



SAR EVALUATION REPORT

Applicant Name:

Samsung Electronics Co., Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:

02/01/16 - 02/15/16

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

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FCC ID:

A3LSMT377T

APPLICANT:

SAMSUNG ELECTRONICS CO., LTD.

DUT Type:

Portable Tablet

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SM-T377T

Equipment Class	Band & Mode	Tx Frequency	SAR
			1 gm Body (W/kg)
PCB	UMTS 850	826.40 - 846.60 MHz	1.01
PCB	UMTS 1750	1712.4 - 1752.6 MHz	1.00
PCB	UMTS 1900	1852.4 - 1907.6 MHz	0.85
PCB	LTE Band 12	699.7 - 715.3 MHz	0.41
PCB	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.96
PCB	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.82
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.66
NII	U-NII-1	5180 - 5240 MHz	0.70
NII	U-NII-2A	5260 - 5320 MHz	0.64
NII	U-NII-2C	5500 - 5720 MHz	0.59
NII	U-NII-3	5745 - 5825 MHz	0.69
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A
Simultaneous SAR per KDB 690783 D01v01r03:			1.53

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 Ortañez
President



The SAR Tick is an initiative of the Mobile Manufacturers Forum (MMF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MMF. Further details can be obtained by emailing: sartick@mmfai.info.

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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 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 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 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 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device. The reduced powers for the power reduction mechanisms were confirmed via conducted power measurements at the RF port (See Section 8).

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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 D01v06.

1.3.1 Maximum Power

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 4 (AWS)	Maximum	24.0
	Nominal	23.5
LTE Band 2 (PCS)	Maximum	24.0
	Nominal	23.5
Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	18.5
	Nominal	18.0
IEEE 802.11g (2.4 GHz)	Maximum	16.5
	Nominal	16.0
IEEE 802.11n (2.4 GHz)	Maximum	14.5
	Nominal	14.0
Bluetooth	Maximum	9.5
	Nominal	9.0
Bluetooth LE	Maximum	7.5
	Nominal	7.0

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Mode / Band		Modulated Average (dBm)		
		20 MHz Bandwidth		40 MHz Bandwidth
		Ch. 36-48	Ch. 52-144	Ch. 149-165
IEEE 802.11a (5 GHz)	Maximum	17.5	15.5	14.5
	Nominal	17.0	15.0	14.0
IEEE 802.11n (5 GHz)	Maximum	14.5		13.5
	Nominal	14.0		13.0

1.3.2 Reduced Power – Proximity Sensor Active

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	3GPP HSDPA	3GPP HSUPA	3GPP DC-HSDPA
UMTS Band 5 (850 MHz)	Maximum	20.0	20.0	20.0	20.0
	Nominal	19.5	19.5	19.5	19.5
UMTS Band 4 (1750 MHz)	Maximum	13.5	13.5	13.5	13.5
	Nominal	13.0	13.0	13.0	13.0
UMTS Band 2 (1900 MHz)	Maximum	13.5	13.5	13.5	13.5
	Nominal	13.0	13.0	13.0	13.0

Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	20.5
	Nominal	20.0
LTE Band 4 (AWS)	Maximum	13.0
	Nominal	12.5
LTE Band 2 (PCS)	Maximum	14.0
	Nominal	13.5
Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	12.5
	Nominal	12.0
IEEE 802.11g (2.4 GHz)	Maximum	12.5
	Nominal	12.0
IEEE 802.11n (2.4 GHz)	Maximum	12.5
	Nominal	12.0

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Mode / Band		Modulated Average (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

1.4 DUT Antenna Locations

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

Table 1-1
Device Edges/Sides for SAR Testing

Mode	Back	Top	Bottom	Right	Left
UMTS 850	Yes	Yes	No	No	Yes
UMTS 1750	Yes	Yes	No	No	Yes
UMTS 1900	Yes	Yes	No	No	Yes
LTE Band 12	Yes	Yes	No	No	Yes
LTE Band 4 (AWS)	Yes	Yes	No	No	Yes
LTE Band 2 (PCS)	Yes	Yes	No	No	Yes
2.4 GHz WLAN	Yes	Yes	No	No	No
5 GHz WLAN	Yes	Yes	No	No	No

Note: Per FCC KDB 616217 D04v01r02, particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01v06.

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, 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 D01v06 4.3.2 procedures.

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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

When proximity sensor is not active, since U-NII-1 band has higher maximum output power compared to that of U-NII-2A band, and the highest reported SAR for U-NII-1 is less than 1.2 W/kg for 1g SAR, SAR is not required for U-NII-2A band according to FCC KDB 248227 D01v02r02.

When proximity sensor is active, 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 for 1g SAR, SAR is not required for U-NII-1 band according to FCC KDB 248227 D01v02r01.

Per FCC KDB 447498 D01v06, the 1g SAR exclusion threshold for distances <50mm is defined by the following equation:

$$\frac{\text{Max Power of Channel (mW)}}{\text{Test Separation Dist (mm)}} * \sqrt{\text{Frequency(GHz)}} \leq 3.0$$

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth body SAR was not required; $[(9/5) * \sqrt{2.480}] = 2.8 < 3.0$. Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

(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 D01v03r01.

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 D05v02r04.

This device supports LTE Carrier Aggregation (CA) in the downlink only. All uplink communications are identical to Release 8 specifications. Per FCC KDB Publication 941225 D05A v01r02, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

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1.7 Guidance Applied

- FCC KDB Publication 941225 D01v03r01, D05v02r04, D05Av01r02 (3G/4G)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04v01r02

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 Serial Number	Reduced Serial Number
UMTS 850	17255	17974
UMTS 1750	17974	17974
UMTS 1900	16273	18030
LTE Band 12	17255	17974
LTE Band 4 (AWS)	17974	17974
LTE Band 2 (PCS)	16273	17255
2.4 GHz WLAN	17255	16273
5 GHz WLAN	17255	17255

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LTE Information			
FCC ID	A3LSMT377T		
Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz)		
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)		
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
Channel Bandwidths	LTE Band 12: 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		
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 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)
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	The technical description includes all the possible carrier aggregation combinations		
LTE Release 10 Additional Information	This device does not support full CA features on 3GPP Release 10. It supports a maximum of 2 carriers in the downlink. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. The following LTE Release 10 Features are not supported: Relay, HetNet, Enhanced MIMO, eICI, WIFI Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.		

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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/m³)
- 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]

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

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 D01v01r04 (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 D01v01r04 (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.

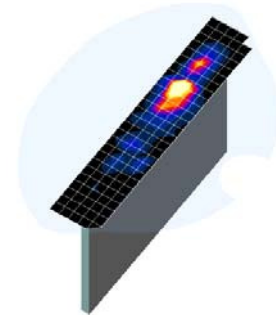


Figure 4-1 point
Sample SAR Area
Scan was

Table 4-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

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

*Also compliant to IEEE 1528-2013 Table 6

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5 SAR TESTING PROCEDURES

5.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon = 3$ and loss tangent $\delta = 0.02$.

5.2 SAR Testing for Tablet per KDB Publication 616217 D04v01r02

Per FCC KDB Publication 616217 D04v01r02, 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 D01v06 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.

5.3 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 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional test positions. The sensor does not trigger power reduction from the front of the device. 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.

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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 <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (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.

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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 D01v06, 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 D01v01r03.

7.2 3G SAR Test Reduction Procedure

In FCC KDB Publication 941225 D01v03r01, 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 ≤ 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 ≤ 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 D01v03r01 “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.

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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.

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 D05v02r04 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.

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7.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r04:

- a. Per Section 5.2.1, 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 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
- c. Per Section 5.2.3, 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 5.2.4 and 5.3, 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 5.2.1 through 5.2.3 is less than or equal to $\frac{1}{2}$ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/kg.

7.5.5 Downlink Only Carrier Aggregation

Conducted power measurements with LTE Carrier Aggregation (CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s) (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to specifications when downlink carrier aggregation is inactive on the PCC. For every supported combination of downlink only carrier aggregation, additional conducted output powers are measured with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band. Per FCC KDB Publication 941225 D05Av01r02, no SAR measurements are required for carrier aggregation configurations when the average output power with downlink only carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink only carrier aggregation inactive.

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 D01v02r02 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.

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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. 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.

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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, lowest data rate and lowest order IEEE 802.11 mode. 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.

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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	22.85	22.65	22.68	23.01	23.06	23.04	23.60	23.20	23.32	-
6	HSDPA	Subtest 1	22.89	22.90	22.89	23.15	22.78	23.25	23.79	23.20	23.50	0
6		Subtest 2	21.85	21.73	21.61	23.20	22.86	23.11	21.94	21.71	22.21	0
6		Subtest 3	22.32	22.63	22.24	22.20	21.93	22.45	22.39	22.00	22.75	0.5
6		Subtest 4	21.42	21.29	21.25	22.20	21.89	22.49	21.50	21.30	21.82	0.5
6	HSUPA	Subtest 1	22.70	22.55	22.54	22.31	22.04	22.53	22.94	22.70	23.35	0
6		Subtest 2	21.40	21.25	21.22	21.04	20.90	21.47	21.30	21.28	21.80	2
6		Subtest 3	22.50	22.38	22.34	21.71	21.88	22.50	22.00	21.00	22.70	1
6		Subtest 4	21.46	21.24	21.21	21.08	20.84	20.49	21.33	21.22	21.71	2
6		Subtest 5	23.04	22.71	22.84	22.14	22.08	22.21	23.70	23.41	23.53	0
8	DC-HSDPA	Subtest 1	23.05	22.75	22.81	22.35	22.24	22.52	23.09	23.11	23.17	0
8		Subtest 2	23.10	22.78	22.87	22.07	22.06	22.26	23.22	23.30	23.27	0
8		Subtest 3	22.66	22.73	22.74	21.79	21.64	21.82	22.62	22.75	22.81	0.5
8		Subtest 4	22.88	22.61	22.75	21.60	21.51	21.71	22.74	22.75	22.84	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	19.20	18.99	18.92	13.18	12.94	13.31	13.26	13.04	13.48	-
6	HSDPA	Subtest 1	19.39	19.12	19.00	13.19	12.97	13.48	13.33	13.09	13.21	0
6		Subtest 2	19.35	19.14	19.17	13.20	13.15	13.45	13.11	12.84	12.94	0
6		Subtest 3	19.30	19.17	19.04	13.30	13.00	13.38	13.10	12.78	12.80	0.5
6		Subtest 4	19.44	19.15	19.04	13.24	13.03	13.33	13.09	12.82	12.90	0.5
6	HSUPA	Subtest 1	18.72	18.53	18.28	12.34	12.00	12.72	12.35	12.07	12.70	0
6		Subtest 2	18.54	18.38	18.16	12.12	12.02	12.50	12.36	12.07	12.77	2
6		Subtest 3	18.50	18.33	18.33	12.25	11.78	12.47	12.31	12.00	12.61	1
6		Subtest 4	18.45	18.22	18.34	12.15	11.76	12.48	12.68	11.99	12.60	2
6		Subtest 5	19.41	19.21	19.29	12.41	12.14	12.64	13.02	13.20	13.24	0
8	DC-HSDPA	Subtest 1	19.47	19.24	19.26	12.45	12.21	12.50	13.05	13.16	13.22	0
8		Subtest 2	19.28	19.11	19.13	12.33	12.19	12.42	12.98	13.15	13.11	0
8		Subtest 3	18.97	18.90	18.77	11.91	12.02	12.15	12.83	12.82	12.88	0.5
8		Subtest 4	18.86	18.94	18.79	11.84	11.91	12.22	12.77	12.65	12.80	0.5

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.

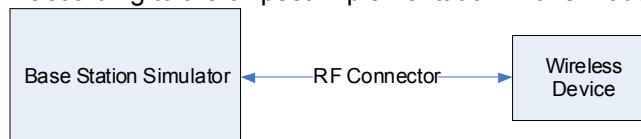


Figure 8-1
Power Measurement Setup

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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	MPR Allowed per 3GPP [dB]	MPR [dB]
			23095 (707.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	23.70	0	0
	1	25	23.76		0
	1	49	23.73		0
	25	0	22.77	0-1	1
	25	12	22.67		1
	25	25	22.65		1
	50	0	22.70		1
16QAM	1	0	21.59	0-1	1
	1	25	21.58		1
	1	49	21.55		1
	25	0	20.69	0-2	2
	25	12	20.62		2
	25	25	20.53		2
	50	0	20.65		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	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23035 (701.5 MHz)	23095 (707.5 MHz)	23155 (713.5 MHz)		
			Conducted Power [dBm]	Conducted Power [dBm]	Conducted Power [dBm]		
QPSK	1	0	23.78	23.92	23.96	0	0
	1	12	23.83	23.91	24.08		0
	1	24	23.90	23.89	23.72		0
	12	0	22.88	22.89	22.84	0-1	1
	12	6	22.87	22.85	22.86		1
	12	13	22.90	22.84	22.82		1
	25	0	22.88	22.92	22.85		1
16QAM	1	0	21.60	21.60	21.54	0-1	1
	1	12	21.74	21.63	21.58		1
	1	24	21.59	21.65	21.56		1
	12	0	20.83	20.83	20.76	0-2	2
	12	6	20.94	20.80	20.75		2
	12	13	20.96	20.79	20.82		2
	25	0	20.93	20.83	20.80		2

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

LTE Band 12 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23025 (700.5 MHz)	23095 (707.5 MHz)	23165 (714.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.99	23.96	23.95	0	0
	1	7	23.98	23.98	23.94		0
	1	14	23.96	23.95	23.83		0
	8	0	22.55	22.56	22.52	0-1	1
	8	4	22.54	22.55	22.51		1
	8	7	22.52	22.53	22.50		1
	15	0	22.53	22.53	22.51		1
16QAM	1	0	21.56	21.56	21.57	0-1	1
	1	7	21.54	21.60	21.53		1
	1	14	21.55	21.54	21.51		1
	8	0	20.60	20.52	20.55	0-2	2
	8	4	20.53	20.55	20.56		2
	8	7	20.55	20.53	20.51		2
	15	0	20.51	20.51	20.53		2

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

LTE Band 12 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23017 (699.7 MHz)	23095 (707.5 MHz)	23173 (715.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	24.03	23.98	23.97	0	0
	1	2	24.05	23.98	23.98		0
	1	5	24.07	24.00	23.85		0
	3	0	23.92	24.02	23.97		0
	3	2	23.96	23.99	23.93		0
	3	3	24.01	23.95	23.89		0
	6	0	22.56	22.53	22.54	0-1	1
16QAM	1	0	21.72	21.53	21.54	0-1	1
	1	2	21.63	21.52	21.53		1
	1	5	21.71	21.60	21.55		1
	3	0	21.70	21.58	21.53		1
	3	2	21.65	21.55	21.52		1
	3	3	21.66	21.52	21.54		1
	6	0	20.58	20.53	20.51	0-2	2

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Table 8-7
LTE Band 12 Conducted Powers - 10 MHz Bandwidth
Reduced Power

LTE Band 12 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23095 (707.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	20.31	0	0
	1	25	20.27		0
	1	49	20.29		0
	25	0	19.04	0-1	1
	25	12	18.97		1
	25	25	19.06		1
16QAM	50	0	18.94	0-1	1
	1	0	17.68		1
	1	25	17.63		1
	1	49	17.65	0-2	1
	25	0	17.33		2
	25	12	17.17		2
	25	25	17.12		2
	50	0	17.13		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 Power

LTE Band 12 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23035 (701.5 MHz)	23095 (707.5 MHz)	23155 (713.5 MHz)		
			Conducted Power [dBm]	Conducted Power [dBm]	Conducted Power [dBm]		
QPSK	1	0	19.82	19.87	19.76	0	0
	1	12	19.79	19.82	19.81		0
	1	24	19.75	19.89	19.78		0
	12	0	18.60	18.77	18.68	0-1	1
	12	6	18.58	18.68	18.62		1
	12	13	18.56	18.70	18.65		1
16QAM	25	0	18.53	18.78	18.68	0-1	1
	1	0	17.66	17.81	17.84		1
	1	12	17.60	17.78	17.84		1
	1	24	17.68	17.81	17.82	0-2	1
	12	0	17.09	17.23	17.24		2
	12	6	17.10	17.19	17.15		2
	12	13	17.13	17.15	17.12		2
	25	0	17.13	17.28	17.21		2

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Table 8-9
LTE Band 12 Conducted Powers - 3 MHz Bandwidth
Reduced Power

LTE Band 12 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23025 (700.5 MHz)	23095 (707.5 MHz)	23165 (714.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	19.67	19.78	19.56	0	0
	1	7	19.72	19.72	19.66		0
	1	14	19.84	19.69	19.72		0
	8	0	18.55	18.86	18.58	0-1	1
	8	4	18.50	18.60	18.43		1
	8	7	18.48	18.65	18.66		1
	15	0	18.59	18.66	18.62		1
16QAM	1	0	17.66	17.87	17.81	0-1	1
	1	7	17.50	17.66	17.66		1
	1	14	17.78	17.74	17.76		1
	8	0	17.01	17.26	17.09	0-2	2
	8	4	17.12	17.24	17.03		2
	8	7	17.19	17.22	17.15		2
	15	0	16.98	17.13	17.11		2

Table 8-10
LTE Band 12 Conducted Powers -1.4 MHz Bandwidth
Reduced Power

LTE Band 12 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23017 (699.7 MHz)	23095 (707.5 MHz)	23173 (715.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	19.67	19.91	19.76	0	0
	1	2	19.60	19.87	19.73		0
	1	5	19.84	19.87	19.66		0
	3	0	19.65	19.90	19.56		0
	3	2	19.68	19.86	19.64		0
	3	3	19.58	19.82	19.61		0
	6	0	18.27	18.21	18.56	0-1	1
16QAM	1	0	17.80	17.89	17.84	0-1	1
	1	2	17.73	17.85	17.74		1
	1	5	17.64	17.85	17.72		1
	3	0	17.65	17.68	17.66		1
	3	2	17.64	17.63	17.71		1
	3	3	17.68	17.63	17.69		1
	6	0	16.89	16.82	16.96	0-2	2

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8.2.2 LTE Band 4 (AWS)

Table 8-11
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth
Maximum Power

LTE Band 4 (AWS) 20 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20175 (1732.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	23.62	0	0
	1	50	23.64		0
	1	99	23.68		0
	50	0	21.73	0-1	1
	50	25	21.71		1
	50	50	21.75		1
	100	0	21.73		1
16QAM	1	0	21.77	1	1
	1	50	21.74		1
	1	99	21.82		1
	50	0	20.71	0-2	2
	50	25	20.70		2
	50	50	20.74		2
	100	0	20.78		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 8-12
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	Frequency [MHz]	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	23.56	23.52	23.72	0	0
	1	36	23.64	23.59	23.78		0
	1	74	23.73	23.74	23.67		0
	36	0	21.79	21.63	21.81	0-1	1
	36	18	21.75	21.81	21.77		1
	36	37	21.66	21.65	21.73		1
	75	0	21.73	21.83	21.77		1
16QAM	1	0	21.76	21.67	21.70	0-1	1
	1	36	21.81	21.79	21.79		1
	1	74	21.87	21.78	21.72		1
	36	0	20.64	20.78	20.69	0-2	2
	36	18	20.71	20.67	20.78		2
	36	37	20.66	20.82	20.64		2
	75	0	20.74	20.79	20.87		2

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Table 8-13
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	23.56	23.67	23.64	0	0
	1	25	23.69	23.67	23.70		0
	1	49	23.59	23.58	23.60		0
	25	0	21.71	21.64	21.76	0-1	1
	25	12	21.76	21.62	21.78		1
	25	25	21.81	21.82	21.79		1
	50	0	21.83	21.77	21.79		1
16QAM	1	0	21.76	21.84	21.71	0-1	1
	1	25	21.69	21.65	21.76		1
	1	49	21.80	21.90	21.87		1
	25	0	20.64	20.69	20.74	0-2	2
	25	12	20.71	20.63	20.66		2
	25	25	20.77	20.77	20.72		2
	50	0	20.85	20.86	20.68		2

Table 8-14
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	23.55	23.58	23.56	0	0
	1	12	23.62	23.61	23.60		0
	1	24	23.66	23.77	23.66		0
	12	0	21.67	21.82	21.74	0-1	1
	12	6	21.76	21.79	21.65		1
	12	13	21.81	21.71	21.82		1
	25	0	21.81	21.80	21.77		1
16QAM	1	0	21.72	21.82	21.84	0-1	1
	1	12	21.66	21.69	21.70		1
	1	24	21.76	21.79	21.80		1
	12	0	20.63	20.69	20.74	0-2	2
	12	6	20.77	20.67	20.61		2
	12	13	20.81	20.69	20.79		2
	25	0	20.71	20.68	20.68		2

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Table 8-15
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth
Maximum Power

LTE Band 4 (AWS) 3 MHzBandwidth							
Modulation	RB Size	RB Offset	Frequency [MHz]	Frequency [MHz]	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			19965 (1711.5 MHz)	20175 (1732.5 MHz)	20385 (1753.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.67	23.57	23.55	0	0
	1	7	23.65	23.71	23.71		0
	1	14	23.61	23.76	23.60		0
	8	0	21.78	21.79	21.63	0-1	1
	8	4	21.74	21.81	21.81		1
	8	7	21.80	21.83	21.75		1
	15	0	21.71	21.77	21.67		1
16QAM	1	0	21.87	21.71	21.86	0-1	1
	1	7	21.80	21.70	21.71		1
	1	14	21.78	21.90	21.83		1
	8	0	20.75	20.77	20.68	0-2	2
	8	4	20.71	20.69	20.69		2
	8	7	20.70	20.84	20.67		2
	15	0	20.70	20.75	20.72		2

Table 8-16
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	Mid Channel	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			19957 (1710.7 MHz)	20175 (1732.5 MHz)	20393 (1754.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.61	23.70	23.54	0	0
	1	2	23.56	23.56	23.62		0
	1	5	23.65	23.61	23.60		0
	3	0	22.64	22.83	22.80		0
	3	2	22.73	22.61	22.74		0
	3	3	22.67	22.81	22.83		0
	6	0	21.68	21.71	21.82	0-1	1
16QAM	1	0	21.67	21.74	21.74	0-1	1
	1	2	21.67	21.75	21.81		1
	1	5	21.85	21.74	21.80		1
	3	0	21.75	21.80	21.79		1
	3	2	21.73	21.73	21.75		1
	3	3	21.84	21.66	21.77		1
	6	0	20.73	20.75	20.69	0-2	2

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Table 8-17
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth
Reduced Power

LTE Band 4 (AWS) 20 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20175 (1732.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	12.46	0	0
	1	50	12.50		0
	1	99	12.48		0
	50	0	10.37	0-1	1
	50	25	10.38		1
	50	50	10.34		1
	100	0	10.35		1
16QAM	1	0	10.57		1
	1	50	10.66		1
	1	99	10.62		1
	50	0	9.36	0-2	2
	50	25	9.34		2
	50	50	9.30		2
	100	0	9.31		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 8-18
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth
Reduced Power

LTE Band 4 (AWS) 15 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	Frequency [MHz]	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	12.36	12.49	12.41	0	0
	1	36	12.45	12.42	12.59		0
	1	74	12.40	12.41	12.55		0
	36	0	10.43	10.44	10.34	0-1	1
	36	18	10.38	10.32	10.42		1
	36	37	10.31	10.26	10.34		1
	75	0	10.35	10.44	10.30		1
16QAM	1	0	10.63	10.67	10.55	0-1	1
	1	36	10.60	10.74	10.56		1
	1	74	10.54	10.61	10.64		1
	36	0	9.46	9.33	9.41	0-2	2
	36	18	9.35	9.28	9.31		2
	36	37	9.28	9.33	9.30		2
	75	0	9.28	9.35	9.24		2

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Table 8-19
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth
Reduced 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	12.51	12.43	12.50	0	0
	1	25	12.48	12.44	12.46		0
	1	49	12.47	12.58	12.58		0
	25	0	10.44	10.31	10.40	0-1	1
	25	12	10.38	10.45	10.39		1
	25	25	10.38	10.43	10.36		1
	50	0	10.26	10.39	10.25		1
16QAM	1	0	10.48	10.49	10.56	0-1	1
	1	25	10.59	10.65	10.72		1
	1	49	10.55	10.58	10.68		1
	25	0	9.40	9.33	9.29	0-2	2
	25	12	9.28	9.24	9.30		2
	25	25	9.21	9.40	9.38		2
	50	0	9.22	9.25	9.33		2

Table 8-20
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth
Reduced 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	12.44	12.48	12.46	0	0
	1	12	12.52	12.54	12.42		0
	1	24	12.38	12.42	12.40		0
	12	0	10.46	10.42	10.44	0-1	1
	12	6	10.38	10.44	10.33		1
	12	13	10.25	10.27	10.36		1
	25	0	10.34	10.33	10.25		1
16QAM	1	0	10.47	10.50	10.64	0-1	1
	1	12	10.76	10.73	10.56		1
	1	24	10.58	10.65	10.55		1
	12	0	9.35	9.27	9.36	0-2	2
	12	6	9.25	9.42	9.37		2
	12	13	9.31	9.37	9.39		2
	25	0	9.33	9.26	9.22		2

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Table 8-21
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth
Reduced Power

LTE Band 4 (AWS) 3 MHzBandwidth							
Modulation	RB Size	RB Offset	Frequency [MHz]	Frequency [MHz]	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			19965 (1711.5 MHz)	20175 (1732.5 MHz)	20385 (1753.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.39	12.53	12.41	0	0
	1	7	12.40	12.45	12.56		0
	1	14	12.52	12.49	12.56		0
	8	0	10.28	10.31	10.41	0-1	1
	8	4	10.31	10.36	10.35		1
	8	7	10.32	10.24	10.39		1
	15	0	10.25	10.30	10.40		1
16QAM	1	0	10.48	10.61	10.53	0-1	1
	1	7	10.73	10.69	10.68		1
	1	14	10.52	10.70	10.54		1
	8	0	9.31	9.35	9.46	0-2	2
	8	4	9.33	9.42	9.43		2
	8	7	9.32	9.25	9.28		2
	15	0	9.35	9.30	9.37		2

Table 8-22
LTE Band 4 (AWS) Conducted Powers -1.4 MHz Bandwidth
Reduced Power

LTE Band 4 (AWS) 1.4 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			19957 (1710.7 MHz)	20175 (1732.5 MHz)	20393 (1754.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.52	12.38	12.45	0	0
	1	2	12.43	12.44	12.43		0
	1	5	12.57	12.45	12.55		0
	3	0	12.39	12.33	12.47		0
	3	2	12.43	12.32	12.46		0
	3	3	12.35	12.42	12.35		0
	6	0	10.37	10.28	10.40	0-1	1
16QAM	1	0	10.57	10.58	10.50	0-1	1
	1	2	10.60	10.61	10.68		1
	1	5	10.59	10.67	10.67		1
	3	0	10.36	10.29	10.40		1
	3	2	10.39	10.42	10.24		1
	3	3	10.38	10.21	10.20		1
	6	0	9.33	9.28	9.34	0-2	2

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8.2.3 LTE Band 2 (PCS)

Table 8-23
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	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18700 (1860.0 MHz)	18900 (1880.0 MHz)	19100 (1900.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.34	22.93	23.09	0	0
	1	50	23.37	23.03	23.18		0
	1	99	23.38	23.04	23.12		0
	50	0	22.40	21.99	22.22	0-1	1
	50	25	22.41	22.12	22.19		1
	50	50	22.39	22.01	22.13		1
	100	0	22.37	22.06	22.23		1
16QAM	1	0	22.35	21.94	22.08	0-1	1
	1	50	22.49	22.04	22.17		1
	1	99	22.48	21.94	22.18		1
	50	0	21.38	21.01	21.17	0-2	2
	50	25	21.40	21.04	21.19		2
	50	50	21.38	21.03	21.17		2
	100	0	21.31	21.02	21.17		2

Table 8-24
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	Mid Channel	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			18675 (1857.5 MHz)	18900 (1880.0 MHz)	19125 (1902.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.51	23.12	23.20	0	0
	1	36	23.54	23.11	23.25		0
	1	74	23.55	23.13	23.31		0
	36	0	22.54	22.12	22.30	0-1	1
	36	18	22.60	22.20	22.32		1
	36	37	22.59	22.21	22.33		1
	75	0	22.60	22.18	22.32		1
16QAM	1	0	22.84	22.07	22.24	0-1	1
	1	36	22.81	22.12	22.26		1
	1	74	22.88	22.12	22.31		1
	36	0	21.65	21.24	21.31	0-2	2
	36	18	21.69	21.25	21.34		2
	36	37	21.65	21.25	21.35		2
	75	0	21.62	21.23	21.30		2

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Table 8-25
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	Frequency [MHz]	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			18650 (1855.0 MHz)	18900 (1880.0 MHz)	19150 (1905.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.65	23.31	23.26	0	0
	1	25	23.71	23.21	23.32		0
	1	49	23.69	23.18	23.35		0
	25	0	22.61	22.22	22.30	0-1	1
	25	12	22.63	22.24	22.38		1
	25	25	22.60	22.26	22.34		1
	50	0	22.62	22.24	22.35		1
16QAM	1	0	22.64	22.16	22.17	0-1	1
	1	25	22.65	22.18	22.23		1
	1	49	22.59	22.24	22.21		1
	25	0	21.67	21.24	21.31	0-2	2
	25	12	21.66	21.26	21.35		2
	25	25	21.62	21.27	21.37		2
	50	0	21.64	21.20	21.38		2

Table 8-26
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	Mid Channel	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			18625 (1852.5 MHz)	18900 (1880.0 MHz)	19175 (1907.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.70	23.16	23.35	0	0
	1	12	23.69	23.25	23.32		0
	1	24	23.67	23.35	23.37		0
	12	0	22.71	22.26	22.40	0-1	1
	12	6	22.70	22.25	22.37		1
	12	13	22.72	22.24	22.39		1
	25	0	22.70	22.23	22.41		1
16QAM	1	0	22.66	22.15	22.27	0-1	1
	1	12	22.62	22.20	22.33		1
	1	24	22.64	22.18	22.31		1
	12	0	21.69	21.19	21.41	0-2	2
	12	6	21.68	21.23	21.36		2
	12	13	21.62	21.26	21.38		2
	25	0	21.67	21.25	21.40		2

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Table 8-27
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	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	23.70	23.21	23.43	0	0
	1	7	23.68	23.22	23.48		0
	1	14	23.69	23.25	23.28		0
	8	0	22.65	22.24	22.41	0-1	1
	8	4	22.67	22.21	22.36		1
	8	7	22.64	22.28	22.30		1
	15	0	22.65	22.27	22.38		1
16QAM	1	0	22.57	22.24	22.42	0-1	1
	1	7	22.51	22.26	22.40		1
	1	14	22.53	22.20	22.38		1
	8	0	21.61	21.16	21.32	0-2	2
	8	4	21.64	21.12	21.36		2
	8	7	21.62	21.17	21.35		2
	15	0	21.65	21.22	21.37		2

Table 8-28
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	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	23.65	23.17	23.35	0	0
	1	2	23.61	23.20	23.36		0
	1	5	23.62	23.22	23.31		0
	3	0	23.64	23.21	23.40		0
	3	2	23.60	23.24	23.38		0
	3	3	23.66	23.20	23.35		0
	6	0	22.69	22.22	22.38	0-1	1
16QAM	1	0	22.68	21.94	22.21	0-1	1
	1	2	22.71	21.93	22.21		1
	1	5	22.64	21.95	22.25		1
	3	0	22.70	22.13	22.38		1
	3	2	22.72	22.16	22.40		1
	3	3	22.60	22.17	22.32		1
	6	0	21.62	21.16	21.33	0-2	2

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Table 8-29
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth
Reduced Power

LTE Band 2 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18700 (1860.0 MHz)	18900 (1880.0 MHz)	19100 (1900.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	13.11	13.07	13.57	0	0
	1	50	13.20	13.21	13.67		0
	1	99	13.25	13.24	13.79		0
	50	0	13.14	13.10	13.58	0-1	0
	50	25	13.28	13.17	13.65		0
	50	50	13.23	13.14	13.63		0
	100	0	13.24	13.18	13.64		0
16QAM	1	0	13.20	12.98	13.50	0-1	0
	1	50	13.23	12.99	13.69		0
	1	99	13.36	13.27	13.72		0
	50	0	13.16	13.11	13.54	0-2	0
	50	25	13.30	13.14	13.62		0
	50	50	13.22	13.12	13.49		0
	100	0	13.22	13.18	13.66		0

Table 8-30
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth
Reduced Power

LTE Band 2 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			18675 (1857.5 MHz)	18900 (1880.0 MHz)	19125 (1902.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.92	12.81	13.50	0	0
	1	36	12.93	12.70	13.48		0
	1	74	12.98	12.85	13.53		0
	36	0	12.95	12.97	13.50	0-1	0
	36	18	13.01	12.79	13.33		0
	36	37	12.85	13.00	13.32		0
	75	0	12.85	12.70	13.30		0
16QAM	1	0	12.89	12.77	13.46	0-1	0
	1	36	12.93	12.82	13.31		0
	1	74	12.86	12.88	13.49		0
	36	0	12.96	12.97	13.40	0-2	0
	36	18	12.98	13.00	13.39		0
	36	37	13.03	12.84	13.35		0
	75	0	12.87	12.78	13.50		0

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Table 8-31
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth
Reduced Power

LTE Band 2 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Frequency [MHz]	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			18650 (1855.0 MHz)	18900 (1880.0 MHz)	19150 (1905.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.99	12.96	13.59	0	0
	1	25	12.92	12.97	13.45		0
	1	49	13.10	12.99	13.47		0
	25	0	13.10	12.83	13.50	0-1	0
	25	12	12.80	12.91	13.46		0
	25	25	12.89	12.99	13.43		0
	50	0	13.01	12.97	13.48		0
16QAM	1	0	12.89	12.82	13.49	0-1	0
	1	25	13.07	12.96	13.45		0
	1	49	12.90	12.83	13.42		0
	25	0	13.03	12.99	13.43	0-2	0
	25	12	13.05	12.91	13.50		0
	25	25	13.05	12.89	13.56		0
	50	0	12.80	12.91	13.41		0

Table 8-32
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth
Reduced Power

LTE Band 2 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	Frequency [MHz]	MPR Allowed per 3GPP [dB]	MPR [dB]
			18625 (1852.5 MHz)	18900 (1880.0 MHz)	19175 (1907.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	13.04	12.86	13.51	0	0
	1	12	13.01	12.92	13.53		0
	1	24	13.00	12.92	13.57		0
	12	0	13.04	12.95	13.53	0-1	0
	12	6	12.98	12.90	13.51		0
	12	13	12.94	12.88	13.52		0
	25	0	13.00	12.90	13.42		0
16QAM	1	0	13.02	12.91	13.45	0-1	0
	1	12	13.06	12.93	13.51		0
	1	24	12.99	12.93	13.46		0
	12	0	13.01	12.90	13.44	0-2	0
	12	6	12.96	12.84	13.49		0
	12	13	12.97	12.82	13.47		0
	25	0	12.91	12.88	13.45		0

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Table 8-33
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth
Reduced Power

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	13.16	12.93	13.55	0	0
	1	7	13.13	12.97	13.46		0
	1	14	13.12	12.93	13.51		0
	8	0	13.16	13.00	13.55	0-1	0
	8	4	13.15	12.98	13.47		0
	8	7	13.19	12.99	13.50		0
	15	0	13.21	13.00	13.59		0
16QAM	1	0	13.12	12.99	13.58	0-1	0
	1	7	13.19	12.91	13.59		0
	1	14	13.20	12.96	13.58		0
	8	0	13.17	12.97	13.62	0-2	0
	8	4	13.18	12.99	13.56		0
	8	7	13.19	13.00	13.59		0
	15	0	13.16	12.96	13.54		0

Table 8-34
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth
Reduced Power

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	13.17	12.94	13.52	0	0
	1	2	13.14	12.99	13.54		0
	1	5	13.20	12.96	13.50		0
	3	0	13.21	12.97	13.56		0
	3	2	13.22	12.91	13.50		0
	3	3	13.18	12.91	13.44		0
	6	0	13.22	13.02	13.53	0-1	0
16QAM	1	0	13.06	12.89	13.46	0-1	0
	1	2	13.11	12.91	13.41		0
	1	5	13.12	12.94	13.44		0
	3	0	13.02	12.85	13.40		0
	3	2	13.04	12.86	13.35		0
	3	3	13.07	12.89	13.36		0
	6	0	13.18	13.01	13.55	0-2	0

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8.2.4 LTE Carrier Aggregation Conducted Powers

Table 8-35
LTE Carrier Aggregation Conducted Powers
Maximum Power

PCC								SCC				Power	
PCC Band	PCC Bandwidth [MHz]	PCC (UL) Channel	PCC (UL) Frequency [MHz]	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Frequency [MHz]	SCC Band	SCC Bandwidth [MHz]	SCC (DL) Channel	SCC (DL) Frequency [MHz]	LTE Rel 10 Tx.Power (dBm)	LTE Rel. 8 Tx.Power (dBm)
LTE B2	10	18650	1855	1	25	650	1935	LTE B4	10	2175	2132.5	23.55	23.71
LTE B4	5	20175	1732.5	1	24	2175	2132.5	LTE B2	10	900	1960	23.61	23.77
LTE B2	10	18650	1855	1	25	650	1935	LTE B12	10	5095	737.5	23.40	23.71
LTE B12	5	23155	713.5	1	12	5155	743.5	LTE B2	10	900	1960	23.94	24.08
LTE B4	5	20175	1732.5	1	24	2175	2132.5	LTE B12	10	5095	737.5	23.66	23.77
LTE B12	5	23155	713.5	1	12	5155	743.5	LTE B4	10	2175	2132.5	23.89	24.08
LTE B4	5	20175	1732.5	1	24	2175	2132.5	LTE B4	10	2250	2140	23.59	23.77

Table 8-36
LTE Carrier Aggregation Conducted Powers
Reduced Power

PCC								SCC				Power	
PCC Band	PCC Bandwidth [MHz]	PCC (UL) Channel	PCC (UL) Frequency [MHz]	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Frequency [MHz]	SCC Band	SCC Bandwidth [MHz]	SCC (DL) Channel	SCC (DL) Frequency [MHz]	LTE Rel 10 Tx.Power (dBm)	LTE Rel. 8 Tx.Power (dBm)
LTE B2	10	19150	1905	1	0	1150	1985	LTE B4	10	2175	2132.5	13.51	13.59
LTE B4	10	20175	1732.5	1	49	2175	2132.5	LTE B2	10	900	1960	12.55	12.58
LTE B2	10	19150	1905	1	0	1150	1985	LTE B12	10	5095	737.5	13.64	13.59
LTE B12	10	23095	707.5	1	0	5095	737.5	LTE B2	10	900	1960	20.16	20.31
LTE B4	10	20175	1732.5	1	49	2175	2132.5	LTE B12	10	5095	737.5	12.49	12.58
LTE B12	10	23095	707.5	1	0	5095	737.5	LTE B4	10	2175	2132.5	20.19	20.31
LTE B4	10	20175	1732.5	1	49	2175	2132.5	LTE B4	10	2274	2142.4	12.54	12.58

Notes:

1. The device only supports downlink Carrier Aggregation. Uplink Carrier Aggregation is not supported. For every supported combination of downlink carrier aggregation, power measurements were performed with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.
2. All control and acknowledge data is sent on uplink channels that operate identical to specifications when downlink carrier aggregation is inactive.

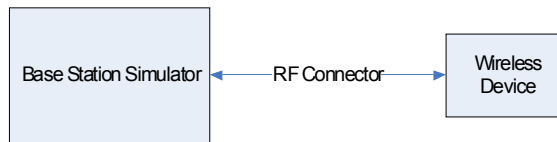


Figure 8-2
Power Measurement Setup

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8.3 WLAN Conducted Powers

Table 8-37
2.4 GHz WLAN Maximum Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	17.65	16.03
2437	6	18.21	16.12
2462	11	17.61	16.24

Table 8-38
2.4 GHz WLAN Reduced Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11b	802.11g	802.11n
2412	1	11.98	12.34	12.21
2437	6	11.84	12.38	12.16
2462	11	12.04	12.41	12.26

Table 8-39
5 GHz WLAN Maximum Average RF Power– 20 MHz Bandwidth

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11a	802.11n
5180	36	17.42	14.16
5200	40	17.29	14.02
5220	44	17.14	14.12
5240	48	17.07	14.03
5260	52	14.72	14.22
5280	56	14.67	14.13
5300	60	14.69	14.02
5320	64	14.68	13.91
5500	100	15.29	14.01
5600	120	15.13	13.84
5620	124	15.02	13.80
5720	144	14.96	13.73
5745	149	13.93	13.68
5785	157	13.94	13.69
5825	165	14.01	13.64

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Table 8-40
5 GHz WLAN Reduced Average RF Power – 40 MHz Bandwidth

Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm]
		IEEE Transmission Mode
		802.11n
5190	38	11.29
5230	46	11.49
5270	54	10.75
5310	62	11.19
5510	102	10.49
5590	118	10.70
5630	126	10.86
5710	142	11.00
5755	151	11.49
5795	159	11.44

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- 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.

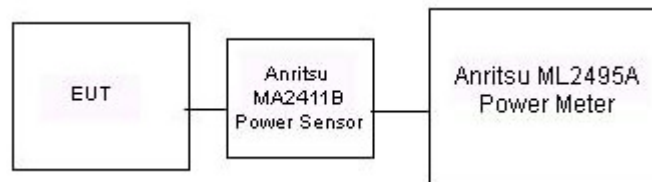


Figure 8-3
Power Measurement Setup

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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
2/1/2016	750B	21.8	700	0.912	54.768	0.959	55.726	-4.90%	-1.72%
			710	0.921	54.557	0.960	55.687	-4.06%	-2.03%
			740	0.949	54.339	0.963	55.570	-1.45%	-2.22%
			755	0.967	54.219	0.964	55.512	0.31%	-2.33%
2/2/2016	835B	22.8	820	0.990	55.592	0.969	55.258	2.17%	0.60%
			835	1.004	55.452	0.970	55.200	3.51%	0.46%
			850	1.018	55.321	0.988	55.154	3.04%	0.30%
2/1/2016	1750B	22.5	1710	1.467	51.695	1.463	53.537	0.27%	-3.44%
			1750	1.512	51.539	1.488	53.432	1.61%	-3.54%
			1790	1.557	51.370	1.514	53.326	2.84%	-3.67%
2/1/2016	1900B	21.8	1850	1.520	51.666	1.520	53.300	0.00%	-3.07%
			1880	1.550	51.522	1.520	53.300	1.97%	-3.34%
			1910	1.590	51.453	1.520	53.300	4.61%	-3.47%
2/3/2016	1900B	22.6	1850	1.524	51.472	1.520	53.300	0.26%	-3.43%
			1880	1.551	51.355	1.520	53.300	2.04%	-3.65%
			1910	1.586	51.255	1.520	53.300	4.34%	-3.84%
2/3/2016	2450B	22.5	2400	1.956	50.545	1.902	52.767	2.84%	-4.21%
			2450	2.024	50.380	1.950	52.700	3.79%	-4.40%
			2500	2.089	50.195	2.021	52.636	3.36%	-4.64%
02/15/2016	5200B-5800B	20.3	5180	5.434	48.243	5.276	49.041	2.99%	-1.63%
			5240	5.505	48.105	5.346	48.960	2.97%	-1.75%
			5260	5.523	48.099	5.369	48.933	2.87%	-1.70%
02/01/2016	5200B-5800B	21.8	5240	5.472	46.861	5.346	48.960	2.36%	-4.29%
			5260	5.494	46.817	5.369	48.933	2.33%	-4.32%
			5300	5.555	46.798	5.416	48.879	2.57%	-4.26%
			5320	5.583	46.808	5.439	48.851	2.65%	-4.18%
			5500	5.847	46.578	5.650	48.607	3.49%	-4.17%
			5600	5.979	46.471	5.766	48.471	3.69%	-4.13%
			5700	6.089	46.283	5.883	48.336	3.50%	-4.25%
			5745	6.126	46.156	5.936	48.275	3.20%	-4.39%
			5765	6.149	46.119	5.959	48.248	3.19%	-4.41%
			5785	6.183	46.082	5.982	48.220	3.36%	-4.43%
			5800	6.216	46.070	6.000	48.200	3.60%	-4.42%

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 D01v01r04 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.

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9.2 Test System Verification

Prior to SAR assessment, the system is verified to $\pm 10\%$ 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

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} (%)
B	750	BODY	02/01/2016	23.3	22.1	0.200	1046	3287	1.580	8.290	7.900	-4.70%
G	835	BODY	02/02/2016	24.3	22.8	0.200	4d119	3334	1.990	9.200	9.950	8.15%
K	1750	BODY	02/01/2016	23.2	22.5	0.100	1051	3022	4.030	37.100	40.300	8.63%
C	1900	BODY	02/01/2016	23.1	21.8	0.100	5d148	3288	4.070	40.200	40.700	1.24%
I	1900	BODY	02/03/2016	24.5	22.6	0.100	5d149	3333	4.220	40.400	42.200	4.46%
B	2450	BODY	02/03/2016	23.5	22.5	0.100	882	3287	4.770	50.700	47.700	-5.92%
E	5250	BODY	02/15/2016	22.3	20.9	0.050	1191	7308	3.520	77.200	70.400	-8.81%
A	5250	BODY	02/01/2016	22.3	21.8	0.050	1057	3589	3.720	73.900	74.400	0.68%
A	5600	BODY	02/01/2016	22.3	21.8	0.050	1057	3589	3.830	79.000	76.600	-3.04%
A	5750	BODY	02/01/2016	23.1	22.7	0.050	1191	3589	3.730	77.100	74.600	-3.24%

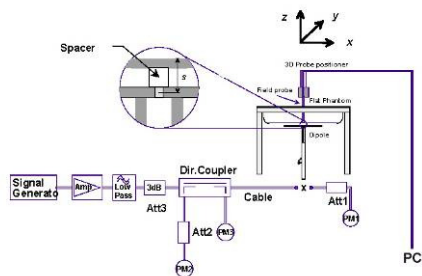


Figure 9-1
System Verification Setup Diagram



Figure 9-2
System Verification Setup Photo

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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	24.0	22.65	0.00	17 mm	17255	1:1	back	0.278	1.365	0.379	
836.60	4183	UMTS 850	RMC	24.0	22.65	0.03	13 mm	17255	1:1	top	0.221	1.365	0.302	
836.60	4183	UMTS 850	RMC	24.0	22.65	0.00	6 mm	17255	1:1	left	0.279	1.365	0.381	
826.40	4132	UMTS 850	RMC	20.0	19.20	0.04	0 mm	17974	1:1	back	0.763	1.202	0.917	
836.60	4183	UMTS 850	RMC	20.0	18.99	0.00	0 mm	17974	1:1	back	0.780	1.262	0.984	
846.60	4233	UMTS 850	RMC	20.0	18.92	-0.03	0 mm	17974	1:1	back	0.789	1.282	1.011	A1
836.60	4183	UMTS 850	RMC	20.0	18.99	0.05	0 mm	17974	1:1	top	0.315	1.262	0.398	
836.60	4183	UMTS 850	RMC	20.0	18.99	-0.05	0 mm	17974	1:1	left	0.333	1.262	0.420	
1732.40	1412	UMTS 1750	RMC	23.5	23.06	-0.02	17 mm	17974	1:1	back	0.613	1.107	0.679	
1732.40	1412	UMTS 1750	RMC	23.5	23.06	0.00	13 mm	17974	1:1	top	0.456	1.107	0.505	
1732.40	1412	UMTS 1750	RMC	23.5	23.06	-0.01	6 mm	17974	1:1	left	0.462	1.107	0.511	
1712.40	1312	UMTS 1750	RMC	13.5	13.18	0.00	0 mm	17974	1:1	back	0.828	1.076	0.891	
1732.40	1412	UMTS 1750	RMC	13.5	12.94	0.03	0 mm	17974	1:1	back	0.880	1.138	1.001	A2
1752.60	1513	UMTS 1750	RMC	13.5	13.31	-0.02	0 mm	17974	1:1	back	0.876	1.045	0.915	
1732.40	1412	UMTS 1750	RMC	13.5	12.94	0.11	0 mm	17974	1:1	top	0.377	1.138	0.429	
1732.40	1412	UMTS 1750	RMC	13.5	12.94	-0.19	0 mm	17974	1:1	left	0.106	1.138	0.121	
1732.40	1412	UMTS 1750	RMC	13.5	12.94	0.01	0 mm	17974	1:1	back	0.776	1.138	0.883	
1880.00	9400	UMTS 1900	RMC	24.0	23.20	0.02	17 mm	16273	1:1	back	0.452	1.202	0.543	
1880.00	9400	UMTS 1900	RMC	24.0	23.20	-0.01	13 mm	16273	1:1	top	0.472	1.202	0.567	
1880.00	9400	UMTS 1900	RMC	24.0	23.20	-0.02	6 mm	16273	1:1	left	0.297	1.202	0.357	
1852.40	9262	UMTS 1900	RMC	13.5	13.26	0.04	0 mm	18030	1:1	back	0.800	1.057	0.846	A3
1880.00	9400	UMTS 1900	RMC	13.5	13.04	0.08	0 mm	18030	1:1	back	0.743	1.112	0.826	
1907.60	9538	UMTS 1900	RMC	13.5	13.48	0.01	0 mm	18030	1:1	back	0.749	1.005	0.753	
1880.00	9400	UMTS 1900	RMC	13.5	13.04	-0.06	0 mm	18030	1:1	top	0.294	1.112	0.327	
1880.00	9400	UMTS 1900	RMC	13.5	13.04	0.03	0 mm	18030	1:1	left	0.063	1.112	0.070	
1852.40	9262	UMTS 1900	RMC	13.5	13.26	0.13	0 mm	18030	1:1	back	0.768	1.057	0.812	
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: Blue entries represent variability measurements

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Table 10-2
LTE Band 12 Body SAR Data

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	23.76	-0.08	0	17255	QPSK	1	25	17 mm	back	1:1	0.294	1.186	0.349	
707.50	23095	Mid	LTE Band 12	10	23.5	22.77	-0.01	1	17255	QPSK	25	0	17 mm	back	1:1	0.226	1.183	0.267	
707.50	23095	Mid	LTE Band 12	10	24.5	23.76	-0.15	0	17255	QPSK	1	25	13 mm	top	1:1	0.179	1.186	0.212	
707.50	23095	Mid	LTE Band 12	10	23.5	22.77	0.11	1	17255	QPSK	25	0	13 mm	top	1:1	0.144	1.183	0.170	
707.50	23095	Mid	LTE Band 12	10	24.5	23.76	-0.06	0	17255	QPSK	1	25	6 mm	left	1:1	0.189	1.186	0.224	
707.50	23095	Mid	LTE Band 12	10	23.5	22.77	-0.08	1	17255	QPSK	25	0	6 mm	left	1:1	0.141	1.183	0.167	
707.50	23095	Mid	LTE Band 12	10	20.5	20.31	0.11	0	17974	QPSK	1	0	0 mm	back	1:1	0.392	1.045	0.410	A4
707.50	23095	Mid	LTE Band 12	10	19.5	19.06	0.00	1	17974	QPSK	25	25	0 mm	back	1:1	0.292	1.107	0.323	
707.50	23095	Mid	LTE Band 12	10	20.5	20.31	-0.03	0	17974	QPSK	1	0	0 mm	top	1:1	0.276	1.045	0.288	
707.50	23095	Mid	LTE Band 12	10	19.5	19.06	0.09	1	17974	QPSK	25	25	0 mm	top	1:1	0.199	1.107	0.220	
707.50	23095	Mid	LTE Band 12	10	20.5	20.31	0.07	0	17974	QPSK	1	0	0 mm	left	1:1	0.236	1.045	0.247	
707.50	23095	Mid	LTE Band 12	10	19.5	19.06	0.01	1	17974	QPSK	25	25	0 mm	left	1:1	0.196	1.107	0.217	
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 4 (AWS) Body SAR Data

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	0.02	0	17974	QPSK	1	99	17 mm	back	1:1	0.645	1.076	0.694	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	21.75	-0.05	1	17974	QPSK	50	50	17 mm	back	1:1	0.421	1.334	0.562	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.68	0.00	0	17974	QPSK	1	99	13 mm	top	1:1	0.535	1.076	0.576	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	21.75	-0.14	1	17974	QPSK	50	50	13 mm	top	1:1	0.342	1.334	0.456	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.68	0.00	0	17974	QPSK	1	99	6 mm	left	1:1	0.533	1.076	0.574	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	21.75	-0.03	1	17974	QPSK	50	50	6 mm	left	1:1	0.337	1.334	0.450	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	13.0	12.50	0.20	0	17974	QPSK	1	50	0 mm	back	1:1	0.852	1.122	0.956	A5
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.0	10.38	0.16	1	17974	QPSK	50	25	0 mm	back	1:1	0.508	1.452	0.738	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.0	10.35	0.16	1	17974	QPSK	100	0	0 mm	back	1:1	0.513	1.462	0.750	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	13.0	12.50	-0.10	0	17974	QPSK	1	50	0 mm	top	1:1	0.354	1.122	0.397	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.0	10.38	-0.07	1	17974	QPSK	50	25	0 mm	top	1:1	0.210	1.452	0.305	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	13.0	12.50	0.07	0	17974	QPSK	1	50	0 mm	left	1:1	0.095	1.122	0.107	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.0	10.38	0.15	1	17974	QPSK	50	25	0 mm	left	1:1	0.058	1.452	0.084	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body 1.6 W/kg (mW/g) averaged over 1 gram											
Spatial Peak Uncontrolled Exposure/General Population																			

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Table 10-4
LTE Band 2 (PCS) Body SAR Data

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)		
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.0	23.38	0.02	0	16273	QPSK	1	99	17 mm	back	1:1	0.450	1.153	0.519	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.41	-0.09	1	16273	QPSK	50	25	17 mm	back	1:1	0.377	1.146	0.432	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.0	23.38	-0.04	0	16273	QPSK	1	99	13 mm	top	1:1	0.502	1.153	0.579	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.41	-0.04	1	16273	QPSK	50	25	13 mm	top	1:1	0.398	1.146	0.456	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.0	23.38	0.03	0	16273	QPSK	1	99	6 mm	left	1:1	0.306	1.153	0.353	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.41	0.01	1	16273	QPSK	50	25	6 mm	left	1:1	0.238	1.146	0.273	
1860.00	18700	Low	LTE Band 2 (PCS)	20	14.0	13.25	0.00	0	17255	QPSK	1	99	0 mm	back	1:1	0.682	1.189	0.811	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	14.0	13.24	-0.01	0	17255	QPSK	1	99	0 mm	back	1:1	0.665	1.191	0.792	
1900.00	19100	High	LTE Band 2 (PCS)	20	14.0	13.79	0.09	0	17255	QPSK	1	99	0 mm	back	1:1	0.781	1.050	0.820	A6
1900.00	19100	High	LTE Band 2 (PCS)	20	14.0	13.65	-0.04	0	17255	QPSK	50	25	0 mm	back	1:1	0.708	1.084	0.767	
1900.00	19100	High	LTE Band 2 (PCS)	20	14.0	13.64	-0.03	0	17255	QPSK	100	0	0 mm	back	1:1	0.707	1.086	0.768	
1900.00	19100	High	LTE Band 2 (PCS)	20	14.0	13.79	-0.11	0	17255	QPSK	1	99	0 mm	top	1:1	0.357	1.050	0.375	
1900.00	19100	High	LTE Band 2 (PCS)	20	14.0	13.65	0.01	0	17255	QPSK	50	25	0 mm	top	1:1	0.337	1.084	0.365	
1900.00	19100	High	LTE Band 2 (PCS)	20	14.0	13.79	0.16	0	17255	QPSK	1	99	0 mm	left	1:1	0.066	1.050	0.069	
1900.00	19100	High	LTE Band 2 (PCS)	20	14.0	13.65	0.03	0	17255	QPSK	50	25	0 mm	left	1:1	0.063	1.084	0.068	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak								Body 1.6 W/kg (mW/g) averaged over 1 gram											
Uncontrolled Exposure/General Population																			

Table 10-5
WLAN Body SAR Data

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)	
2437	6	802.11b	DSSS	22	18.5	18.21	-0.01	12 mm	17255	1	back	99.9	0.335	1.069	1.001	0.358	
2437	6	802.11b	DSSS	22	18.5	18.21	-0.01	6 mm	17255	1	top	99.9	0.517	1.069	1.001	0.554	
2462	11	802.11b	DSSS	22	12.5	12.04	0.01	0 mm	16273	1	back	99.9	0.588	1.112	1.001	0.655	A7
2462	11	802.11b	DSSS	22	12.5	12.04	0.02	0 mm	16273	1	top	99.9	0.262	1.112	1.001	0.291	
5180	36	802.11a	OFDM	20	17.5	17.42	0.14	12 mm	17255	6	back	99.3	0.157	1.019	1.007	0.161	
5180	36	802.11a	OFDM	20	17.5	17.42	0.10	6 mm	17255	6	top	99.3	0.681	1.019	1.007	0.699	A8
5310	62	802.11n	OFDM	40	11.5	11.19	0.10	0 mm	17255	13.5	back	98.5	0.532	1.074	1.015	0.580	
5310	62	802.11n	OFDM	40	11.5	11.19	0.16	0 mm	17255	13.5	top	98.5	0.586	1.074	1.015	0.638	
5500	100	802.11a	OFDM	20	15.5	15.29	0.14	12 mm	17255	6	back	99.3	0.131	1.050	1.007	0.139	
5500	100	802.11a	OFDM	20	15.5	15.29	0.12	6 mm	17255	6	top	99.3	0.470	1.050	1.007	0.497	
5710	142	802.11n	OFDM	40	11.5	11.00	0.17	0 mm	17255	13.5	back	98.5	0.514	1.122	1.015	0.586	
5710	142	802.11n	OFDM	40	11.5	11.00	0.18	0 mm	17255	13.5	top	98.5	0.412	1.122	1.015	0.469	
5825	165	802.11a	OFDM	20	14.5	14.01	0.15	12 mm	17255	6	back	99.3	0.145	1.119	1.007	0.163	
5825	165	802.11a	OFDM	20	14.5	14.01	0.13	6 mm	17255	6	top	99.3	0.251	1.119	1.007	0.283	
5755	151	802.11n	OFDM	40	11.5	11.49	0.10	0 mm	17255	13.5	back	98.5	0.675	1.002	1.015	0.686	
5755	151	802.11n	OFDM	40	11.5	11.49	0.17	0 mm	17255	13.5	top	98.5	0.457	1.002	1.015	0.465	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram									

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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 D04v01r02 and FCC KDB Publication 447498 D01v06.
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 D01v06.
6. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than or equal to 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 D04v01r02 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 D01v06 was applied to determine SAR test exclusion for adjacent edge configurations.

UMTS Notes:

1. UMTS mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. HSPA SAR was not required per the 3G Test Reduction Procedure in KDB Publication 941225 D01v03r01.
2. Per FCC KDB Publication 447498 D01v06, 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 $> \frac{1}{2}$ 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 D05v02r04. 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).
4. Per KDB Publication 941225 D05Av01r02, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

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WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 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 D01v02r02 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.

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11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 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 Publication 447498 D01v06 4.3.2 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 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 SAR.

When standalone SAR is not required to be measured, per FCC KDB 447498 D01v06 4.3.2 b), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{7.5} * \frac{(\text{Max Power of channel, mW})}{\text{Min. Separation Distance, mm}}$$

Table 11-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	9.50	5	0.378

Note:

1. Per FCC KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.
2. Per FCC KDB Publication 447498 D01v06, when the test separation distance is < 5 mm, a distance of 5 mm is applied to determine estimated SAR.
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.

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11.3 Body SAR Simultaneous Transmission Analysis

Table 11-2
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	1.011	0.655	See Note 1	0.04	Back	1.001	0.655	See Note 1	0.04
Top	0.398	0.554	0.952	N/A	Top	0.505	0.554	1.059	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	0.420	0.400	0.820	N/A	Left	0.511	0.400	0.911	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	0.846	0.655	1.501	N/A	Back	0.410	0.655	1.065	N/A
Top	0.567	0.554	1.121	N/A	Top	0.288	0.554	0.842	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	0.357	0.400	0.757	N/A	Left	0.247	0.400	0.647	N/A
Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.956	0.655	See Note 1	0.04	Back	0.820	0.655	1.475	N/A
Top	0.576	0.554	1.130	N/A	Top	0.579	0.554	1.133	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	0.574	0.400	0.974	N/A	Left	0.353	0.400	0.753	N/A

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Table 11-3
Simultaneous Transmission Scenario with 5 GHz WLAN

Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	UMTS 1750 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	1.011	0.686	See Note 1	0.03	Back	1.001	0.686	See Note 1	0.03
Top	0.398	0.699	1.097	N/A	Top	0.505	0.699	1.204	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	0.420	0.400	0.820	N/A	Left	0.511	0.400	0.911	N/A
Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.846	0.686	1.532	N/A	Back	0.410	0.686	1.096	N/A
Top	0.567	0.699	1.266	N/A	Top	0.288	0.699	0.987	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	0.357	0.400	0.757	N/A	Left	0.247	0.400	0.647	N/A
Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.956	0.686	See Note 1	0.03	Back	0.820	0.686	1.506	N/A
Top	0.576	0.699	1.275	N/A	Top	0.579	0.699	1.278	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	0.574	0.400	0.974	N/A	Left	0.353	0.400	0.753	N/A

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Table 11-4
Simultaneous Transmission Scenario with Bluetooth

Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	UMTS 1750 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	1.011	0.378	1.389	N/A	Back	1.001	0.378	1.379	N/A
Top	0.398	0.378	0.776	N/A	Top	0.505	0.378	0.883	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	0.420	0.400	0.820	N/A	Left	0.511	0.400	0.911	N/A
Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	LTE Band 12 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.846	0.378	1.224	N/A	Back	0.410	0.378	0.788	N/A
Top	0.567	0.378	0.945	N/A	Top	0.288	0.378	0.666	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	0.357	0.400	0.757	N/A	Left	0.247	0.400	0.647	N/A
Configuration	LTE Band 4 (AWS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Configuration	LTE Band 2 (PCS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back	0.956	0.378	1.334	N/A	Back	0.820	0.378	1.198	N/A
Top	0.576	0.378	0.954	N/A	Top	0.579	0.378	0.957	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	0.574	0.400	0.974	N/A	Left	0.353	0.400	0.753	N/A

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 more 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.

11.4 SPLSR Evaluation and Analysis

Per FCC KDB Publication 447498 D01v06, 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.

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

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

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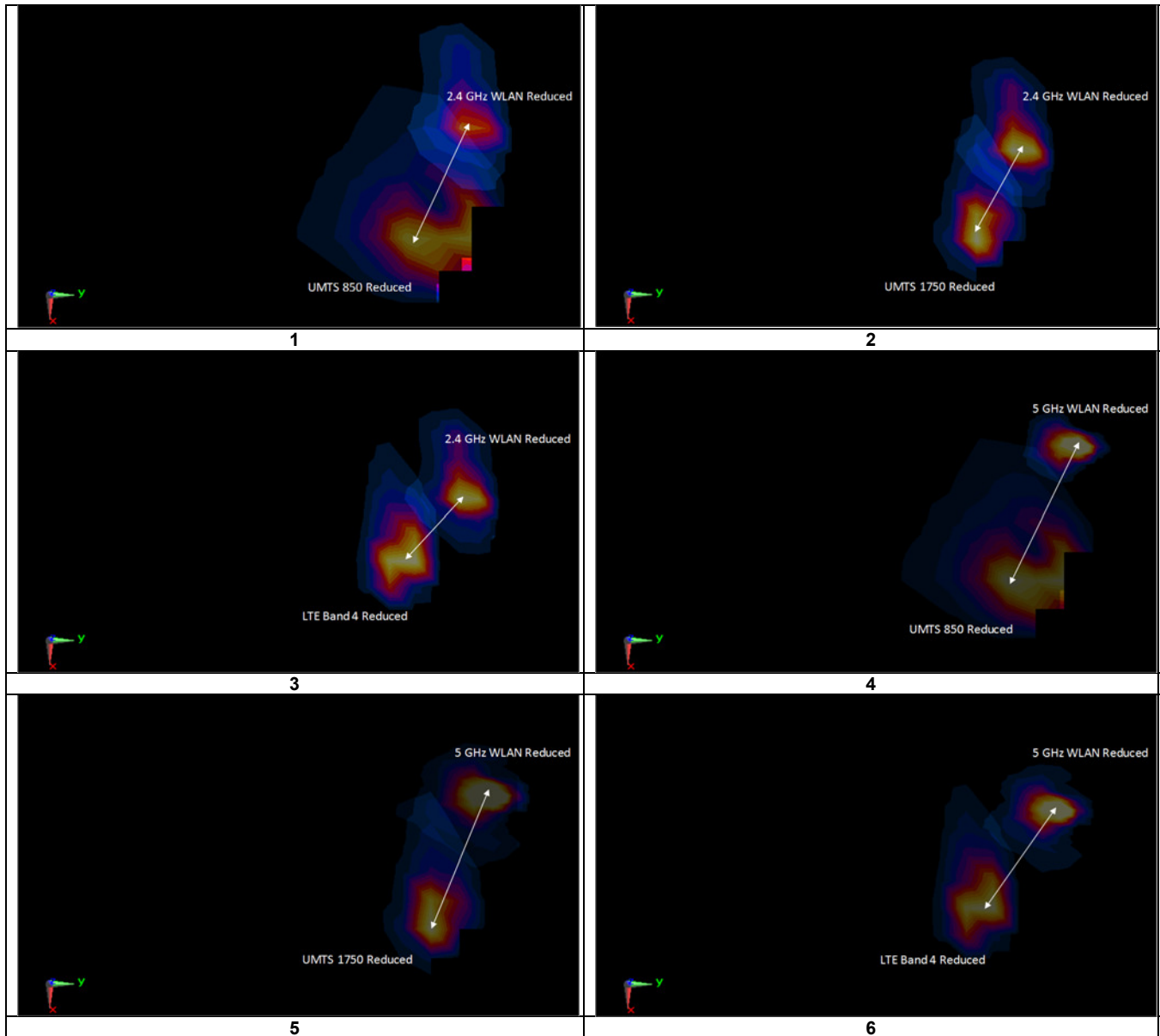
Table 11-5
Peak SAR Locations for Body Back Side

Mode/Band	x (mm)	y (mm)	Reported SAR (W/kg)
2.4 GHz WLAN Red	-24.20	102.70	0.655
5 GHz WLAN Red	-41.00	107.50	0.686
UMTS 850 Red	28.00	78.00	1.011
UMTS 1750 Red	22.00	78.00	1.001
LTE Band 4 Red	11.50	64.00	0.956

Table 11-6
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}	$(a+b)^{1.5}/D_{a-b}$	
2.4 GHz WLAN Red	UMTS 850 Red	0.655	1.011	1.666	57.75	0.04	1
2.4 GHz WLAN Red	UMTS 1750 Red	0.655	1.001	1.656	52.39	0.04	2
2.4 GHz WLAN Red	LTE Band 4 Red	0.655	0.956	1.611	52.65	0.04	3
5 GHz WLAN Red	UMTS 850 Red	0.686	1.011	1.697	75.04	0.03	4
5 GHz WLAN Red	UMTS 1750 Red	0.686	1.001	1.687	69.57	0.03	5
5 GHz WLAN Red	LTE Band 4 Red	0.686	0.956	1.642	68.18	0.03	6

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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 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

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12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, 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 performed 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	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)	
1750	1732.40	1412	UMTS 1750	RMC	back	0 mm	0.880	0.776	1.13	N/A	N/A	N/A	N/A
1900	1852.40	9262	UMTS 1900	RMC	back	0 mm	0.800	0.768	1.04	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT						Body							
Spatial Peak						1.6 W/kg (mW/g)							
Uncontrolled Exposure/General Population						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 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

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13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
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
Agilent	8753ES	S-Parameter Network Analyzer	3/12/2015	Annual	3/12/2016	MY40000670
Agilent	8753ES	Network Analyzer	3/20/2015	Annual	3/20/2016	MY40001472
Agilent	E4432B	ESG-D Series Signal Generator	3/16/2015	Annual	3/16/2016	US40053896
Agilent	E4438C	ESG Vector Signal Generator	3/12/2015	Annual	3/12/2016	MY45090700
Agilent	E5515C	Wireless Communications Test Set	4/13/2015	Annual	4/13/2016	GB43460554
Agilent	E8257D	(250kHz–20GHz) Signal Generator	3/15/2015	Annual	3/15/2016	MY45470194
Agilent	N5182A	MXG Vector Signal Generator	3/16/2015	Annual	3/16/2016	MY47420800
Agilent	N920A	MXA Signal Analyzer	11/5/2015	Annual	11/5/2016	US46470561
Amplifier Research	15S1G6	Amplifier	N/A	N/A	N/A	433971
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
Anritsu	MA2411B	Pulse Power Sensor	3/13/2015	Annual	3/13/2016	1207470
Anritsu	MA2411B	Pulse Power Sensor	8/3/2015	Annual	8/3/2016	1126066
Anritsu	MA2481A	Power Sensor	3/10/2015	Annual	3/10/2016	5821
Anritsu	MA2481A	Power Sensor	3/10/2015	Annual	3/10/2016	5605
Anritsu	ML2438A	Power Meter	3/13/2015	Annual	3/13/2016	1190013
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	941001
Anritsu	ML2496A	Power Meter	3/13/2015	Annual	3/13/2016	1306009
Anritsu	MT8820C	Radio Communication Analyzer	6/12/2015	Annual	6/12/2016	6201240328
COMTech	AR85729-5	Solid State Amplifier	N/A	N/A	N/A	M1SSA00-009
Control Company	4040	Digital Thermometer	3/15/2015	Biennial	3/15/2017	150194929
Control Company	4353	Long Stem Thermometer	1/22/2015	Biennial	1/22/2017	150053081
Keysight	772D	Dual Directional Coupler	N/A	CBT	N/A	MY52180215
MCL	BW-N6W5+	6dB Attenuator	N/A	CBT	N/A	1139
MiniCircuits	SLP-2400+	Low Pass Filter	N/A	CBT	N/A	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	N/A	CBT	N/A	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	N/A	CBT	N/A	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	N/A	CBT	N/A	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	N/A	CBT	N/A	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	N/A	CBT	N/A	N/A
Mitutoyo	CD-6" CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Narda	4014C-6	4 – 8 GHz SMA 6 dB Directional Coupler	N/A	CBT	N/A	N/A
Narda	4772-3	Attenuator (3dB)	N/A	CBT	N/A	9406
Pasternack	NC-100	Torque Wrench	5/21/2015	Biennial	5/21/2017	N/A
Pasternack	PE2208-6	Bidirectional Coupler	N/A	CBT	N/A	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	3/18/2015	Annual	3/18/2016	128633
Rohde & Schwarz	NRVD	Dual Channel Power Meter	N/A	CBT	N/A	101695
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	N/A	CBT	N/A	836019/013
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
SPEAG	D1750V2	1750 MHz SAR Dipole	4/15/2015	Annual	4/15/2016	1051
SPEAG	D1900V2	1900 MHz SAR Dipole	2/18/2015	Annual	2/18/2016	5d148
SPEAG	D1900V2	1900 MHz SAR Dipole	7/14/2015	Annual	7/14/2016	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	2/18/2015	Annual	2/18/2016	882
SPEAG	D5GHZV2	5 GHz SAR Dipole	9/16/2015	Annual	9/16/2016	1191
SPEAG	D5GHZV2	5 GHz SAR Dipole	1/19/2016	Annual	1/19/2017	1057
SPEAG	D750V3	750 MHz SAR 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	2/18/2015	Annual	2/18/2016	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/18/2015	Annual	9/18/2016	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/20/2015	Annual	10/20/2016	1408
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/27/2015	Annual	10/27/2016	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/11/2015	Annual	11/11/2016	1415
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/24/2015	Annual	8/24/2016	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/15/2016	Annual	1/15/2017	1466
SPEAG	ES3DV2	SAR Probe	8/26/2015	Annual	8/26/2016	3022
SPEAG	ES3DV3	SAR Probe	9/18/2015	Annual	9/18/2016	3288
SPEAG	ES3DV3	SAR Probe	10/29/2015	Annual	10/29/2016	3287
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	EX3DV4	SAR Probe	1/20/2016	Annual	1/20/2017	3589
SPEAG	EX3DV4	SAR Probe	7/21/2015	Annual	7/21/2016	7308

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.

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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 Uncertainty	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	

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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]

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APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377T; Type: Portable Tablet; Serial: 17974

Communication System: UID 0, UMTS; Frequency: 846.6 MHz; Duty Cycle: 1:1

Medium: 835 Body; Medium parameters used (interpolated):

$f = 846.6 \text{ MHz}$; $\sigma = 1.015 \text{ S/m}$; $\epsilon_r = 55.351$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-02-2016; Ambient Temp: 24.3°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3334; ConvF(6.24, 6.24, 6.24); 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 850, Body SAR, Back side, High.ch

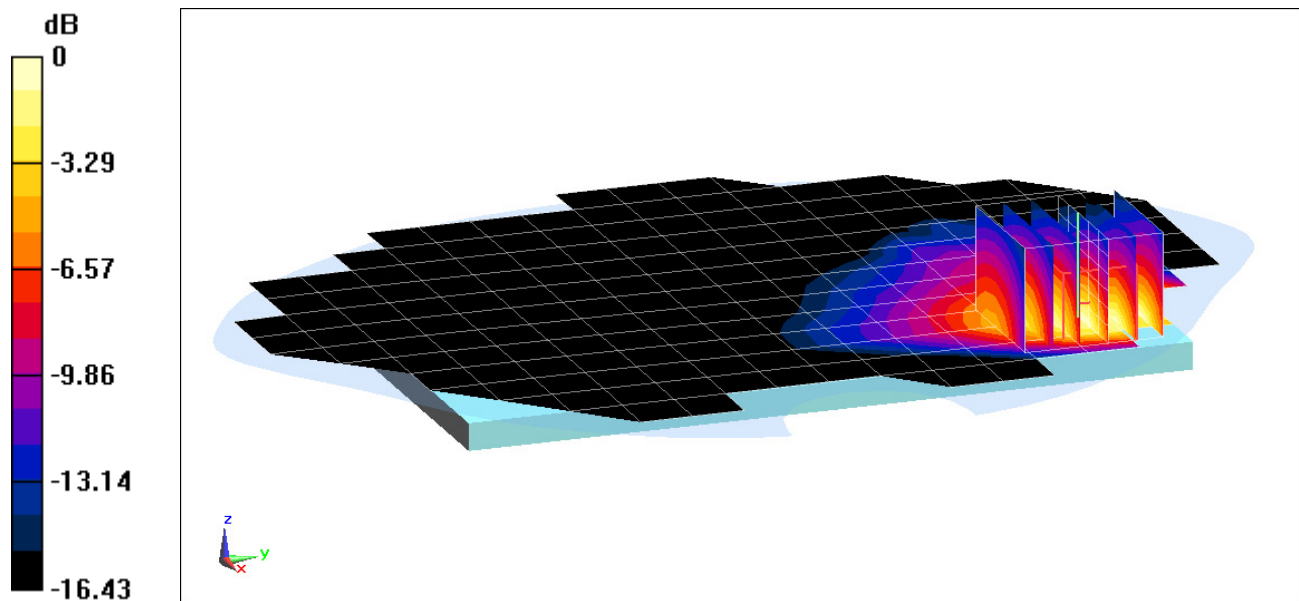
Area Scan (15x19x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 27.65 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.64 W/kg

SAR(1 g) = 0.789 W/kg



0 dB = 0.944 W/kg = -0.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377T; Type: Portable Tablet; Serial: 17974

Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1
Medium: 1750 Body; Medium parameters used (interpolated):
 $f = 1732.4 \text{ MHz}$; $\sigma = 1.492 \text{ S/m}$; $\epsilon_r = 51.608$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-01-2016; Ambient Temp: 23.2°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.79, 4.79, 4.79); Calibrated: 8/26/2015;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/18/2015
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

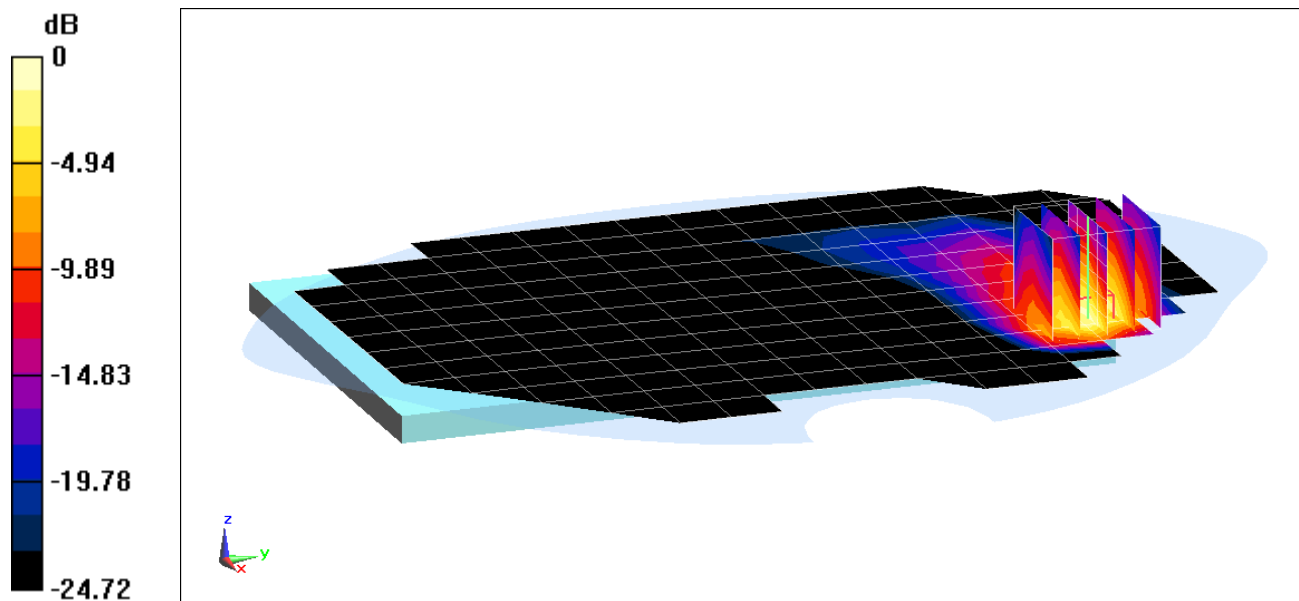
Area Scan (13x17x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.88 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.80 W/kg

SAR(1 g) = 0.880 W/kg



0 dB = 1.17 W/kg = 0.68 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377T; Type: Portable Tablet; Serial: 18030

Communication System: UID 0, UMTS; Frequency: 1852.4 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
 $f = 1852.4 \text{ MHz}$; $\sigma = 1.526 \text{ S/m}$; $\epsilon_r = 51.463$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-03-2016; Ambient Temp: 24.5°C; Tissue Temp: 22.6°C

Probe: ES3DV3 - SN3333; ConvF(4.7, 4.7, 4.7); 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: UMTS 1900, Body SAR, Back side, Low.ch

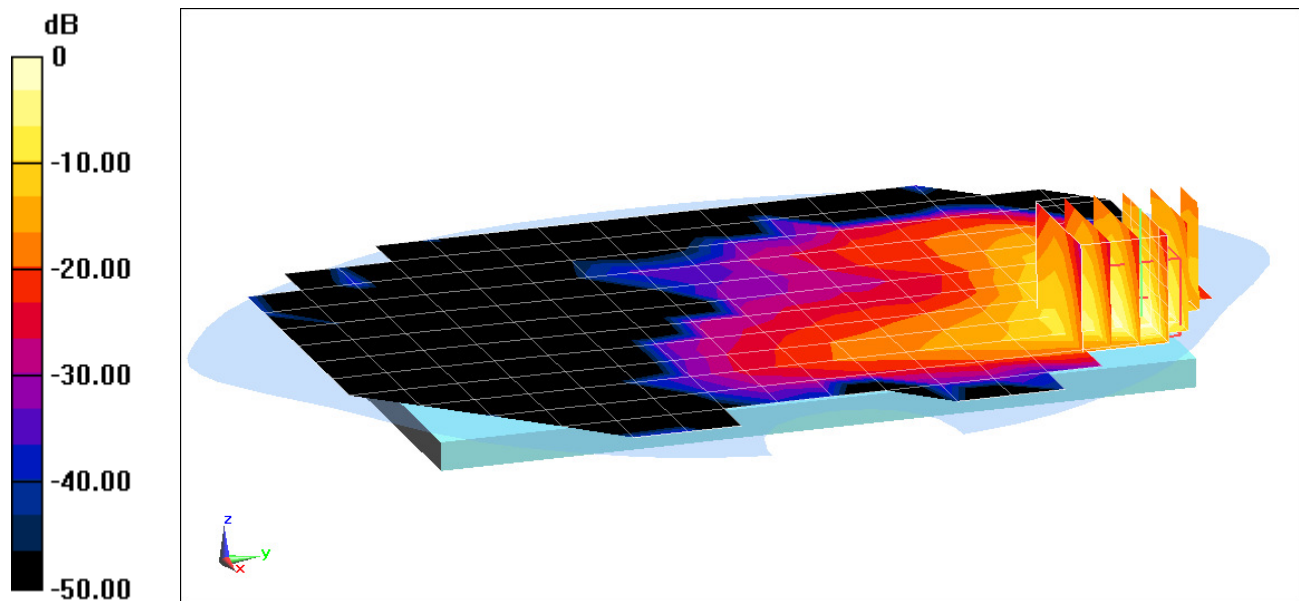
Area Scan (13x17x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 19.72 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 1.67 W/kg

SAR(1 g) = 0.800 W/kg



0 dB = 1.12 W/kg = 0.49 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377T; Type: Portable Tablet; Serial: 17974

Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: 750 Body; Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.919 \text{ S/m}$; $\epsilon_r = 54.61$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-01-2016; Ambient Temp: 23.3°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3287; ConvF(6.62, 6.62, 6.62); Calibrated: 10/29/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/20/2015

Phantom: Sub Twin Sam v5.0; Type: QD000P40CD; Serial: TP:1626

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, 0 RB Offset**

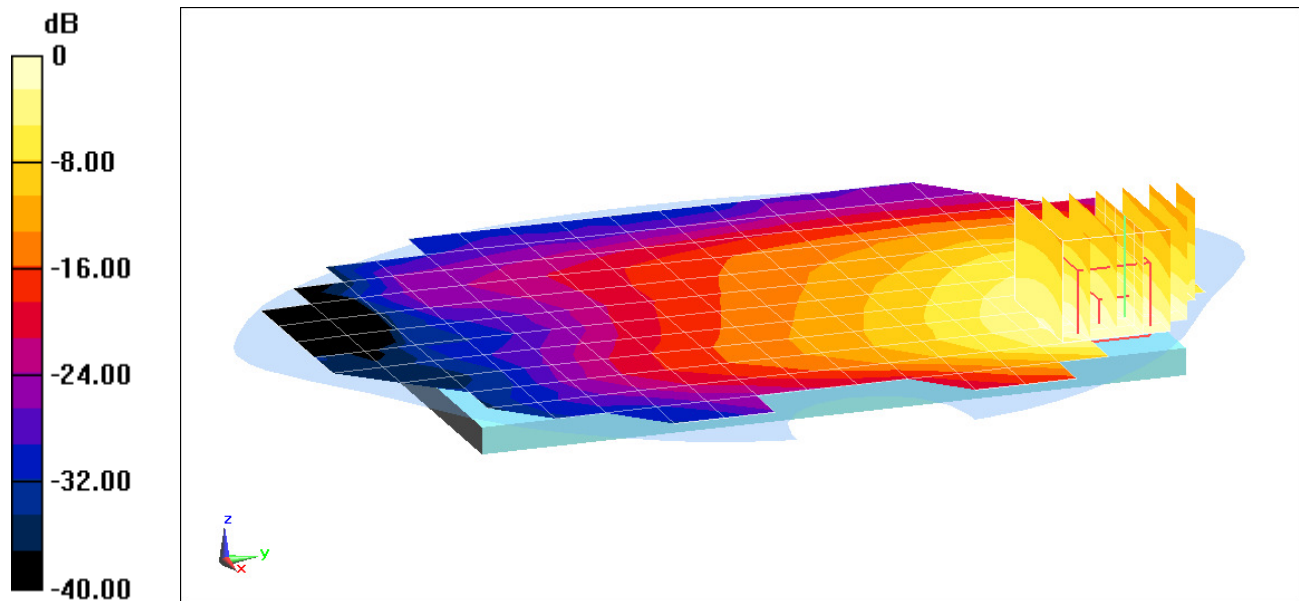
Area Scan (13x18x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (6x7x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 20.01 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.688 W/kg

SAR(1 g) = 0.392 W/kg



0 dB = 0.483 W/kg = -3.16 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377T; Type: Portable Tablet; Serial: 17974

Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: 1750 Body; Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.492 \text{ S/m}$; $\epsilon_r = 51.607$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-01-2016; Ambient Temp: 23.2°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.79, 4.79, 4.79); Calibrated: 8/26/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/18/2015

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

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, 50 RB Offset**

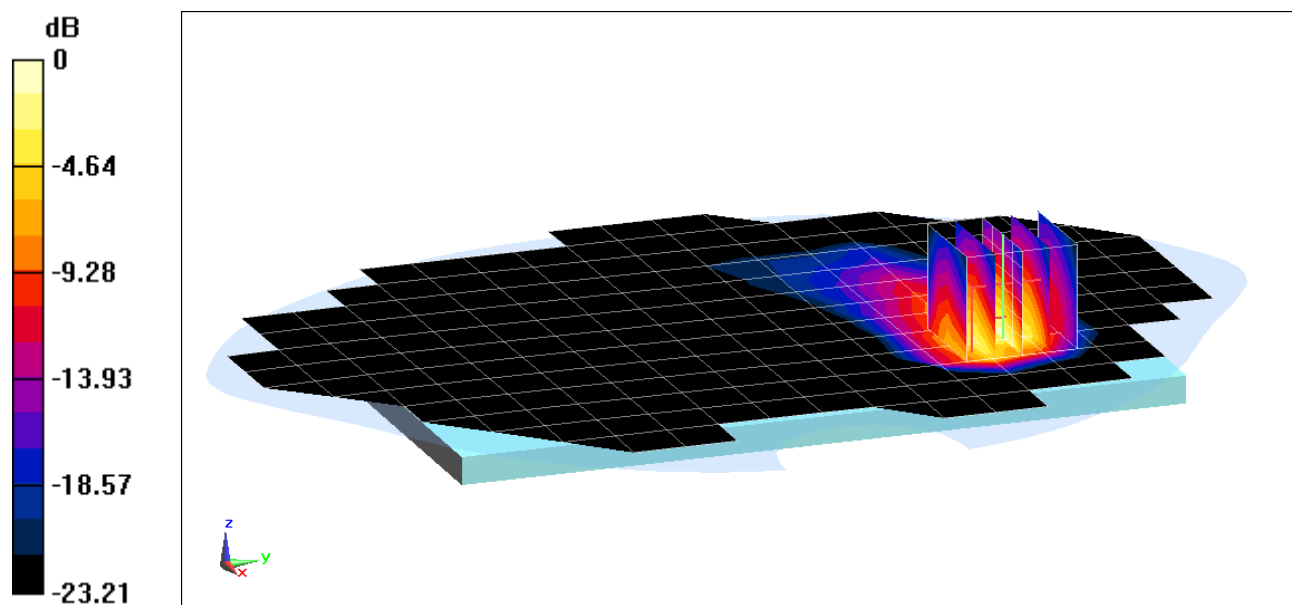
Area Scan (15x19x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.93 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 1.72 W/kg

SAR(1 g) = 0.852 W/kg



0 dB = 1.16 W/kg = 0.64 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377T; Type: Portable Tablet; Serial: 17255

Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body; Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.577 \text{ S/m}$; $\epsilon_r = 51.476$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-01-2016; Ambient Temp: 23.1°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3288; ConvF(4.81, 4.81, 4.81); Calibrated: 9/18/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2015

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

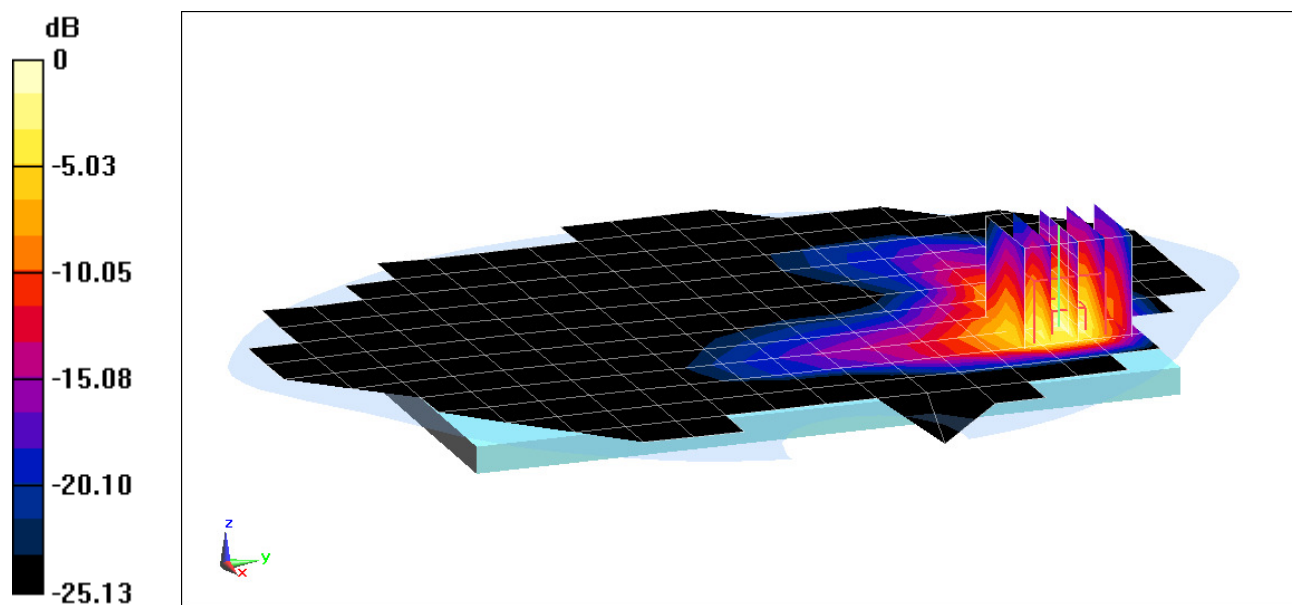
Area Scan (15x19x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 23.42 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 1.63 W/kg

SAR(1 g) = 0.781 W/kg



0 dB = 1.10 W/kg = 0.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377T; Type: Portable Tablet; Serial: 16273

Communication System: UID 0, IEEE 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: 2450 Body; Medium parameters used (interpolated):

$f = 2462 \text{ MHz}$; $\sigma = 2.04 \text{ S/m}$; $\epsilon_r = 50.336$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 02-03-2016; Ambient Temp: 23.5°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3287; ConvF(4.2, 4.2, 4.2); Calibrated: 10/29/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/20/2015

Phantom: Sub Twin Sam v5.0; Type: QD000P40CD; Serial: TP:1626

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11b, 22 MHz Bandwidth, Body SAR, Ch 11, 1 Mbps, Back Side

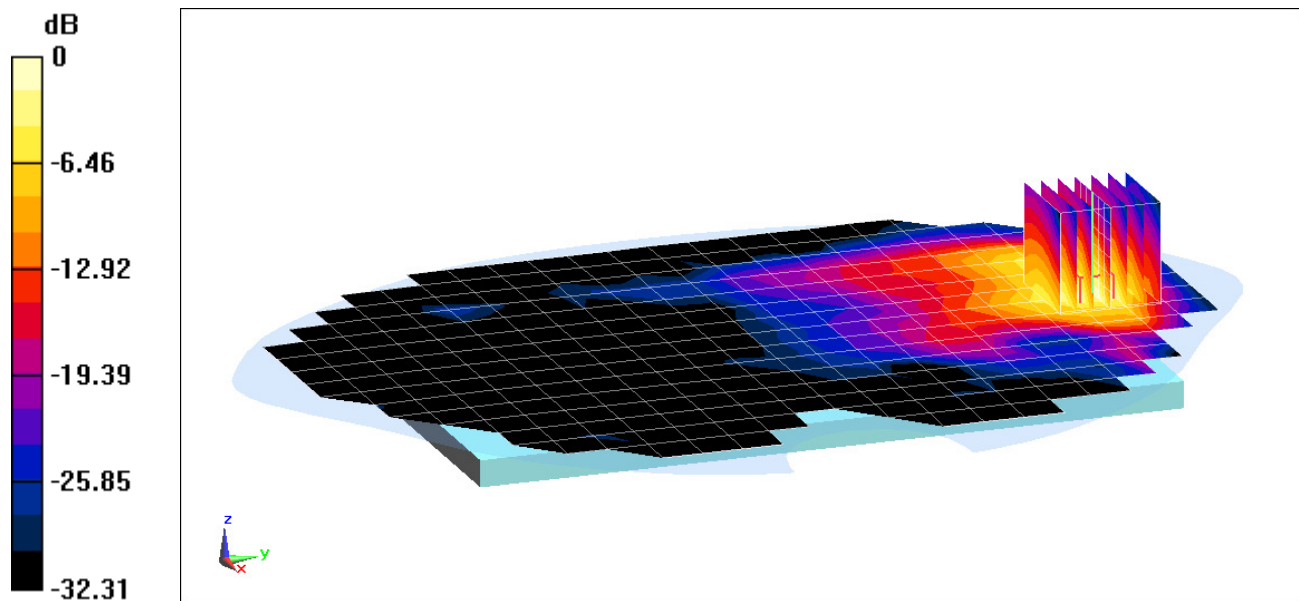
Area Scan (16x23x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 16.17 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.60 W/kg

SAR(1 g) = 0.588 W/kg



0 dB = 0.809 W/kg = -0.92 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT377T; Type: Portable Tablet; Serial: 17255

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5180 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body; Medium parameters used:

$f = 5180 \text{ MHz}$; $\sigma = 5.434 \text{ S/m}$; $\epsilon_r = 48.243$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section; Space: 0.6 cm

Test Date: 02-15-2016; Ambient Temp: 22.3°C; Tissue Temp: 20.9°C

Probe: EX3DV4 - SN7308; ConvF(4.63, 4.63, 4.63); Calibrated: 7/21/2015;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2015

Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: 1001

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, U-NII-1, 20 MHz Bandwidth, Body SAR, Ch 36, 6 Mbps, Top Edge

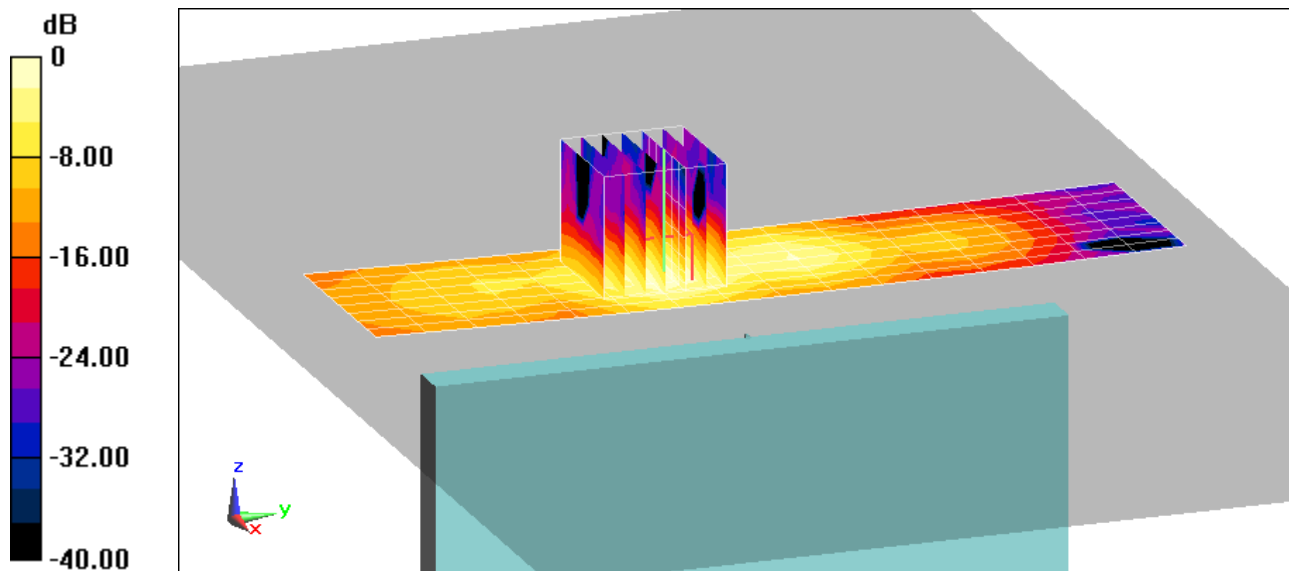
Area Scan (9x17x1): Measurement grid: $dx=5\text{mm}$, $dy=10\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Reference Value = 11.61 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 2.49 W/kg

SAR(1 g) = 0.681 W/kg



0 dB = 1.56 W/kg = 1.93 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):

$f = 750 \text{ MHz}$; $\sigma = 0.961 \text{ S/m}$; $\epsilon_r = 54.259$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 02-01-2016; Ambient Temp: 23.3°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3287; ConvF(6.62, 6.62, 6.62); Calibrated: 10/29/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/20/2015

Phantom: Sub Twin Sam v5.0; Type: QD000P40CD; Serial: TP:1626

Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification at 23.0 dBm (200 mW)

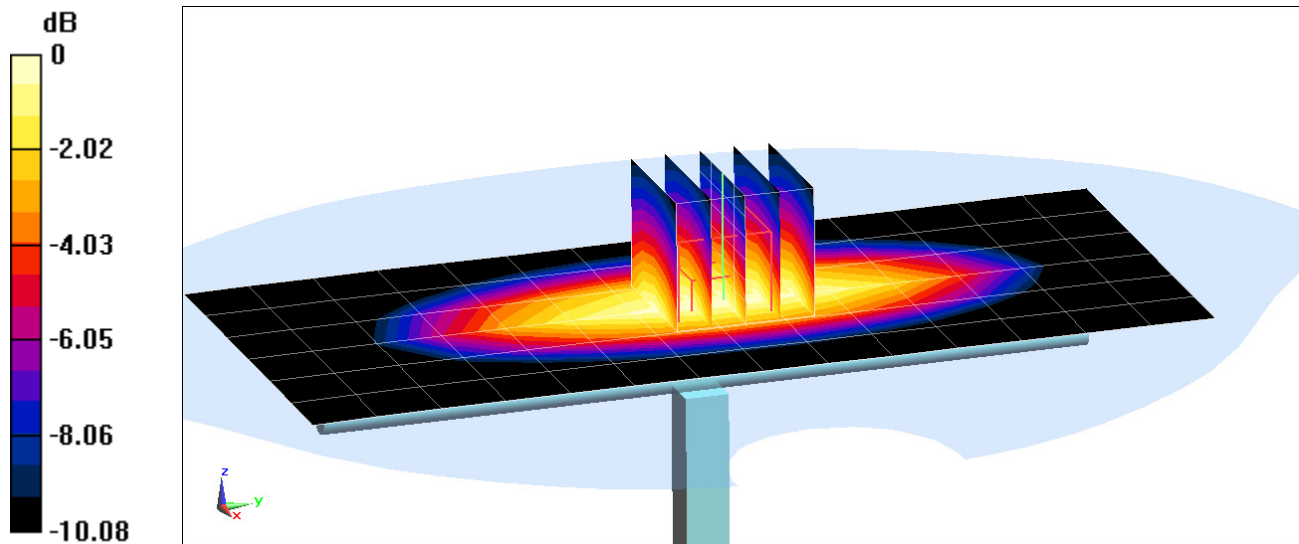
Area Scan (7x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Peak SAR (extrapolated) = 2.32 W/kg

SAR(1 g) = 1.58 W/kg

Deviation(1 g) = -4.70%



0 dB = 1.84 W/kg = 2.65 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:

$f = 835 \text{ MHz}$; $\sigma = 1.004 \text{ S/m}$; $\epsilon_r = 55.452$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 02-02-2016; Ambient Temp: 24.3°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3334; ConvF(6.24, 6.24, 6.24); 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)

835 MHz System Verification at 23.0 dBm (200 mW)

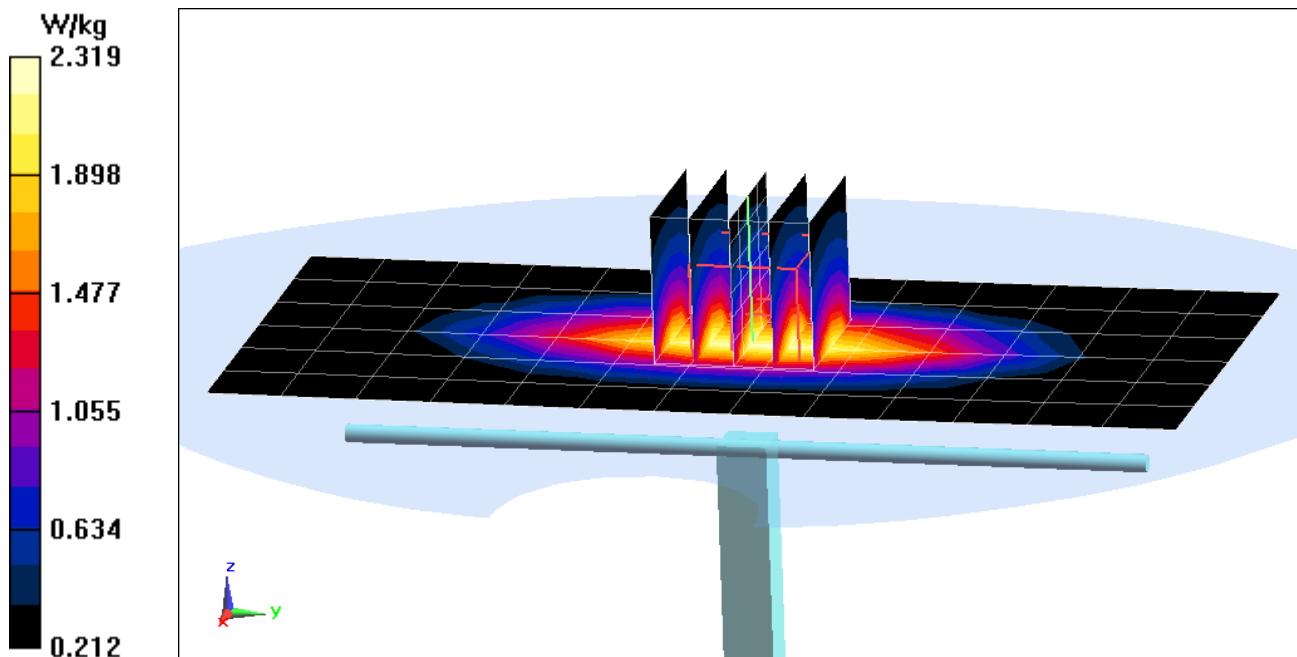
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Peak SAR (extrapolated) = 2.91 W/kg

SAR(1 g) = 1.99 W/kg

Deviation(1 g) = 8.15%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1051

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.512 \text{ S/m}$; $\epsilon_r = 51.539$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-01-2016; Ambient Temp: 23.2°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.79, 4.79, 4.79); Calibrated: 8/26/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/18/2015

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1797

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification at 20.0 dBm (100 mW)

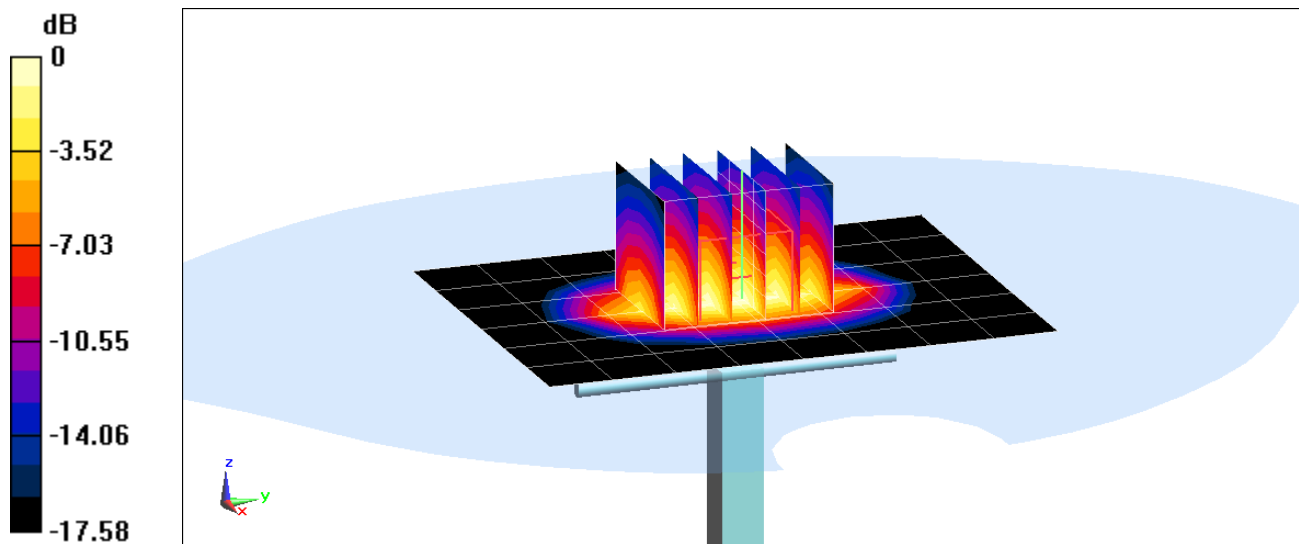
Area Scan (7x9x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x6x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Peak SAR (extrapolated) = 7.01 W/kg

SAR(1 g) = 4.03 W/kg

Deviation(1 g) = 8.63%



0 dB = 5.00 W/kg = 6.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d148

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.577 \text{ S/m}$; $\epsilon_r = 51.476$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-01-2016; Ambient Temp: 23.1°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3288; ConvF(4.81, 4.81, 4.81); Calibrated: 9/18/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2015

Phantom: Main TWIN SAM; Type: QD000P40CC; Serial: TP-1406

Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification at 20.0 dBm (100 mW)

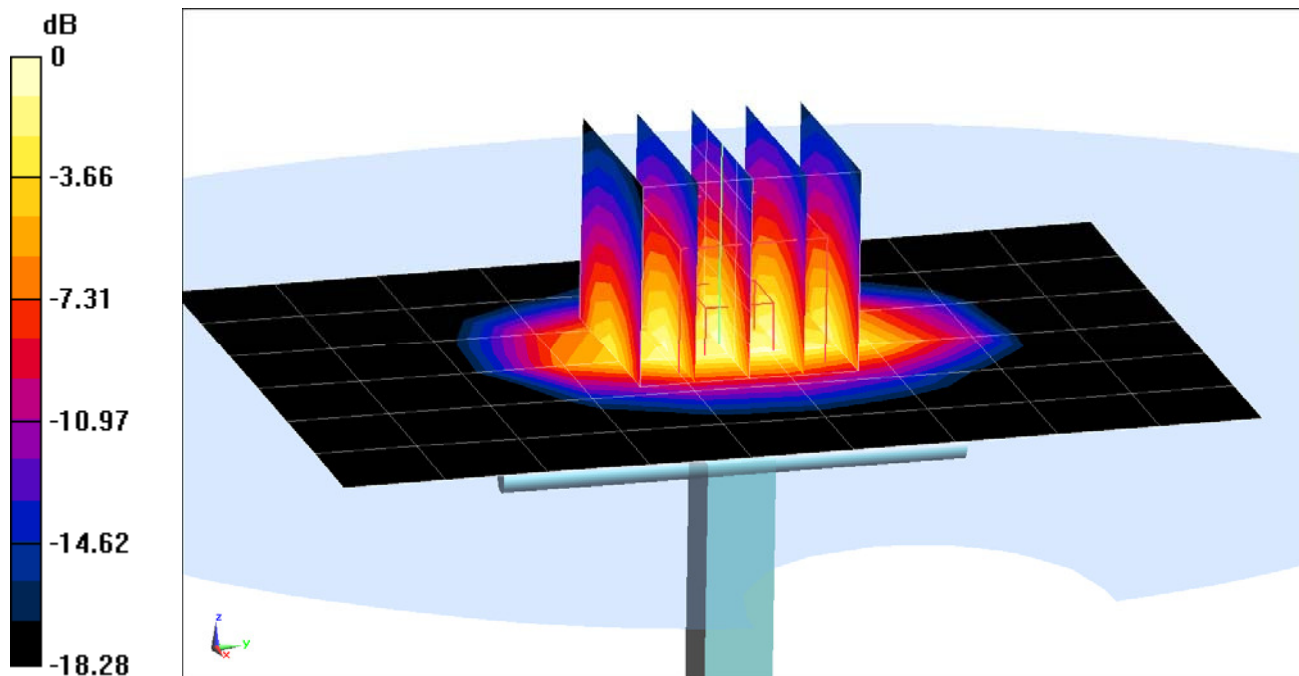
Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Peak SAR (extrapolated) = 7.28 W/kg

SAR(1 g) = 4.07 W/kg

Deviation(1 g) = 1.24%



0 dB = 5.19 W/kg = 7.15 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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):

$f = 1900 \text{ MHz}$; $\sigma = 1.574 \text{ S/m}$; $\epsilon_r = 51.288$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-03-2016; Ambient Temp: 24.5°C; Tissue Temp: 22.6°C

Probe: ES3DV3 - SN3333; ConvF(4.7, 4.7, 4.7); 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)

1900 MHz System Verification at 20.0 dBm (100 mW)

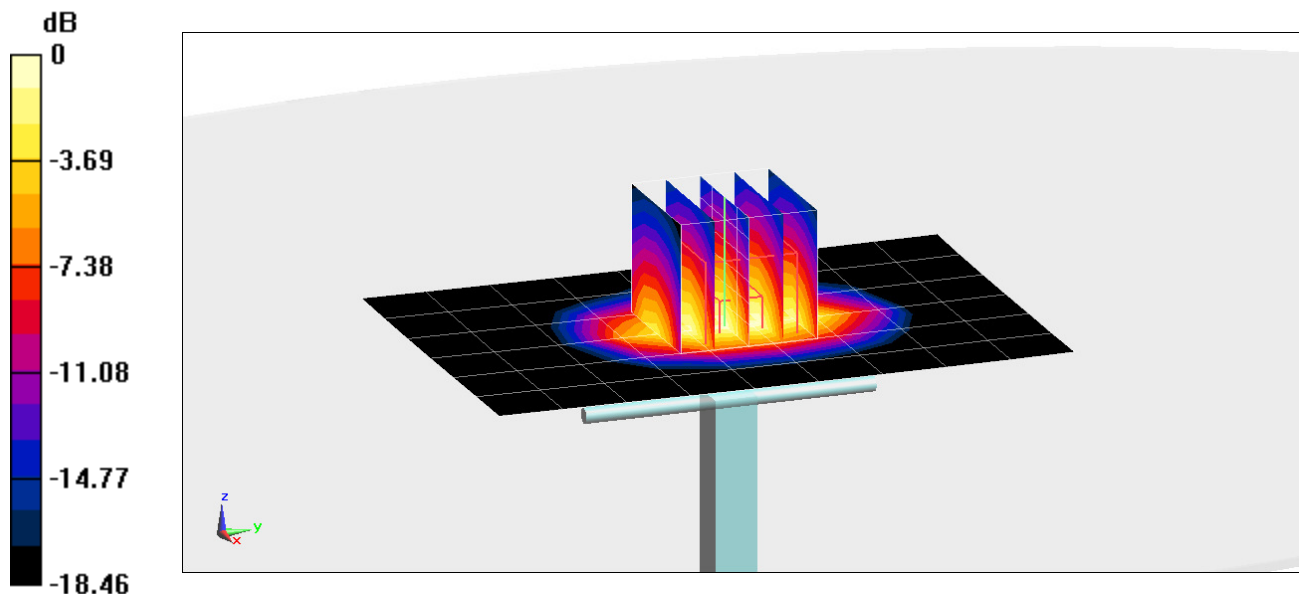
Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Peak SAR (extrapolated) = 7.51 W/kg

SAR(1 g) = 4.22 W/kg

Deviation(1 g) = 4.46%



0 dB = 5.24 W/kg = 7.19 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 882

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.024 \text{ S/m}$; $\epsilon_r = 50.38$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-03-2016; Ambient Temp: 23.5°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3287; ConvF(4.2, 4.2, 4.2); Calibrated: 10/29/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 10/20/2015

Phantom: Sub Twin Sam v5.0; Type: QD000P40CD; Serial: TP:1626

Measurement SW: DASY52, Version 52.8 (8);SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification at 20.0 dBm (100 mW)

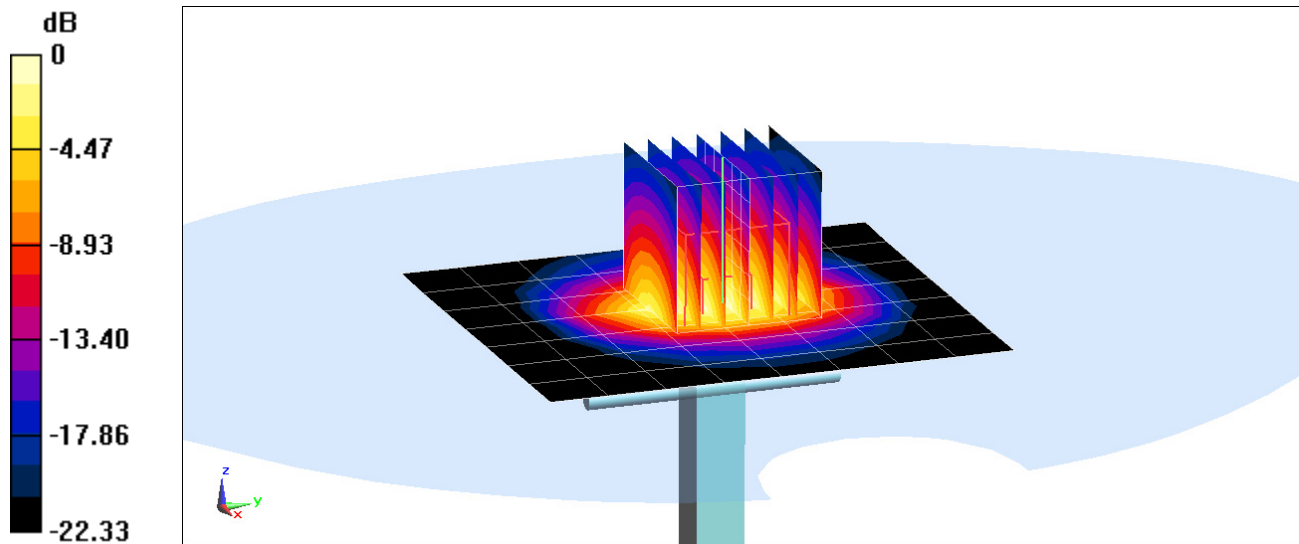
Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Peak SAR (extrapolated) = 10.1 W/kg

SAR(1 g) = 4.77 W/kg

Deviation(1 g) = -5.92%



0 dB = 6.31 W/kg = 8.00 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used (interpolated):

$f = 5250 \text{ MHz}$; $\sigma = 5.514 \text{ S/m}$; $\epsilon_r = 48.102$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section; Space: 1.0 cm

Test Date: 02-15-2016; Ambient Temp: 22.3°C; Tissue Temp: 20.9°C

Probe: EX3DV4 - SN7308; ConvF(4.63, 4.63, 4.63); Calibrated: 7/21/2015;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2015

Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: 1001

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5250 MHz System Verification at 17.0 dBm (50 mW)

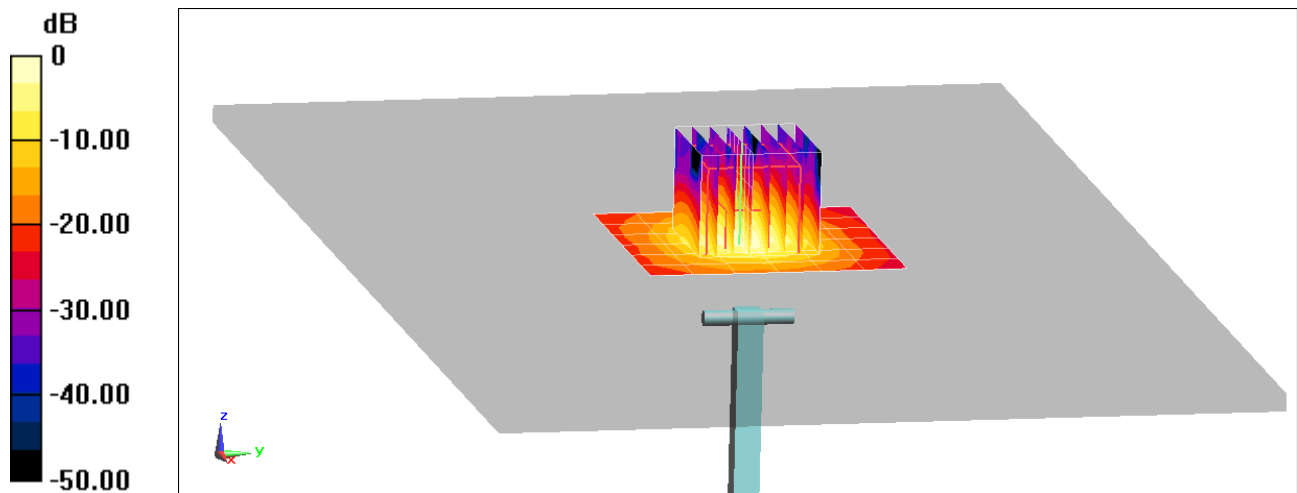
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 14.4 W/kg

SAR(1 g) = 3.52 W/kg

Deviation(1 g) = -8.81%



0 dB = 8.31 W/kg = 9.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1057

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used (interpolated):

$f = 5250 \text{ MHz}$; $\sigma = 5.483 \text{ S/m}$; $\epsilon_r = 46.839$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-01-2016; Ambient Temp: 22.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3589; ConvF(3.8, 3.8, 3.8); Calibrated: 1/20/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/15/2016

Phantom: SAM Sub; Type: QD000P40CC; Serial: TP:1357

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5250 MHz System Verification at 17.0 dBm (50 mW)

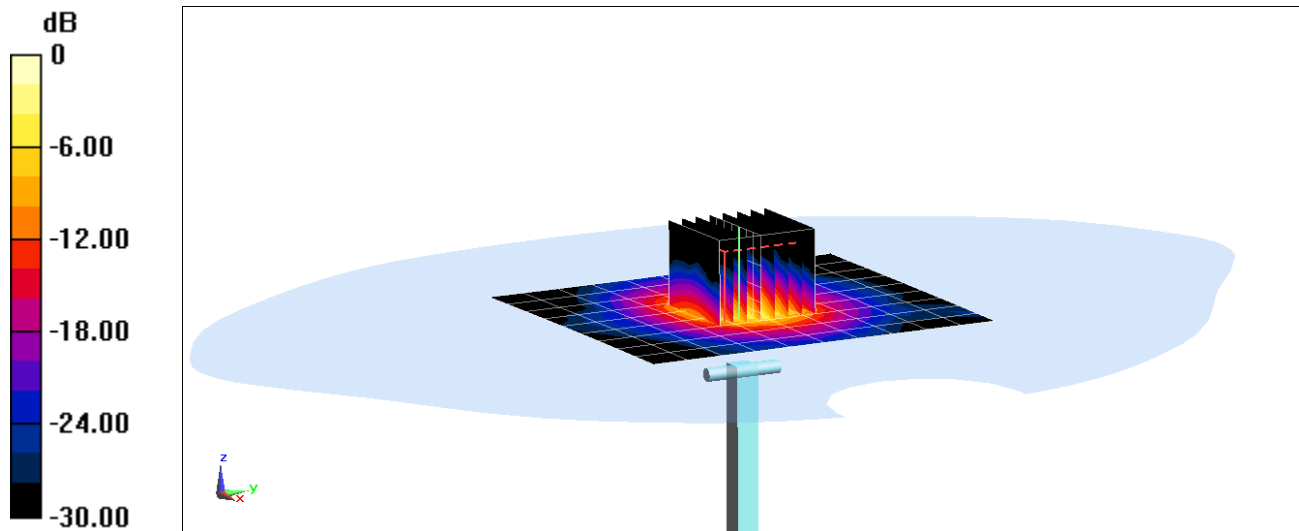
Area Scan (10x11x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 15.3 W/kg

SAR(1 g) = 3.72 W/kg

Deviation(1 g) = 0.68%



0 dB = 4.17 W/kg = 6.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1057

Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.979 \text{ S/m}$; $\epsilon_r = 46.471$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-01-2016; Ambient Temp: 22.3°C; Tissue Temp: 21.8°C

Probe: EX3DV4 - SN3589; ConvF(3.37, 3.37, 3.37); Calibrated: 1/20/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/15/2016

Phantom: SAM Sub; Type: QD000P40CC; Serial: TP:1357

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5600 MHz System Verification at 17.0 dBm (50 mW)

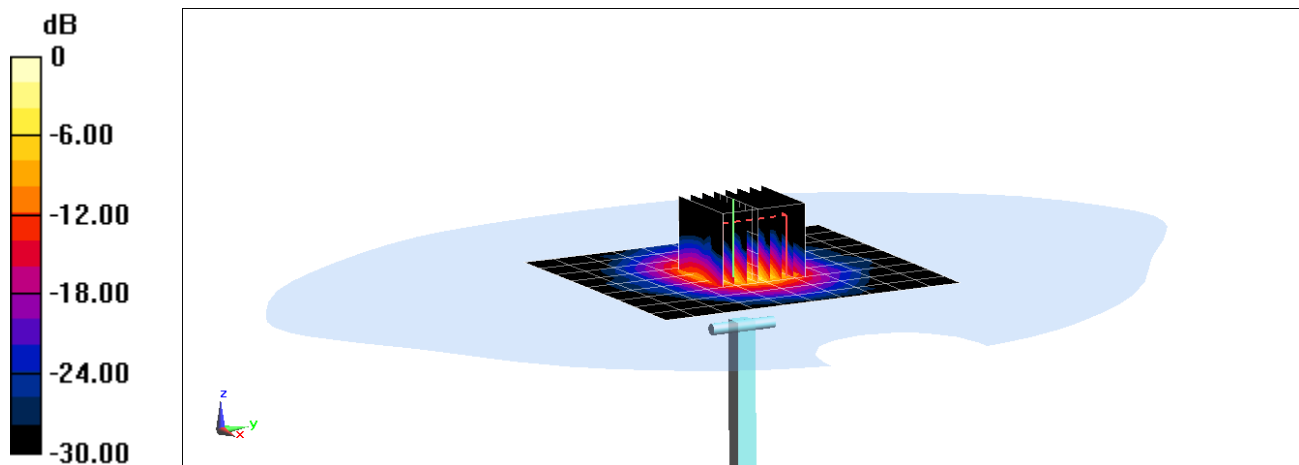
Area Scan (10x11x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 3.83 W/kg

Deviation(1 g) = -3.04%



0 dB = 4.82 W/kg = 6.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used (interpolated):

$f = 5750 \text{ MHz}$; $\sigma = 6.132 \text{ S/m}$; $\epsilon_r = 46.147$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-01-2016; Ambient Temp: 23.1°C; Tissue Temp: 22.7°C

Probe: EX3DV4 - SN3589; ConvF(3.71, 3.71, 3.71); Calibrated: 1/20/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/15/2016

Phantom: SAM Sub; Type: QD000P40CC; Serial: TP:1357

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5750 MHz System Verification at 17.0 dBm (50 mW)

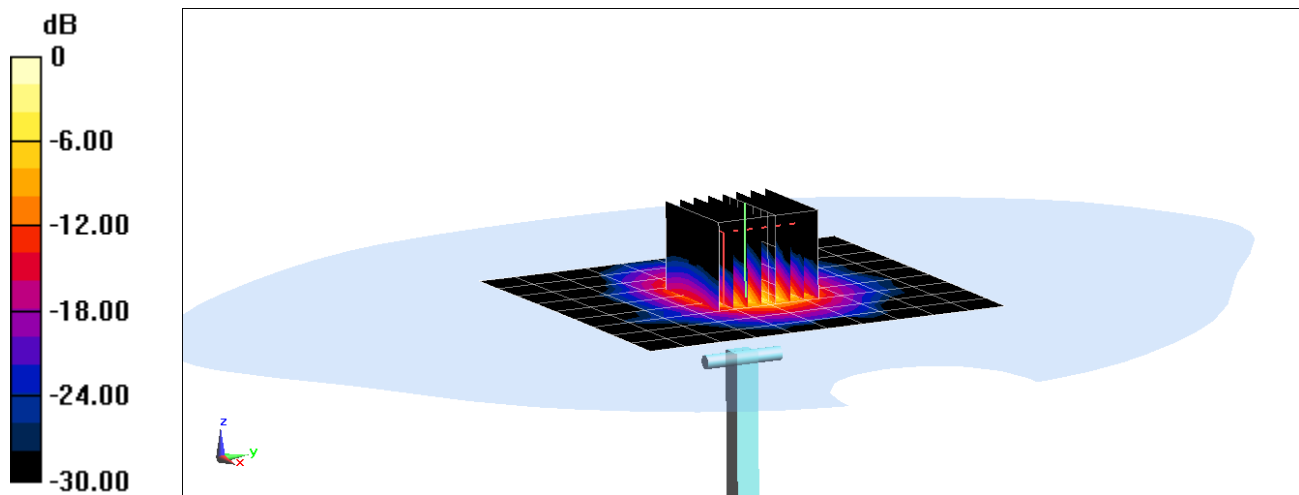
Area Scan (10x11x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 3.73 W/kg

Deviation(1 g) = -3.24%



0 dB = 4.66 W/kg = 6.68 dBW/kg

APPENDIX C: PROBE CALIBRATION



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: **ES3-3022_Aug15**

CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

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

Calibration date: **August 26, 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)

BN ✓
9/3/2015

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

Calibrated by:	Name Michael Weber	Function Laboratory Technician	Signature <i>M. Weber</i>
Approved by:	Katja Pokovic	Technical Manager	<i>[Signature]</i>

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

Issued: August 27, 2015



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
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ 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:

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 26, 2015

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

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.00	1.03	0.95	$\pm 10.1 \%$
DCP (mV) ^B	99.9	99.7	100.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	179.6	$\pm 3.3 \%$
		Y	0.0	0.0	1.0		183.9	
		Z	0.0	0.0	1.0		179.0	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	3.60	65.9	14.2	10.00	43.5	$\pm 2.2 \%$
		Y	2.84	63.5	13.0		43.3	
		Z	2.76	63.7	12.7		41.7	
10011-CAB	UMTS-FDD (WCDMA)	X	3.32	67.0	18.7	2.91	144.4	$\pm 0.7 \%$
		Y	3.24	66.3	18.0		147.3	
		Z	3.19	66.3	18.0		143.5	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.15	69.9	19.5	1.87	146.1	$\pm 0.7 \%$
		Y	2.88	67.7	18.0		147.9	
		Z	2.78	67.4	17.8		145.6	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.40	71.3	23.8	9.46	144.9	$\pm 3.3 \%$
		Y	11.15	70.5	23.1		146.9	
		Z	10.95	70.5	23.3		140.3	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	20.66	99.8	29.2	9.39	132.6	$\pm 2.2 \%$
		Y	14.36	93.3	26.6		145.3	
		Z	17.17	97.2	27.8		145.4	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	17.22	96.5	28.2	9.57	125.4	$\pm 1.9 \%$
		Y	11.06	88.6	25.0		136.0	
		Z	8.71	84.6	23.4		130.7	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	31.05	99.5	25.9	6.56	135.2	$\pm 2.2 \%$
		Y	25.28	97.4	25.0		132.5	
		Z	21.58	95.7	24.5		144.4	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	42.88	99.9	24.0	4.80	129.5	$\pm 1.9 \%$
		Y	40.80	99.6	23.7		124.9	
		Z	38.42	99.7	23.7		137.8	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	44.48	100.0	23.2	3.55	138.2	$\pm 1.9 \%$
		Y	44.03	99.7	22.8		133.0	
		Z	41.36	99.8	22.8		147.5	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	16.08	99.5	23.3	1.16	127.5	$\pm 1.4 \%$
		Y	79.69	99.6	19.3		146.2	
		Z	45.81	99.9	20.4		138.2	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.43	67.4	19.8	5.67	138.7	$\pm 1.4 \%$
		Y	6.27	66.8	19.2		134.9	
		Z	6.16	66.6	19.2		127.6	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.13	75.0	25.9	9.29	129.4	±3.3 %
		Y	9.46	73.0	24.5		131.8	
		Z	9.52	74.0	25.4		137.0	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.27	66.9	19.7	5.80	137.0	±1.7 %
		Y	6.24	66.7	19.3		140.0	
		Z	6.06	66.3	19.2		127.1	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.16	68.7	21.3	8.07	127.7	±2.2 %
		Y	9.99	68.2	20.9		131.5	
		Z	10.22	69.1	21.4		141.6	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.34	73.4	25.2	9.28	125.0	±3.3 %
		Y	8.92	72.2	24.3		127.2	
		Z	8.95	73.1	25.1		131.9	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.95	66.4	19.4	5.75	134.4	±1.4 %
		Y	5.92	66.2	19.1		137.0	
		Z	5.98	66.7	19.5		146.8	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.39	66.9	19.6	5.82	139.9	±1.7 %
		Y	6.35	66.7	19.3		141.9	
		Z	6.15	66.2	19.2		128.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.96	66.6	19.8	5.73	137.3	±1.4 %
		Y	4.85	66.1	19.3		139.8	
		Z	4.85	66.6	19.7		146.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.75	78.7	28.3	9.21	138.9	±3.0 %
		Y	7.69	75.1	26.1		140.1	
		Z	7.80	76.6	27.2		144.0	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.88	66.2	19.6	5.72	132.0	±1.4 %
		Y	4.77	65.8	19.1		132.6	
		Z	4.83	66.5	19.6		146.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.91	66.3	19.7	5.72	131.7	±1.4 %
		Y	4.82	66.0	19.2		138.4	
		Z	4.86	66.7	19.7		145.7	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.04	69.1	21.7	8.10	140.9	±2.2 %
		Y	9.62	67.9	20.8		125.2	
		Z	9.74	68.6	21.3		133.3	
10225-CAB	UMTS-FDD (HSPA+)	X	7.01	67.1	19.6	5.97	143.7	±1.4 %
		Y	6.78	66.2	19.0		129.3	
		Z	6.80	66.7	19.3		136.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.55	78.0	27.9	9.21	134.6	±3.0 %
		Y	7.79	75.6	26.3		141.6	
		Z	7.89	76.9	27.4		145.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.30	74.8	26.1	9.24	134.8	±3.3 %
		Y	8.65	72.5	24.5		136.4	
		Z	8.33	72.3	24.8		126.6	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	10.20	76.2	26.8	9.30	144.8	±3.3 %
		Y	9.41	73.7	25.1		145.9	
		Z	9.18	73.9	25.6		138.6	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.45	66.7	18.9	3.96	147.0	±0.9 %
		Y	4.21	65.5	17.9		126.5	
		Z	4.36	66.5	18.5		148.0	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.57	66.3	18.5	3.46	134.3	±0.7 %
		Y	3.48	65.6	17.8		136.8	
		Z	3.51	66.2	18.3		136.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.53	66.4	18.6	3.39	135.8	±0.7 %
		Y	3.45	65.8	17.9		140.4	
		Z	3.50	66.5	18.5		137.0	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.18	66.5	19.5	5.81	129.4	±1.4 %
		Y	6.15	66.3	19.1		133.6	
		Z	6.13	66.5	19.3		131.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.77	67.2	19.9	6.06	134.8	±1.7 %
		Y	6.81	67.3	19.7		144.8	
		Z	6.68	67.1	19.7		136.7	
10400-AAC	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.30	69.4	22.0	8.37	142.0	±2.5 %
		Y	9.90	68.2	21.1		126.8	
		Z	10.15	69.3	21.9		142.6	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.72	68.1	18.9	3.76	147.8	±0.7 %
		Y	4.56	67.5	18.2		133.6	
		Z	4.61	68.2	18.7		147.4	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.57	67.8	18.8	3.77	144.3	±0.7 %
		Y	4.43	67.3	18.1		131.3	
		Z	4.57	68.3	18.8		145.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.64	67.9	18.7	1.54	142.1	±0.5 %
		Y	2.36	65.4	16.8		130.3	
		Z	2.50	66.7	17.7		145.0	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.04	69.0	21.7	8.23	138.8	±2.2 %
		Y	9.71	68.0	20.9		125.6	
		Z	9.94	69.0	21.6		140.4	

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 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: ES3DV2 - SN:3022

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	6.33	6.33	6.33	0.46	1.43	± 12.0 %
835	41.5	0.90	6.11	6.11	6.11	0.24	2.08	± 12.0 %
1750	40.1	1.37	5.08	5.08	5.08	0.45	1.47	± 12.0 %
1900	40.0	1.40	4.93	4.93	4.93	0.59	1.25	± 12.0 %
2300	39.5	1.67	4.63	4.63	4.63	0.55	1.39	± 12.0 %
2450	39.2	1.80	4.30	4.30	4.30	0.51	1.47	± 12.0 %
2600	39.0	1.96	4.12	4.12	4.12	0.57	1.46	± 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: ES3DV2 - SN:3022

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	6.16	6.16	6.16	0.50	1.34	± 12.0 %
835	55.2	0.97	6.13	6.13	6.13	0.25	2.16	± 12.0 %
1750	53.4	1.49	4.79	4.79	4.79	0.61	1.33	± 12.0 %
1900	53.3	1.52	4.56	4.56	4.56	0.31	2.02	± 12.0 %
2300	52.9	1.81	4.32	4.32	4.32	0.79	1.19	± 12.0 %
2450	52.7	1.95	4.08	4.08	4.08	0.80	1.12	± 12.0 %
2600	52.5	2.16	3.96	3.96	3.96	0.80	1.10	± 12.0 %

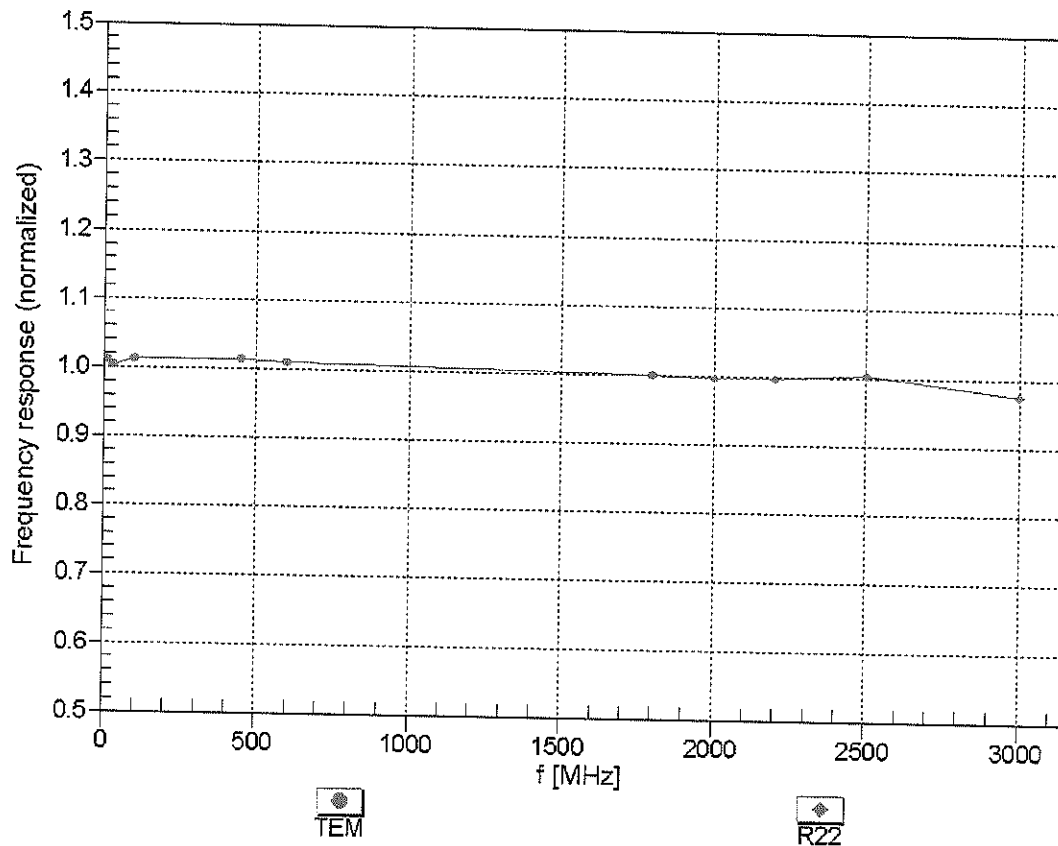
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is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

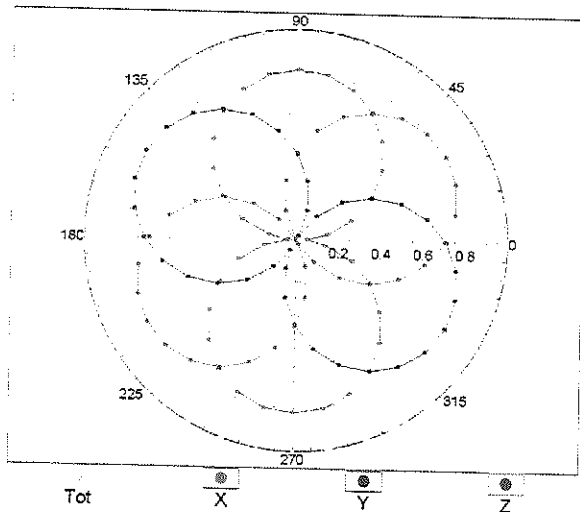
(TEM-Cell:ifi110 EXX, Waveguide: R22)



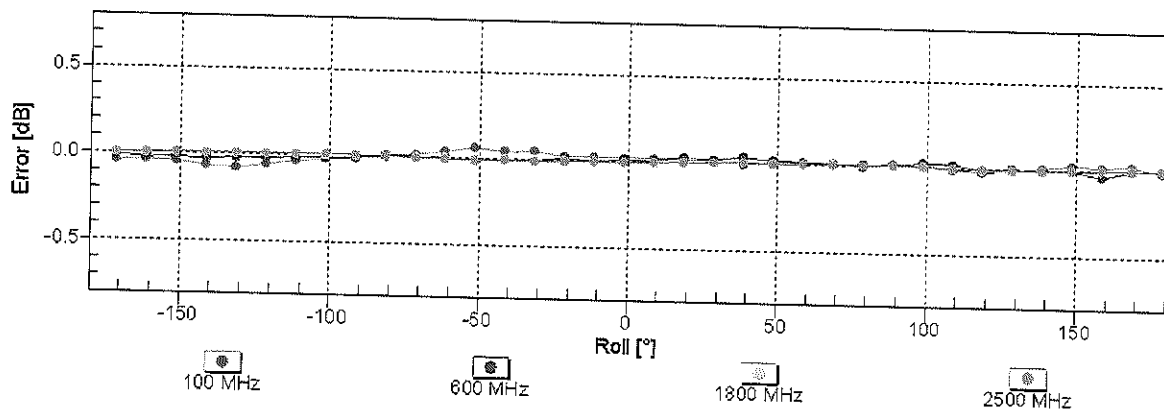
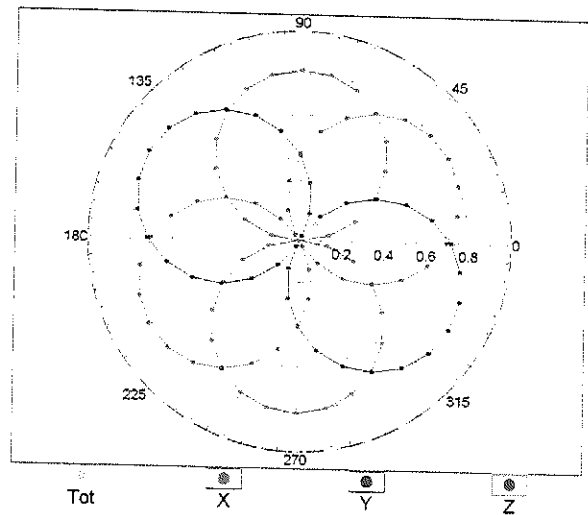
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

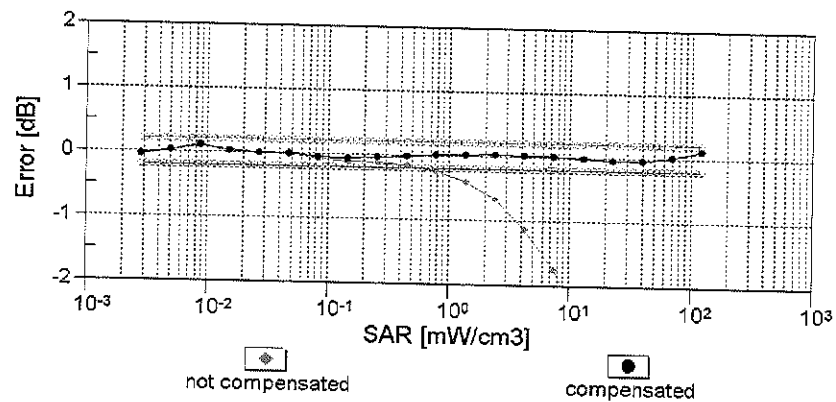
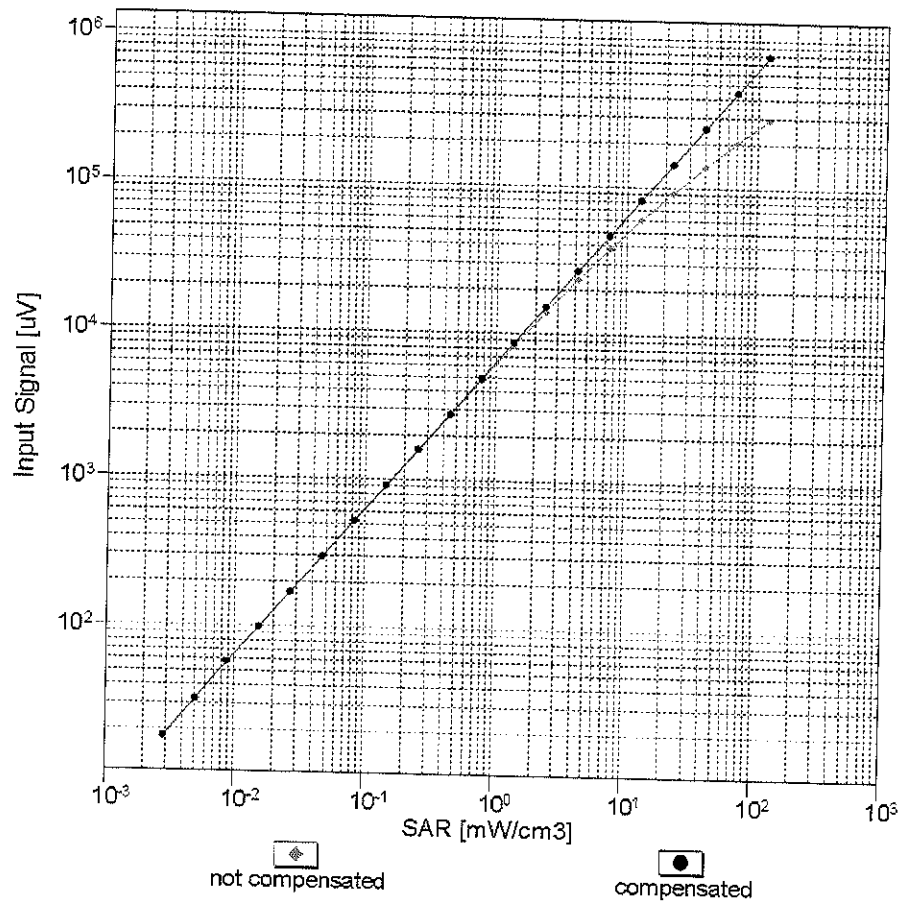


f=1800 MHz, R22



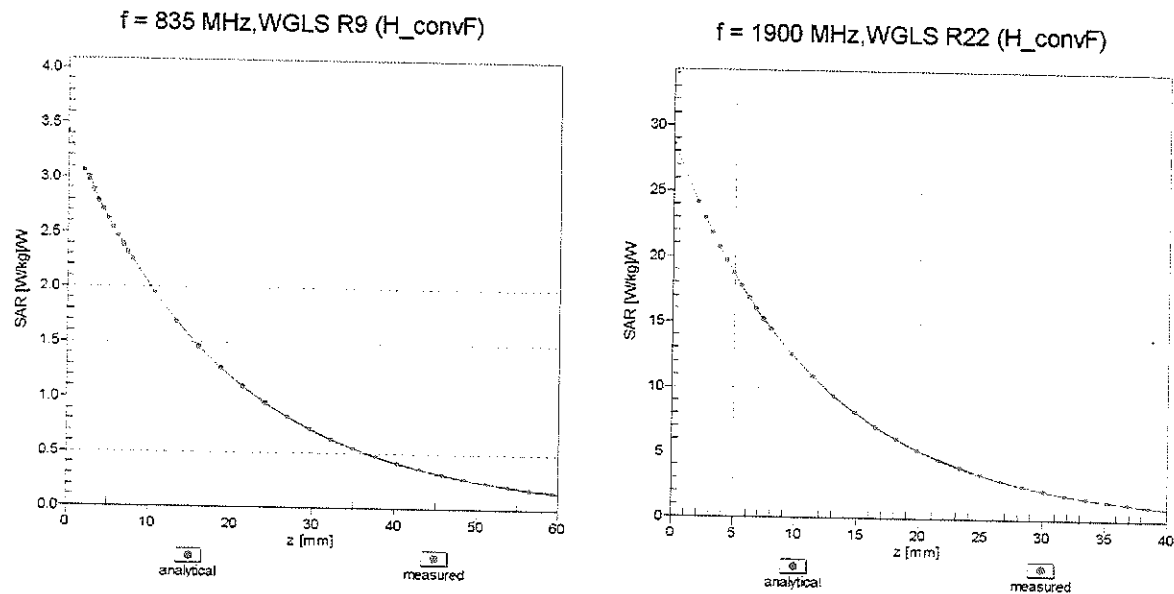
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



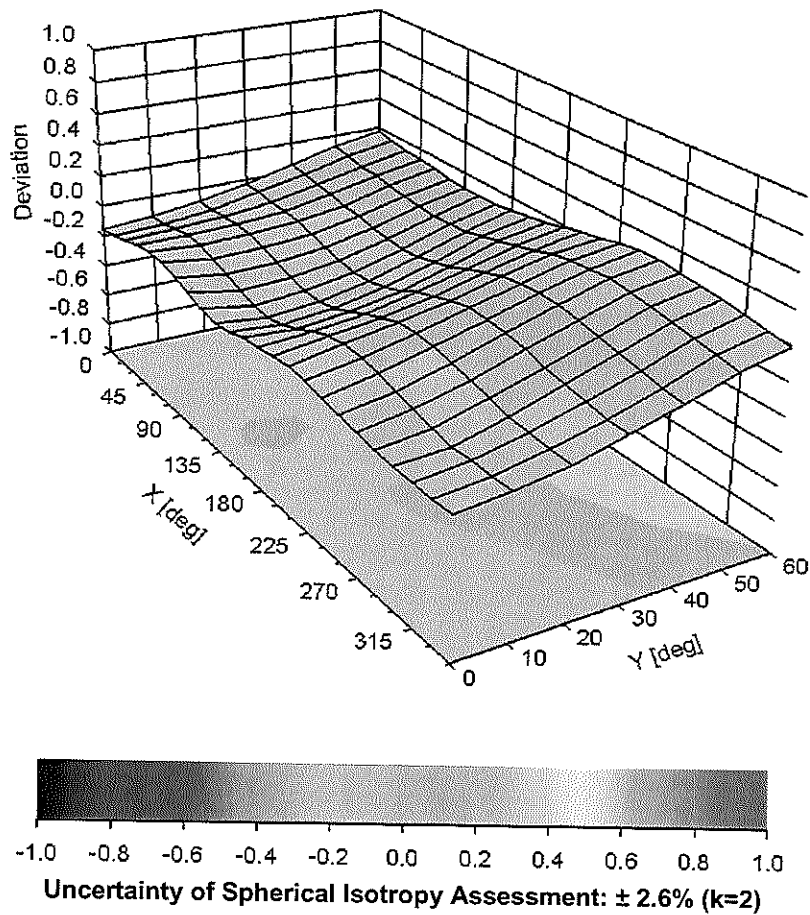
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), f = 900 MHz



DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	98.5
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



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: **ES3-3288_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 $(22 \pm 3)^{\circ}\text{C}$ 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: 560	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	
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.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Glossary:

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

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

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 ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.05	1.16	0.92	$\pm 10.1 \%$
DCP (mV) ^B	106.9	106.9	107.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	190.7	$\pm 3.0 \%$
		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	2.56	61.8	10.9	10.00	38.0	$\pm 1.2 \%$
		Y	99.34	97.0	21.5		36.6	
		Z	6.26	70.5	13.9		36.2	
10011- CAB	UMTS-FDD (WCDMA)	X	3.28	67.4	18.7	2.91	129.4	$\pm 0.5 \%$
		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	$\pm 0.7 \%$
		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	$\pm 2.7 \%$
		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	$\pm 2.2 \%$
		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	$\pm 2.7 \%$
		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	$\pm 2.5 \%$
		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	$\pm 1.9 \%$
		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	56.25	99.8	21.6	3.55	141.8	$\pm 1.9 \%$
		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	$\pm 1.9 \%$
		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	$\pm 1.4 \%$
		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	19.8	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.

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

DASY/EASY - Parameters of Probe: 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 %

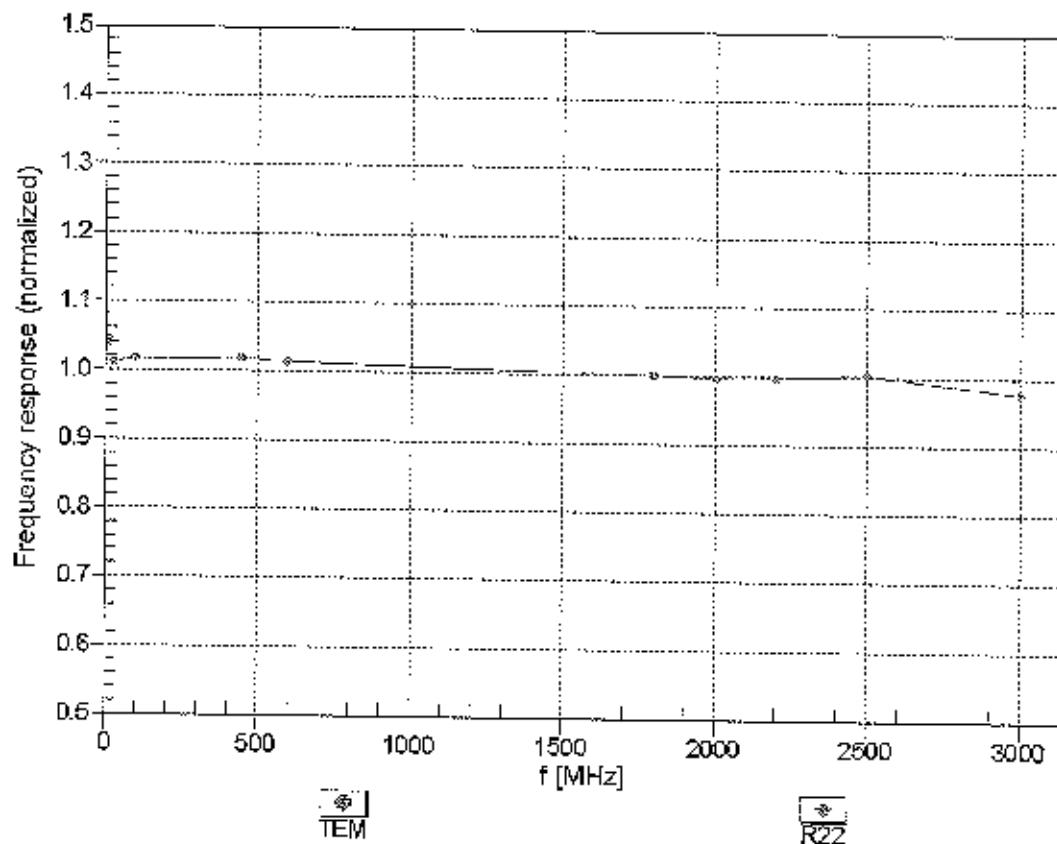
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is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

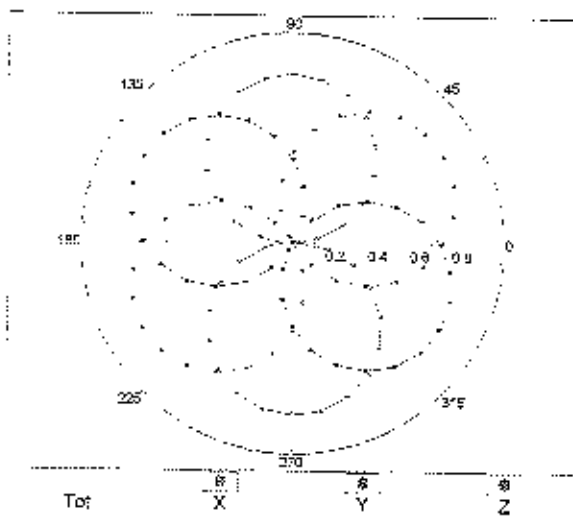
(TEM-Cell: ifi110 EXX, Waveguide: R22)



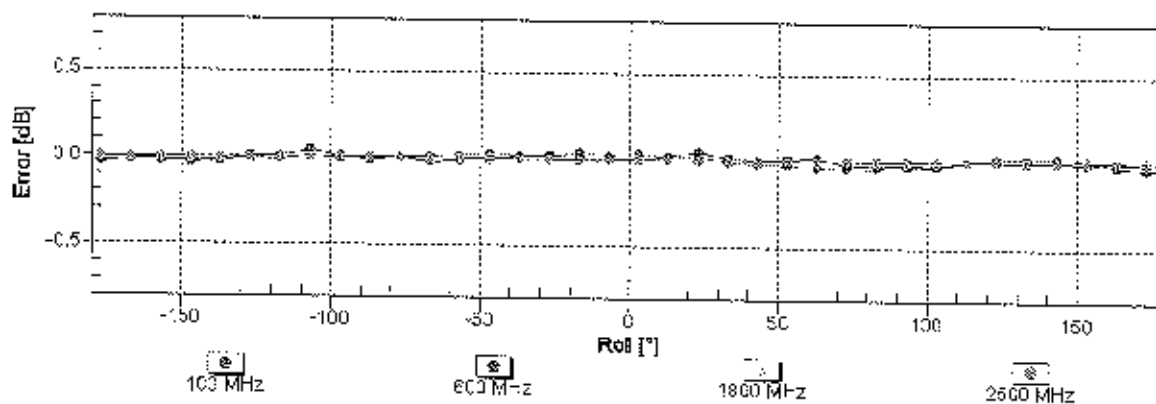
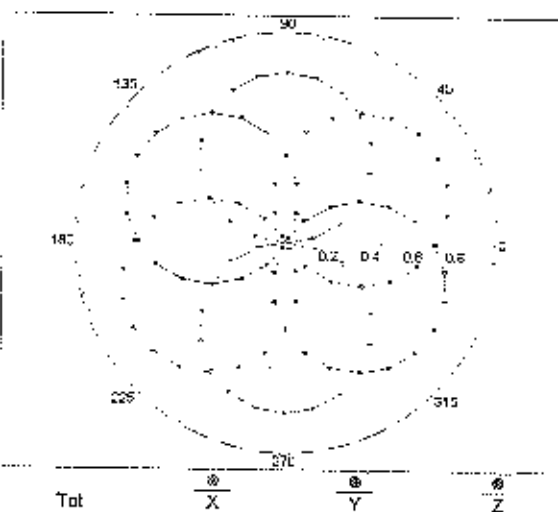
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM



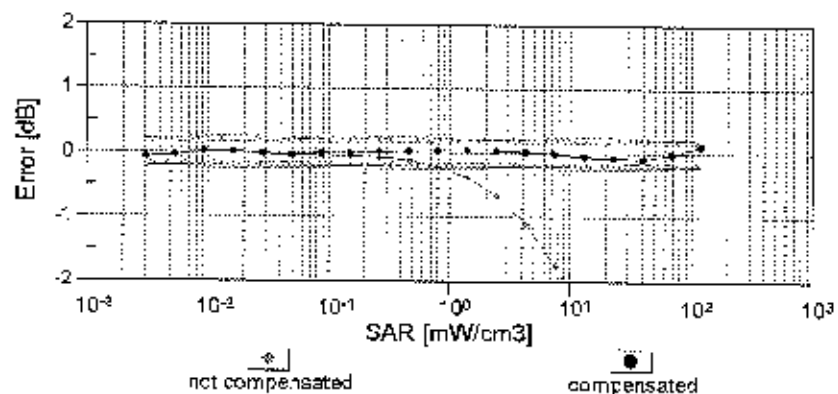
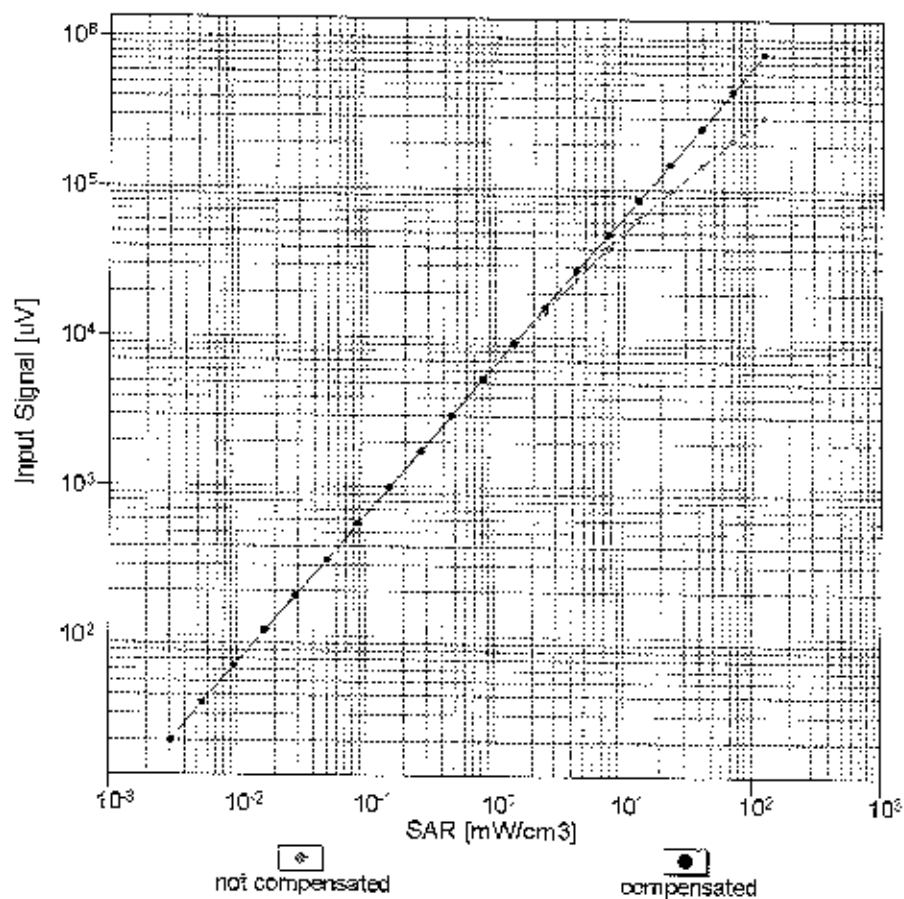
f=1800 MHz,R22



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

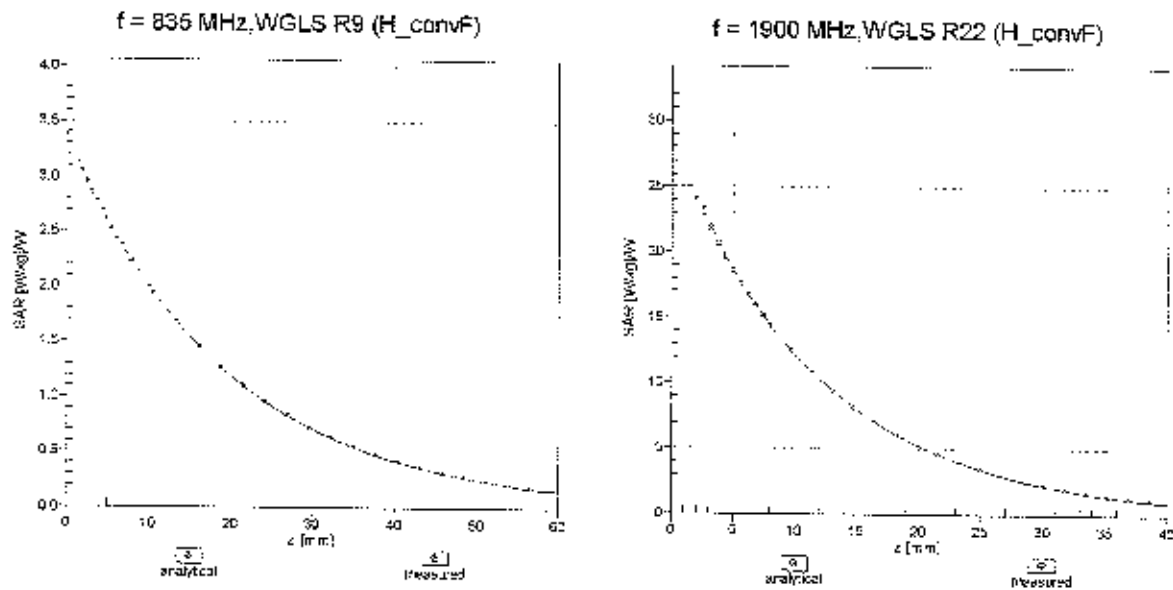
Dynamic Range f(SAR_{head})

(TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)



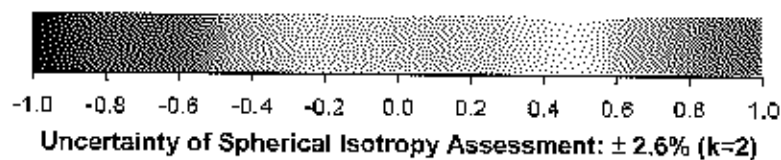
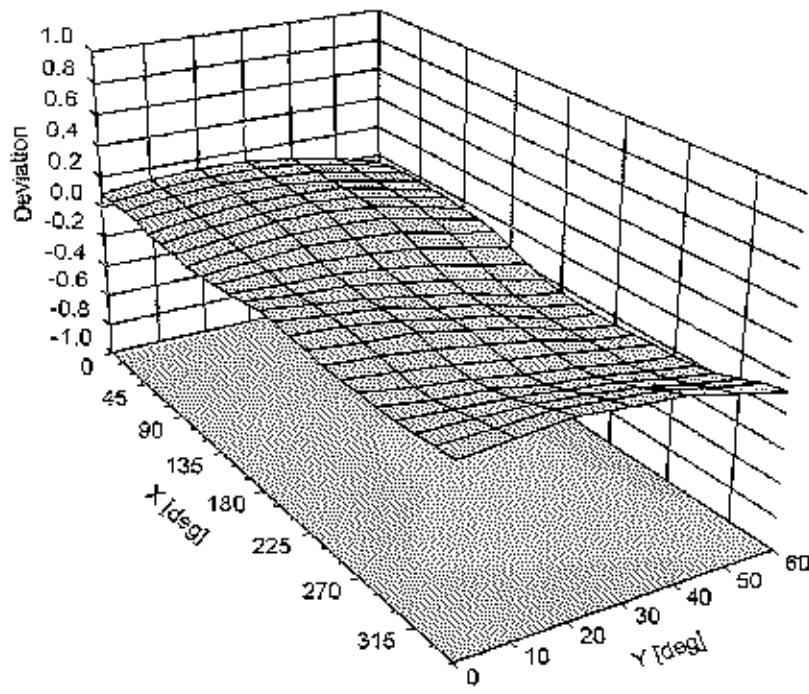
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client: **PC Test**

Certificate No: **ES3-3287_Oct15**

CALIBRATION CERTIFICATE

Object: **ES3DV3 - SN:3287**

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

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 8848C	US3842U01700	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

Calibrated by:	Name Leif Klysner	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	
			Issued: October 29, 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**

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Glossary:

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

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3287

Manufactured:	June 7, 2010
Repaired:	October 26, 2015
Calibrated:	October 29, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	0.90	1.02	1.03	$\pm 10.1 \%$
DCP (mV) ^B	107.9	102.8	106.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dBV μV	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	174.4	$\pm 3.3 \%$
		Y	0.0	0.0	1.0		182.0	
		Z	0.0	0.0	1.0		190.2	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	0.95	51.7	5.1	10.00	43.9	$\pm 2.7 \%$
		Y	3.69	64.5	12.4		37.8	
		Z	1.91	60.6	10.8		37.4	
10011- CAB	UMTS-FDD (WCDMA)	X	3.47	68.1	18.7	2.91	138.9	$\pm 0.7 \%$
		Y	3.34	66.7	17.8		146.6	
		Z	3.09	66.1	17.9		111.1	
10012- CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.91	68.5	18.3	1.87	141.3	$\pm 0.7 \%$
		Y	2.89	67.5	17.4		147.4	
		Z	2.68	67.5	18.0		112.6	
10013- CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.98	70.7	23.2	9.46	134.1	$\pm 3.0 \%$
		Y	11.47	71.3	23.4		146.7	
		Z	10.21	69.0	22.4		101.8	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	7.66	80.9	20.7	9.39	135.4	$\pm 1.7 \%$
		Y	17.65	94.3	26.1		149.8	
		Z	7.45	82.4	21.8		147.9	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	6.04	76.8	19.2	9.57	126.0	$\pm 1.9 \%$
		Y	12.07	87.2	23.6		140.2	
		Z	9.85	87.1	23.5		141.5	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	7.78	79.2	17.8	6.56	115.4	$\pm 1.7 \%$
		Y	25.36	94.3	23.2		133.5	
		Z	8.04	80.7	18.5		131.8	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	63.55	99.9	21.9	4.80	131.7	$\pm 1.4 \%$
		Y	64.01	99.9	22.5		103.3	
		Z	52.80	99.9	22.2		149.1	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	7.45	76.8	14.5	3.55	141.6	$\pm 1.4 \%$
		Y	52.62	99.8	22.3		109.9	
		Z	12.72	84.3	17.2		113.6	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	94.45	95.7	17.0	1.16	115.8	$\pm 1.4 \%$
		Y	97.58	91.9	15.8		123.7	
		Z	96.27	92.2	15.3		131.4	
10100- CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.04	66.4	19.0	5.67	105.9	$\pm 1.2 \%$
		Y	6.03	65.9	18.6		112.4	
		Z	6.15	66.9	19.4		121.2	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	9.68	74.8	25.6	9.29	132.9	±2.7 %
		Y	9.08	71.7	23.7		101.1	
		Z	8.43	71.3	24.0		103.5	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.48	68.0	20.0	5.80	149.4	±1.2 %
		Y	5.86	65.8	18.5		112.0	
		Z	6.01	66.5	19.3		120.0	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.29	89.4	21.5	8.07	138.8	±1.9 %
		Y	9.51	67.1	20.1		100.8	
		Z	9.72	68.1	20.8		108.8	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.12	74.0	25.4	9.28	129.0	±2.5 %
		Y	10.12	75.5	25.8		146.3	
		Z	9.36	75.5	26.5		146.1	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.14	67.5	19.8	5.75	145.7	±1.2 %
		Y	5.67	65.1	18.3		110.8	
		Z	5.74	66.2	19.1		117.5	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.02	65.9	18.9	5.82	106.3	±1.2 %
		Y	6.11	65.7	18.6		115.6	
		Z	6.13	66.5	19.2		122.5	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.82	67.2	19.8	5.73	125.8	±1.2 %
		Y	4.98	66.5	19.2		135.6	
		Z	4.85	67.5	20.1		142.9	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.18	78.3	27.8	9.21	141.5	±1.9 %
		Y	7.34	73.2	24.7		111.0	
		Z	6.97	74.4	26.1		113.2	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.84	66.8	19.6	5.72	124.7	±1.2 %
		Y	4.98	66.5	19.2		133.9	
		Z	4.90	67.3	20.0		141.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.91	67.1	19.8	5.72	125.6	±1.2 %
		Y	4.93	66.3	19.0		133.1	
		Z	4.89	67.2	19.9		141.6	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.85	69.0	21.4	8.10	132.0	±2.2 %
		Y	10.13	69.3	21.4		146.4	
		Z	9.32	67.8	20.8		103.6	
10225-CAB	UMTS-FDD (HSPA+)	X	6.63	66.2	18.9	5.97	112.6	±1.4 %
		Y	6.86	66.4	18.9		124.6	
		Z	6.77	66.9	19.4		129.8	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.17	78.3	27.8	9.21	141.6	±1.9 %
		Y	7.56	74.1	26.2		114.4	
		Z	7.01	74.5	26.2		114.6	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.44	73.0	25.0	9.24	120.9	±2.7 %
		Y	9.42	74.6	25.4		138.7	
		Z	8.64	74.5	26.1		137.8	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.13	74.0	25.4	9.30	128.7	±2.7 %
		Y	10.25	75.8	26.0		148.8	
		Z	9.31	75.3	26.4		145.2	

10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.56	67.6	19.0	3.96	140.5	±0.7 %
		Y	4.11	64.9	17.4		107.6	
		Z	4.17	65.9	18.2		114.1	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.71	67.5	18.8	3.46	130.6	±0.7 %
		Y	3.66	66.4	18.0		138.5	
		Z	3.68	67.6	18.9		147.9	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.68	67.7	18.9	3.39	132.6	±0.7 %
		Y	3.54	66.0	17.7		142.3	
		Z	3.67	67.9	19.1		149.2	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	5.99	66.2	19.1	5.81	105.7	±1.2 %
		Y	6.00	65.7	18.6		113.0	
		Z	6.00	66.4	19.2		120.3	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.44	66.4	19.2	6.06	109.3	±1.2 %
		Y	6.55	66.4	19.0		118.2	
		Z	6.62	67.2	19.7		125.0	
10400-AAC	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.23	69.6	21.9	8.37	135.7	±2.5 %
		Y	10.44	69.6	21.8		149.1	
		Z	9.60	68.1	21.2		104.3	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.94	69.5	19.2	3.76	142.7	±0.5 %
		Y	4.44	66.5	17.5		109.4	
		Z	4.57	68.4	18.7		113.6	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.97	69.9	19.4	3.77	140.3	±0.5 %
		Y	4.57	67.3	17.9		107.6	
		Z	4.62	69.2	19.2		113.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	3.00	70.3	19.4	1.54	139.9	±0.5 %
		Y	2.56	66.7	17.1		147.2	
		Z	2.91	70.0	19.2		114.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.01	69.2	21.6	8.23	134.8	±2.5 %
		Y	10.23	69.4	21.5		146.8	
		Z	9.44	68.0	21.0		104.7	

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 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:3287

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	6.72	6.72	6.72	0.19	2.32	± 12.0 %
835	41.5	0.90	6.57	6.57	6.57	0.15	2.57	± 12.0 %
1750	40.1	1.37	5.30	5.30	5.30	0.31	1.72	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.50	1.29	± 12.0 %
2300	39.5	1.67	4.69	4.69	4.69	0.37	1.63	± 12.0 %
2450	39.2	1.80	4.38	4.38	4.38	0.65	1.26	± 12.0 %
2600	39.0	1.96	4.25	4.25	4.25	0.44	1.65	± 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:3287

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	6.62	6.62	6.62	0.39	1.42	± 12.0 %
835	55.2	0.97	6.34	6.34	6.34	0.20	2.47	± 12.0 %
1750	53.4	1.49	4.96	4.96	4.96	0.35	1.65	± 12.0 %
1900	53.3	1.52	4.72	4.72	4.72	0.31	1.87	± 12.0 %
2300	52.9	1.81	4.38	4.38	4.38	0.49	1.49	± 12.0 %
2450	52.7	1.95	4.20	4.20	4.20	0.75	1.05	± 12.0 %
2600	52.5	2.16	4.00	4.00	4.00	0.68	1.06	± 12.0 %

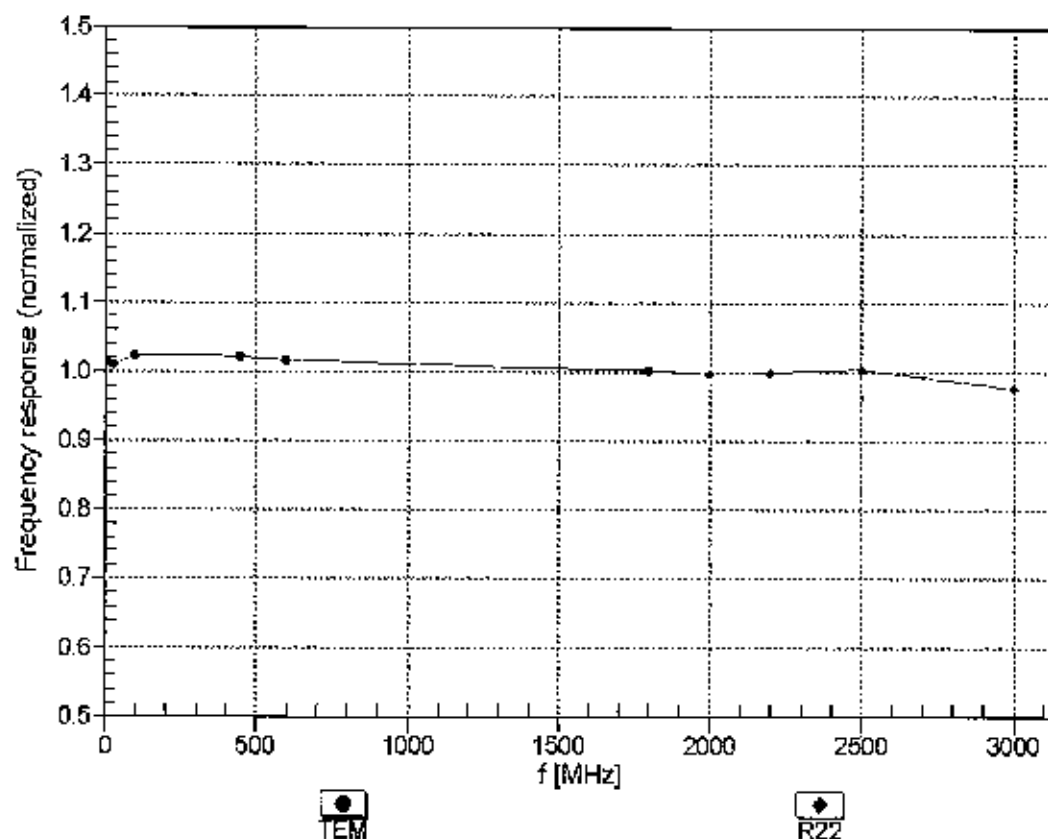
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 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 3-8 GHz at any distance larger than half the probe tip diameter from the boundary.

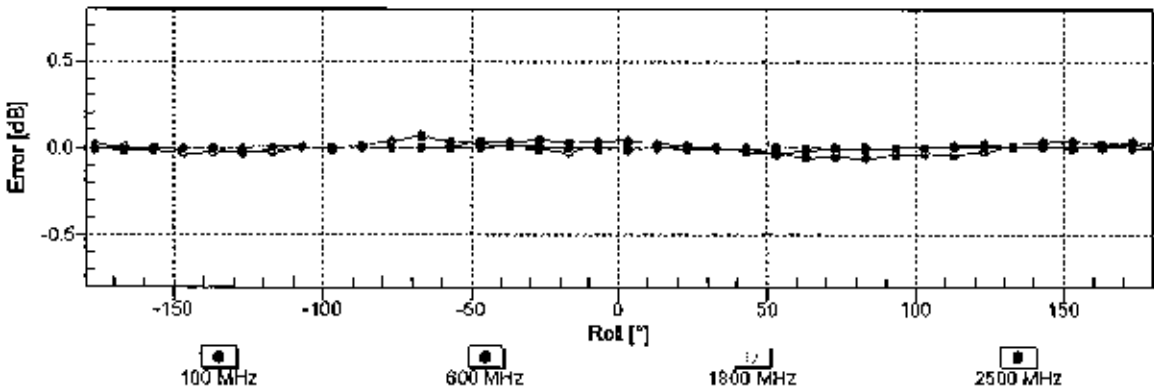
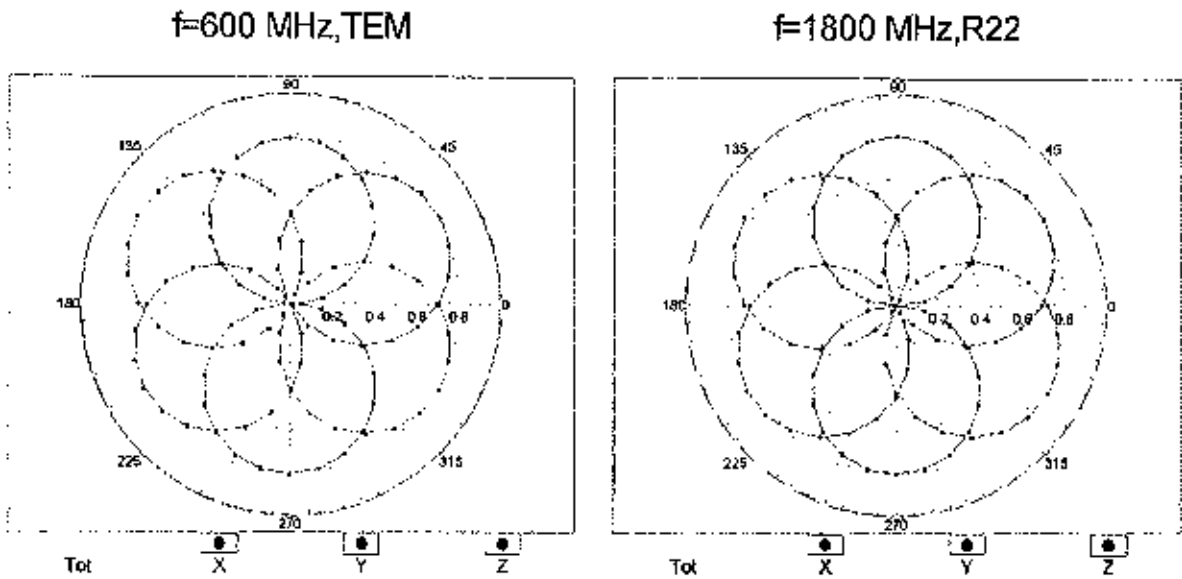
Frequency Response of E-Field

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



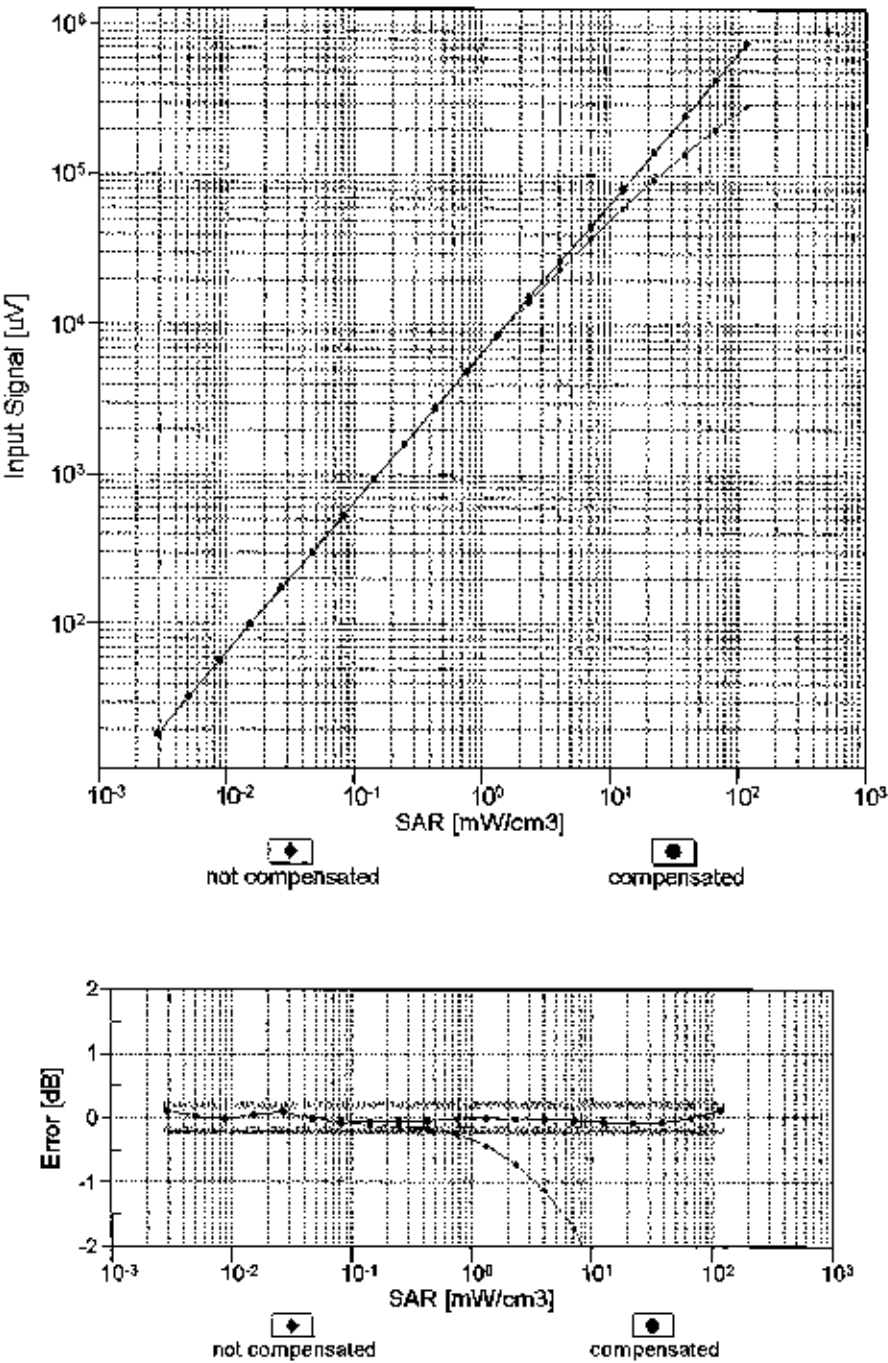
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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



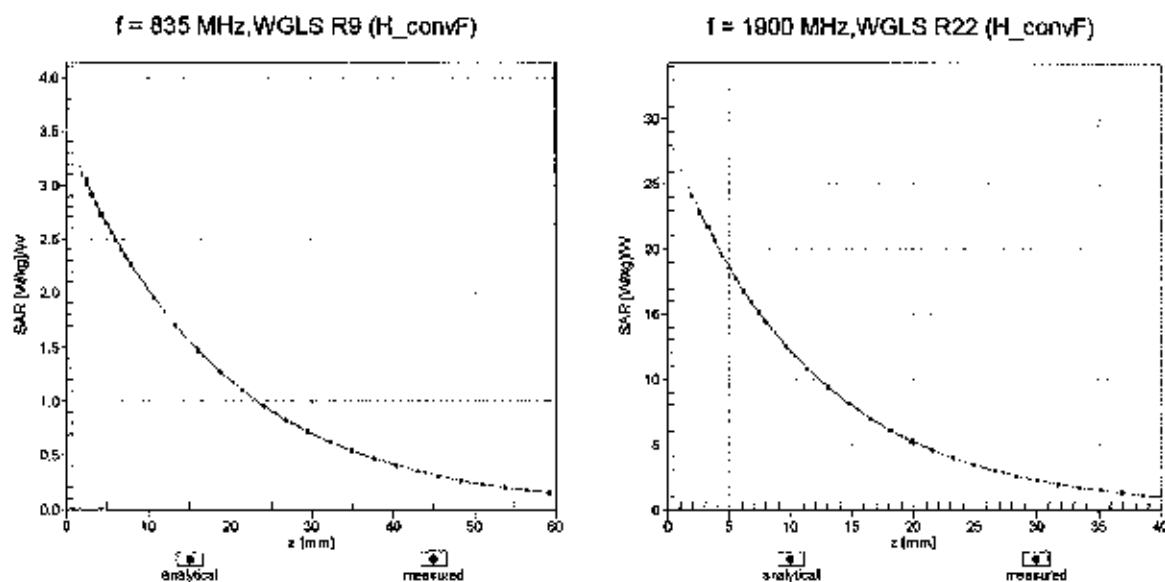
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



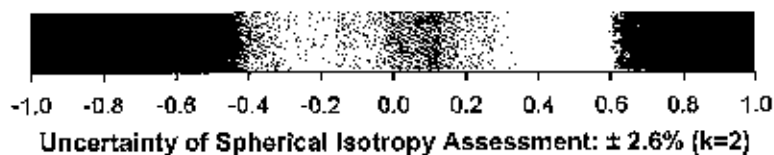
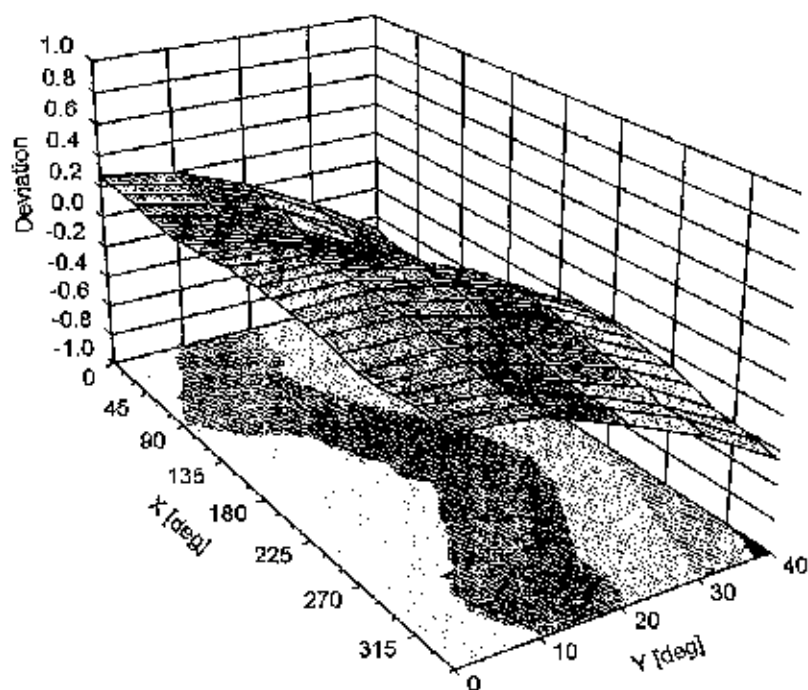
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	83.3
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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

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

*DN ✓
14/03/15*

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 $(22 \pm 3)^\circ\text{C}$ 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

Calibrated by:	Name Lutz Klysner	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Issued: October 29, 2015



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- 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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

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 ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.07	0.90	0.88	$\pm 10.1 \%$
DCP (mV) ^B	106.8	108.5	106.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	201.0	$\pm 3.5 \%$
		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	80.7	11.4	10.00	41.6	$\pm 2.2 \%$
		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	$\pm 0.5 \%$
		Y	3.48	68.8	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	3.80	72.8	20.8	1.87	141.0	$\pm 0.7 \%$
		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	$\pm 3.0 \%$
		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	$\pm 2.5 \%$
		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	$\pm 2.2 \%$
		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	$\pm 1.9 \%$
		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	$\pm 2.5 \%$
		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	$\pm 2.7 \%$
		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	98.1	22.8	1.16	127.5	$\pm 1.9 \%$
		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	87.6	19.8	5.67	137.5	$\pm 1.2 \%$
		Y	6.29	87.4	19.6		128.9	
		Z	6.35	87.5	19.7		139.5	

10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	10.85	76.6	28.4	9.29	130.8	±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	8.21	67.0	19.7	5.80	128.9	±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	9.08	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	68.7	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	68.5	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	4.80	68.5	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, 8 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 (mm)	Unc (k=2)
750	55.5	0.98	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 %

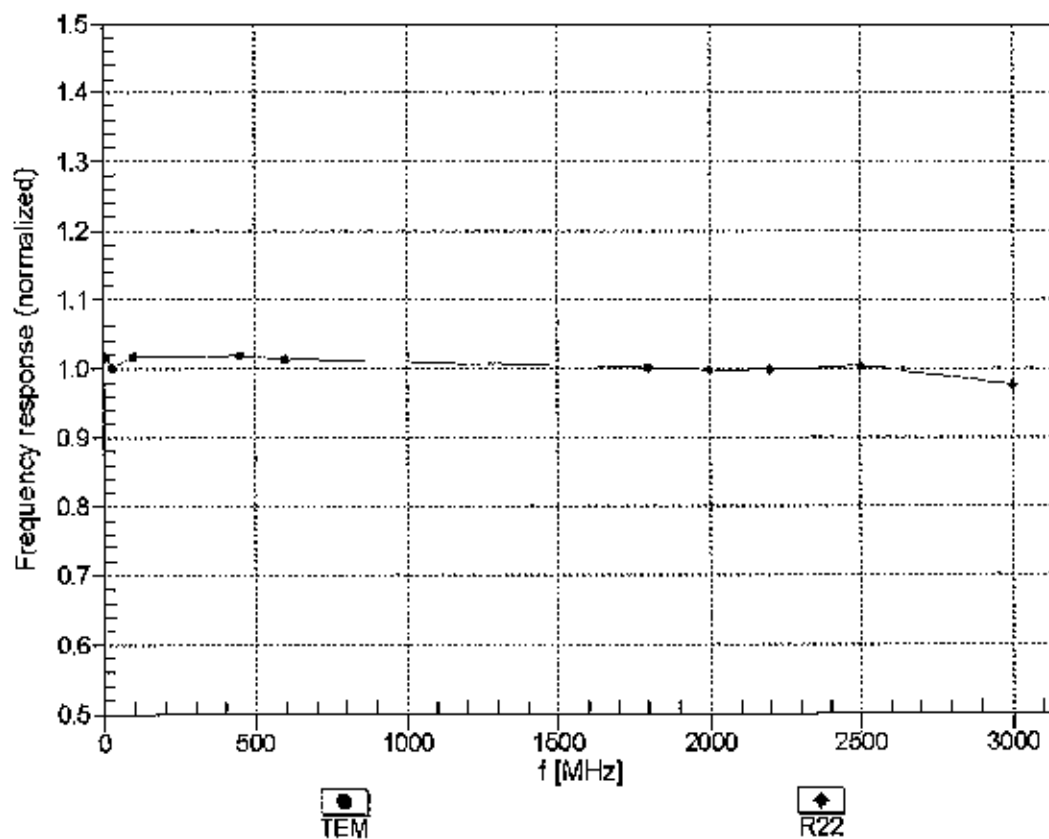
^c Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 160 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

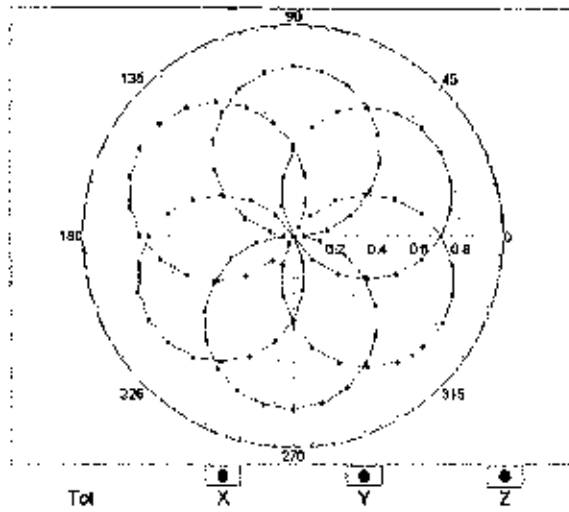
(TEM-Cell:ifi110 EXX, Waveguide: R22)



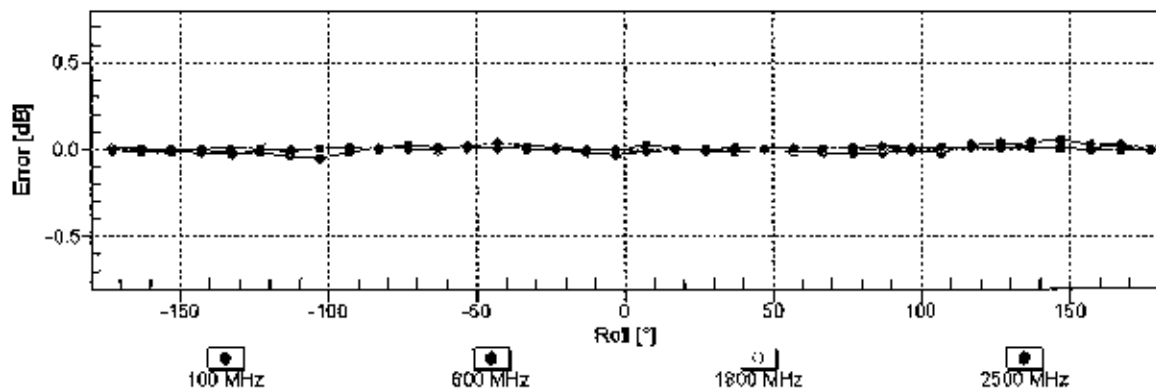
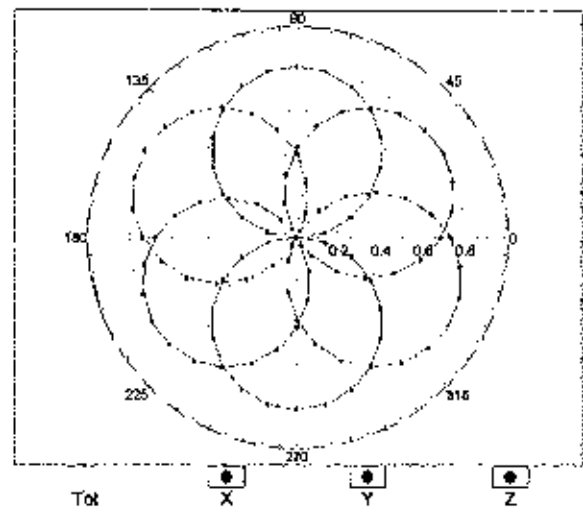
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

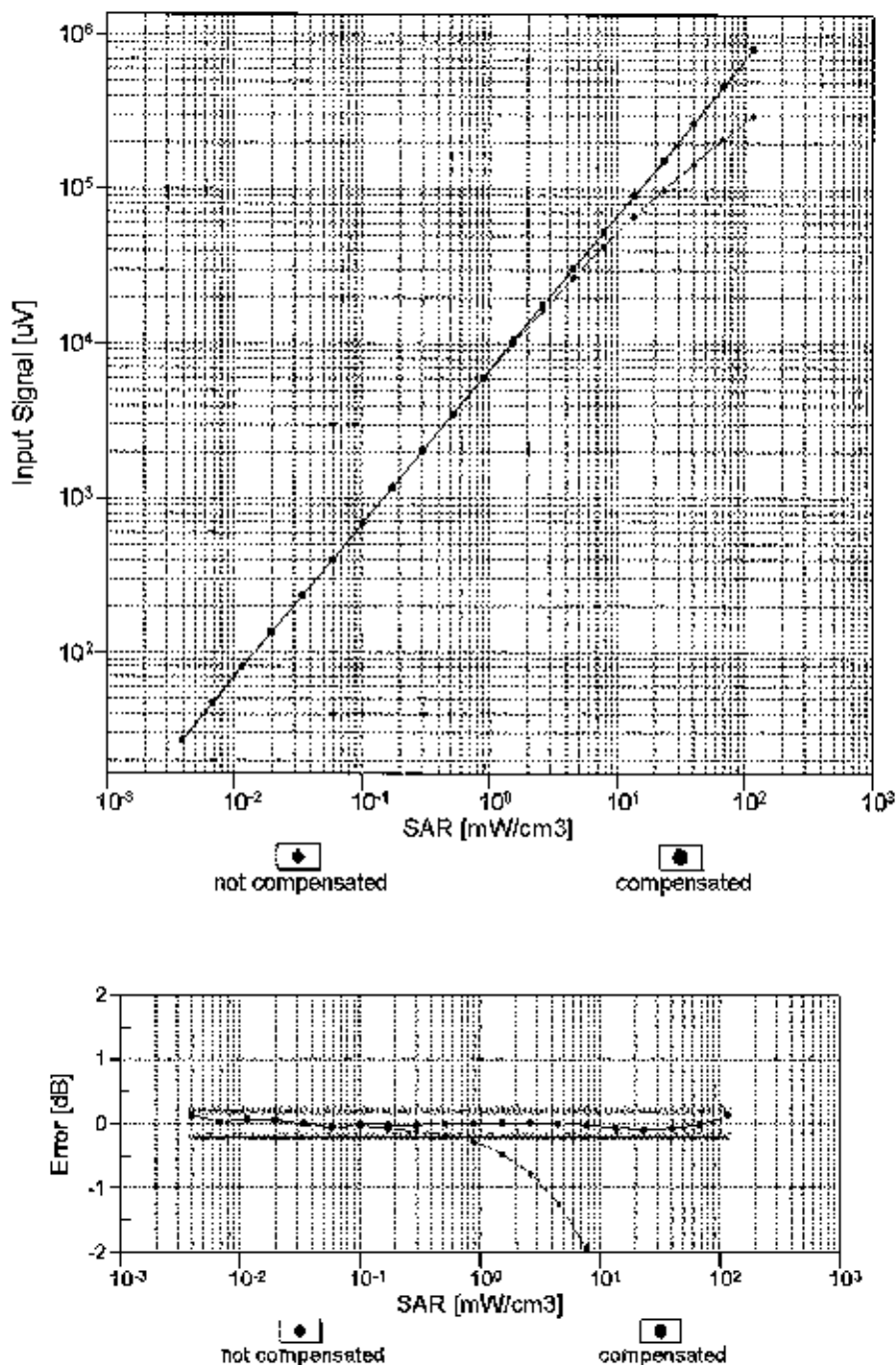


f=1800 MHz,R22



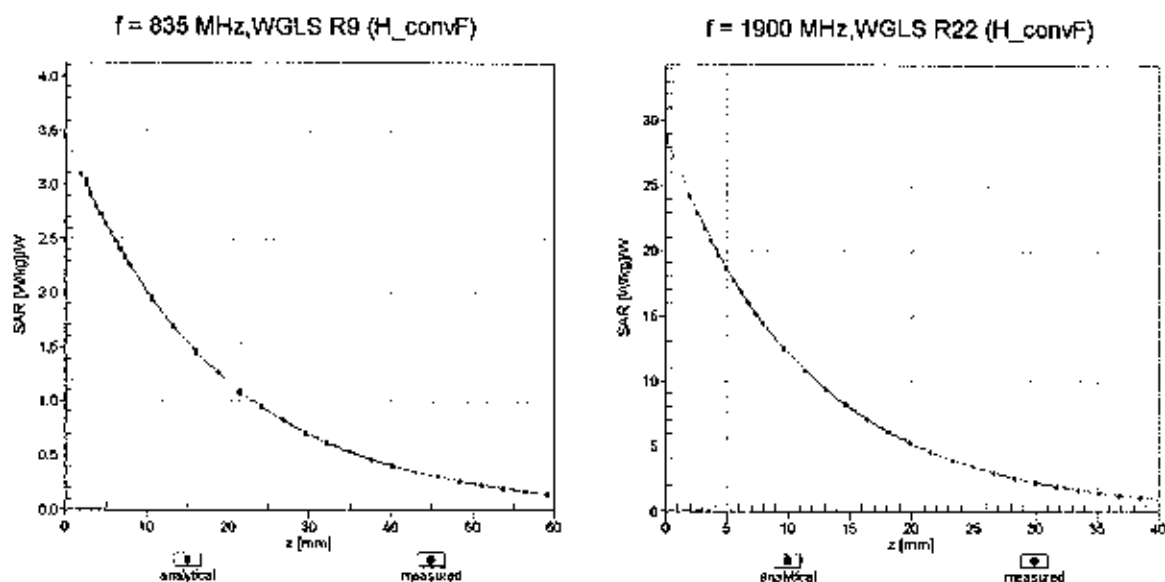
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



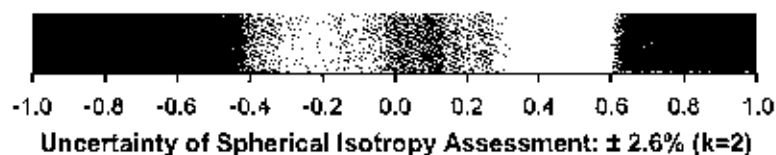
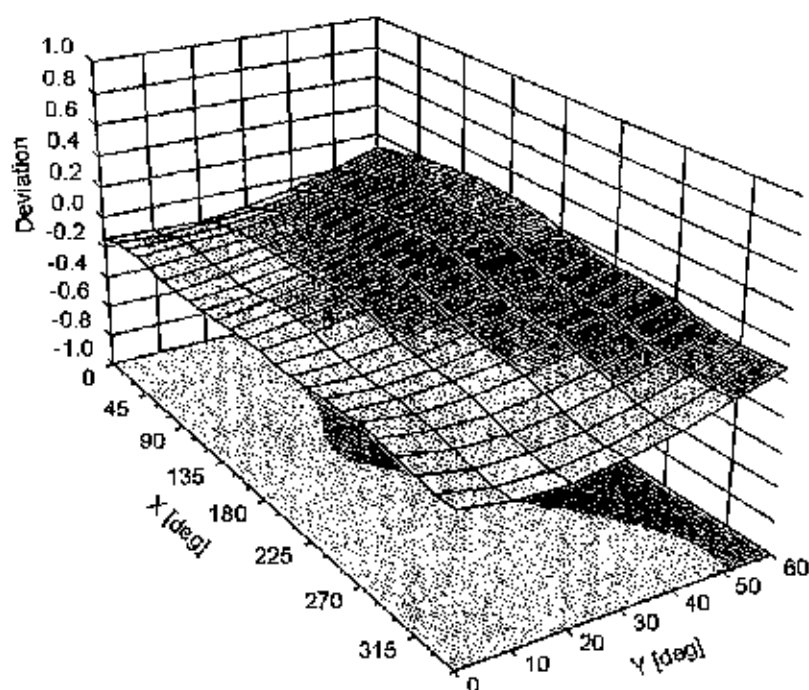
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

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