142.2	
		Z	6.45	81.5	20.2		145.7	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	28.34	94.6	21.9	4.80	131.4	±2.5 %
		Y	52.22	99.6	23.3		126.8	
		Z	28.33	99.5	23.9		140.7	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	52.17	100.0	22.2	3.55	147.0	±1.7 %
		Y	57.29	99.6	22.4		133.0	
		Z	25.84	99.5	23.3		126.2	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	59.05	100.0	19.9	1.16	135.5	±1.9 %
		Y	100.00	99.7	19.2		143.5	
		Z	34.97	100.0	20.4		143.1	

10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.78	66.9	18.9	4.57	134.6	±0.9 %
		Y	4.85	67.1	19.1		141.0	
		Z	4.76	67.8	19.4		140.7	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.98	66.4	18.6	3.97	130.4	±0.7 %
		Y	3.98	66.5	18.7		136.2	
		Z	4.04	67.7	19.2		137.4	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.75	67.3	18.8	3.98	144.4	±0.7 %
		Y	4.55	66.5	18.5		126.5	
		Z	4.72	67.9	19.0		128.1	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.26	66.9	19.2	5.67	124.5	±1.2 %
		Y	6.38	67.4	19.7		131.7	
		Z	6.36	67.7	19.7		132.3	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.44	67.5	19.7	5.80	147.4	±1.4 %
		Y	6.31	67.2	19.7		130.2	
		Z	6.17	67.2	19.6		130.1	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.08	66.9	19.5	5.75	142.7	±1.4 %
		Y	5.97	66.6	19.4		127.3	
		Z	5.84	66.7	19.3		126.2	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.13	68.7	21.0	8.10	136.9	±2.5 %
		Y	10.57	69.9	21.9		146.3	
		Z	10.06	69.0	21.1		143.6	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.12	68.6	21.0	8.07	138.2	±2.5 %
		Y	10.60	69.9	21.9		148.0	
		Z	10.07	69.0	21.1		146.6	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.76	71.7	23.8	9.28	130.7	±3.0 %
		Y	10.03	75.2	25.9		121.5	
		Z	8.15	70.7	23.5		134.1	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.10	67.0	19.5	5.75	144.4	±1.4 %
		Y	5.98	66.6	19.4		127.8	
		Z	5.84	66.6	19.3		127.2	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.56	67.5	19.7	5.82	149.5	±1.7 %
		Y	6.41	67.1	19.6		132.5	
		Z	6.17	66.8	19.4		130.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.01	67.0	19.7	5.73	147.8	±1.2 %
		Y	5.01	66.9	19.8		132.1	
		Z	4.75	66.9	19.7		130.3	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.65	75.0	25.8	9.21	144.9	±2.7 %
		Y	10.17	82.4	29.7		136.4	
		Z	6.53	72.3	24.6		145.6	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.98	66.9	19.6	5.72	141.0	±1.2 %
		Y	4.98	66.7	19.7		130.5	
		Z	4.71	66.7	19.5		128.1	

10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.95	66.7	19.5	5.72	139.8	±1.2 %
		Y	4.97	66.7	19.7		129.5	
		Z	4.72	66.8	19.6		128.0	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.75	68.2	20.9	8.09	131.8	±2.5 %
		Y	10.16	69.4	21.7		139.2	
		Z	9.62	68.6	21.0		137.3	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.77	68.3	20.9	8.10	133.6	±2.5 %
		Y	10.17	69.4	21.8		140.1	
		Z	9.61	68.5	21.0		140.1	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.69	68.3	20.9	8.03	133.6	±2.5 %
		Y	10.05	69.3	21.7		139.2	
		Z	9.58	68.7	21.1		139.4	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.13	68.7	21.0	8.06	140.7	±2.5 %
		Y	10.51	69.8	21.8		145.1	
		Z	10.11	69.1	21.2		148.4	
10225-CAB	UMTS-FDD (HSPA+)	X	7.03	67.2	19.4	5.97	138.0	±1.4 %
		Y	7.07	67.2	19.6		140.2	
		Z	6.97	67.8	19.7		144.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	7.11	72.9	24.7	9.21	124.6	±2.7 %
		Y	10.04	82.0	29.5		135.7	
		Z	6.29	71.2	24.0		126.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.61	72.5	24.3	9.24	145.2	±3.3 %
		Y	10.53	77.8	27.4		136.7	
		Z	7.56	70.0	23.1		126.7	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	8.74	71.6	23.8	9.30	128.7	±3.3 %
		Y	11.51	79.1	28.0		147.2	
		Z	8.07	70.4	23.2		134.1	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.90	66.7	18.7	4.87	128.0	±0.9 %
		Y	5.93	66.8	18.9		134.5	
		Z	5.92	67.6	19.1		138.2	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.53	67.1	18.8	3.96	133.8	±0.7 %
		Y	4.48	67.0	18.8		139.6	
		Z	4.62	68.3	19.3		145.0	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.82	67.8	19.0	3.46	147.6	±0.7 %
		Y	3.66	67.0	18.8		131.7	
		Z	3.97	69.6	20.0		135.9	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.70	67.5	18.8	3.39	128.1	±0.7 %
		Y	3.60	66.9	18.7		132.5	
		Z	3.80	68.9	19.5		139.8	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.47	67.6	19.8	5.81	149.7	±1.7 %
		Y	6.24	66.9	19.5		126.3	
		Z	6.20	67.3	19.6		130.9	

10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.72	67.1	19.5	6.06	128.8	±1.4 %
		Y	6.85	67.7	20.0		132.4	
		Z	6.75	67.7	19.8		136.6	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.27	71.1	19.8	1.71	140.1	±0.7 %
		Y	2.95	69.4	19.1		139.8	
		Z	3.75	74.4	21.2		146.9	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.04	68.7	21.3	8.36	136.3	±2.5 %
		Y	10.42	69.8	22.1		138.1	
		Z	9.84	68.9	21.3		139.7	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	5.01	69.3	19.2	3.76	144.3	±0.7 %
		Y	4.79	68.1	18.7		146.3	
		Z	5.40	72.5	20.8		146.7	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.97	69.5	19.3	3.77	141.3	±0.7 %
		Y	4.72	68.2	18.8		143.1	
		Z	5.12	71.8	20.5		144.4	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	3.05	70.5	19.5	1.54	139.7	±0.7 %
		Y	2.71	68.7	18.9		140.2	
		Z	4.22	77.3	22.5		145.9	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.92	68.6	21.1	8.23	136.3	±2.5 %
		Y	10.20	69.4	21.8		138.3	
		Z	9.76	68.8	21.3		138.9	

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 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:3332

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)
750	41.9	0.89	6.56	6.56	6.56	0.50	1.43	± 12.0 %
835	41.5	0.90	6.31	6.31	6.31	0.61	1.31	± 12.0 %
1750	40.1	1.37	5.17	5.17	5.17	0.62	1.33	± 12.0 %
1900	40.0	1.40	5.04	5.04	5.04	0.80	1.17	± 12.0 %
2450	39.2	1.80	4.49	4.49	4.49	0.77	1.24	± 12.0 %
2600	39.0	1.96	4.35	4.35	4.35	0.73	1.38	± 12.0 %

[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.

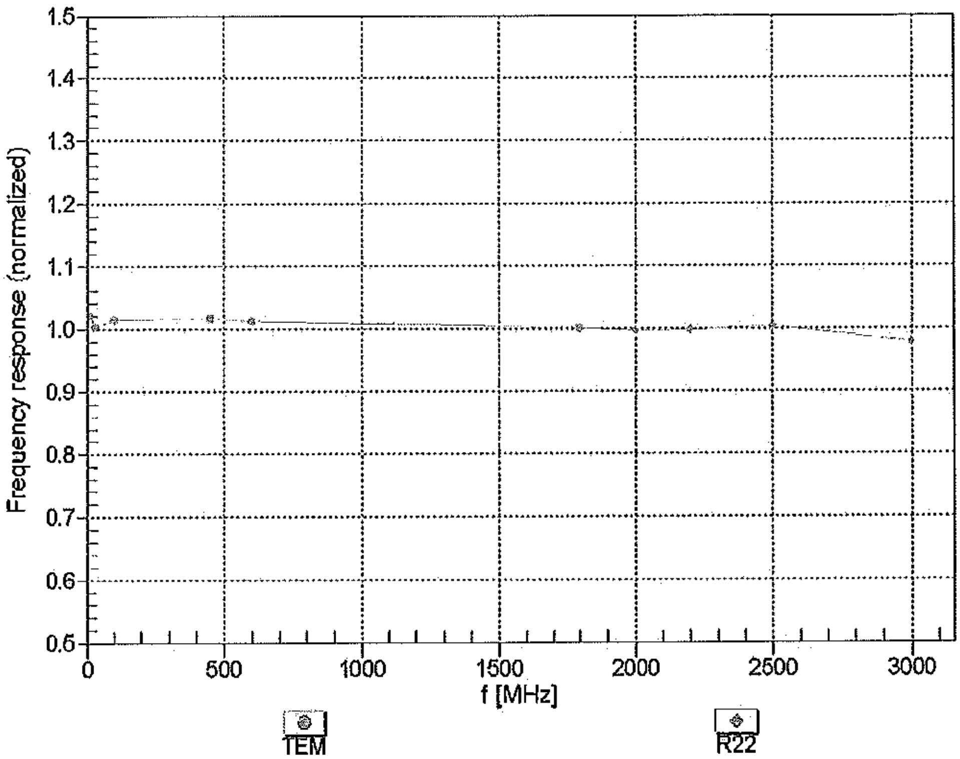
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3332

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)
750	55.5	0.96	6.24	6.24	6.24	0.50	1.50	± 12.0 %
835	55.2	0.97	6.21	6.21	6.21	0.45	1.59	± 12.0 %
1750	53.4	1.49	4.88	4.88	4.88	0.39	1.78	± 12.0 %
1900	53.3	1.52	4.64	4.64	4.64	0.61	1.47	± 12.0 %
2450	52.7	1.95	4.31	4.31	4.31	0.80	1.18	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.68	0.99	± 12.0 %

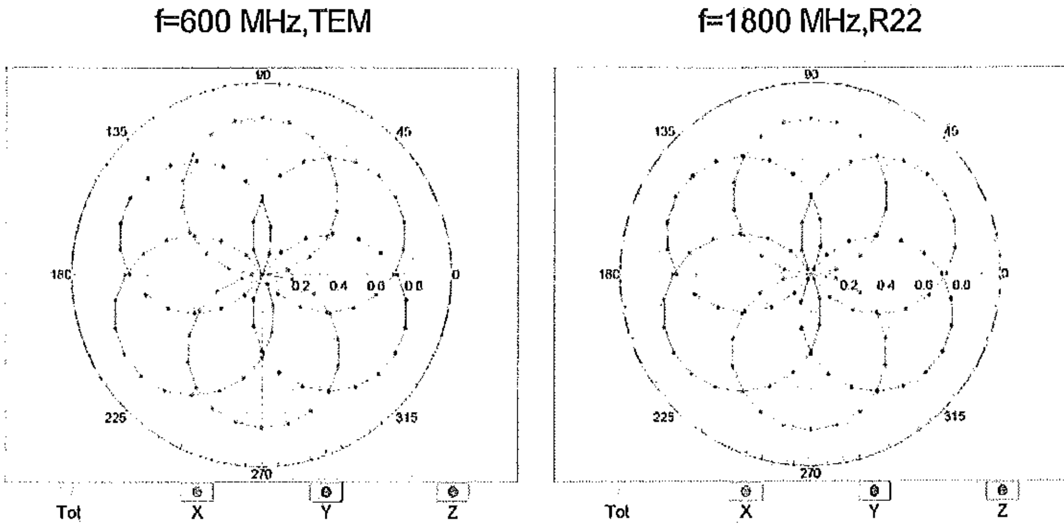
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz 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.

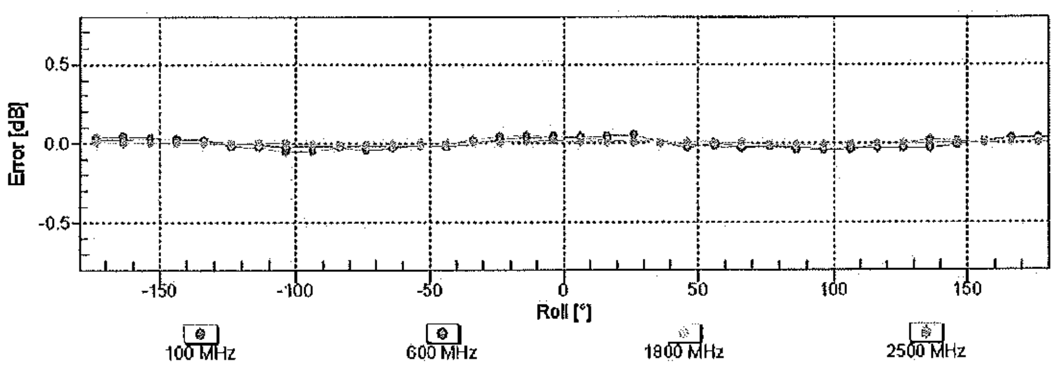
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

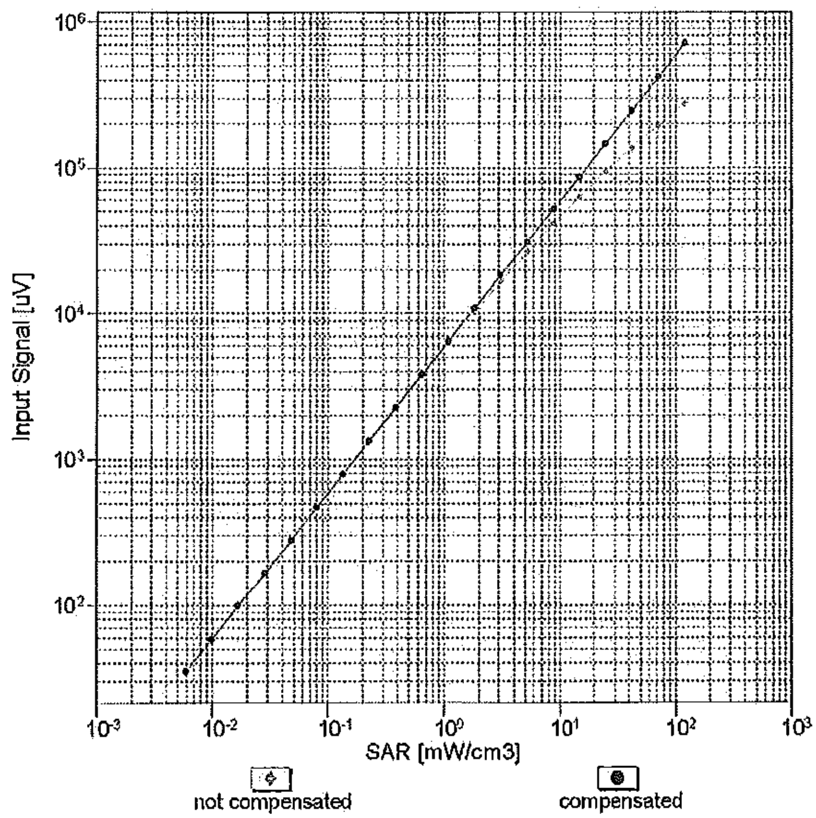
Receiving Pattern (ϕ), ϑ = 0°

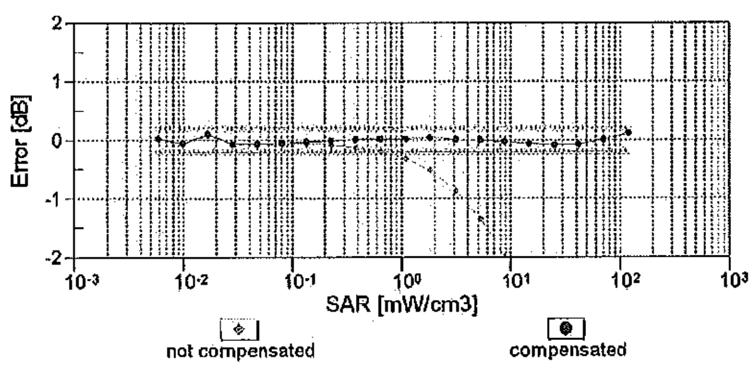




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

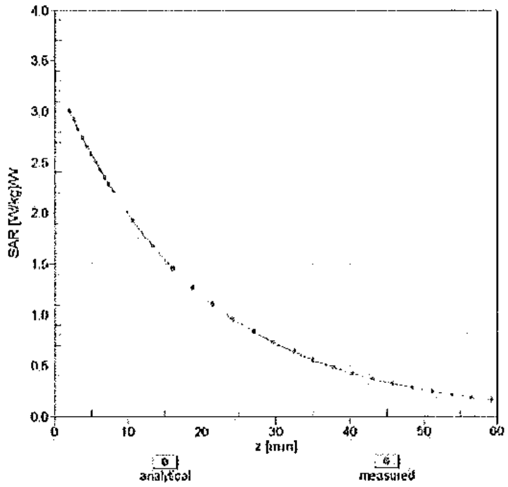




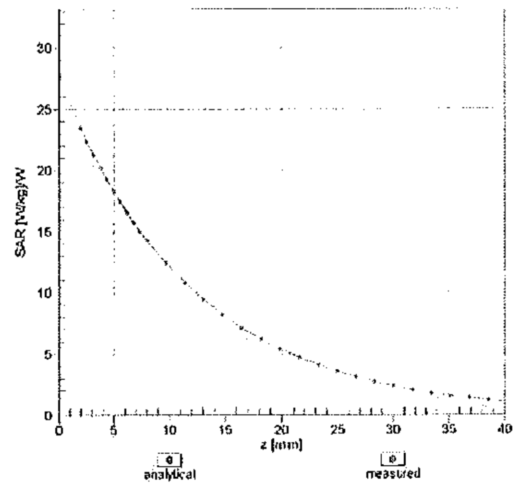
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

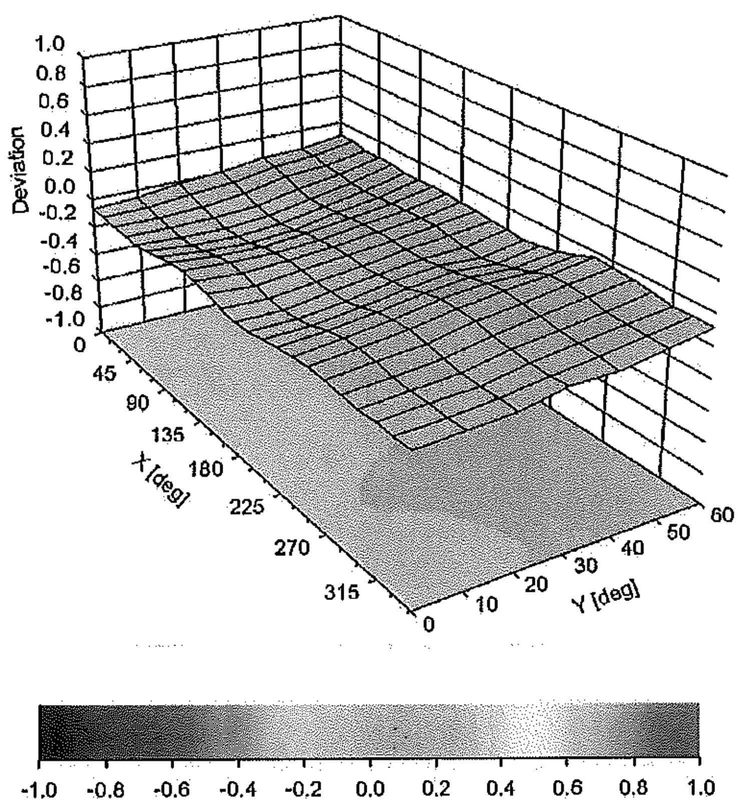


f = 1900 MHz,WGLS R22 (H_convF)



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:3332

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-3.7
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

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 **PC Test**

Certificate No: **ES3-3333_Oct14**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3333

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

CC
10/31/14

Calibration date: October 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-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 24, 2014

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:3333

Manufactured: January 24, 2012
Calibrated: October 24, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.08	0.90	0.88	± 10.1 %
DCP (mV)[B]	102.7	107.7	106.3	

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	190.7	±2.5 %
		Y	0.0	0.0	1.0		183.3	
		Z	0.0	0.0	1.0		197.9	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	3.17	61.7	12.2	10.00	42.4	±1.9 %
		Y	3.16	63.7	12.4		38.0	
		Z	1.84	59.2	10.5		39.9	
10011-CAB	UMTS-FDD (WCDMA)	X	3.22	65.9	17.6	2.91	128.5	±0.5 %
		Y	3.60	69.3	19.8		146.7	
		Z	3.51	68.1	18.8		133.7	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.14	68.6	18.2	1.87	132.6	±0.7 %
		Y	3.64	73.3	21.1		127.5	
		Z	3.50	71.4	19.6		136.4	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.56	70.8	23.0	9.46	135.8	±3.5 %
		Y	10.93	70.2	23.0		122.3	
		Z	10.93	70.0	22.6		132.8	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	24.60	96.9	27.6	9.39	147.6	±1.9 %
		Y	19.44	94.3	26.1		148.6	
		Z	9.58	82.7	21.9		138.2	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	20.09	93.0	26.4	9.57	141.7	±2.7 %
		Y	24.86	99.0	27.9		143.5	
		Z	11.74	86.4	23.4		134.4	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	23.76	91.2	23.1	6.56	147.8	±2.5 %
		Y	37.10	99.8	25.3		149.9	
		Z	16.01	88.1	21.6		128.0	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	36.24	94.5	22.6	4.80	128.6	±2.5 %
		Y	47.57	99.9	23.7		133.5	
		Z	44.37	99.7	23.6		140.1	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	65.86	99.7	22.7	3.55	133.1	±2.7 %
		Y	55.92	100.0	22.6		142.0	
		Z	59.41	100.0	22.2		125.1	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	85.87	100.0	20.1	1.16	138.3	±2.2 %
		Y	14.41	99.2	23.3		130.5	
		Z	85.82	99.8	19.3		135.9	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.49	67.4	19.4	5.67	144.6	±1.7 %
		Y	6.49	68.0	20.1		139.9	
		Z	6.54	67.9	19.7		147.3	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.81	74.7	24.9	9.29	122.0	±3.0 %
		Y	10.50	75.9	26.1		131.6	
		Z	9.76	73.5	24.5		138.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.43	67.2	19.4	5.80	143.3	±1.7 %
		Y	6.37	67.7	20.0		138.0	
		Z	6.43	67.5	19.7		146.7	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.19	68.6	20.9	8.07	136.2	±2.5 %
		Y	10.15	68.9	21.4		128.3	
		Z	10.12	68.7	21.0		137.9	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	11.48	77.0	26.1	9.28	147.5	±3.3 %
		Y	9.81	74.9	25.8		125.7	
		Z	9.22	72.8	24.3		133.2	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.10	66.5	19.1	5.75	140.0	±1.7 %
		Y	6.04	67.1	19.8		134.8	
		Z	6.12	67.1	19.5		143.2	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.57	67.2	19.4	5.82	146.3	±1.7 %
		Y	6.47	67.6	20.0		139.6	
		Z	6.56	67.6	19.7		148.5	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.16	66.7	19.4	5.73	145.8	±1.4 %
		Y	5.02	67.5	20.2		137.5	
		Z	5.07	67.2	19.7		147.1	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	10.07	79.2	27.3	9.21	136.5	±3.0 %
		Y	9.70	81.5	29.3		142.5	
		Z	7.63	74.3	25.3		125.0	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.13	66.6	19.3	5.72	145.9	±1.4 %
		Y	5.01	67.4	20.1		137.5	
		Z	5.04	67.1	19.7		146.3	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.14	66.6	19.3	5.72	145.7	±1.4 %
		Y	5.03	67.5	20.3		137.4	
		Z	5.06	67.2	19.7		146.6	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.88	68.3	20.8	8.10	130.9	±2.5 %
		Y	10.13	69.6	21.8		149.0	
		Z	9.77	68.4	20.9		131.6	
10225-CAB	UMTS-FDD (HSPA+)	X	6.98	66.5	19.0	5.97	132.9	±1.7 %
		Y	7.14	67.8	20.0		149.7	
		Z	7.02	67.2	19.4		134.3	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	10.13	79.4	27.4	9.21	137.5	±3.0 %
		Y	9.73	81.6	29.3		143.3	
		Z	7.59	74.1	25.1		125.6	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	10.80	76.4	25.9	9.24	140.0	±3.3 %
		Y	10.19	77.2	27.1		147.2	
		Z	8.55	71.8	23.9		124.9	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	11.59	77.3	26.3	9.30	148.4	±3.5 %
		Y	9.87	75.1	25.9		126.0	
		Z	9.21	72.7	24.2		133.6	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.40	66.1	18.1	3.96	134.1	±0.7 %
		Y	4.48	67.4	19.2		129.7	
		Z	4.54	67.2	18.7		137.4	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.59	65.7	17.7	3.46	127.5	±0.7 %
		Y	3.85	68.4	19.7		143.4	
		Z	3.78	67.6	18.8		129.7	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.56	65.9	17.8	3.39	127.9	±0.7 %
		Y	3.81	68.6	19.8		144.2	
		Z	3.71	67.5	18.8		130.7	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.44	67.1	19.4	5.81	143.0	±1.7 %
		Y	6.37	67.6	20.0		137.9	
		Z	6.43	67.5	19.7		146.5	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.02	67.8	19.8	6.06	148.7	±1.9 %
		Y	6.96	68.2	20.4		143.6	
		Z	6.72	67.1	19.5		126.9	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.73	67.0	17.9	3.76	140.2	±0.7 %
		Y	4.96	69.4	19.5		130.7	
		Z	5.05	69.3	19.1		140.9	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.70	67.2	18.1	3.77	138.1	±0.7 %
		Y	4.85	69.5	19.6		129.6	
		Z	5.14	70.1	19.5		139.3	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.47	66.1	17.1	1.54	133.2	±0.7 %
		Y	3.15	72.2	20.9		127.9	
		Z	3.32	72.0	20.1		137.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.99	68.4	21.0	8.23	131.6	±2.5 %
		Y	9.84	68.6	21.4		123.3	
		Z	9.89	68.6	21.1		133.4	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

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)
750	41.9	0.89	6.55	6.55	6.55	0.34	1.74	± 12.0 %
835	41.5	0.90	6.33	6.33	6.33	0.44	1.48	± 12.0 %
1750	40.1	1.37	5.26	5.26	5.26	0.73	1.21	± 12.0 %
1900	40.0	1.40	5.11	5.11	5.11	0.66	1.32	± 12.0 %
2450	39.2	1.80	4.53	4.53	4.53	0.62	1.40	± 12.0 %
2600	39.0	1.96	4.40	4.40	4.40	0.68	1.38	± 12.0 %

[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:3333

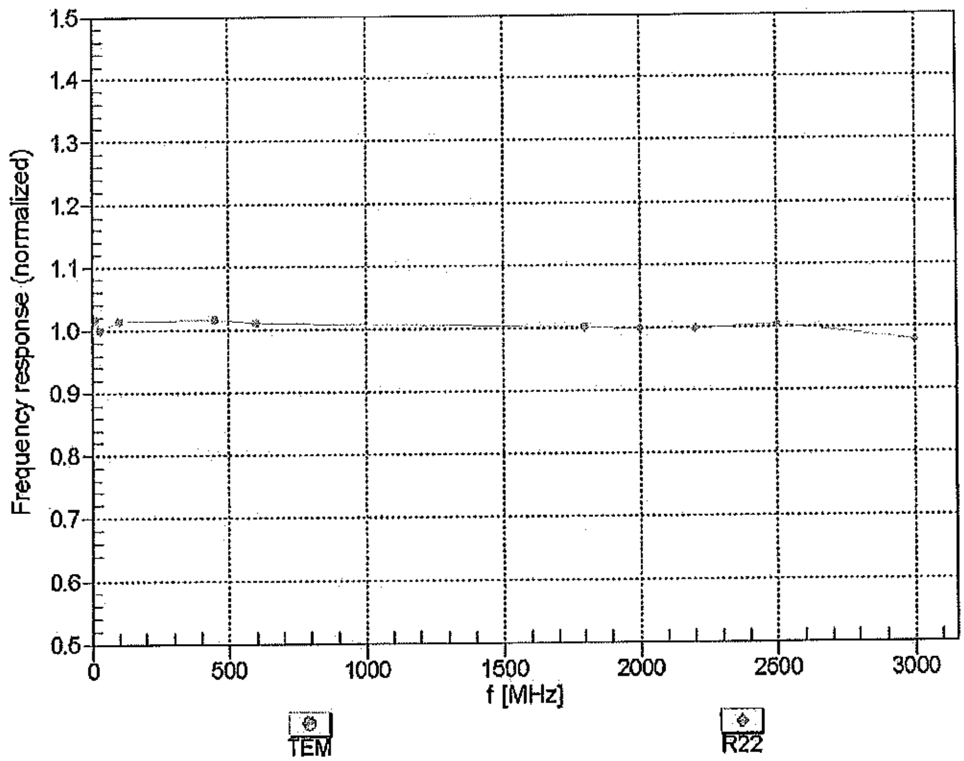
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.14	6.14	6.14	0.35	1.76	± 12.0 %
835	55.2	0.97	6.12	6.12	6.12	0.57	1.37	± 12.0 %
1750	53.4	1.49	4.89	4.89	4.89	0.80	1.24	± 12.0 %
1900	53.3	1.52	4.67	4.67	4.67	0.75	1.29	± 12.0 %
2450	52.7	1.95	4.26	4.26	4.26	0.80	1.01	± 12.0 %
2600	52.5	2.16	4.13	4.13	4.13	0.80	0.99	± 12.0 %

[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.

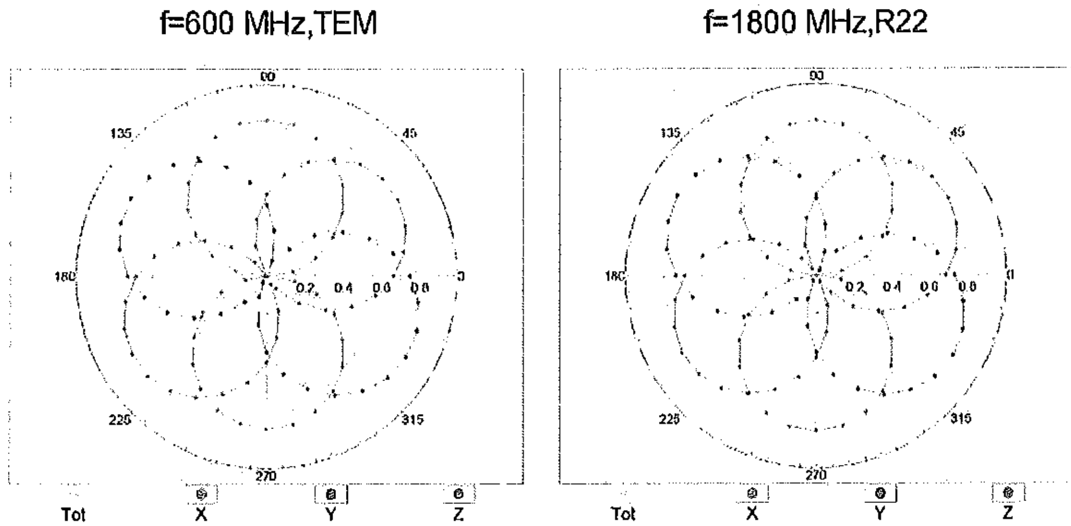
Frequency Response of E-Field

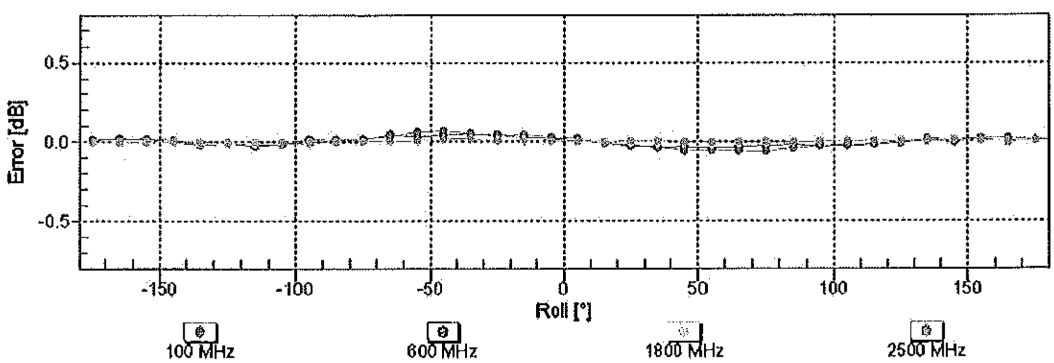
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

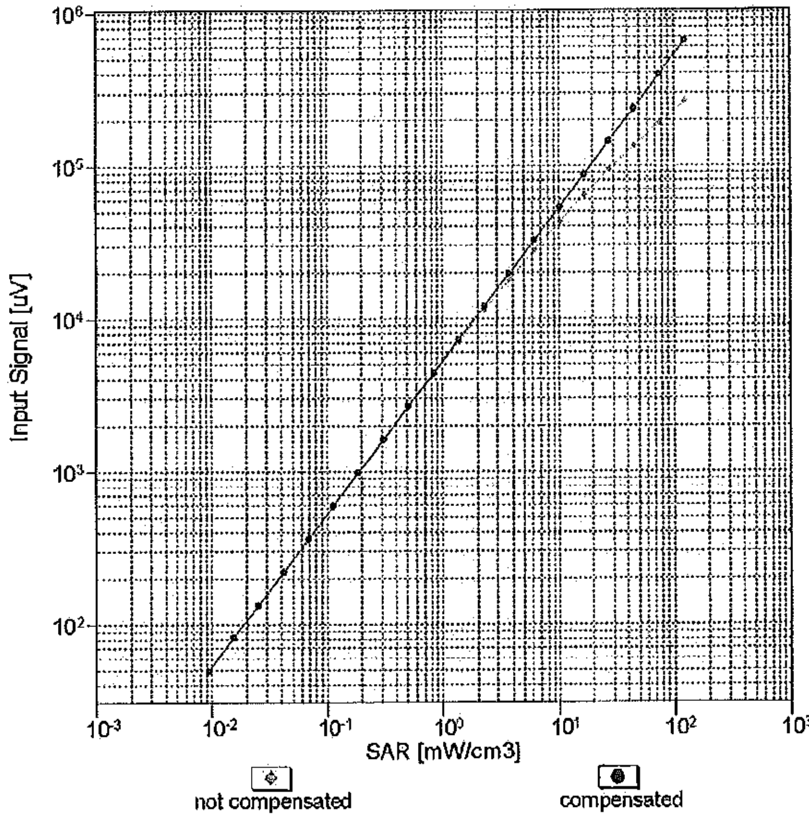
Receiving Pattern (ϕ), $\vartheta = 0°$

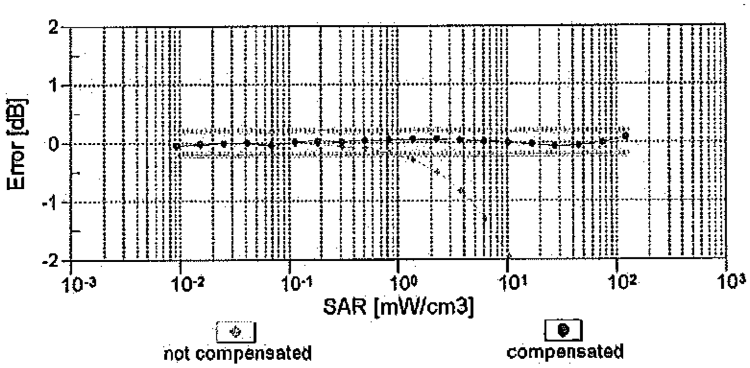




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

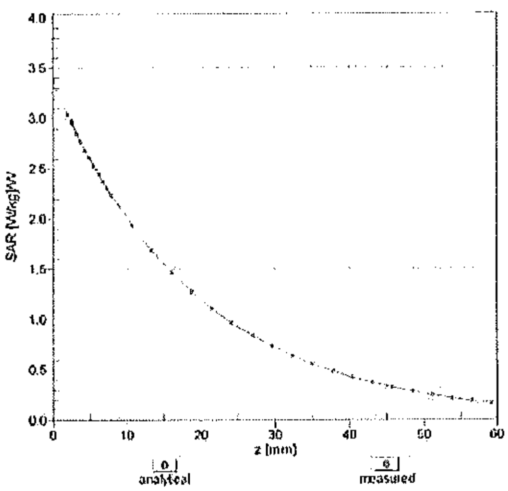




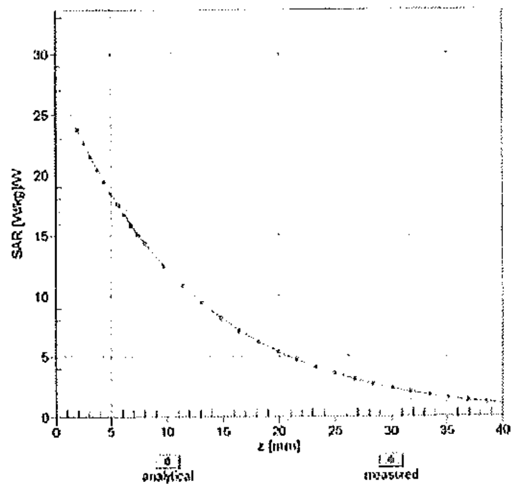
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

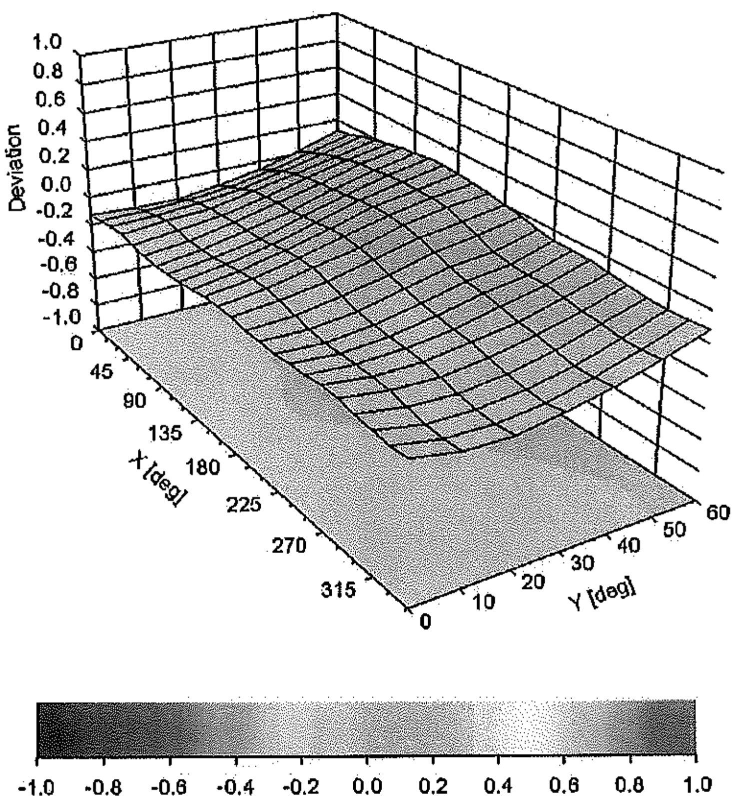


f = 1900 MHz,WGLS R22 (H_convF)



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:3333

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-34.9
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

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

S Schweizerischer Kalibrierdienst
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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 **PC Test**

Certificate No: **EX3-3914_Feb15**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3914

CCV 3/6/15

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

Calibration date: February 10, 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	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-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:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 10, 2015

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

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

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

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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:3914

Manufactured: December 18, 2012
Repaired: January 23, 2015
Calibrated: February 10, 2015

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3914

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.48	0.42	0.45	± 10.1 %
DCP (mV)[B]	102.7	103.2	101.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	137.3	±2.7 %
		Y	0.0	0.0	1.0		140.8	
		Z	0.0	0.0	1.0		134.6	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	1.33	60.3	9.9	10.00	40.4	±1.2 %
		Y	1.02	57.7	9.2		42.2	
		Z	1.41	61.3	11.0		39.9	
10011-CAB	UMTS-FDD (WCDMA)	X	3.39	67.3	18.6	2.91	148.9	±0.5 %
		Y	3.47	67.6	18.6		130.1	
		Z	3.30	66.5	17.9		145.8	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.92	68.9	18.9	1.87	149.0	±0.7 %
		Y	3.17	70.1	19.2		131.4	
		Z	2.72	67.0	17.6		146.9	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.52	69.1	22.1	9.46	140.7	±3.3 %
		Y	10.67	69.8	22.6		146.8	
		Z	10.44	68.9	22.0		136.8	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	1.64	63.4	11.8	9.39	86.2	±1.7 %
		Y	2.03	65.7	13.6		105.2	
		Z	1.78	63.6	12.4		85.9	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.78	65.0	13.2	9.57	84.0	±2.2 %
		Y	1.84	63.8	12.5		101.1	
		Z	1.92	64.9	13.4		83.0	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	2.04	68.8	13.2	6.56	141.3	±1.9 %
		Y	2.32	70.4	14.4		134.7	
		Z	1.59	65.5	12.3		139.3	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.51	67.3	11.9	4.80	148.8	±1.9 %
		Y	1.27	63.7	10.0		136.2	
		Z	3.26	75.5	15.4		148.7	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	52.54	99.9	20.2	3.55	143.3	±1.7 %
		Y	2.95	74.0	13.7		149.7	
		Z	32.98	99.9	21.5		141.9	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	96.97	99.5	17.5	1.16	145.3	±1.2 %
		Y	83.69	99.7	18.1		128.6	
		Z	0.69	65.4	9.0		143.2	

10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.27	68.9	21.5	8.68	145.1	±2.7 %
		Y	9.95	68.4	21.3		123.8	
		Z	10.18	68.8	21.4		140.9	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.38	67.0	19.3	5.67	140.1	±1.4 %
		Y	6.54	67.7	19.6		147.0	
		Z	6.34	66.8	19.1		137.4	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	7.44	67.6	21.6	9.29	132.4	±1.7 %
		Y	7.78	69.0	22.4		140.2	
		Z	7.40	67.4	21.4		129.5	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.25	66.7	19.2	5.80	137.9	±1.4 %
		Y	6.36	67.2	19.5		143.3	
		Z	6.20	66.4	19.0		135.0	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.03	68.2	20.7	8.07	128.5	±2.5 %
		Y	10.17	68.7	21.0		134.9	
		Z	9.94	68.0	20.5		125.2	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.21	67.6	21.8	9.28	149.5	±1.9 %
		Y	7.39	68.5	22.3		135.1	
		Z	7.19	67.5	21.7		147.3	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.91	66.2	19.1	5.75	133.8	±1.2 %
		Y	6.04	66.8	19.4		139.4	
		Z	5.88	66.0	18.9		131.1	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.36	66.7	19.3	5.82	139.0	±1.4 %
		Y	6.51	67.4	19.7		145.5	
		Z	6.31	66.4	19.0		136.5	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.79	66.3	19.4	5.73	136.1	±1.2 %
		Y	4.90	67.0	19.8		141.5	
		Z	4.76	66.0	19.1		133.8	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.66	68.8	22.7	9.21	138.2	±2.5 %
		Y	5.93	70.3	23.7		147.0	
		Z	5.68	68.6	22.6		136.7	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.77	66.2	19.3	5.72	135.7	±1.2 %
		Y	4.92	67.1	19.8		141.2	
		Z	4.72	65.8	19.0		133.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.77	66.2	19.3	5.72	134.8	±1.2 %
		Y	4.91	67.0	19.7		141.1	
		Z	4.76	66.0	19.1		132.8	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.99	68.8	21.1	8.10	146.9	±2.5 %
		Y	9.71	68.4	21.0		127.0	
		Z	9.91	68.7	21.0		143.4	
10225-CAB	UMTS-FDD (HSPA+)	X	7.10	67.5	19.5	5.97	149.1	±1.2 %
		Y	6.98	67.4	19.5		128.9	
		Z	7.01	67.2	19.3		145.5	

10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.68	68.9	22.8	9.21	139.9	±2.2 %
		Y	5.93	70.3	23.6		148.1	
		Z	5.70	68.8	22.7		137.5	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.81	67.4	21.7	9.24	143.4	±2.2 %
		Y	6.93	68.0	22.2		129.3	
		Z	6.79	67.2	21.6		140.3	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.23	67.7	21.9	9.30	149.4	±1.9 %
		Y	7.42	68.6	22.4		135.2	
		Z	7.19	67.4	21.6		146.2	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.44	66.7	18.6	3.96	129.1	±0.7 %
		Y	4.57	67.4	18.9		134.5	
		Z	4.35	66.1	18.1		126.6	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.64	66.9	18.6	3.46	140.9	±0.7 %
		Y	3.87	68.3	19.3		147.1	
		Z	3.61	66.5	18.2		138.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.64	67.4	18.8	3.39	142.3	±0.5 %
		Y	3.85	68.5	19.3		148.3	
		Z	3.59	66.7	18.3		139.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.23	66.6	19.2	5.81	136.3	±1.4 %
		Y	6.42	67.4	19.7		142.8	
		Z	6.19	66.3	19.0		133.9	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.84	67.3	19.6	6.06	142.4	±1.4 %
		Y	6.98	67.8	19.9		149.5	
		Z	6.75	66.8	19.3		140.0	
10317-AAB	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	10.13	68.9	21.3	8.36	147.4	±2.7 %
		Y	9.84	68.4	21.1		127.5	
		Z	10.04	68.7	21.2		143.2	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.24	69.0	21.4	8.37	148.6	±2.7 %
		Y	9.92	68.4	21.2		126.6	
		Z	10.14	68.8	21.3		144.6	
10401-AAB	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	10.60	68.6	21.2	8.60	129.4	±3.0 %
		Y	10.77	69.1	21.5		136.8	
		Z	10.52	68.4	21.1		125.9	
10402-AAB	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.60	68.5	20.9	8.53	129.7	±3.0 %
		Y	11.01	69.5	21.5		139.1	
		Z	10.54	68.3	20.8		126.7	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	5.07	70.1	19.4	3.76	127.5	±0.5 %
		Y	5.47	71.9	20.2		133.6	
		Z	4.93	69.5	19.0		124.9	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	5.01	70.2	19.5	3.77	149.3	±0.7 %
		Y	5.38	71.9	20.2		132.0	
		Z	4.94	69.9	19.2		146.4	

10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	3.20	71.2	19.8	1.54	126.8	±0.7 %
		Y	3.51	72.6	20.4		134.5	
		Z	2.79	68.1	18.1		148.4	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.07	68.8	21.2	8.23	147.8	±2.7 %
		Y	9.81	68.4	21.1		128.4	
		Z	10.00	68.7	21.1		144.0	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	10.07	68.8	21.2	8.23	148.4	±2.7 %
		Y	9.82	68.4	21.1		129.0	
		Z	9.99	68.7	21.1		144.6	

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

[A] The uncertainties of NormX,Y,Z do not affect the 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: EX3DV4 - SN:3914

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)
750	41.9	0.89	9.82	9.82	9.82	0.39	0.92	± 12.0 %
835	41.5	0.90	9.50	9.50	9.50	0.43	0.83	± 12.0 %
1750	40.1	1.37	8.04	8.04	8.04	0.30	0.93	± 12.0 %
1900	40.0	1.40	7.86	7.86	7.86	0.35	0.86	± 12.0 %
2450	39.2	1.80	7.02	7.02	7.02	0.28	1.05	± 12.0 %
2600	39.0	1.96	6.82	6.82	6.82	0.26	1.17	± 12.0 %
5200	36.0	4.66	5.26	5.26	5.26	0.35	1.80	± 13.1 %
5300	35.9	4.76	5.06	5.06	5.06	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.92	4.92	4.92	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.73	4.73	4.73	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.67	4.67	4.67	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:3914

Calibration Parameter Determined in Body Tissue Simulating Media

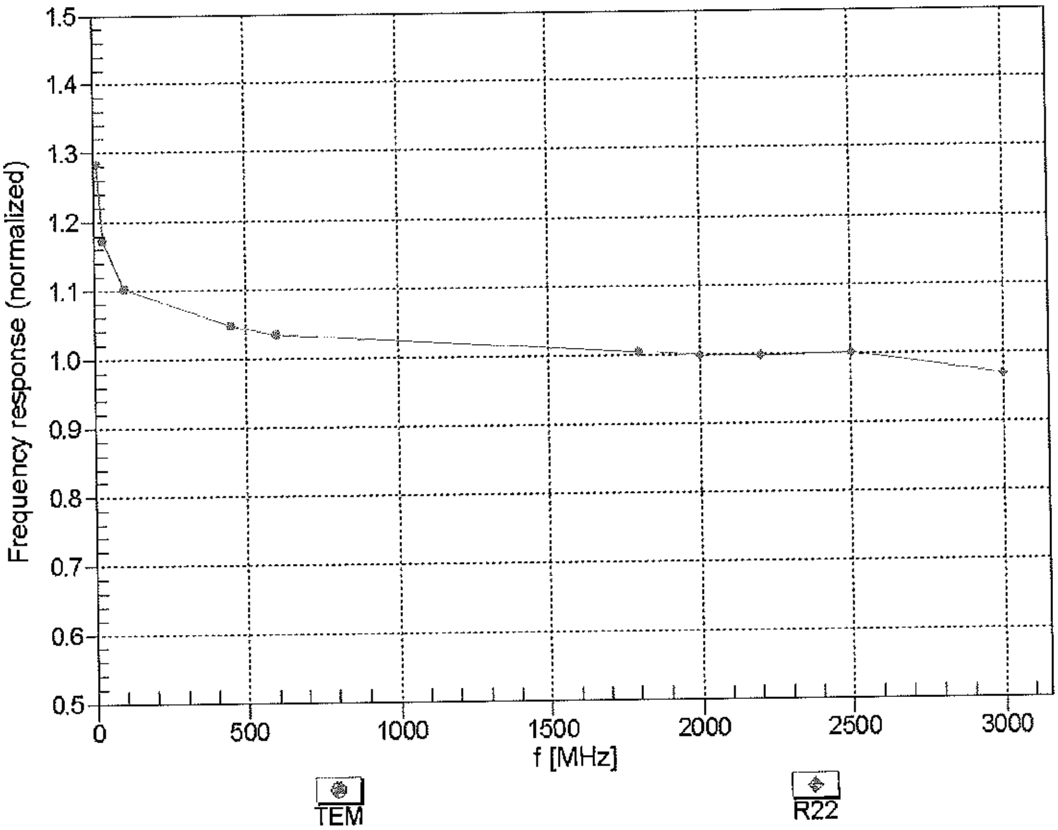
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	9.53	9.53	9.53	0.33	1.09	± 12.0 %
835	55.2	0.97	9.49	9.49	9.49	0.27	1.25	± 12.0 %
1750	53.4	1.49	7.78	7.78	7.78	0.51	0.79	± 12.0 %
1900	53.3	1.52	7.49	7.49	7.49	0.73	0.64	± 12.0 %
2450	52.7	1.95	7.15	7.15	7.15	0.69	0.64	± 12.0 %
2600	52.5	2.16	6.84	6.84	6.84	0.80	0.57	± 12.0 %
5200	49.0	5.30	4.50	4.50	4.50	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.33	4.33	4.33	0.45	1.90	± 13.1 %
5500	48.6	5.65	3.91	3.91	3.91	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.89	3.89	3.89	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.01	4.01	4.01	0.55	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.

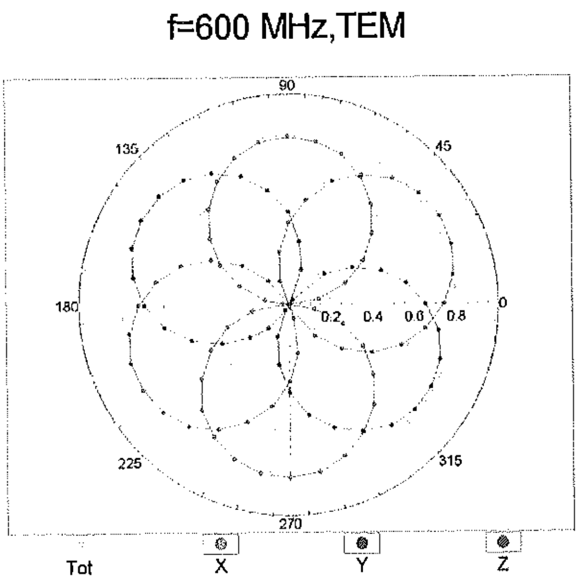
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from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

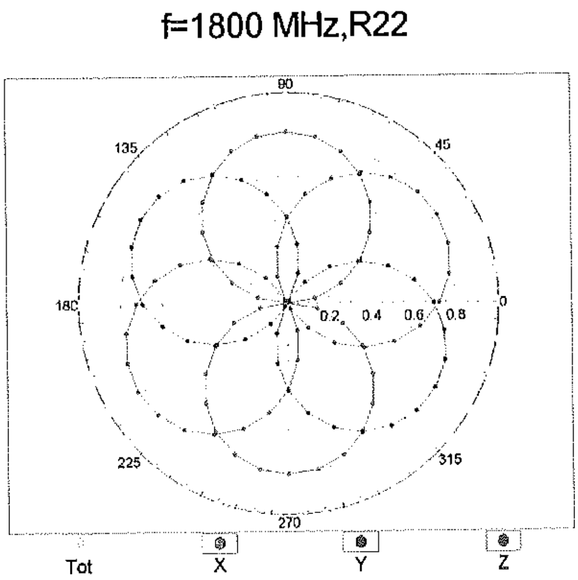
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

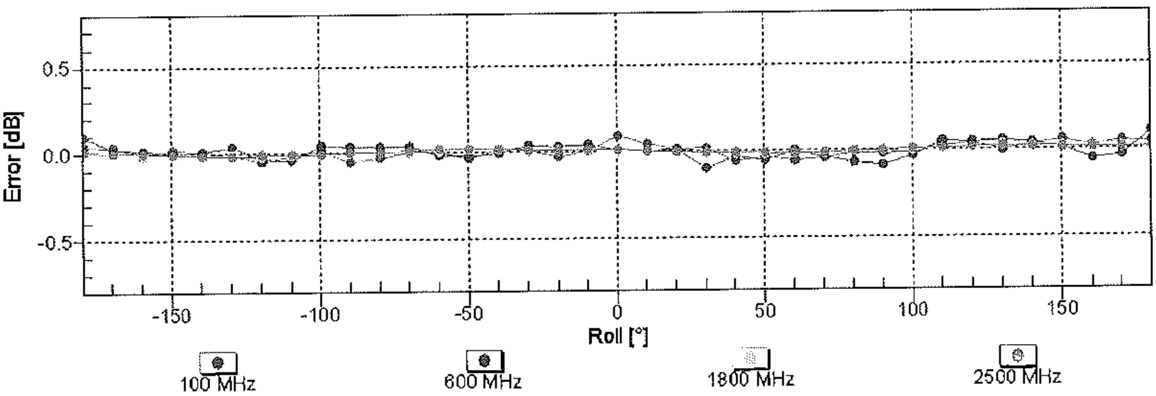


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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

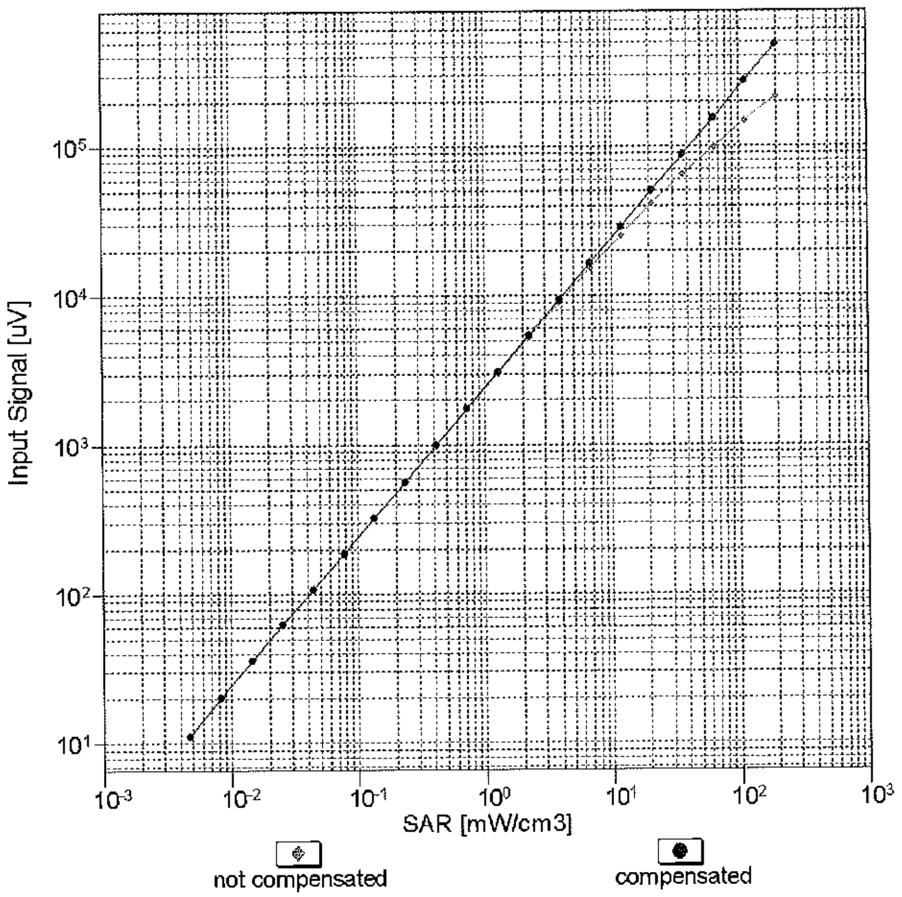


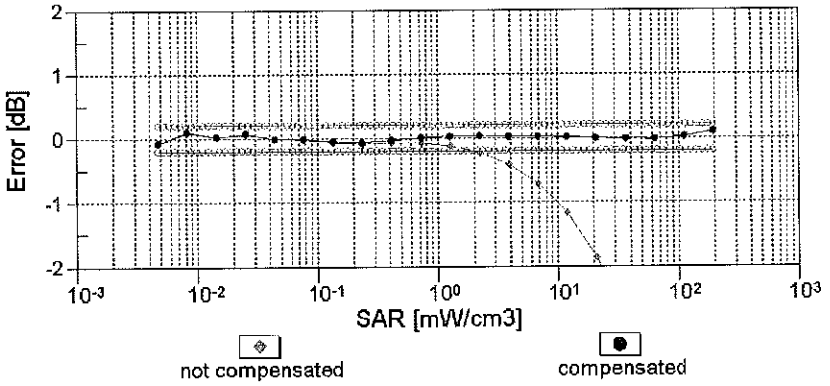




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

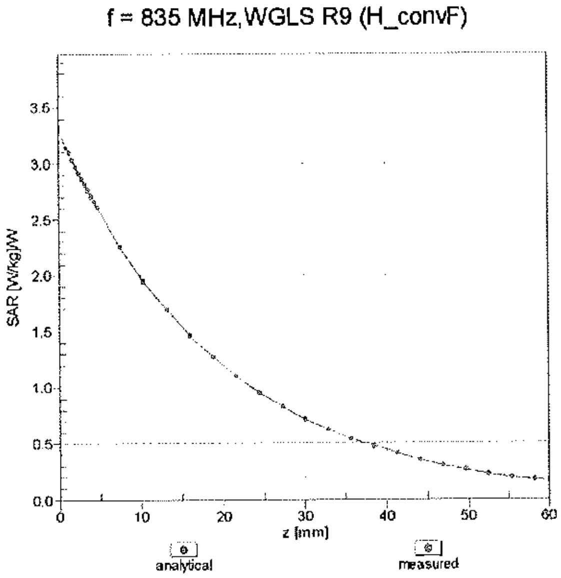
Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)

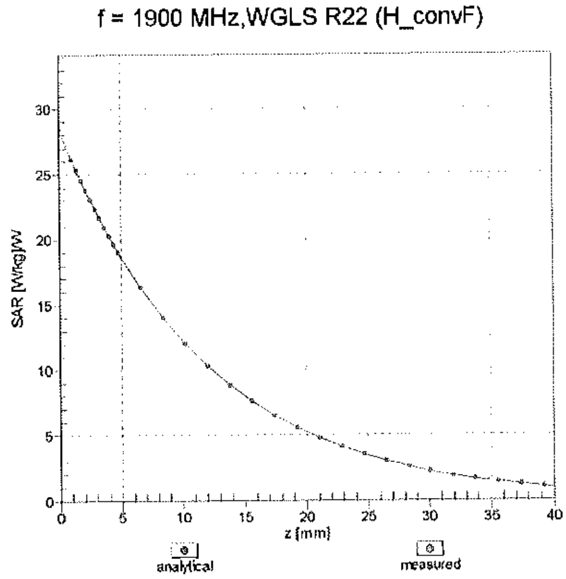




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

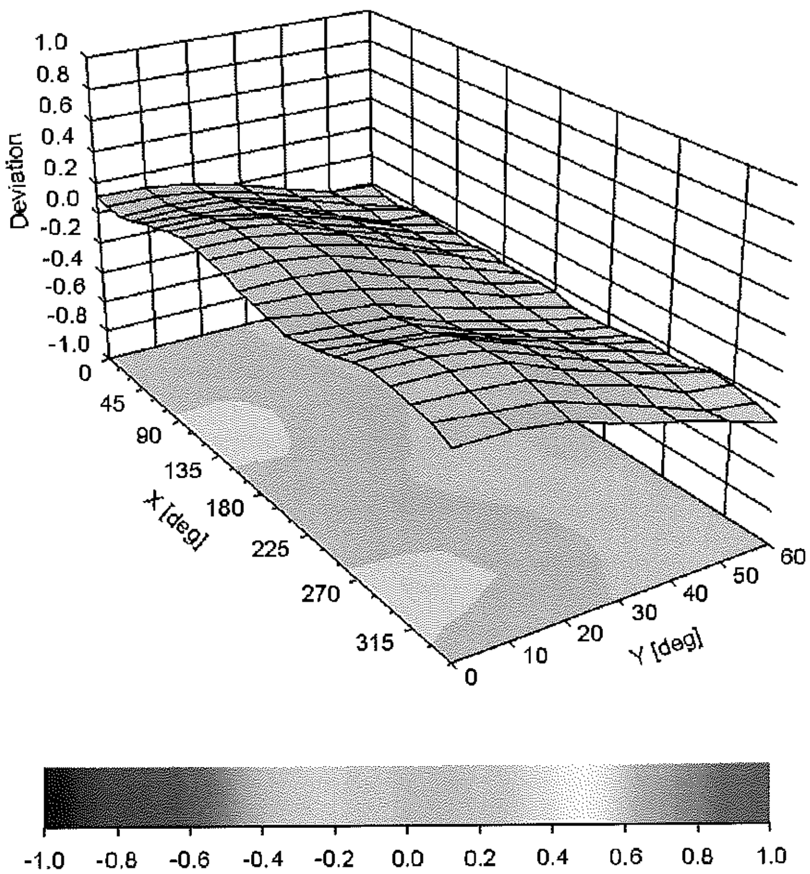
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3914

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-49.5
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
Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1765V2-1008_May15

CALIBRATION CERTIFICATE

Object	D1765V2 - SN: 1008
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 13, 2015

CC✓ 5/28/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: May 15, 2015

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.1	1.38 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.0 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**37.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.1 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.4	1.50 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.5 ± 6 %	1.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.55 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**38.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.4 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.5 Ω - 4.6 jΩ
Return Loss	- 26.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.8 Ω - 5.3 jΩ
Return Loss	- 22.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.211 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2005

DASY5 Validation Report for Head TSL

Date: 13.05.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN: 1008

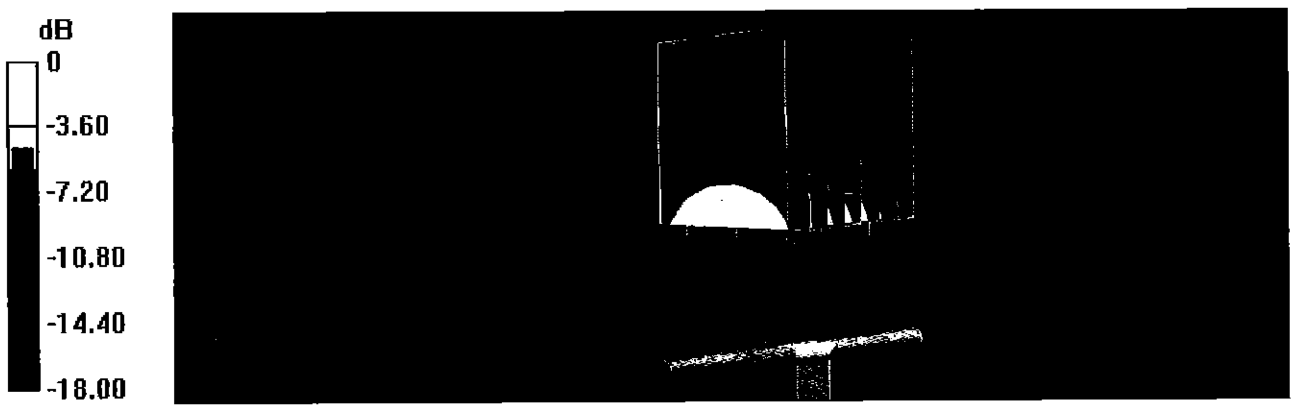
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.37 S/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

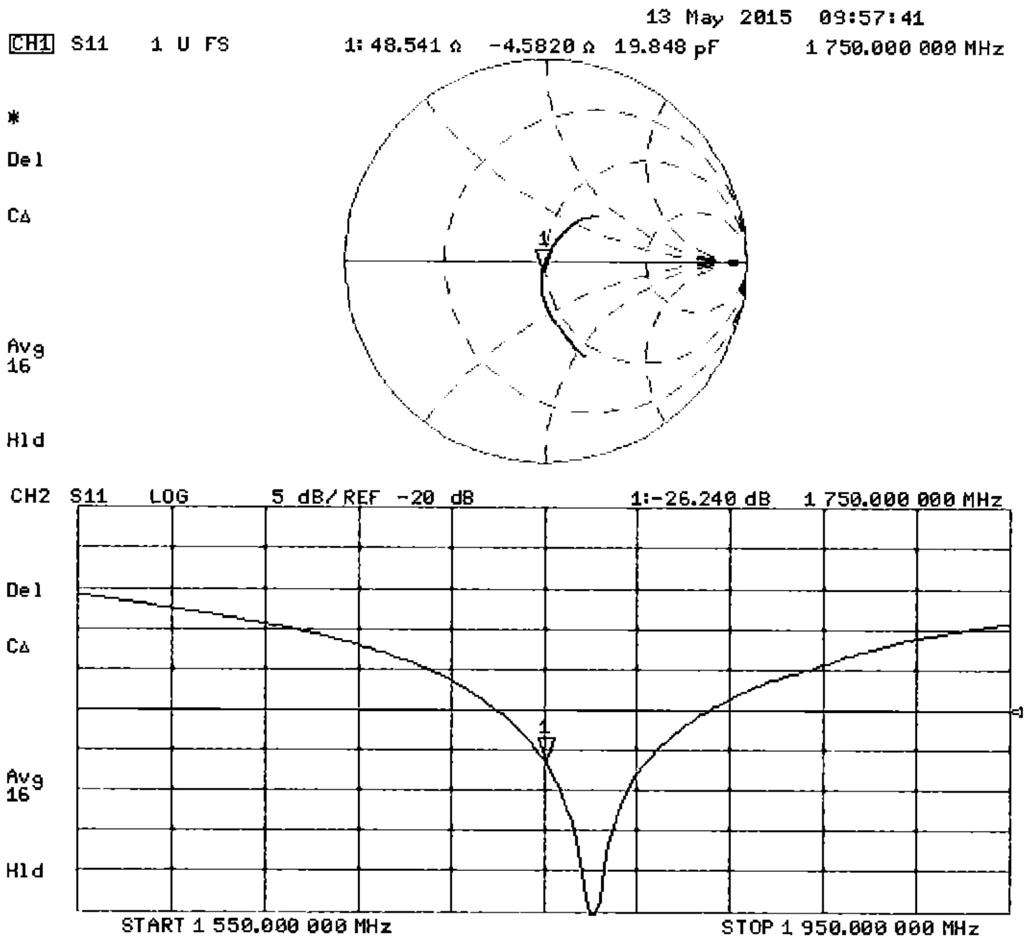
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.56 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 17.0 W/kg
SAR(1 g) = 9.45 W/kg; SAR(10 g) = 5.02 W/kg
Maximum value of SAR (measured) = 11.9 W/kg



0 dB = 11.9 W/kg = 10.76 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.05.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1765 MHz; Type: D1765V2; Serial: D1765V2 - SN: 1008

Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.49 S/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

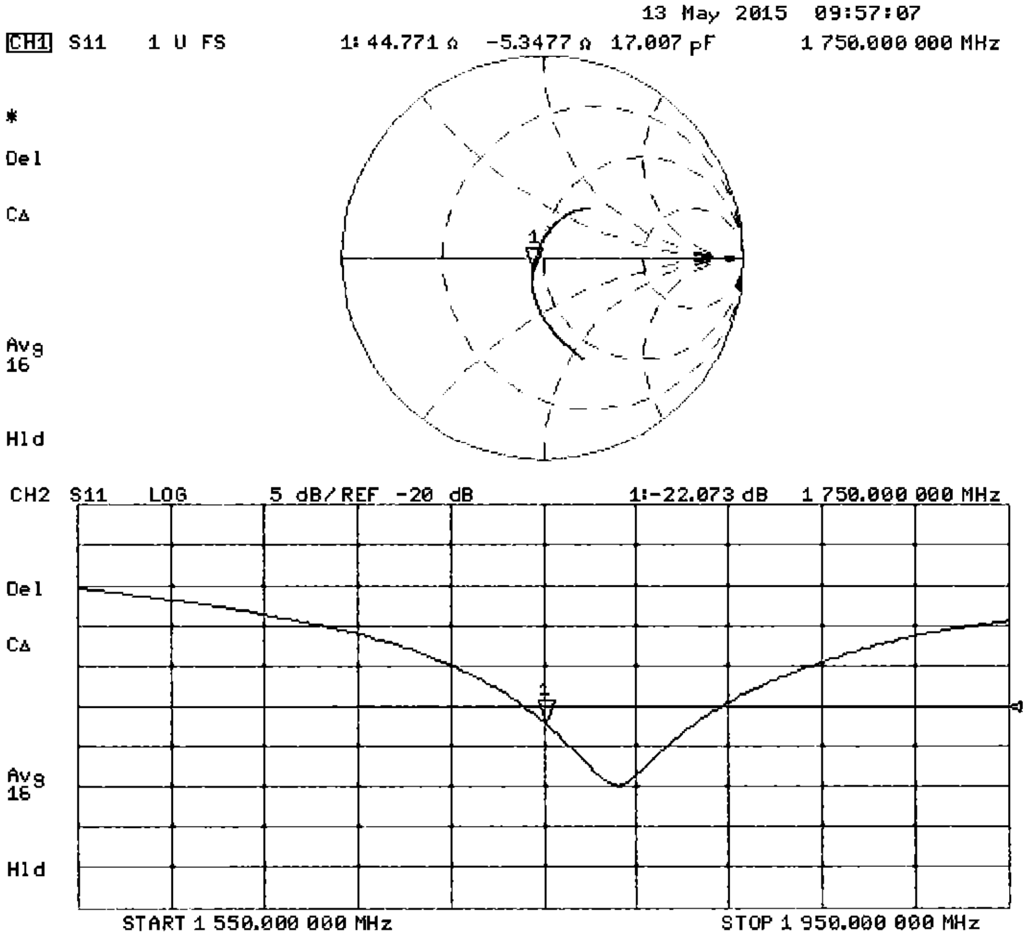
- Probe: ES3DV3 - SN3205; ConvF(4.88, 4.88, 4.88); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.70 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 16.5 W/kg
SAR(1 g) = 9.55 W/kg; SAR(10 g) = 5.12 W/kg
Maximum value of SAR (measured) = 12.0 W/kg

0 dB = 12.0 W/kg = 10.79 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1900V2-5d149_Jul15

CALIBRATION CERTIFICATE

Object	D1900V2 - SN:5d149
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 14, 2015

CC✓ 8/4/15

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: July 14, 2015

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.7 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.5 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.7 ± 6 %	1.54 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.8 W/kg ± 16.5 % (k=2)**

((

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.4 Ω + 5.6 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.7 Ω + 6.1 jΩ
Return Loss	- 23.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 14.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d149

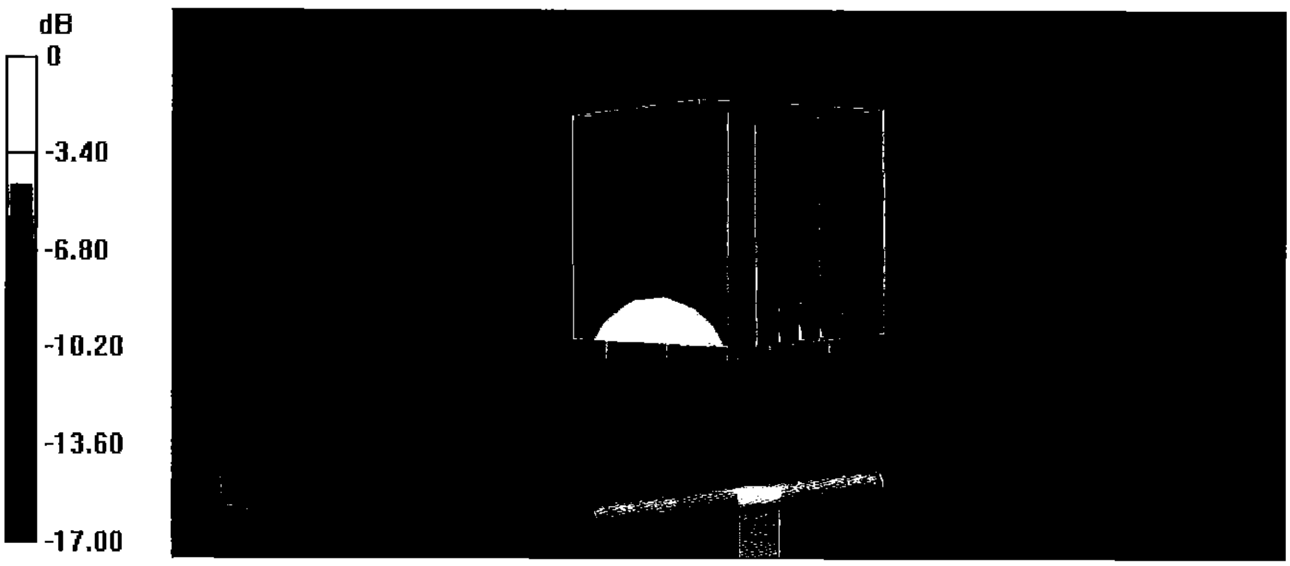
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

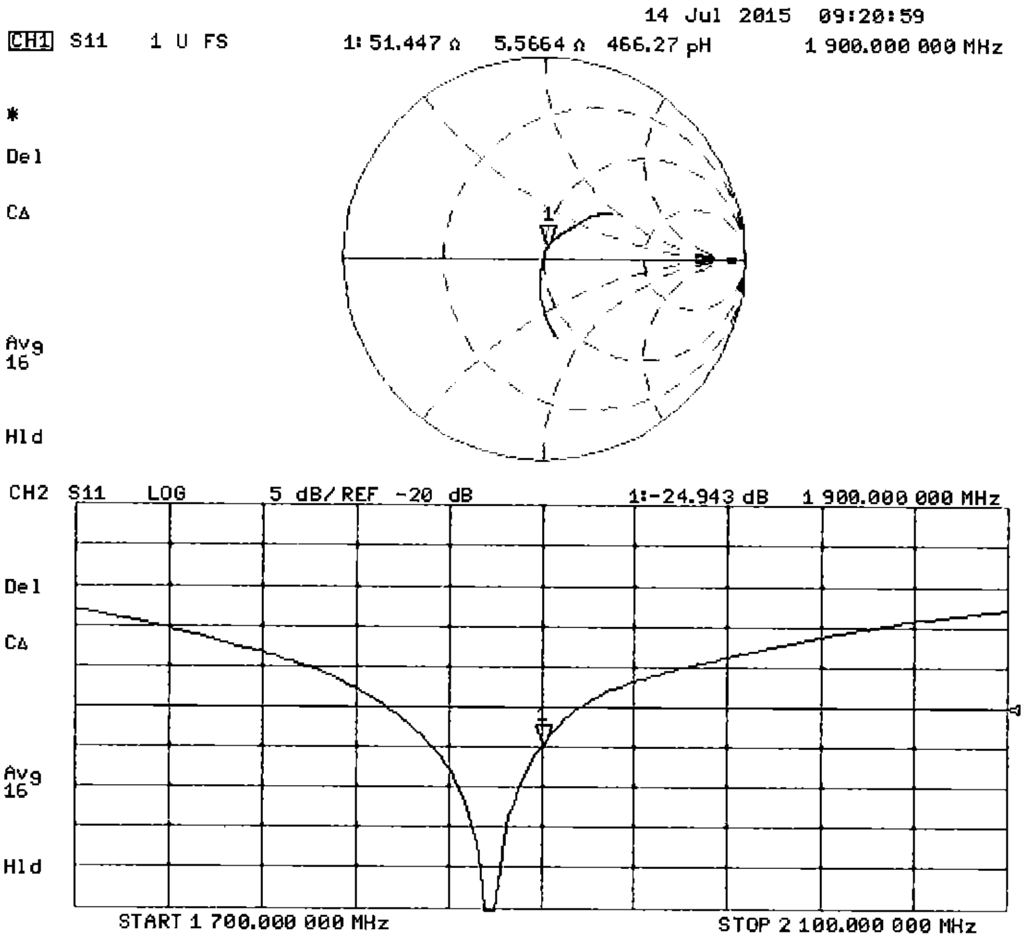
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.22 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 18.3 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.34 W/kg
Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d149

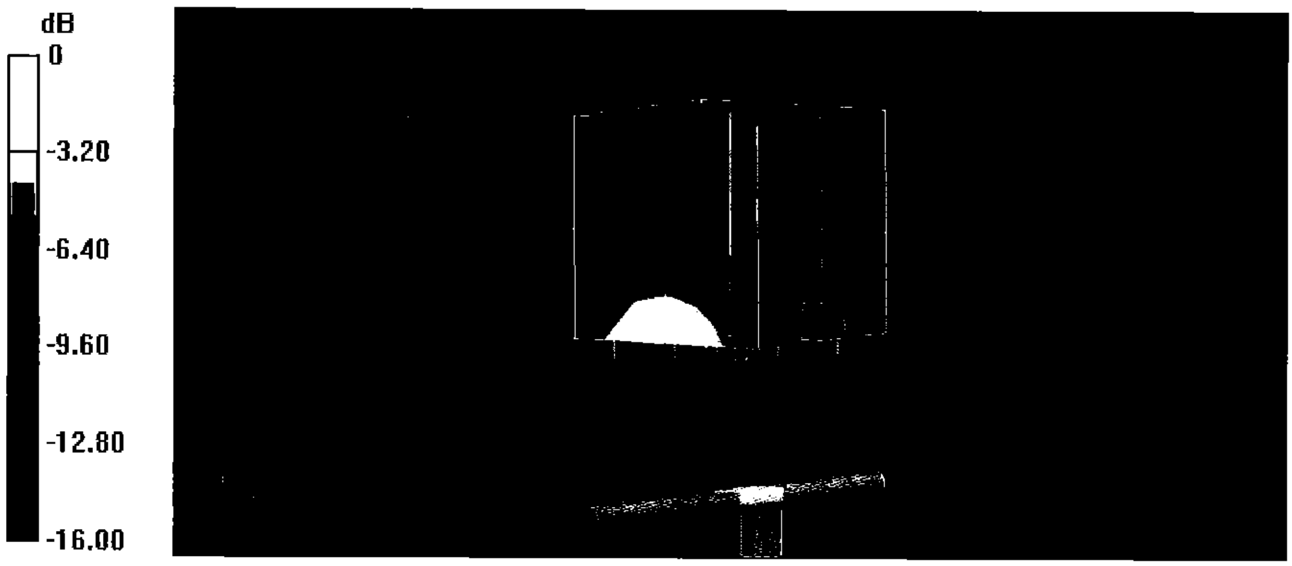
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.54 S/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

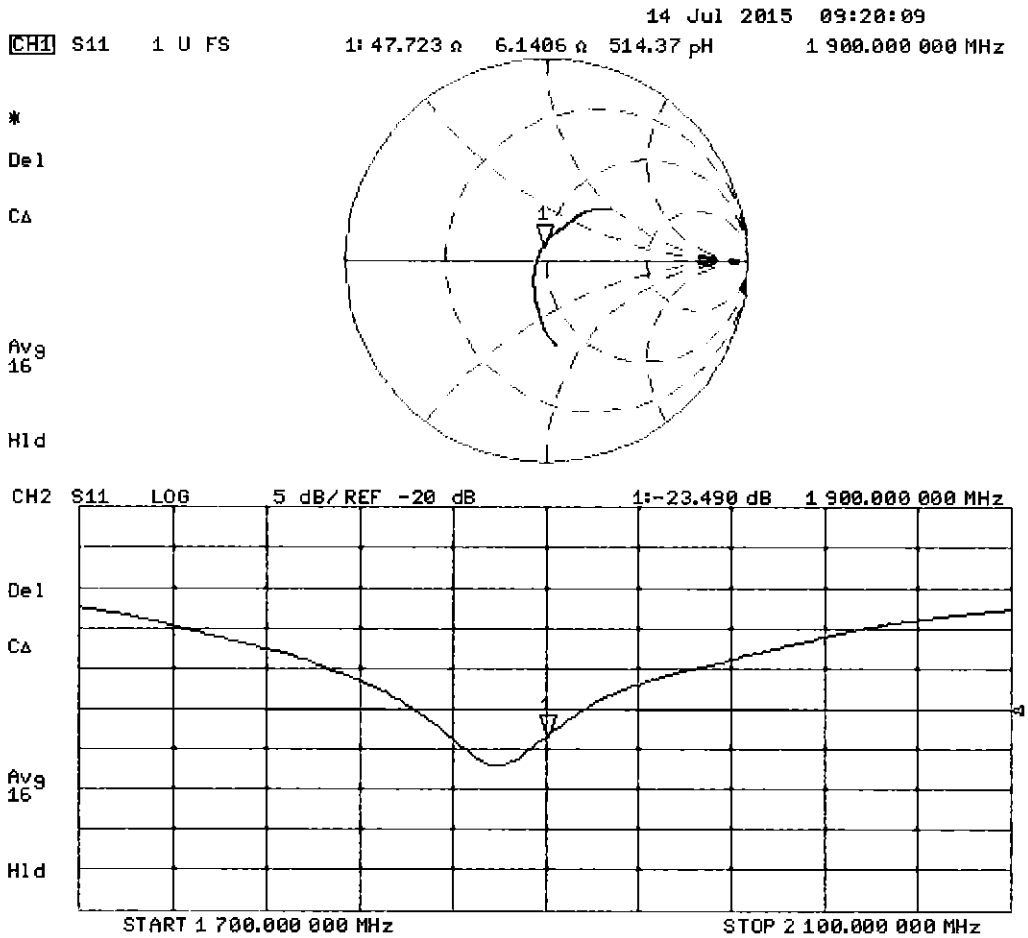
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.96 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 17.2 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.49 W/kg
Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client PC Test

Certificate No: D2300V2-1064_Dec15

CALIBRATION CERTIFICATE

Object	D2300V2 - SN: 1064
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	December 08, 2015

BNV 12/16/2015

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 EPM-442A	GB37480704	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	30-Dec-14 (No. EX3-7349_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M. Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 8, 2015

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2300 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.8 ± 6 %	1.71 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**47.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.73 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.9	1.81 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.1 ± 6 %	1.85 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	11.5 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**45.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.7 Ω - 5.4 jΩ
Return Loss	- 25.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 3.4 jΩ
Return Loss	- 25.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.167 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 20, 2015

DASY5 Validation Report for Head TSL

Date: 08.12.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1064

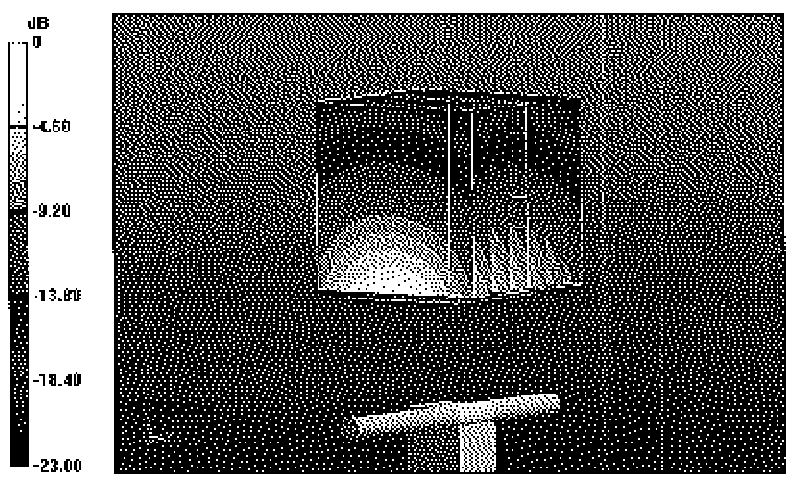
Communication System: UID 0 - CW; Frequency: 2300 MHz
Medium parameters used: f = 2300 MHz; σ = 1.71 S/m; ε_r = 38.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

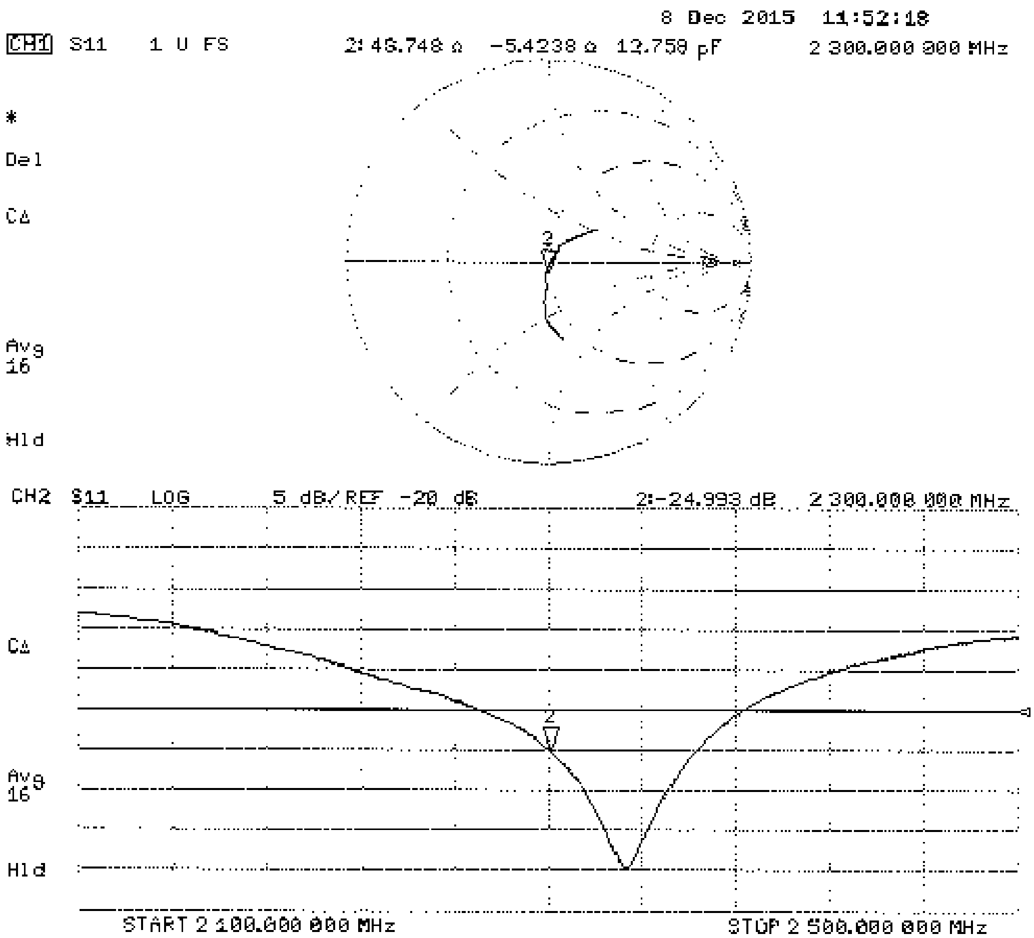
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 111.1 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 24.4 W/kg
SAR(1 g) = 12.1 W/kg; SAR(10 g) = 5.73 W/kg
Maximum value of SAR (measured) = 19.7 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 08.12.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1064

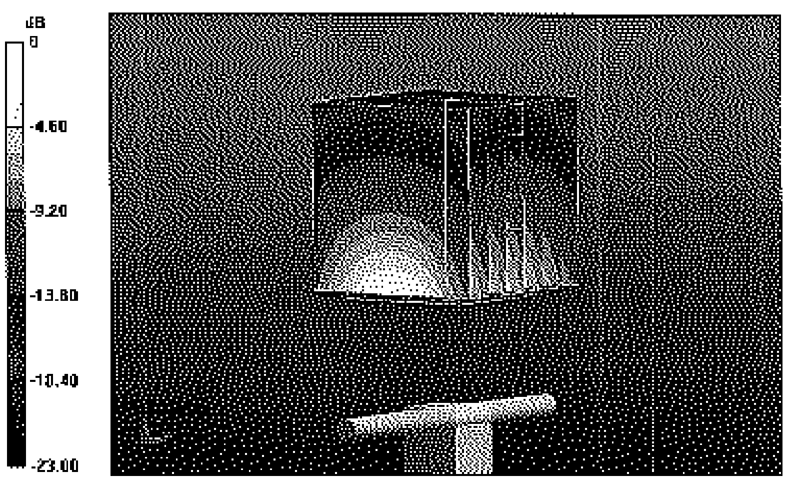
Communication System: UID 0 - CW; Frequency: 2300 MHz
Medium parameters used: f = 2300 MHz; σ = 1.85 S/m; ε_r = 53.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.74, 7.74, 7.74); Calibrated: 30.12.2014;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

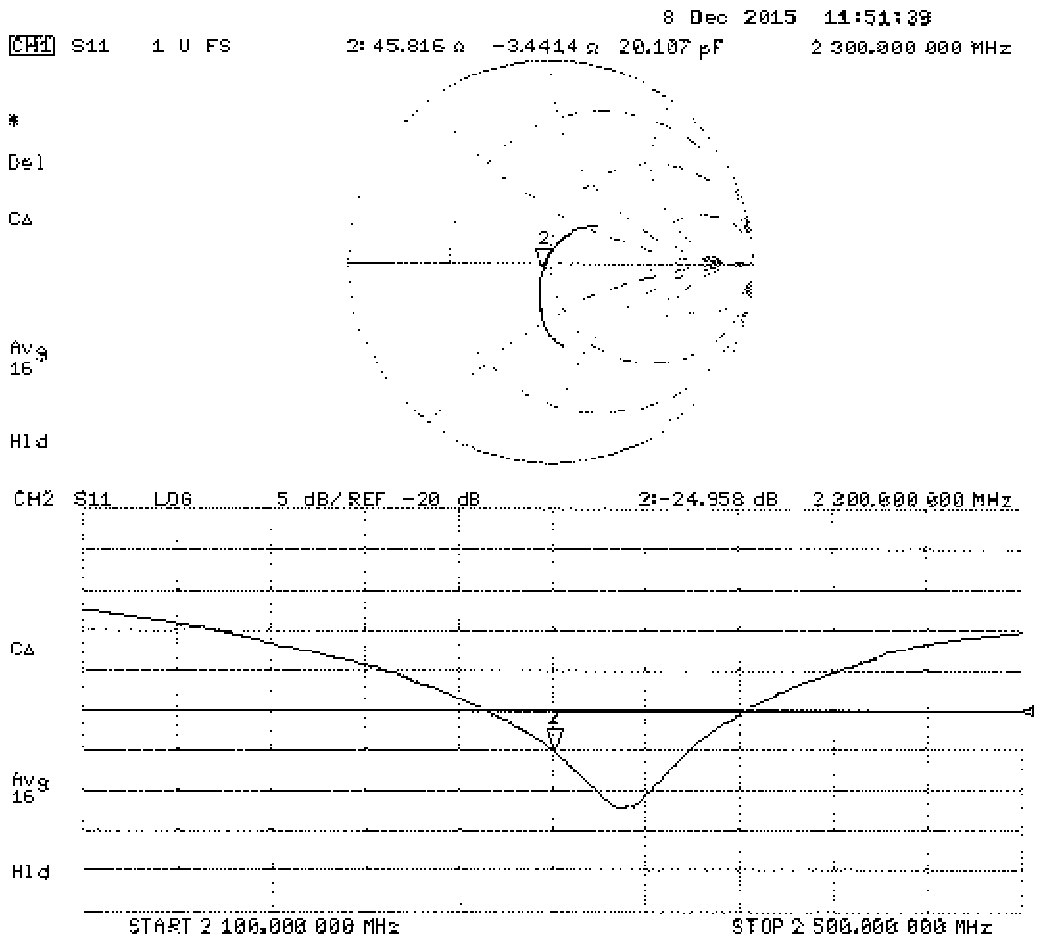
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.8 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 22.5 W/kg
SAR(1 g) = 11.5 W/kg; SAR(10 g) = 5.52 W/kg
Maximum value of SAR (measured) = 18.6 W/kg



0 dB = 18.6 W/kg = 12.70 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D2450V2-719_Aug15

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 719

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

BN ✓
9/3/15

Calibration date: August 20, 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 EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	17-Aug-15 (No. DAE4-601_Aug15)	Aug-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: August 21, 2015

((

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.2 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**54.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.7 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.2 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.3 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω + 5.3 jΩ
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 Ω + 6.5 jΩ
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 20.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 719

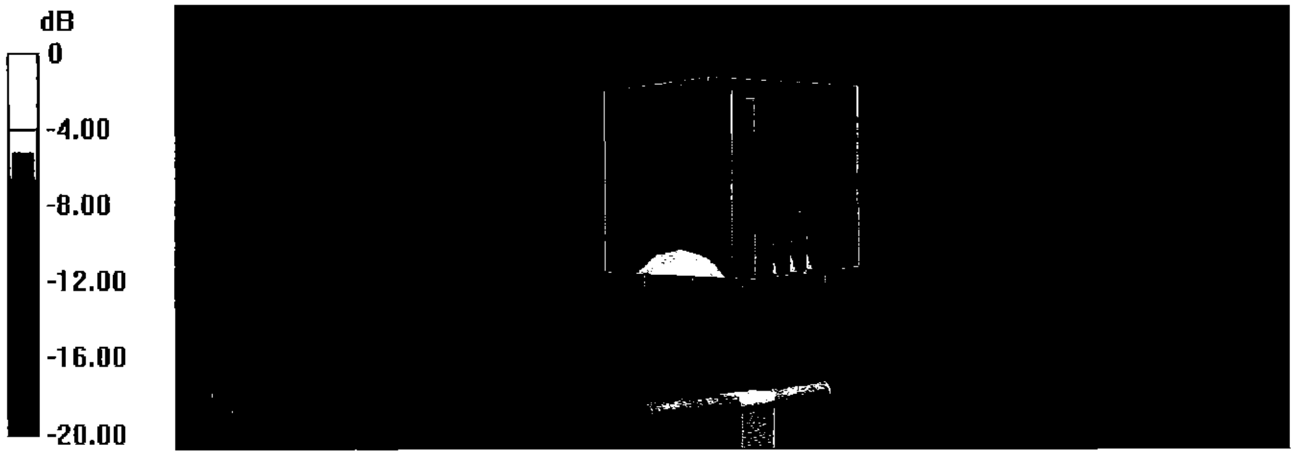
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.87 S/m; ε_r = 39.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.54, 4.54, 4.54); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

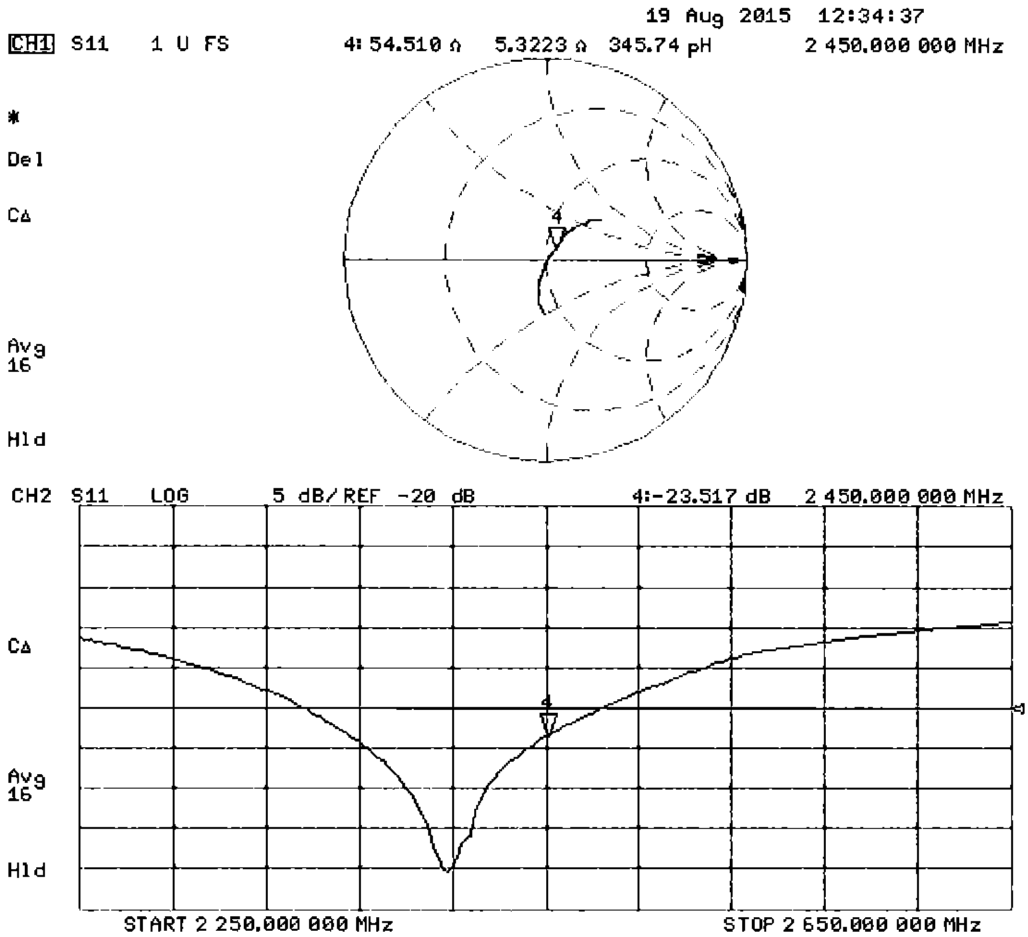
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.2 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.48 W/kg
Maximum value of SAR (measured) = 18.2 W/kg



0 dB = 18.2 W/kg = 12.60 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 719

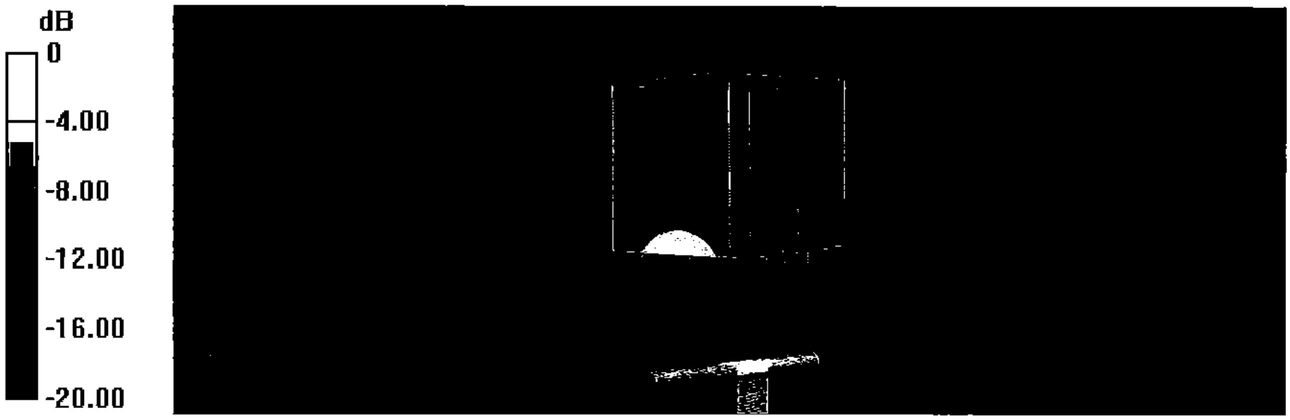
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 2$ S/m; $\varepsilon_r = 53.2$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 17.08.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

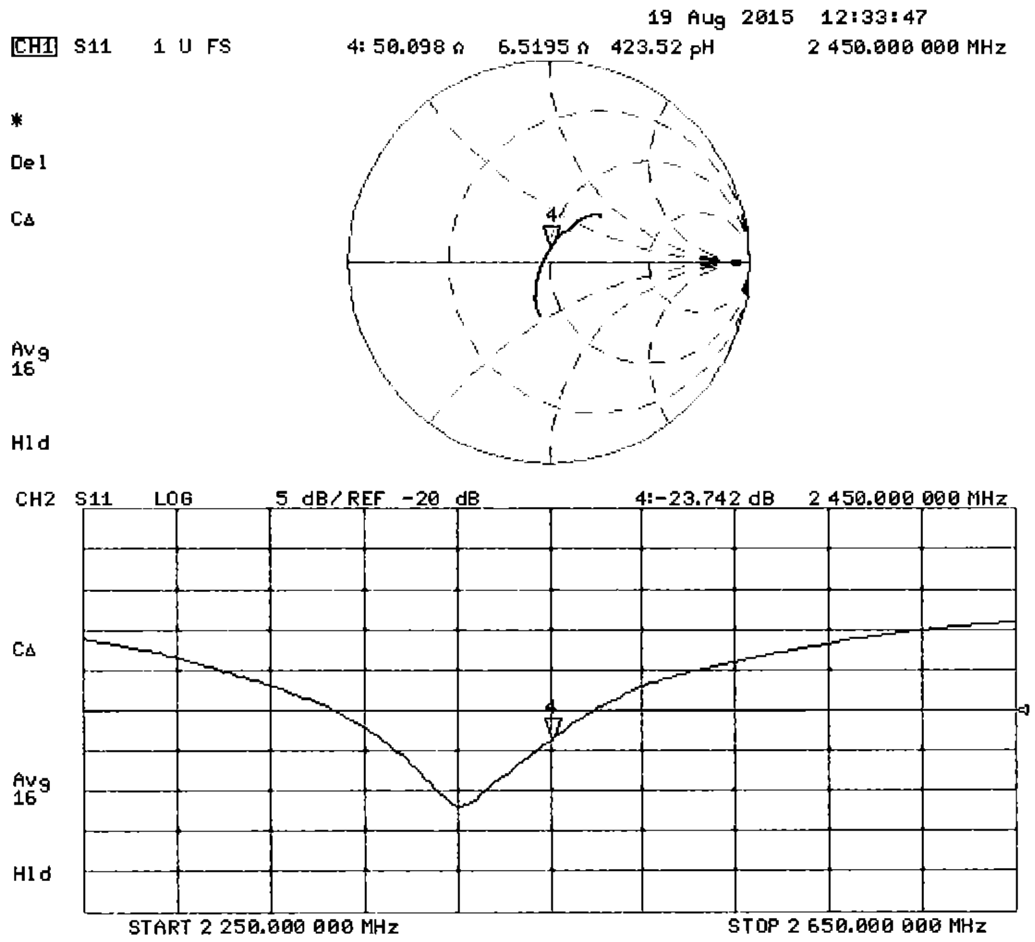
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.73 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.11 W/kg
Maximum value of SAR (measured) = 17.3 W/kg



0 dB = 17.3 W/kg = 12.38 dBW/kg

Impedance Measurement Plot for Body TSL



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

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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **ES3-3288_Sep15**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3288

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

BN ✓ 10/02/15

Calibration date: September 18, 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:	Michael Weber	Laboratory Technician	M. Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 19, 2015

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

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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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
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:3288

Manufactured: July 6, 2010
Calibrated: September 18, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.05	1.16	0.92	± 10.1 %
DCP (mV)[B]	106.9	106.9	107.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	190.7	±3.0 %
		Y	0.0	0.0	1.0		181.4	
		Z	0.0	0.0	1.0		179.1	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.55	61.8	10.9	10.00	38.0	±1.2 %
		Y	99.34	97.0	21.5		36.6	
		Z	6.26	70.5	13.9		35.2	
10011-CAB	UMTS-FDD (WCDMA)	X	3.28	67.4	18.7	2.91	129.4	±0.5 %
		Y	3.60	69.3	19.8		143.8	
		Z	3.38	67.9	18.8		143.0	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.07	70.1	19.4	1.87	131.0	±0.7 %
		Y	3.79	74.2	21.4		145.4	
		Z	3.15	70.5	19.4		144.5	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.64	69.8	22.8	9.46	122.7	±2.7 %
		Y	10.89	70.2	22.9		140.0	
		Z	10.70	70.2	23.0		136.7	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	10.49	86.3	22.8	9.39	138.5	±2.2 %
		Y	13.76	90.7	24.6		145.7	
		Z	7.99	82.4	21.3		141.8	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	9.73	85.3	22.7	9.57	149.4	±2.7 %
		Y	9.12	84.3	22.7		131.8	
		Z	8.21	83.4	22.1		134.8	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	34.75	99.7	24.5	6.56	135.8	±2.5 %
		Y	22.21	94.5	23.5		148.5	
		Z	8.93	81.8	18.8		148.3	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	51.22	100.0	22.6	4.80	132.9	±1.9 %
		Y	45.95	99.6	23.0		139.7	
		Z	14.90	87.0	19.2		138.0	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	66.25	99.8	21.6	3.55	141.8	±1.9 %
		Y	61.05	99.6	21.6		149.8	
		Z	70.48	99.7	20.8		126.6	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	98.24	98.4	18.0	1.16	135.4	±1.9 %
		Y	71.59	99.7	19.3		144.2	
		Z	98.96	91.6	15.1		148.2	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.44	67.9	19.9	5.67	148.9	±1.4 %
		Y	6.27	67.2	19.6		131.4	
		Z	6.28	67.3	19.5		137.9	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	9.52	74.2	25.3	9.29	134.3	±2.5 %
		Y	9.97	75.1	25.7		146.8	
		Z	9.47	74.4	25.4		147.4	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.31	67.5	19.8	5.80	147.4	±1.4 %
		Y	6.21	67.1	19.6		131.0	
		Z	6.16	67.0	19.5		136.4	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.11	68.9	21.2	8.07	137.9	±2.2 %
		Y	10.26	69.3	21.5		147.7	
		Z	9.85	68.3	20.9		126.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.90	73.2	25.0	9.28	129.8	±3.3 %
		Y	9.32	74.0	25.2		142.5	
		Z	8.86	73.4	25.1		142.1	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.98	66.9	19.6	5.75	143.7	±1.2 %
		Y	5.91	66.6	19.4		128.0	
		Z	5.84	66.5	19.3		133.4	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.43	67.5	19.8	5.82	148.9	±1.4 %
		Y	6.31	67.0	19.6		132.2	
		Z	6.30	67.1	19.5		138.0	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.93	67.3	20.0	5.73	145.7	±1.2 %
		Y	4.89	66.9	19.8		131.7	
		Z	4.82	66.9	19.7		134.9	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.96	77.5	27.4	9.21	143.6	±2.7 %
		Y	7.61	75.5	26.3		129.2	
		Z	7.10	74.5	25.9		129.7	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.89	67.1	19.9	5.72	138.9	±1.2 %
		Y	5.02	67.5	20.1		148.1	
		Z	4.77	66.7	19.6		129.3	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.93	67.3	20.0	5.72	143.8	±1.2 %
		Y	5.08	67.8	20.3		149.0	
		Z	4.73	66.5	19.5		129.4	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.73	68.7	21.3	8.10	130.0	±1.9 %
		Y	9.74	68.6	21.2		132.7	
		Z	9.78	69.0	21.4		138.2	
10225-CAB	UMTS-FDD (HSPA+)	X	6.83	66.9	19.4	5.97	134.3	±1.4 %
		Y	6.98	67.3	19.6		139.3	
		Z	6.92	67.4	19.6		142.7	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	7.94	77.5	27.4	9.21	143.5	±2.7 %
		Y	7.44	74.8	25.9		125.0	
		Z	7.14	74.7	26.0		131.4	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.95	74.9	26.1	9.24	140.8	±2.7 %
		Y	8.53	72.8	24.7		127.2	
		Z	8.14	72.3	24.6		127.1	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.66	75.7	26.4	9.30	149.7	±3.0 %
		Y	9.20	73.6	25.1		135.1	
		Z	8.81	73.3	25.1		134.3	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.39	67.0	18.8	3.96	138.0	±0.7 %
		Y	4.51	67.5	19.2		141.4	
		Z	4.46	67.3	18.9		146.2	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.59	67.1	18.7	3.46	128.3	±0.5 %
		Y	3.80	68.2	19.5		130.9	
		Z	3.74	68.1	19.2		135.6	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.55	67.3	18.9	3.39	129.6	±0.5 %
		Y	3.73	68.2	19.4		132.7	
		Z	3.63	67.8	19.0		137.7	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.30	67.4	19.6	5.81	145.6	±1.4 %
		Y	6.38	67.7	19.9		148.2	
		Z	6.12	66.8	19.4		129.8	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.56	66.9	19.5	6.06	126.9	±1.2 %
		Y	6.71	67.4	19.8		129.7	
		Z	6.71	67.5	19.8		136.5	
10400-AAC	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.96	68.8	21.5	8.37	132.0	±2.2 %
		Y	10.06	69.0	21.6		137.4	
		Z	10.06	69.3	21.7		140.2	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.89	69.6	19.3	3.76	139.4	±0.5 %
		Y	5.05	70.0	19.6		143.9	
		Z	4.98	70.0	19.5		146.8	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.81	69.6	19.4	3.77	136.6	±0.7 %
		Y	5.07	70.4	19.9		146.8	
		Z	4.90	70.2	19.6		144.5	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.82	69.8	19.4	1.54	136.4	±0.7 %
		Y	3.19	72.3	20.7		145.1	
		Z	2.84	69.7	19.1		145.5	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.77	68.6	21.3	8.23	130.4	±2.2 %
		Y	9.95	69.0	21.5		140.4	
		Z	9.88	69.0	21.5		138.1	

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 7 and 8).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

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)
750	41.9	0.89	6.69	6.69	6.69	0.80	1.17	± 12.0 %
835	41.5	0.90	6.41	6.41	6.41	0.68	1.22	± 12.0 %
1750	40.1	1.37	5.40	5.40	5.40	0.57	1.39	± 12.0 %
1900	40.0	1.40	5.17	5.17	5.17	0.76	1.14	± 12.0 %
2300	39.5	1.67	4.85	4.85	4.85	0.64	1.32	± 12.0 %
2450	39.2	1.80	4.57	4.57	4.57	0.75	1.34	± 12.0 %
2600	39.0	1.96	4.44	4.44	4.44	0.68	1.38	± 12.0 %

[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:3288

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)
750	55.5	0.96	6.57	6.57	6.57	0.80	1.13	± 12.0 %
835	55.2	0.97	6.40	6.40	6.40	0.53	1.45	± 12.0 %
1750	53.4	1.49	4.99	4.99	4.99	0.37	1.82	± 12.0 %
1900	53.3	1.52	4.81	4.81	4.81	0.42	1.72	± 12.0 %
2300	52.9	1.81	4.54	4.54	4.54	0.80	1.24	± 12.0 %
2450	52.7	1.95	4.37	4.37	4.37	0.80	1.20	± 12.0 %
2600	52.5	2.16	4.23	4.23	4.23	0.80	1.18	± 12.0 %

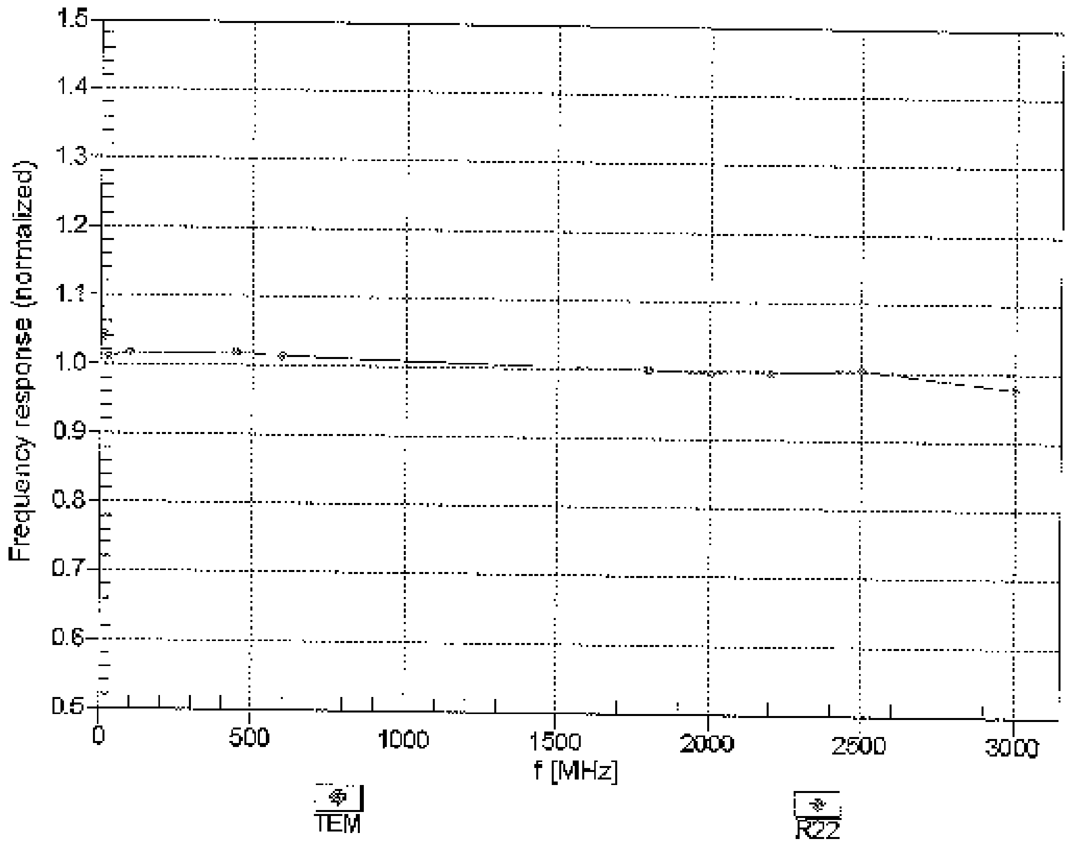
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz 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.

Frequency Response of E-Field

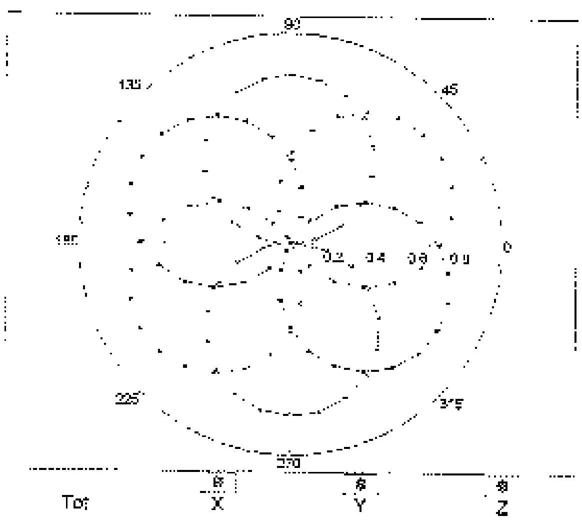
(TEM-Cell:ifi110 EXX, Waveguide: R22)



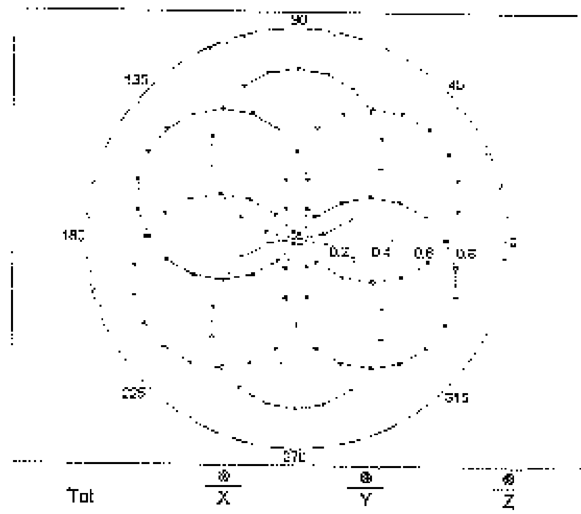
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

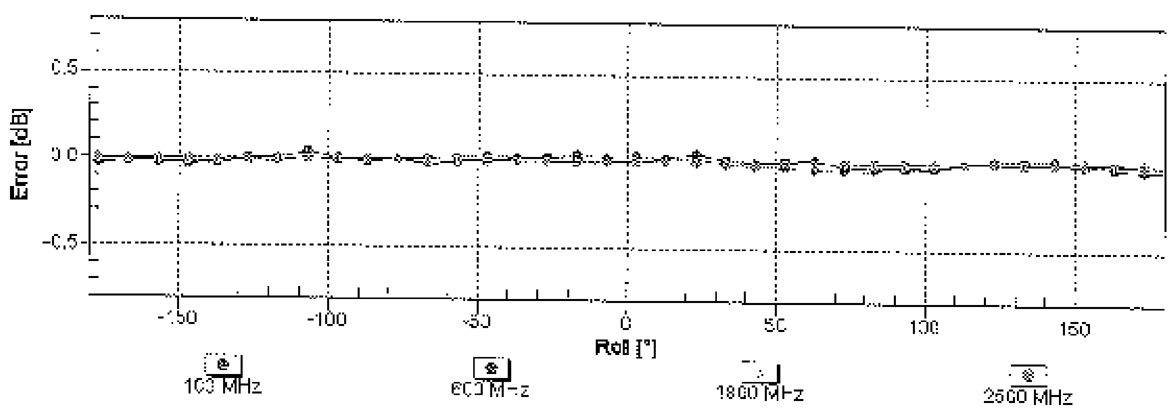
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



f=1800 MHz,R22

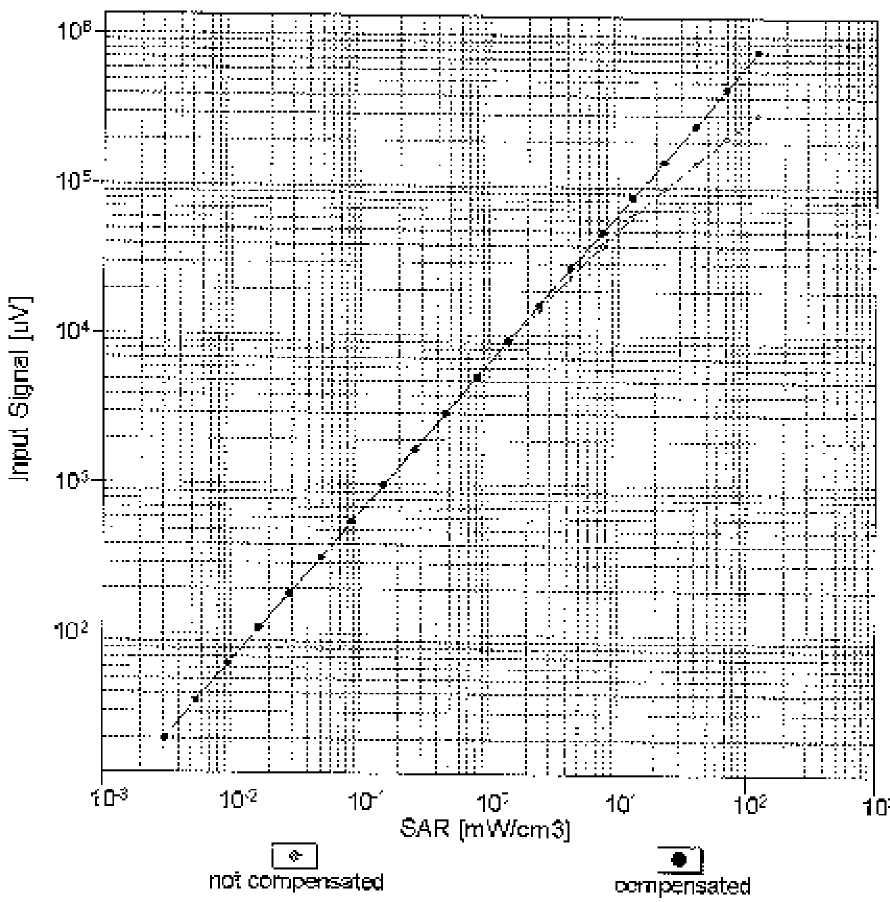


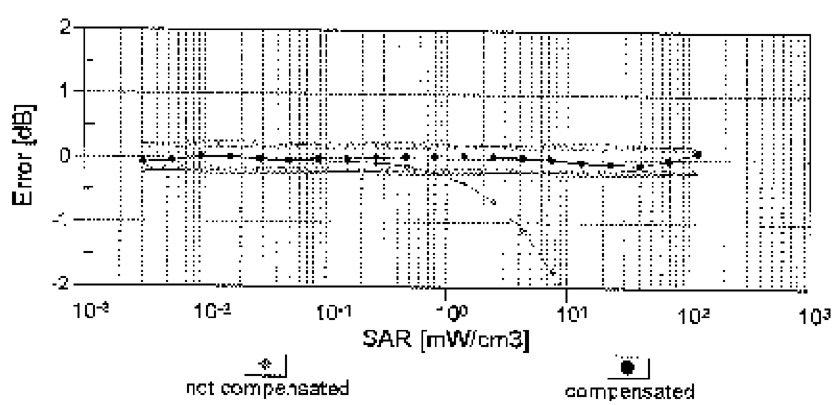


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

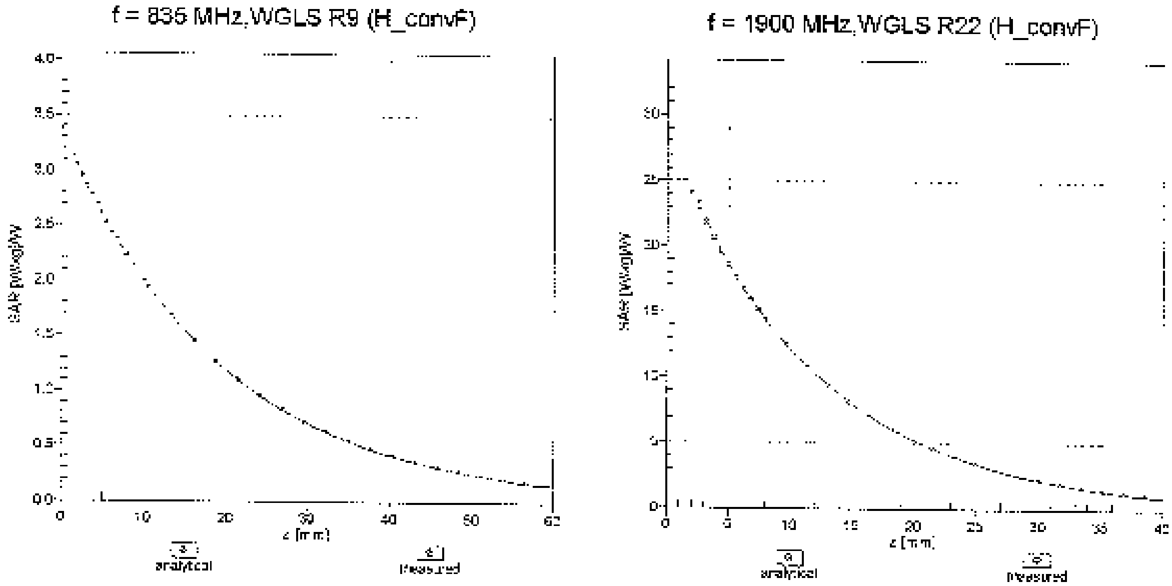
(TEM cell , f_{eval}= 1900 MHz)





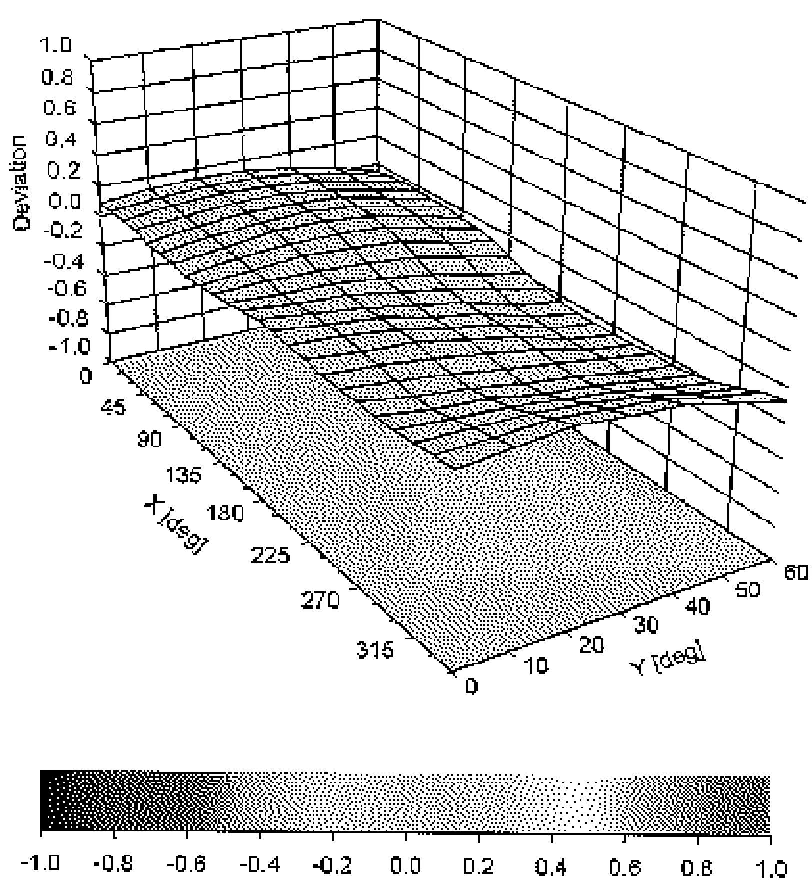
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



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:3288

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	73.1
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

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

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

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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **ES3-3333_Oct15**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3333

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

BN ✓ 11/03/15

Calibration date: October 29, 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-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Leif Klysner
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 29, 2015

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:3333

Manufactured: January 24, 2012
Calibrated: October 29, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.07	0.90	0.88	± 10.1 %
DCP (mV)[B]	106.8	108.5	106.8	

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	201.0	±3.5 %
		Y	0.0	0.0	1.0		187.1	
		Z	0.0	0.0	1.0		184.8	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.43	60.7	11.4	10.00	41.6	±2.2 %
		Y	4.35	67.4	13.2		35.6	
		Z	1.46	57.0	8.7		36.2	
10011-CAB	UMTS-FDD (WCDMA)	X	3.35	67.9	19.1	2.91	138.2	±0.5 %
		Y	3.48	68.6	19.2		127.5	
		Z	3.37	67.6	18.6		149.0	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.60	72.8	20.8	1.87	141.0	±0.7 %
		Y	3.68	73.3	20.8		128.0	
		Z	3.01	69.3	18.8		128.2	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.52	71.7	23.9	9.46	139.3	±3.0 %
		Y	10.94	70.4	22.9		147.1	
		Z	10.95	70.8	23.4		144.5	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	21.45	95.2	26.5	9.39	139.9	±2.5 %
		Y	9.12	82.9	21.9		142.0	
		Z	11.47	88.1	23.9		127.6	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	20.81	95.6	27.0	9.57	135.8	±2.2 %
		Y	9.78	84.4	22.7		135.3	
		Z	9.12	83.5	22.1		144.6	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	39.84	99.8	25.2	6.56	140.9	±1.9 %
		Y	35.07	100.0	25.0		128.4	
		Z	35.20	99.8	24.7		131.9	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	47.16	99.8	23.9	4.80	124.9	±2.5 %
		Y	49.75	99.6	22.8		145.4	
		Z	45.37	99.9	23.1		148.5	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	56.24	99.6	22.6	3.55	140.4	±2.7 %
		Y	56.95	99.7	21.9		129.1	
		Z	48.45	99.6	22.1		133.2	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	18.03	99.1	22.8	1.16	127.5	±1.9 %
		Y	35.17	99.6	20.7		141.1	
		Z	21.08	99.9	21.9		127.5	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.36	67.6	19.8	5.67	137.5	±1.2 %
		Y	6.29	67.4	19.6		129.9	
		Z	6.35	67.5	19.7		139.5	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.65	76.6	26.4	9.29	130.6	±2.7 %
		Y	9.58	73.7	24.8		143.0	
		Z	9.94	75.6	26.2		149.3	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.21	67.0	19.7	5.80	126.9	±1.2 %
		Y	6.16	66.9	19.5		129.2	
		Z	6.22	67.2	19.7		138.0	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.05	68.7	21.2	8.07	126.1	±2.5 %
		Y	10.13	69.0	21.3		146.1	
		Z	9.97	68.7	21.1		126.2	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	10.11	75.5	26.0	9.28	125.8	±3.3 %
		Y	9.06	73.2	24.7		138.2	
		Z	9.32	74.8	26.0		143.1	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.97	66.8	19.6	5.75	133.4	±1.2 %
		Y	5.92	66.7	19.5		127.0	
		Z	5.91	66.7	19.5		134.2	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.40	67.3	19.9	5.82	137.8	±1.2 %
		Y	6.31	67.1	19.6		130.7	
		Z	6.32	67.1	19.6		139.8	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.05	67.3	20.1	5.73	136.8	±1.2 %
		Y	4.89	67.0	19.9		131.1	
		Z	4.93	67.2	20.0		137.4	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	10.74	83.9	30.3	9.21	136.8	±2.7 %
		Y	7.34	74.3	25.5		125.9	
		Z	7.74	76.6	27.1		131.2	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.97	66.9	19.9	5.72	130.8	±1.2 %
		Y	4.86	66.9	19.8		128.5	
		Z	4.97	67.3	20.1		137.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.99	67.0	19.9	5.72	130.1	±1.2 %
		Y	4.88	67.0	19.9		127.6	
		Z	4.95	67.2	20.0		136.2	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.00	69.2	21.7	8.10	137.9	±2.2 %
		Y	9.75	68.7	21.2		137.5	
		Z	9.94	69.4	21.7		145.3	
10225-CAB	UMTS-FDD (HSPA+)	X	7.08	67.5	19.8	5.97	147.1	±1.4 %
		Y	7.06	67.7	19.8		142.3	
		Z	7.04	67.7	19.9		148.8	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	10.66	83.5	30.1	9.21	144.0	±3.0 %
		Y	7.43	74.7	25.7		127.6	
		Z	7.86	77.1	27.4		132.3	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	10.81	78.7	27.9	9.24	139.7	±3.0 %
		Y	8.48	72.4	24.4		130.1	
		Z	8.71	74.1	25.8		135.2	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	11.73	79.9	28.3	9.30	148.6	±3.3 %
		Y	9.11	73.2	24.8		139.0	
		Z	9.38	74.9	26.1		142.7	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.52	67.6	19.3	3.96	144.5	±0.7 %
		Y	4.67	68.3	19.6		146.0	
		Z	4.41	67.0	18.9		130.0	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.66	67.2	19.0	3.46	134.5	±0.5 %
		Y	3.91	68.9	19.9		133.2	
		Z	3.86	66.5	19.6		146.9	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.63	67.5	19.1	3.39	134.9	±0.5 %
		Y	3.93	69.3	20.0		136.0	
		Z	3.81	68.5	19.6		148.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.20	67.1	19.7	5.81	129.0	±1.2 %
		Y	6.20	67.0	19.6		128.0	
		Z	6.32	67.5	19.9		142.7	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.76	67.6	20.0	6.06	134.7	±1.4 %
		Y	6.75	67.5	19.9		133.5	
		Z	6.90	68.1	20.3		149.2	
10400-AAC	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.30	69.7	22.1	8.37	140.1	±2.5 %
		Y	10.05	69.0	21.5		141.2	
		Z	9.94	69.0	21.7		126.3	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.60	66.5	19.0	3.76	129.3	±0.5 %
		Y	5.30	71.1	20.2		148.4	
		Z	5.10	70.4	19.9		135.2	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.77	68.8	19.2	3.77	127.3	±0.7 %
		Y	5.35	71.7	20.5		145.4	
		Z	5.03	70.6	20.1		133.3	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.77	69.7	19.7	1.54	147.0	±0.7 %
		Y	3.73	75.4	22.2		143.7	
		Z	3.25	72.2	20.7		133.9	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.11	69.4	21.8	8.23	144.7	±2.5 %
		Y	9.86	68.8	21.4		139.3	
		Z	9.72	68.6	21.3		126.0	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

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)
750	41.9	0.89	6.46	6.46	6.46	0.75	1.22	± 12.0 %
835	41.5	0.90	6.16	6.16	6.16	0.36	1.67	± 12.0 %
1750	40.1	1.37	5.21	5.21	5.21	0.80	1.19	± 12.0 %
1900	40.0	1.40	5.03	5.03	5.03	0.73	1.25	± 12.0 %
2300	39.5	1.67	4.73	4.73	4.73	0.60	1.43	± 12.0 %
2450	39.2	1.80	4.53	4.53	4.53	0.80	1.28	± 12.0 %
2600	39.0	1.96	4.39	4.39	4.39	0.80	1.29	± 12.0 %

[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.

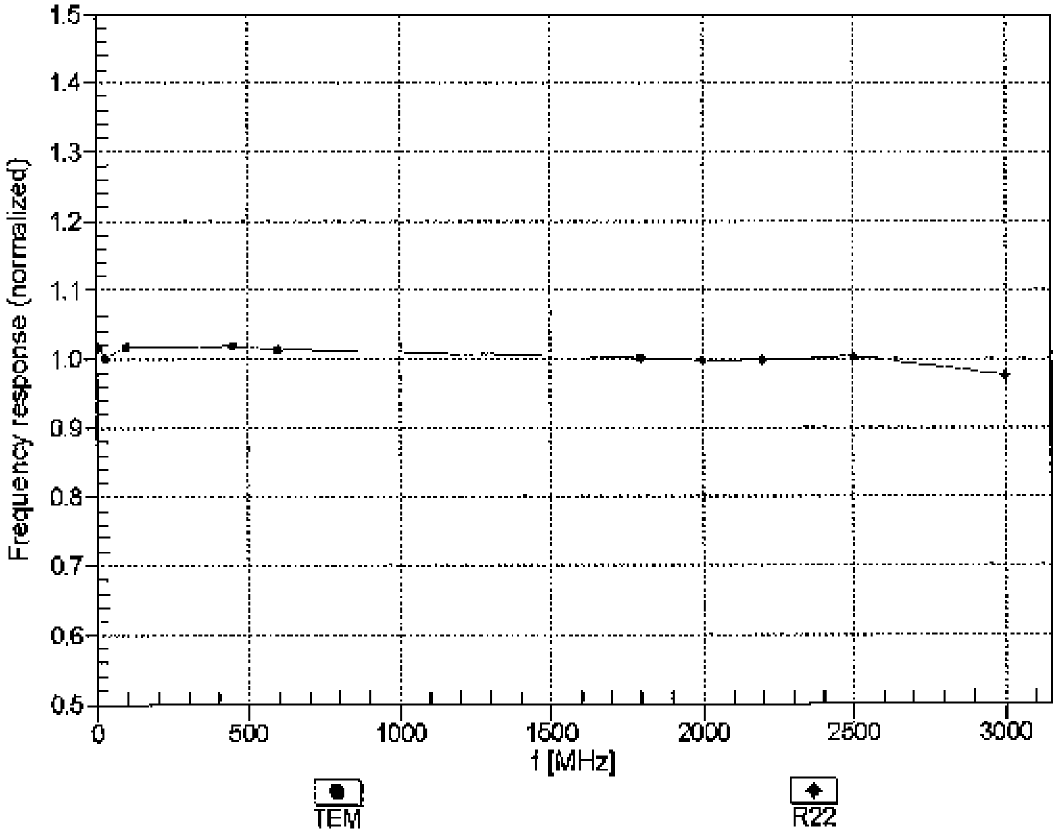
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3333

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)
750	55.5	0.96	6.31	6.31	6.31	0.70	1.26	± 12.0 %
835	55.2	0.97	6.25	6.25	6.25	0.47	1.54	± 12.0 %
1750	53.4	1.49	4.90	4.90	4.90	0.49	1.63	± 12.0 %
1900	53.3	1.52	4.70	4.70	4.70	0.54	1.49	± 12.0 %
2300	52.9	1.81	4.51	4.51	4.51	0.80	1.15	± 12.0 %
2450	52.7	1.95	4.34	4.34	4.34	0.80	1.15	± 12.0 %
2600	52.5	2.16	4.23	4.23	4.23	0.80	1.03	± 12.0 %

[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.

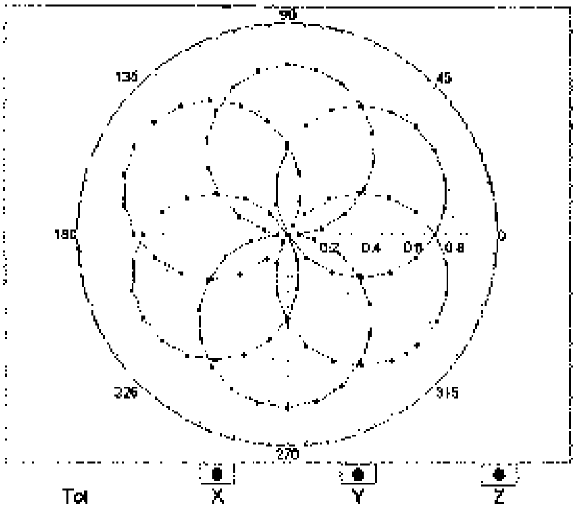
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



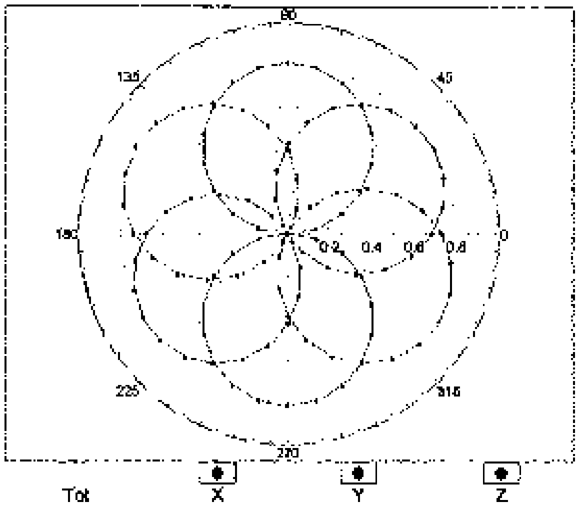
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

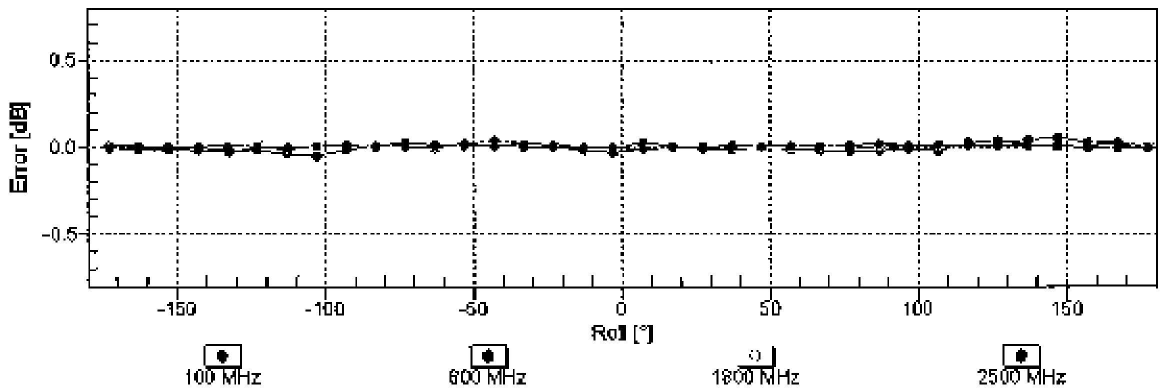
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



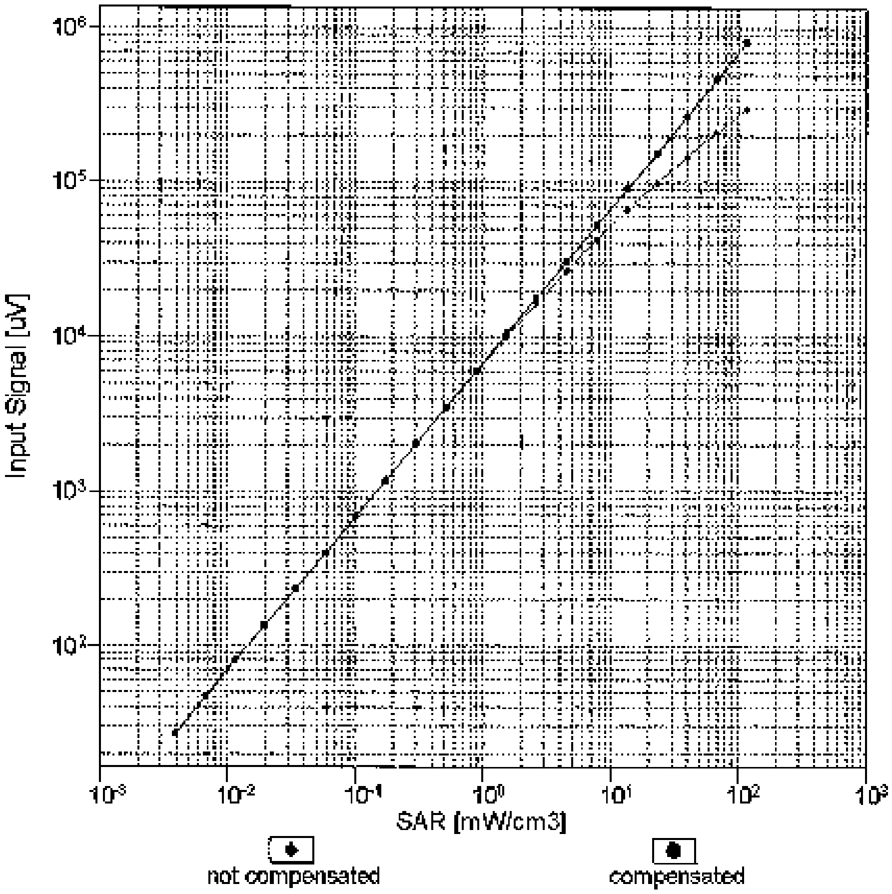
f=1800 MHz,R22

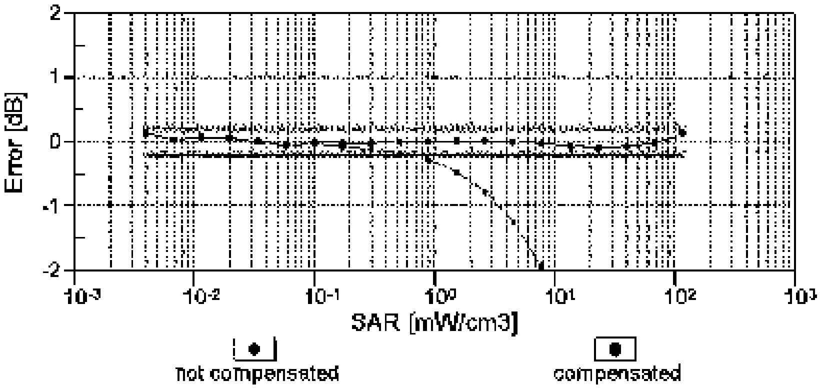




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

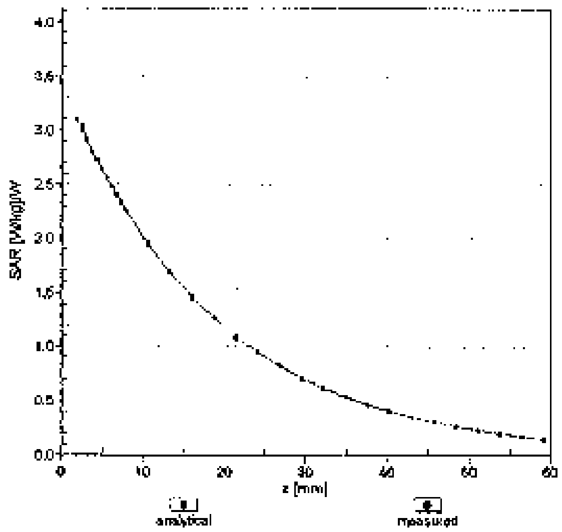




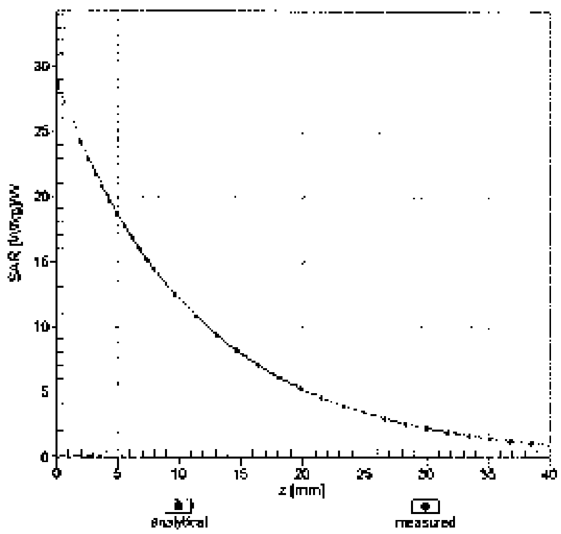
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

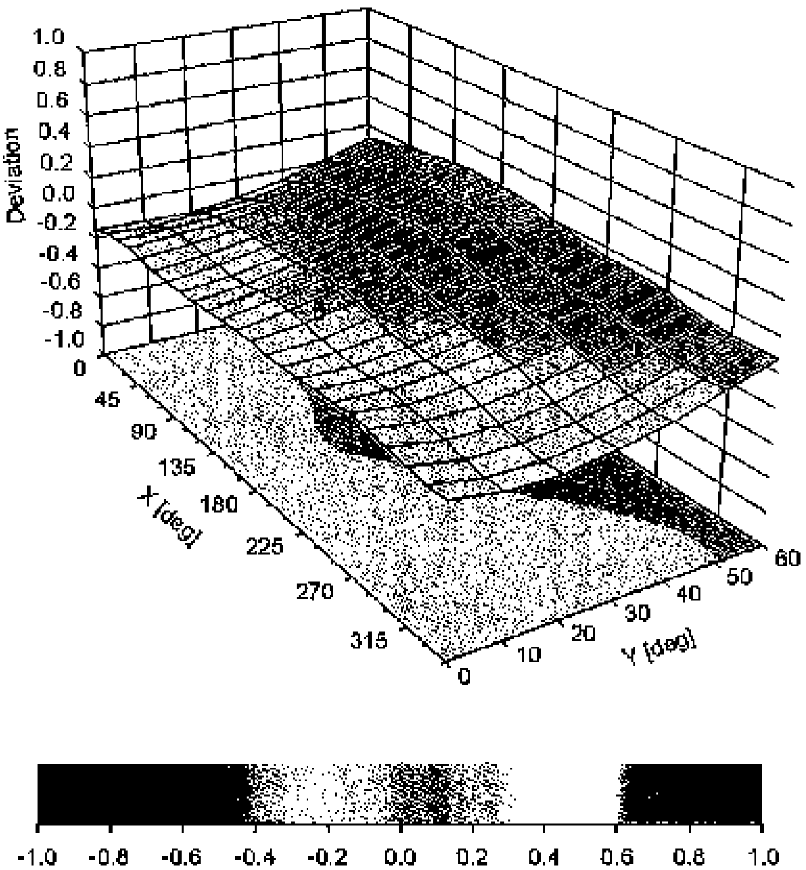


f = 1900 MHz,WGLS R22 (H_convF)



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:3333

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-32.8
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

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 **PC Test**

Certificate No: **ES3-3334_Nov15**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3334
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 17, 2015

BN 11/24/15

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-15)	In house check: Oct-16

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

Issued: November 17, 2015

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

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:3334

Manufactured: January 24, 2012
Calibrated: November 17, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3334

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.03	1.03	0.99	± 10.1 %
DCP (mV)[B]	107.6	105.3	107.9	

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	192.1	±2.7 %
		Y	0.0	0.0	1.0		183.6	
		Z	0.0	0.0	1.0		183.3	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.27	60.1	10.2	10.00	38.6	±1.4 %
		Y	1.99	59.3	10.2		38.4	
		Z	5.38	67.8	12.9		37.2	
10011-CAB	UMTS-FDD (WCDMA)	X	3.40	68.0	18.9	2.91	131.7	±0.5 %
		Y	3.27	67.0	18.2		130.2	
		Z	3.41	68.3	19.1		148.5	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.93	68.9	18.7	1.87	132.9	±0.7 %
		Y	3.12	69.6	18.8		130.2	
		Z	3.24	71.1	19.7		128.2	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.90	70.3	23.0	9.46	133.5	±3.3 %
		Y	10.53	69.0	22.1		124.6	
		Z	11.14	71.2	23.6		147.1	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	15.05	91.0	24.4	9.39	139.5	±1.9 %
		Y	10.11	85.5	23.3		131.9	
		Z	11.84	87.6	23.4		130.0	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	10.42	84.9	22.6	9.57	131.5	±3.0 %
		Y	13.29	89.7	24.6		141.1	
		Z	14.17	90.2	24.2		148.7	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	11.26	83.1	19.4	6.56	140.7	±1.9 %
		Y	26.29	95.5	23.8		134.7	
		Z	16.82	88.9	21.3		131.6	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	64.74	99.9	22.2	4.80	131.5	±2.2 %
		Y	56.71	99.8	22.7		124.7	
		Z	63.10	99.9	22.2		124.1	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	62.11	99.6	21.6	3.55	146.1	±1.9 %
		Y	77.61	99.8	21.2		132.0	
		Z	72.33	99.7	21.2		133.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	96.24	92.7	15.9	1.16	137.2	±1.7 %
		Y	95.69	93.1	16.2		129.5	
		Z	98.67	94.1	16.4		149.7	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.14	66.8	19.2	5.67	126.2	±1.7 %
		Y	6.21	66.8	19.1		139.9	
		Z	6.41	67.9	19.9		145.9	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.07	75.4	25.8	9.29	138.2	±2.5 %
		Y	9.54	73.3	24.5		130.5	
		Z	9.84	75.1	25.8		130.6	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.34	67.6	19.8	5.80	149.5	±1.4 %
		Y	6.13	66.6	19.1		132.1	
		Z	6.19	67.2	19.7		137.8	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.13	68.9	21.2	8.07	138.8	±2.7 %
		Y	10.16	68.9	21.1		149.6	
		Z	9.96	68.7	21.1		127.1	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.42	74.4	25.5	9.28	132.9	±3.0 %
		Y	9.50	74.0	25.0		143.7	
		Z	9.01	73.4	25.0		126.5	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.03	67.1	19.6	5.75	145.5	±1.4 %
		Y	5.81	66.0	18.9		128.9	
		Z	5.91	66.8	19.5		135.1	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.19	66.5	19.2	5.82	126.7	±1.4 %
		Y	6.20	66.4	19.0		132.8	
		Z	6.39	67.5	19.8		141.1	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.05	67.6	20.0	5.73	146.8	±1.4 %
		Y	4.82	66.2	19.2		132.2	
		Z	4.96	67.4	20.0		143.8	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.88	79.7	28.3	9.21	147.9	±3.0 %
		Y	8.00	76.1	26.2		138.9	
		Z	8.39	78.5	27.8		141.5	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.99	67.3	19.9	5.72	140.7	±1.2 %
		Y	4.80	66.2	19.1		131.3	
		Z	4.90	67.1	19.8		136.1	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.99	67.3	19.9	5.72	145.4	±1.4 %
		Y	4.81	66.2	19.2		130.9	
		Z	4.89	67.1	19.8		136.0	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.78	68.8	21.3	8.10	131.0	±2.5 %
		Y	9.73	68.4	21.0		140.7	
		Z	9.94	69.4	21.6		146.6	
10225-CAB	UMTS-FDD (HSPA+)	X	6.88	66.9	19.3	5.97	133.9	±1.7 %
		Y	6.96	67.1	19.3		144.8	
		Z	6.71	66.6	19.2		125.7	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	9.00	80.2	28.5	9.21	148.2	±3.0 %
		Y	7.73	75.1	25.7		131.6	
		Z	8.27	78.2	27.7		136.1	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.59	76.3	26.7	9.24	144.1	±2.7 %
		Y	8.74	72.9	24.5		133.4	
		Z	9.14	75.2	26.1		136.9	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.25	73.9	25.3	9.30	124.8	±3.0 %
		Y	9.40	73.7	24.9		142.1	
		Z	9.86	76.1	26.5		145.3	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.38	66.9	18.7	3.96	133.3	±0.9 %
		Y	4.44	66.9	18.6		148.2	
		Z	4.30	66.7	18.6		128.9	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.68	67.3	18.7	3.46	145.8	±0.7 %
		Y	3.58	66.6	18.2		136.3	
		Z	3.62	67.3	18.8		139.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.73	68.0	19.1	3.39	147.5	±0.7 %
		Y	3.55	66.7	18.3		138.6	
		Z	3.60	67.6	18.9		143.0	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.30	67.4	19.7	5.81	141.4	±1.2 %
		Y	6.11	66.5	19.1		130.3	
		Z	6.17	67.0	19.5		136.8	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.86	68.0	20.1	6.06	147.0	±1.7 %
		Y	6.68	67.1	19.5		136.0	
		Z	6.75	67.7	20.0		141.6	
10400-AAC	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.97	68.8	21.4	8.37	126.9	±2.7 %
		Y	10.07	68.9	21.4		143.6	
		Z	10.21	69.7	22.0		147.4	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.77	68.5	18.8	3.76	134.9	±0.5 %
		Y	4.69	68.1	18.5		126.7	
		Z	4.74	68.6	18.9		129.4	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.72	68.7	18.8	3.77	132.9	±0.7 %
		Y	4.78	68.9	18.9		147.4	
		Z	4.63	68.7	18.9		127.1	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.72	68.9	18.8	1.54	131.9	±0.5 %
		Y	2.65	68.0	18.1		145.9	
		Z	2.72	69.3	19.0		127.3	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.81	68.6	21.2	8.23	131.6	±2.7 %
		Y	9.90	68.7	21.2		144.1	
		Z	9.97	69.3	21.7		146.0	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3334

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)
6	55.5	0.75	6.13	6.13	6.13	0.00	1.00	± 13.3 %
13	55.5	0.75	5.76	5.76	5.76	0.00	1.00	± 13.3 %
750	41.9	0.89	6.56	6.56	6.56	0.24	2.36	± 12.0 %
835	41.5	0.90	6.37	6.37	6.37	0.37	1.70	± 12.0 %
1750	40.1	1.37	5.39	5.39	5.39	0.58	1.32	± 12.0 %
1900	40.0	1.40	5.18	5.18	5.18	0.77	1.20	± 12.0 %
2300	39.5	1.67	4.85	4.85	4.85	0.71	1.28	± 12.0 %
2450	39.2	1.80	4.58	4.58	4.58	0.79	1.17	± 12.0 %
2600	39.0	1.96	4.46	4.46	4.46	0.80	1.26	± 12.0 %

[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:3334

Calibration Parameter Determined in Body Tissue Simulating Media

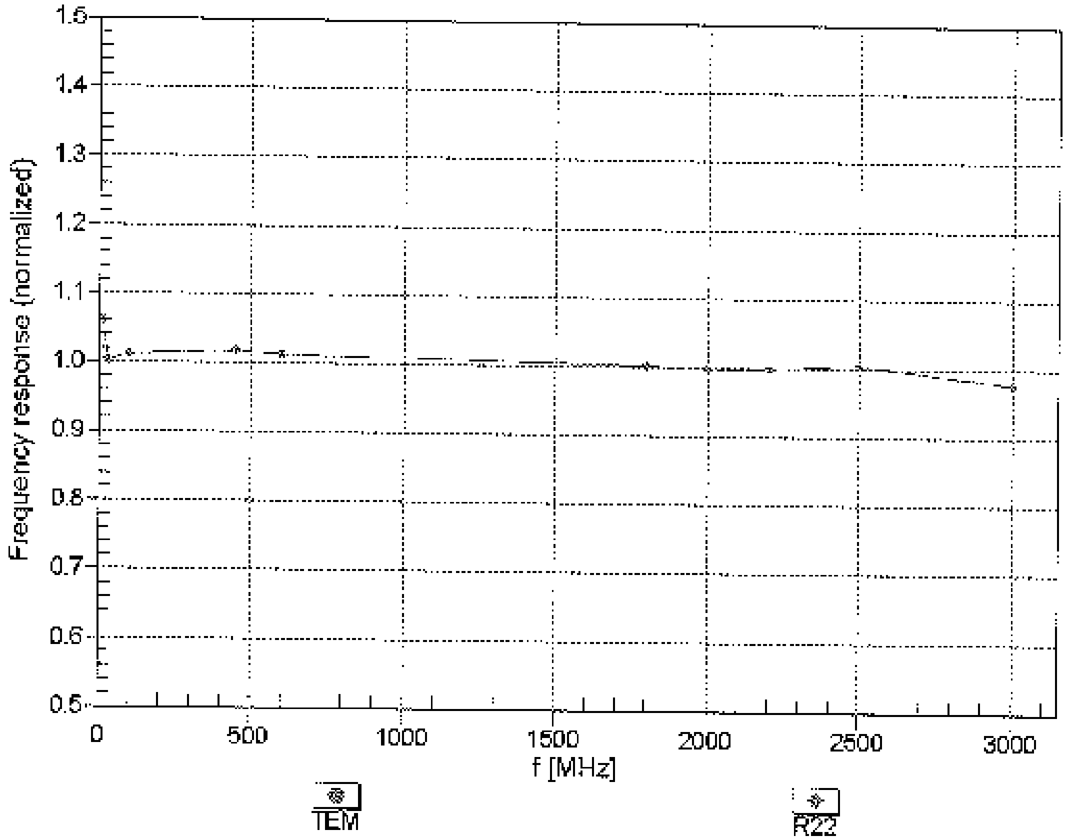
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	6.37	6.37	6.37	0.74	1.22	± 12.0 %
835	55.2	0.97	6.24	6.24	6.24	0.31	1.94	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.50	1.57	± 12.0 %
1900	53.3	1.52	4.84	4.84	4.84	0.50	1.58	± 12.0 %
2300	52.9	1.81	4.61	4.61	4.61	0.74	1.23	± 12.0 %
2450	52.7	1.95	4.45	4.45	4.45	0.74	1.20	± 12.0 %
2600	52.5	2.16	4.29	4.29	4.29	0.80	1.20	± 12.0 %

[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.

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

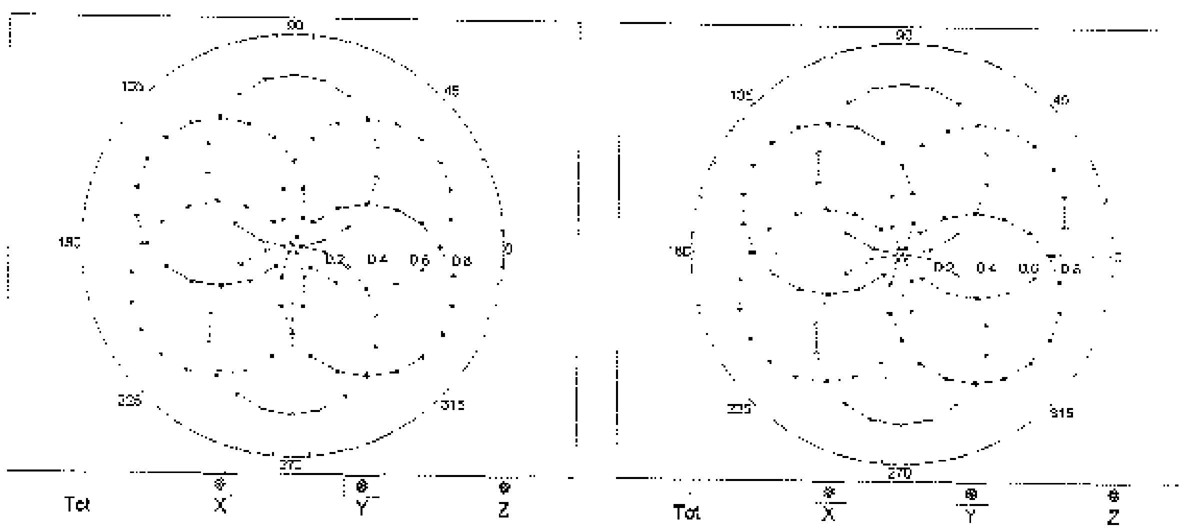


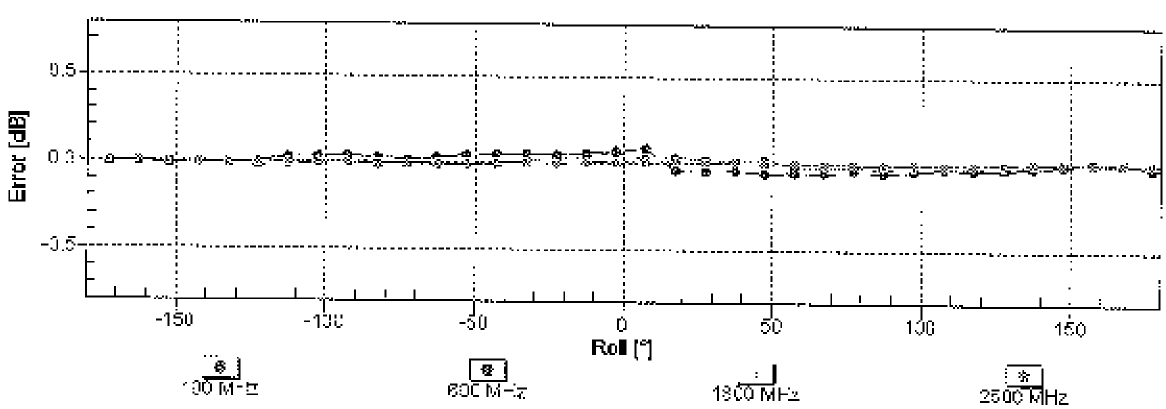
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM

f=1800 MHz,R22

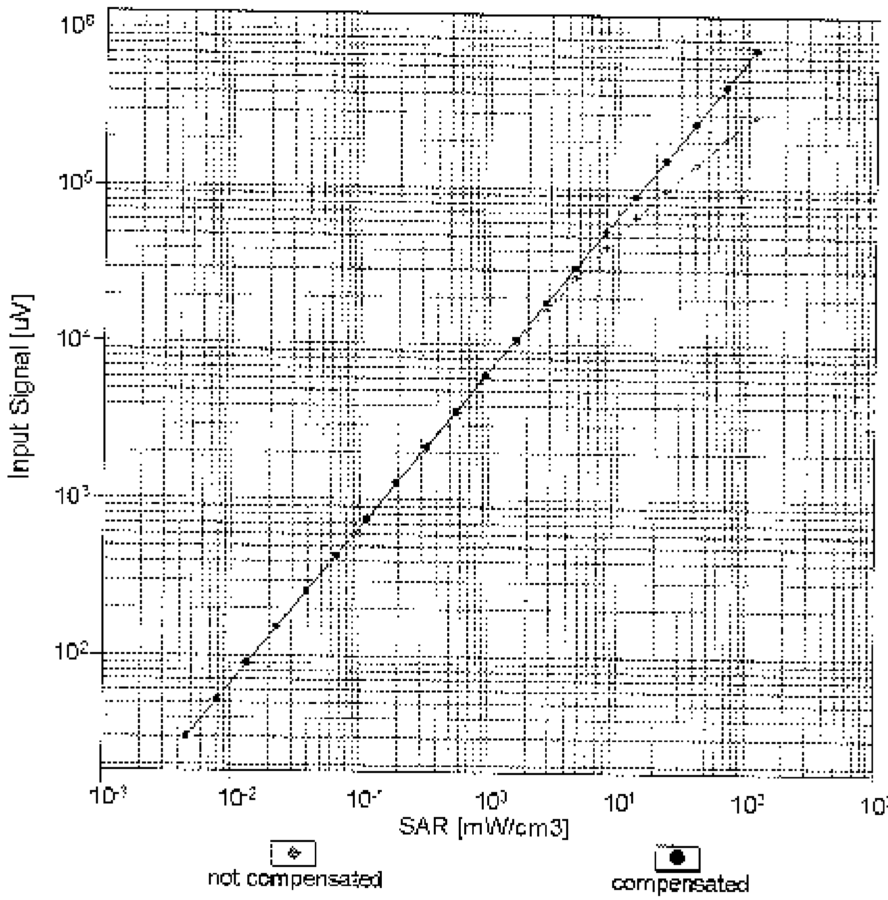


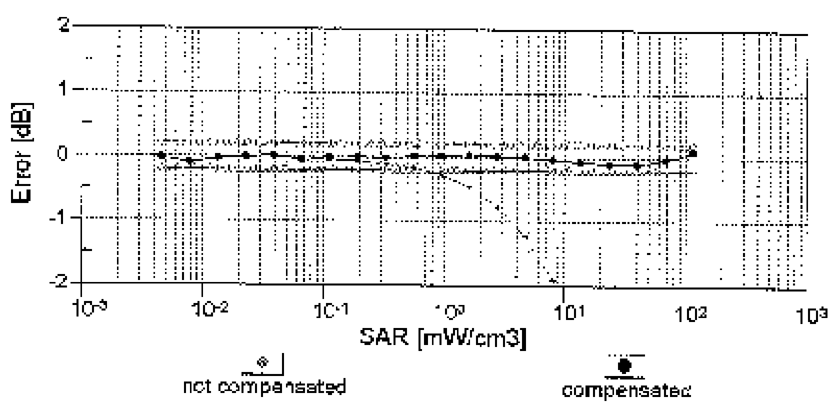


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

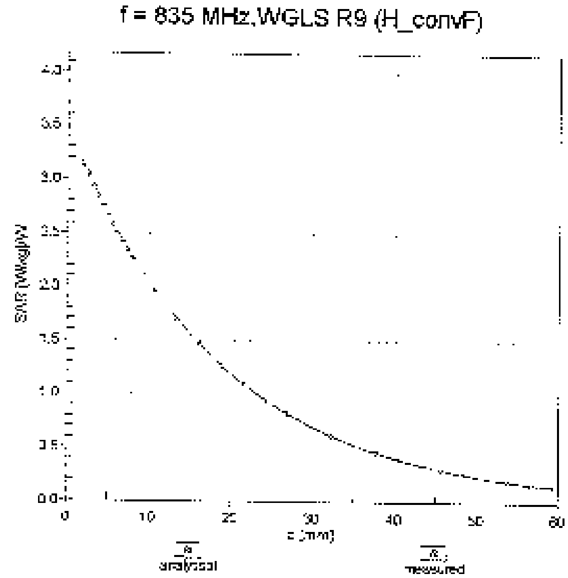
(TEM cell , f_{eval}= 1900 MHz)

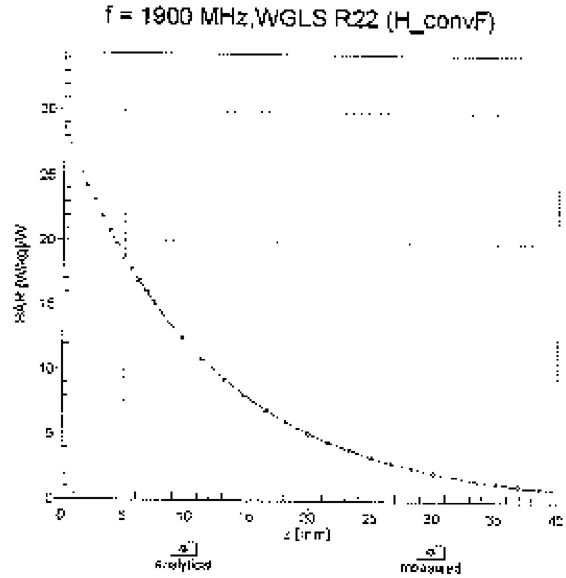




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

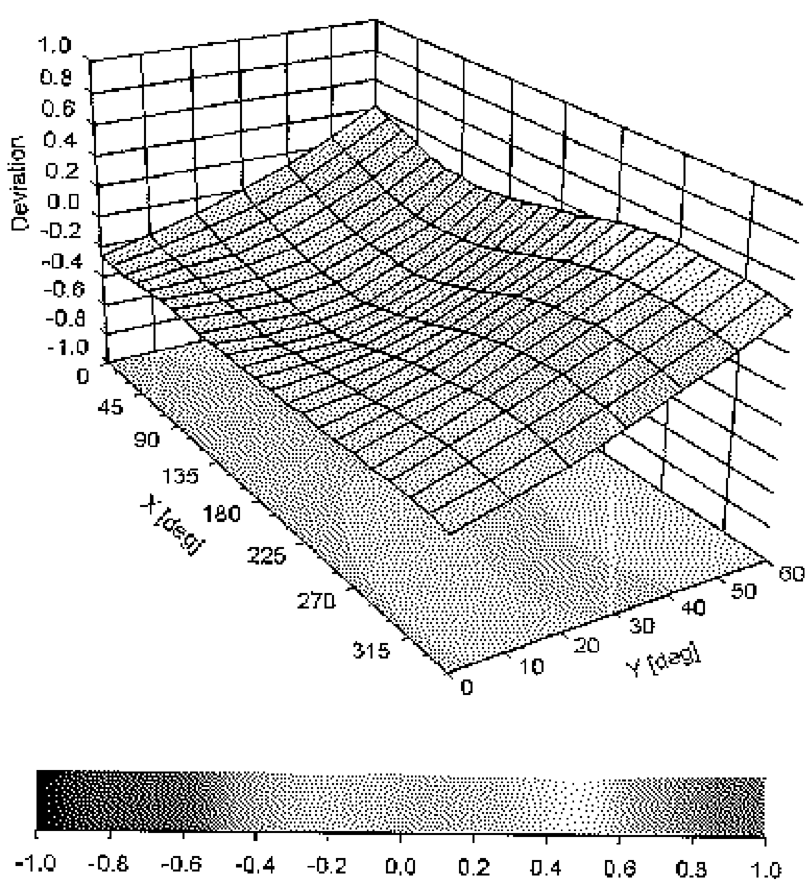
Conversion Factor Assessment





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:3334

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	17.4
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

((

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

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

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

Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: **ES3-3351_Jun15**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3351
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	June 22, 2015

BN ✓ 06/25/15

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:	Leif Klysner	Laboratory Technician	*[signature]*
Approved by:	Katja Pokovic	Technical Manager	*[signature]*

Issued: June 22, 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 ES3DV3

SN:3351

Manufactured: May 22, 2012
Calibrated: June 22, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3351

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m)^2)[A]	0.99	1.17	1.19	± 10.1 %
DCP (mV)[B]	113.6	105.2	104.5	

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	188.8	±3.8 %
		Y	0.0	0.0	1.0		196.2	
		Z	0.0	0.0	1.0		151.3	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.73	65.7	12.7	10.00	35.9	±1.2 %
		Y	1.18	58.1	9.8		37.4	
		Z	2.44	61.9	12.5		42.0	
10011-CAB	UMTS-FDD (WCDMA)	X	3.43	68.2	18.9	2.91	148.5	±0.5 %
		Y	3.14	66.5	18.1		114.3	
		Z	3.26	66.5	18.1		119.3	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.13	70.5	19.4	1.87	149.0	±0.5 %
		Y	2.46	65.9	17.0		115.2	
		Z	3.02	68.7	18.5		120.9	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.59	69.9	22.6	9.46	139.1	±2.5 %
		Y	10.11	68.9	22.4		103.4	
		Z	10.74	69.4	22.4		114.3	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	4.33	75.1	18.5	9.39	125.5	±1.4 %
		Y	5.13	77.6	20.0		144.5	
		Z	17.70	96.1	27.5		123.5	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	4.56	75.8	18.9	9.57	147.7	±2.2 %
		Y	5.75	78.8	20.2		140.4	
		Z	18.60	97.9	28.5		117.3	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	3.42	71.8	15.3	6.56	119.6	±1.4 %
		Y	14.95	90.8	22.0		132.7	
		Z	29.34	98.9	25.6		106.6	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	28.96	99.9	23.5	4.80	135.7	±1.9 %
		Y	55.26	99.9	21.9		107.5	
		Z	35.15	99.9	24.6		120.0	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	36.32	96.2	20.3	3.55	147.5	±1.9 %
		Y	73.22	99.9	20.7		117.0	
		Z	52.78	99.6	22.4		128.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	31.23	99.5	20.1	1.16	122.8	±1.4 %
		Y	0.74	62.4	7.0		135.2	
		Z	56.68	99.6	20.2		141.5	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.01	66.4	18.9	5.67	112.7	±1.2 %
		Y	6.14	66.9	19.3		124.6	
		Z	6.37	67.2	19.4		129.3	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	8.50	71.4	23.6	9.29	137.9	±2.7 %
		Y	8.12	70.6	23.6		105.2	
		Z	9.68	73.4	24.7		118.6	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	5.88	66.0	18.8	5.80	111.2	±1.2 %
		Y	5.99	66.5	19.2		122.8	
		Z	6.28	66.9	19.4		128.7	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.19	69.3	21.2	8.07	149.1	±2.2 %
		Y	9.73	68.2	20.9		111.5	
		Z	9.97	68.3	20.8		117.7	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.07	71.0	23.5	9.28	132.7	±2.5 %
		Y	8.82	74.2	25.9		147.0	
		Z	9.11	72.5	24.4		115.3	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.55	65.4	18.6	5.75	107.9	±0.9 %
		Y	5.67	66.0	19.0		120.3	
		Z	5.96	66.3	19.1		126.2	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	5.96	65.9	18.7	5.82	111.9	±1.2 %
		Y	6.12	66.6	19.3		125.0	
		Z	6.38	66.8	19.3		131.2	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.68	66.6	19.4	5.73	130.7	±0.9 %
		Y	4.81	67.2	20.0		144.7	
		Z	4.74	65.5	18.9		109.9	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.59	73.2	25.1	9.21	143.9	±2.5 %
		Y	6.42	72.7	25.3		113.3	
		Z	7.92	75.5	26.2		127.2	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.68	66.5	19.4	5.72	128.6	±0.9 %
		Y	4.80	67.2	20.0		144.2	
		Z	4.73	65.5	18.9		109.1	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.71	66.7	19.5	5.72	128.9	±1.2 %
		Y	4.78	67.1	19.9		143.9	
		Z	5.12	67.3	19.9		149.9	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.72	68.8	21.1	8.10	138.3	±1.9 %
		Y	9.32	67.9	20.9		105.9	
		Z	9.58	67.8	20.6		111.2	
10225-CAB	UMTS-FDD (HSPA+)	X	6.60	66.5	18.9	5.97	117.6	±1.2 %
		Y	6.69	66.9	19.3		132.0	
		Z	7.08	67.2	19.5		139.9	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	6.57	73.1	25.0	9.21	144.5	±2.2 %
		Y	6.59	73.6	25.8		114.3	
		Z	8.03	76.0	26.4		127.7	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	7.44	70.0	23.2	9.24	122.9	±2.5 %
		Y	8.16	73.3	25.5		138.8	
		Z	8.43	71.6	24.1		108.3	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	8.01	70.7	23.4	9.30	130.5	±2.7 %
		Y	8.86	74.4	26.1		146.7	
		Z	9.12	72.6	24.5		114.0	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.49	67.5	18.8	3.96	146.9	±0.7 %
		Y	4.13	65.9	18.1		117.5	
		Z	4.36	66.2	18.2		121.1	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.66	67.7	18.9	3.46	133.9	±0.5 %
		Y	3.37	66.1	18.1		109.3	
		Z	3.54	66.0	18.0		112.1	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.55	67.5	18.7	3.39	136.7	±0.7 %
		Y	3.35	66.4	18.2		110.1	
		Z	3.44	65.7	17.9		112.9	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	5.86	65.9	18.8	5.81	109.3	±1.2 %
		Y	6.00	66.5	19.3		122.6	
		Z	6.23	66.7	19.3		126.8	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.42	66.5	19.1	6.06	114.1	±1.2 %
		Y	6.60	67.2	19.7		127.9	
		Z	6.85	67.4	19.7		132.6	
10400-AAC	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.03	69.2	21.5	8.37	141.2	±1.9 %
		Y	9.51	68.0	21.1		106.9	
		Z	9.90	68.2	21.1		114.0	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	5.00	70.6	19.6	3.76	146.5	±0.5 %
		Y	4.32	67.9	18.3		115.0	
		Z	4.63	67.5	18.3		121.9	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.99	71.0	19.8	3.77	143.8	±0.5 %
		Y	4.37	68.5	18.7		113.5	
		Z	4.56	67.5	18.2		120.2	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	3.07	71.2	19.9	1.54	145.7	±0.5 %
		Y	2.43	66.6	17.4		116.6	
		Z	2.59	67.1	17.8		124.3	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.84	69.0	21.3	8.23	139.6	±1.9 %
		Y	9.37	67.9	21.0		106.5	
		Z	9.84	68.4	21.1		117.4	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3351

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)
750	41.9	0.89	6.43	6.43	6.43	0.31	1.96	± 12.0 %
835	41.5	0.90	6.17	6.17	6.17	0.21	2.59	± 12.0 %
1750	40.1	1.37	5.24	5.24	5.24	0.55	1.35	± 12.0 %
1900	40.0	1.40	5.07	5.07	5.07	0.54	1.42	± 12.0 %
2300	39.5	1.67	4.74	4.74	4.74	0.69	1.31	± 12.0 %
2450	39.2	1.80	4.46	4.46	4.46	0.80	1.26	± 12.0 %
2600	39.0	1.96	4.35	4.35	4.35	0.80	1.26	± 12.0 %

[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.

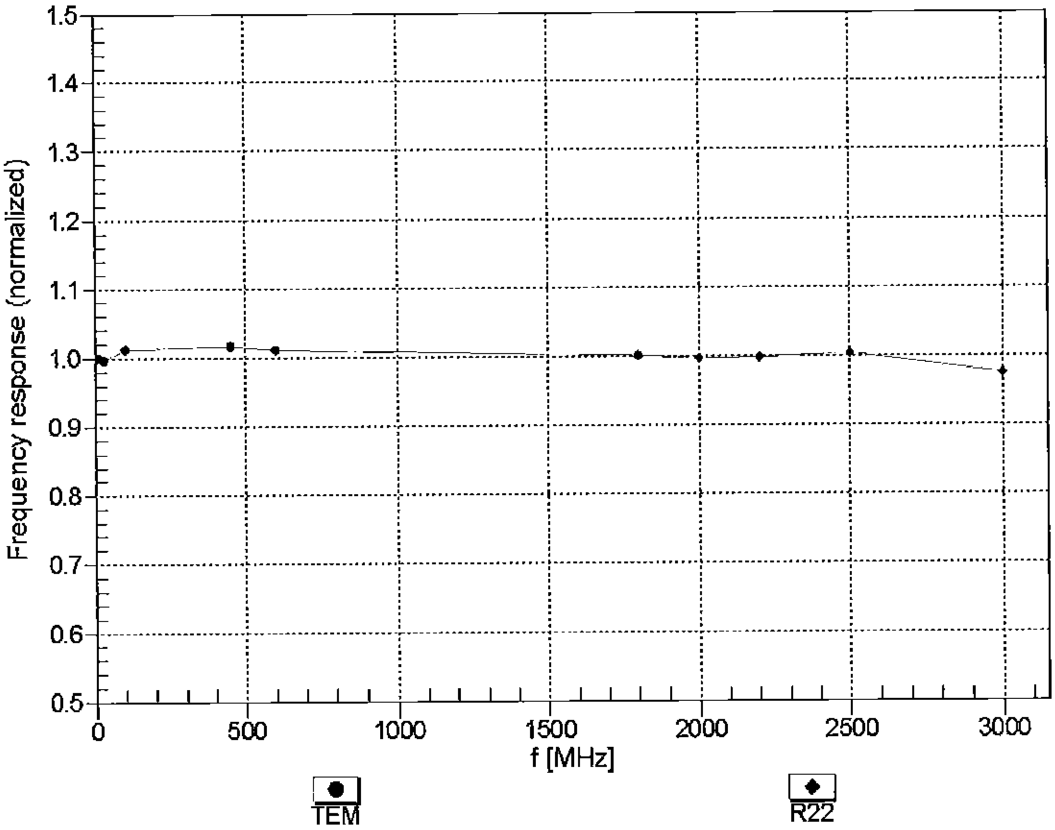
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3351

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)
750	55.5	0.96	6.21	6.21	6.21	0.29	1.98	± 12.0 %
835	55.2	0.97	6.11	6.11	6.11	0.77	1.20	± 12.0 %
1750	53.4	1.49	4.88	4.88	4.88	0.68	1.30	± 12.0 %
1900	53.3	1.52	4.68	4.68	4.68	0.61	1.46	± 12.0 %
2300	52.9	1.81	4.47	4.47	4.47	0.80	1.16	± 12.0 %
2450	52.7	1.95	4.30	4.30	4.30	0.80	1.16	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.80	1.20	± 12.0 %

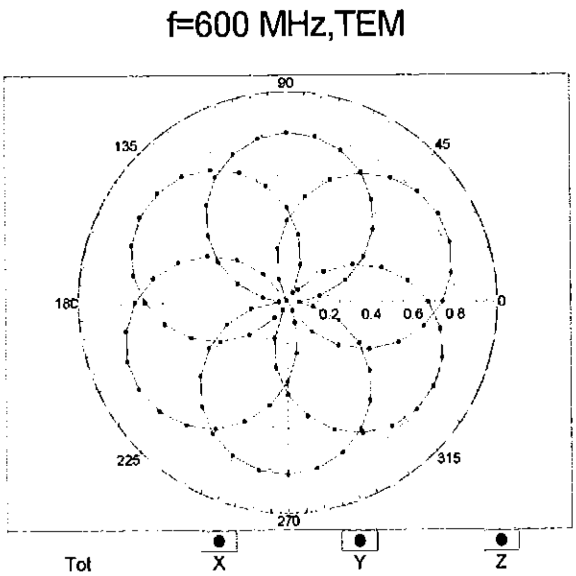
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz 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.

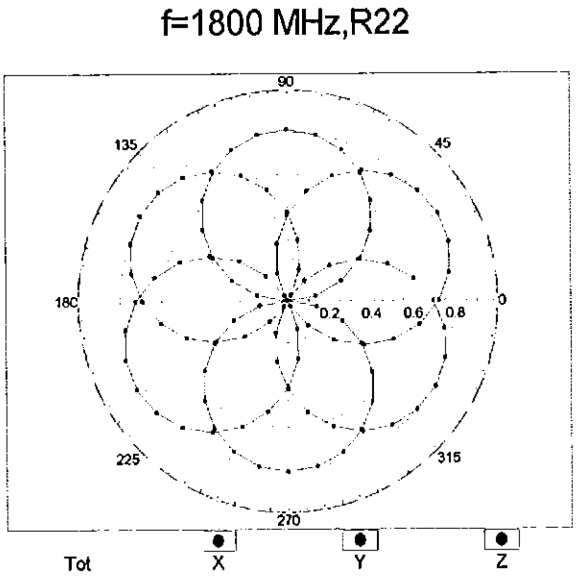
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

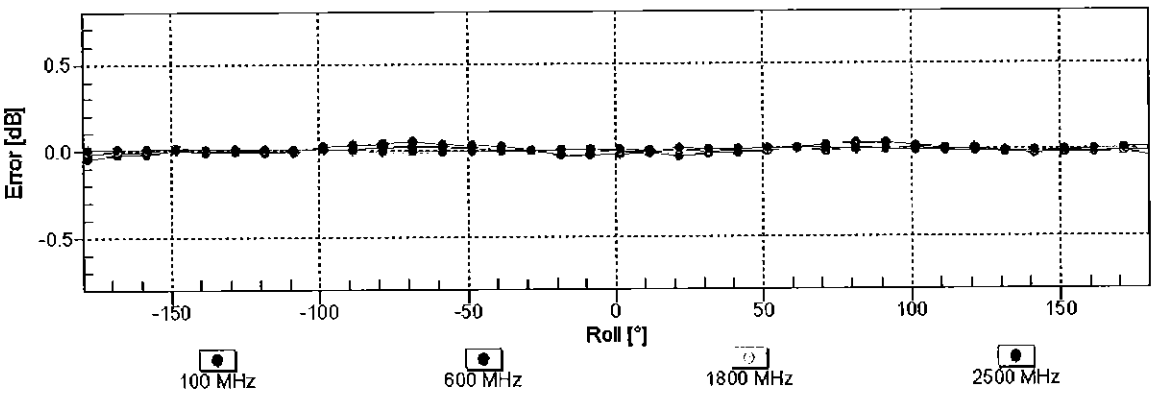


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°



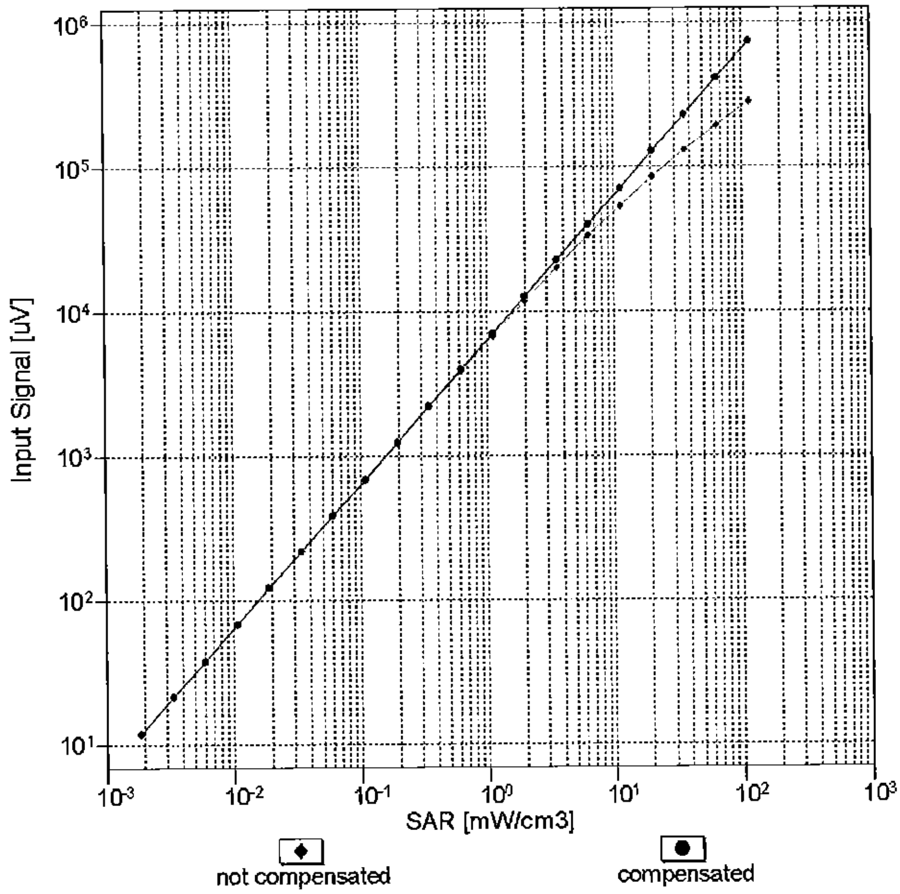


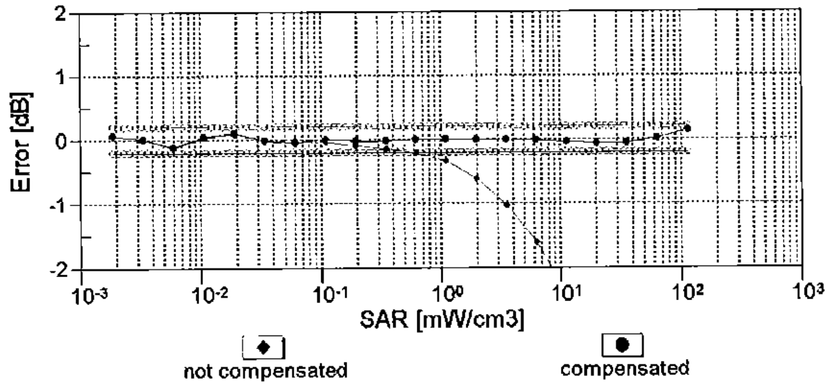


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

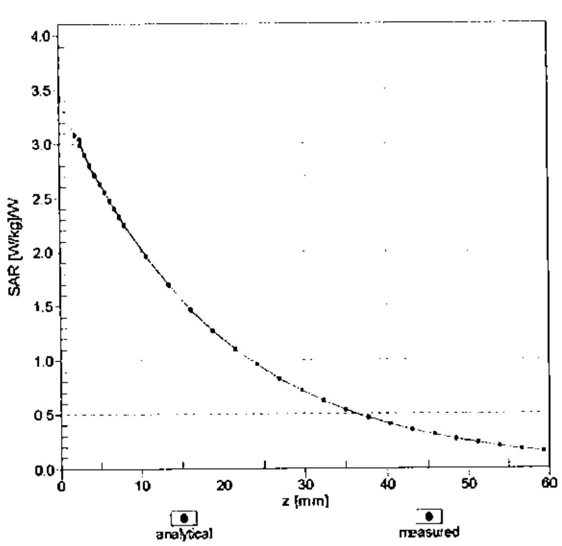
(TEM cell , f_{eval}= 1900 MHz)

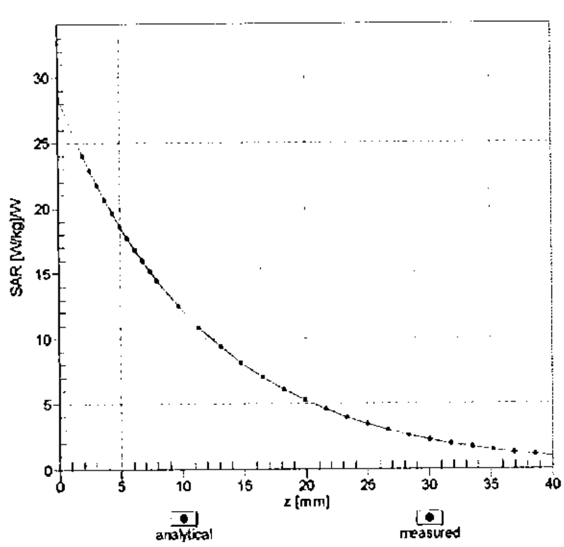




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

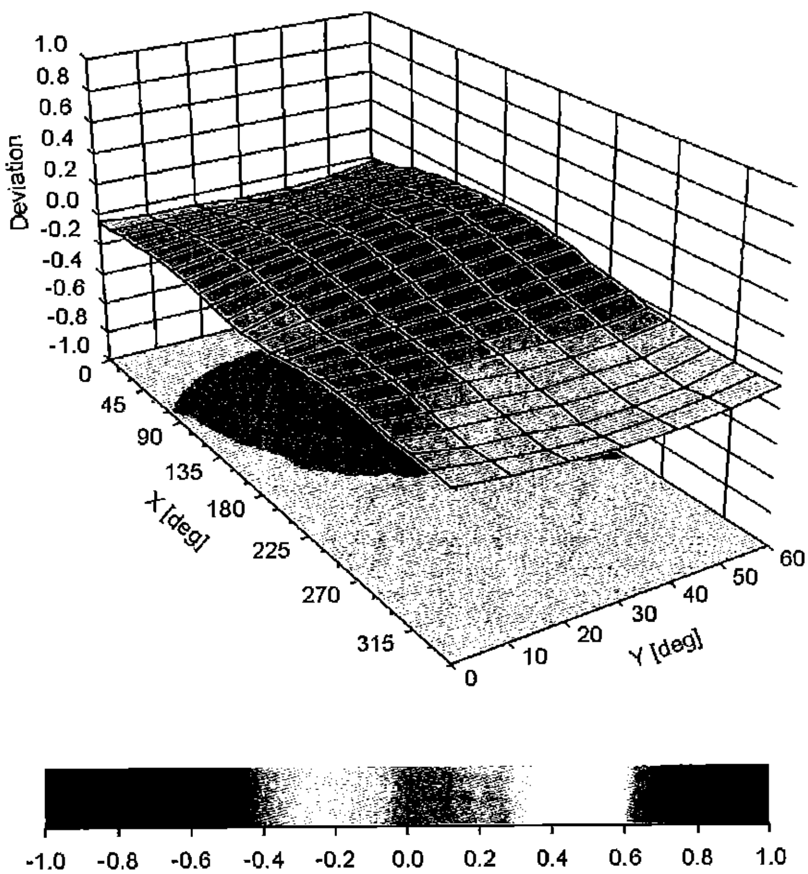
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3351

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	21.5
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 D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity ε' can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r'\varepsilon_0)^{1/2}\right]}{r}d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

Table D-I
Composition of the Tissue Equivalent Matter

Frequency (MHz)	750	835	1750	1900	2450	5200-5800
Tissue	Body	Body	Body	Body	Body	Body
Ingredients (% by weight)						
Bactericide		0.1				
DGBE			31	29.44	26.7	
HEC		1				
NaCl	See page 2	0.94	0.2	0.39	0.1	
Sucrose		44.9				
Polysorbate (Tween) 80						20
Water		53.06	68.8	70.17	73.2	80

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H_2O	Water, 35 – 58%
Sucrose	Sugar, white, refined, 40 – 60%
NaCl	Sodium Chloride, 0 – 6%
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone, 0.1 – 0.7% Relevant for safety; Refer to the respective Safety Data Sheet*.

Figure D-1
Composition of 750 MHz Body Tissue Equivalent Matter

Note: 750MHz liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	**Body Tissue Simulating Liquid (MSL750V2)**
Product No.	SL AAM 075 AA (Charge: 150223-3)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within ± 2.5% towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

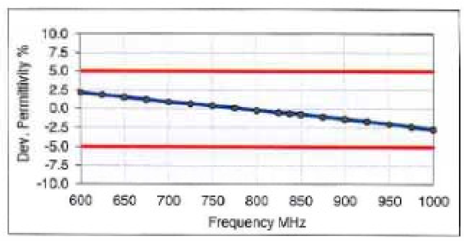
Test Condition

Ambient	Environment temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	25-Feb-15
Operator	IEN

Additional Information

TSL Density	1.212 g/cm^3
TSL Heat-capacity	3.006 kJ/(kg*K)

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
600	57.3	24.76	0.83	56.1	0.95	2.2	-13.2
625	57.1	24.43	0.85	56.0	0.95	1.8	-11.0
650	56.8	24.09	0.87	55.9	0.96	1.5	-8.8
675	56.5	23.80	0.89	55.8	0.96	1.2	-6.7
700	56.2	23.51	0.92	55.7	0.96	0.9	-4.6
725	56.0	23.28	0.94	55.6	0.96	0.6	-2.4
750	55.7	23.06	0.96	55.5	0.96	0.4	-0.1
775	55.5	22.87	0.99	55.4	0.97	0.1	2.1
800	55.2	22.68	1.01	55.3	0.97	-0.2	4.4
825	55.0	22.52	1.03	55.2	0.98	-0.5	5.7
838	54.9	22.44	1.05	55.2	0.98	-0.6	6.3
850	54.8	22.36	1.06	55.2	0.99	-0.7	7.0
875	54.5	22.24	1.08	55.1	1.02	-1.0	6.2
900	54.3	22.12	1.11	55.0	1.05	-1.3	5.5
925	54.1	22.01	1.13	55.0	1.06	-1.6	6.5
950	53.9	21.89	1.16	54.9	1.08	-2.0	7.6
975	53.6	21.81	1.18	54.9	1.09	-2.3	8.8
1000	53.4	21.73	1.21	54.8	1.10	-2.7	10.1



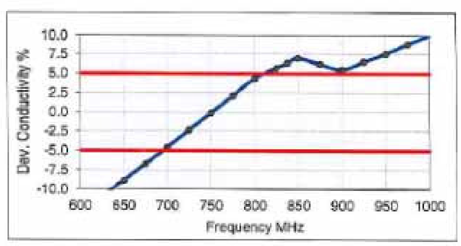


Figure D-2
750MHz Body Tissue Equivalent Matter

APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 v01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-I
SAR System Validation Summary 08/03/15 to 08/10/15

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(εr)	SENSITIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
C	750	12/11/2014	3333	ES3DV3	750	Body	0.988	56.289	PASS	PASS	PASS	N/A	N/A	N/A
J	835	4/28/2015	3319	ES3DV3	835	Body	0.992	54.192	PASS	PASS	PASS	GMSK	PASS	N/A
I	1900	5/30/2015	3213	ES3DV3	1900	Body	1.520	52.410	PASS	PASS	PASS	GMSK	PASS	N/A
E	2450	11/3/2014	3332	ES3DV3	2450	Body	1.996	52.207	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
A	5300	2/19/2015	3914	EX3DV4	5300	Body	5.181	47.442	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	2/19/2015	3914	EX3DV4	5500	Body	5.464	46.921	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	2/19/2015	3914	EX3DV4	5800	Body	5.942	46.314	PASS	PASS	PASS	OFDM	N/A	PASS

Table E-II
SAR System Validation Summary 03/09/16 to 03/22/16

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(εr)	SENSITIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
I	835	11/3/2015	3333	ES3DV3	835	Body	1.006	54.946	PASS	PASS	PASS	GMSK	PASS	N/A
C	1750	10/5/2015	3288	ES3DV3	1750	Body	1.477	51.065	PASS	PASS	PASS	N/A	N/A	N/A
G	1900	12/3/2015	3334	ES3DV3	1900	Body	1.552	50.709	PASS	PASS	PASS	GMSK	PASS	N/A
E	2300	9/15/2015	3351	ES3DV3	2300	Body	1.811	51.484	PASS	PASS	PASS	N/A	N/A	N/A
E	2450	9/15/2015	3351	ES3DV3	2450	Body	2.005	50.900	PASS	PASS	PASS	OFDM/TDD	PASS	PASS

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

A3LSMT377W Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D04v01r02, this device was tested by the manufacturer to determine the proximity sensor triggering distances for all applicable sides and edges of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge per Step i) in Section 6.2 of the KDB. The technical descriptions in the filing contain the complete set of triggering data required by Section 6 of FCC KDB Publication 616217 D04v01r02.

To ensure all production units are compliant, it is necessary to test SAR at a distance 1 mm less than the smallest distance between the device and SAR phantom (determined from the sensor triggering tests according to FCC KDB 616217 D04v01r02) with the device at the maximum output power (without power reduction). These SAR tests are included in addition to the SAR tests for the device touching the SAR phantom (at the reduced output power level).

The operational description contains information explaining how this device remains compliant in the event of a sensor malfunction.

Back Side – Main Antenna 1

Moving device toward the phantom:

KDB 616217 6.2.f Measured Power [dBm]											
Distance[mm]	23	22	21	20	19	18	17	16	15	14	13
UMTS B5	23.70	23.63	23.82	23.70	23.89	18.78	18.65	18.87	18.88	18.78	18.88
UMTS B4	23.10	23.11	23.30	23.36	23.34	11.71	11.72	11.88	11.76	11.89	11.91
UMTS B2	23.79	23.66	23.69	23.60	23.68	12.87	12.67	12.83	12.74	12.94	12.65
LTE B12	24.16	24.24	24.13	24.40	24.43	20.42	20.17	20.17	20.10	20.10	20.33
LTE B17	24.27	24.40	24.34	24.34	24.18	19.93	19.67	19.67	19.61	19.68	19.82
LTE B5	24.13	24.26	24.43	24.21	24.40	19.16	19.18	19.21	19.42	19.14	19.23
LTE B4	23.73	23.94	23.85	23.71	23.79	12.40	12.42	12.40	12.15	12.30	12.15
LTE B2	23.87	23.66	23.79	23.82	23.84	12.42	12.38	12.42	12.35	12.34	12.11

Moving device away from the phantom:

KDB 616217 6.2.h Measured Power [dBm]											
Distance[mm]	23	22	21	20	19	18	17	16	15	14	13
UMTS B5	23.66	23.71	23.65	23.67	23.65	18.94	18.95	18.66	18.65	18.80	18.90
UMTS B4	23.36	23.15	23.42	23.12	23.27	11.71	11.76	11.83	11.75	11.85	11.76
UMTS B2	23.77	23.69	23.65	23.80	23.95	12.78	12.77	12.83	12.95	12.82	12.92
LTE B12	24.11	24.33	24.28	24.37	24.37	20.27	20.21	20.23	20.28	20.11	20.19
LTE B17	24.22	24.17	24.10	24.25	24.15	19.75	19.60	19.86	19.69	19.90	19.83
LTE B5	24.27	24.40	24.15	24.35	24.33	19.28	19.20	19.11	19.27	19.15	19.25
LTE B4	23.94	23.77	23.84	23.80	23.80	12.29	12.24	12.45	12.14	12.39	12.45
LTE B2	23.89	23.90	23.71	23.89	23.74	12.12	12.17	12.34	12.18	12.29	12.42

Based on the most conservative measured triggering distance of 18 mm, additional SAR measurements were required at 17 mm from the back side.

Back Side – Main Antenna 2

Moving device toward the phantom:

KDB 616217 6.2.f Measured Power [dBm]											
Distance[mm]	16	15	14	13	12	11	10	9	8	7	6
LTE B30	22.44	22.21	22.27	22.28	22.15	13.31	13.18	13.28	13.40	13.27	13.23

Moving device away from the phantom:

KDB 616217 6.2.h Measured Power [dBm]											
Distance[mm]	16	15	14	13	12	11	10	9	8	7	6
LTE B30	22.42	22.25	22.39	22.15	22.31	13.13	13.25	13.23	13.16	13.29	13.25

Based on the most conservative measured triggering distance of 11 mm, additional SAR measurements were required at 10 mm from the back side.

Top Edge

Moving device toward the phantom:

KDB 616217 6.2.f Measured Power [dBm]											
Distance[mm]	19	18	17	16	15	14	13	12	11	10	9
UMTS B5	23.60	23.89	23.72	23.66	23.75	18.66	18.81	18.71	18.75	18.85	18.77
UMTS B4	23.25	23.30	23.15	23.11	23.35	11.78	11.60	11.75	11.71	11.91	11.91
UMTS B2	23.82	23.85	23.61	23.75	23.65	12.85	12.68	12.89	12.83	12.68	12.88
LTE B12	24.11	24.21	24.34	24.45	24.15	20.27	20.23	20.22	20.27	20.23	20.32
LTE B17	24.18	24.15	24.42	24.36	24.16	19.91	19.69	19.65	19.65	19.92	19.72
LTE B5	24.19	24.23	24.43	24.38	24.37	19.17	19.22	19.40	19.22	19.14	19.36
LTE B4	23.72	23.94	23.68	23.86	23.66	12.45	12.10	12.38	12.31	12.16	12.13
LTE B2	23.62	23.67	23.83	23.66	23.95	12.23	12.39	12.13	12.28	12.23	12.23

Moving device away from the phantom:

KDB 616217 6.2.h Measured Power [dBm]											
Distance[mm]	19	18	17	16	15	14	13	12	11	10	9
UMTS B5	23.78	23.89	23.71	23.68	23.79	18.80	18.62	18.65	18.95	18.60	18.70
UMTS B4	23.32	23.20	23.43	23.17	23.44	11.60	11.65	11.85	11.78	11.92	11.67
UMTS B2	23.82	23.70	23.76	23.62	23.73	12.81	12.92	12.89	12.67	12.87	12.94
LTE B12	24.23	24.40	24.44	24.36	24.16	20.36	20.10	20.30	20.14	20.13	20.16
LTE B17	24.15	24.20	24.25	24.27	24.38	19.76	19.61	19.70	19.65	19.60	19.61
LTE B5	24.43	24.11	24.36	24.44	24.20	19.43	19.13	19.40	19.38	19.40	19.36
LTE B4	23.78	23.87	23.60	23.68	23.64	12.15	12.12	12.12	12.28	12.34	12.22
LTE B2	23.62	23.69	23.93	23.78	23.94	12.28	12.27	12.26	12.30	12.20	12.26

Based on the most conservative measured triggering distance of 14 mm, additional SAR measurements were required at 13 mm from the top edge.

Left Edge – Main Antenna 1

Moving device toward the phantom:

KDB 616217 6.2.f Measured Power [dBm]											
Distance[mm]	12	11	10	9	8	7	6	5	4	3	2
UMTS B5	23.87	23.76	23.77	23.65	23.87	18.77	18.62	18.93	18.81	18.92	18.87
UMTS B4	23.35	23.31	23.20	23.33	23.16	11.81	11.71	11.63	11.74	11.78	11.69
UMTS B2	23.87	23.84	23.83	23.62	23.61	12.60	12.86	12.66	12.63	12.65	12.65
LTE B12	24.14	24.31	24.11	24.13	24.21	20.26	20.22	20.33	20.31	20.17	20.21
LTE B17	24.32	24.29	24.20	24.11	24.27	19.92	19.65	19.89	19.67	19.64	19.85
LTE B5	24.12	24.31	24.25	24.21	24.12	19.17	19.12	19.32	19.43	19.35	19.10
LTE B4	23.61	23.89	23.62	23.83	23.71	12.31	12.20	12.12	12.11	12.17	12.19
LTE B2	23.86	23.72	23.81	23.91	23.79	12.13	12.41	12.28	12.30	12.11	12.39

Moving device away from the phantom:

KDB 616217 6.2.h Measured Power [dBm]											
Distance[mm]	12	11	10	9	8	7	6	5	4	3	2
UMTS B5	23.84	23.84	23.62	23.88	23.63	18.76	18.65	18.76	18.60	18.69	18.82
UMTS B4	23.21	23.33	23.29	23.11	23.28	11.77	11.84	11.65	11.63	11.60	11.91
UMTS B2	23.93	23.61	23.93	23.65	23.95	12.86	12.67	12.84	12.85	12.77	12.75
LTE B12	24.29	24.41	24.42	24.32	24.41	20.26	20.42	20.16	20.30	20.23	20.28
LTE B17	24.13	24.30	24.34	24.16	24.20	19.75	19.92	19.74	19.81	19.68	19.94
LTE B5	24.35	24.10	24.39	24.23	24.16	19.41	19.20	19.41	19.16	19.34	19.41
LTE B4	23.77	23.88	23.72	23.63	23.65	12.11	12.30	12.20	12.31	12.13	12.25
LTE B2	23.69	23.60	23.61	23.76	23.65	12.27	12.41	12.29	12.45	12.25	12.23

Based on the most conservative measured triggering distance of 7 mm, additional SAR measurements were required at 6 mm from the left edge.

Left Edge – Main Antenna 2

Moving device toward the phantom:

KDB 616217 6.2.f Measured Power [dBm]											
Distance[mm]	11	10	9	8	7	6	5	4	3	2	1
LTE B30	22.30	22.19	22.39	22.19	22.24	13.29	13.28	13.37	13.32	13.37	13.22

Moving device away from the phantom:

KDB 616217 6.2.h Measured Power [dBm]											
Distance[mm]	11	10	9	8	7	6	5	4	3	2	1
LTE B30	22.17	22.25	22.28	22.21	22.15	13.25	13.24	13.25	13.32	13.19	13.40

Based on the most conservative measured triggering distance of 6 mm, additional SAR measurements were required at 5 mm from the left edge.