



SAR EVALUATION REPORT

Applicant Name:

Samsung Electronics, Co. Ltd.
129, Samsung-ro Maetan Dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

Date of Testing:

04/05/13 - 05/07/13

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

OY1304050586.A3L

FCC ID:

A3LSGHI467

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Tablet

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SGH-I467

Equipment Class	Band & Mode	Tx Frequency	Measured Conducted Power [dBm]	SAR
				1 gm Body SAR (W/kg)
PCB	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	29.90	1.09
PCB	UMTS 850	826.40 - 846.60 MHz	21.99	0.83
PCB	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	27.62	1.08
PCB	UMTS 1900	1852.4 - 1907.6 MHz	22.15	1.08
PCB	LTE Band 17	706.5 - 713.5 MHz	23.07	0.61
PCB	LTE Band 5 (Cell)	826.5 - 846.5 MHz	22.60	0.59
PCB	LTE Band 4 (AWS)	1712.5 - 1752.5 MHz	23.56	0.79
PCB	LTE Band 2 (PCS)	1852.5 - 1907.5 MHz	23.00	1.09
DTS	2.4 GHz WLAN	2412 - 2462 MHz	14.02	0.83
DTS	Bluetooth LE	2402-2480 MHz	6.95	N/A
DTS	5.8 GHz WLAN	5745 - 5825 MHz	8.00	0.81
NII	5.2 GHz WLAN	5180 - 5240 MHz	7.73	0.51
NII	5.3 GHz WLAN	5260 - 5320 MHz	7.95	0.65
NII	5.5 GHz WLAN	5500 - 5700 MHz	8.00	0.89
DSS	Bluetooth	2402 - 2480 MHz	11.03	0.21
Simultaneous SAR per KDB 690783 D01v01r02:				1.59

Note: Powers in the above table represent output powers for the SAR test configurations and may not represent the highest output powers for all configurations for each mode.

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

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


Randy Ortanez
President



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Data	824.20 - 848.80 MHz
UMTS 850	Data	826.40 - 846.60 MHz
GSM/GPRS/EDGE 1900	Data	1850.20 - 1909.80 MHz
UMTS 1900	Data	1852.4 - 1907.6 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
LTE Band 5 (Cell)	Data	826.5 - 846.5 MHz
LTE Band 4 (AWS)	Data	1712.5 - 1752.5 MHz
LTE Band 2 (PCS)	Data	1852.5 - 1907.5 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
Bluetooth LE	Data	2402-2480 MHz
5.8 GHz WLAN	Data	5745 - 5825 MHz
5.2 GHz WLAN	Data	5180 - 5240 MHz
5.3 GHz WLAN	Data	5260 - 5320 MHz
5.5 GHz WLAN	Data	5500 - 5700 MHz
Bluetooth	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses a proximity sensor for SAR compliance. The capacitive proximity sensor is activated when used in close proximity to the user's body. The capacitive proximity sensor triggers power reduction for data modes and is only applicable for tablet operations.

Since the device is a full tablet size, the Body SAR was evaluated per FCC KDB Publication 616217 D04v01 for full sized tablets.

1.3 Nominal and Maximum Output Power Specifications

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

Maximum Power: capacitive sensor inactivated:

Mode / Band		Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots
GSM/GPRS/EDGE 850	Maximum	33.0	31.5	30.0	28.5	28.0	25.5	24.0	23.0
	Nominal	32.5	31.0	29.5	28.0	27.5	25.0	23.5	22.5
GSM/GPRS/EDGE 1900	Maximum	30.5	29.0	28.0	26.5	27.0	25.5	24.0	23.0
	Nominal	30.0	28.5	27.5	26.0	26.5	25.0	23.5	22.5

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Mode / Band		Modulated Average (dBm)		
		3GPP Rel 99	3GPP Rel 5	3GPP Rel 6
		WCDMA	HSDPA	HSUPA
UMTS Band 5 (850 MHz)	Maximum	22.5	21.5	21.5
	Nominal	22.0	21.0	21.0
UMTS Band 2 (1900 MHz)	Maximum	22.5	21.5	21.5
	Nominal	22.0	21.0	21.0

Mode / Band		Modulated Average (dBm)
LTE Band 17	Maximum	23.5
	Nominal	23.0
LTE Band 5 (Cell)	Maximum	23.0
	Nominal	22.5
LTE Band 4 (AWS)	Maximum	24.0
	Nominal	23.5
LTE Band 2 (PCS)	Maximum	23.0
	Nominal	22.5

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	14.5
	Nominal	14.0
IEEE 802.11g (2.4 GHz)	Maximum	11.0
	Nominal	10.5
IEEE 802.11n (2.4 GHz)	Maximum	10.0
	Nominal	9.5
IEEE 802.11a (5 GHz)	Maximum	8.0
	Nominal	7.5
IEEE 802.11n (5 GHz)	Maximum	8.0
	Nominal	7.5
Bluetooth LE	Maximum	7.0
	Nominal	6.5
Bluetooth	Maximum	11.5
	Nominal	11.0

With power backoff, capacitive proximity sensor activated:

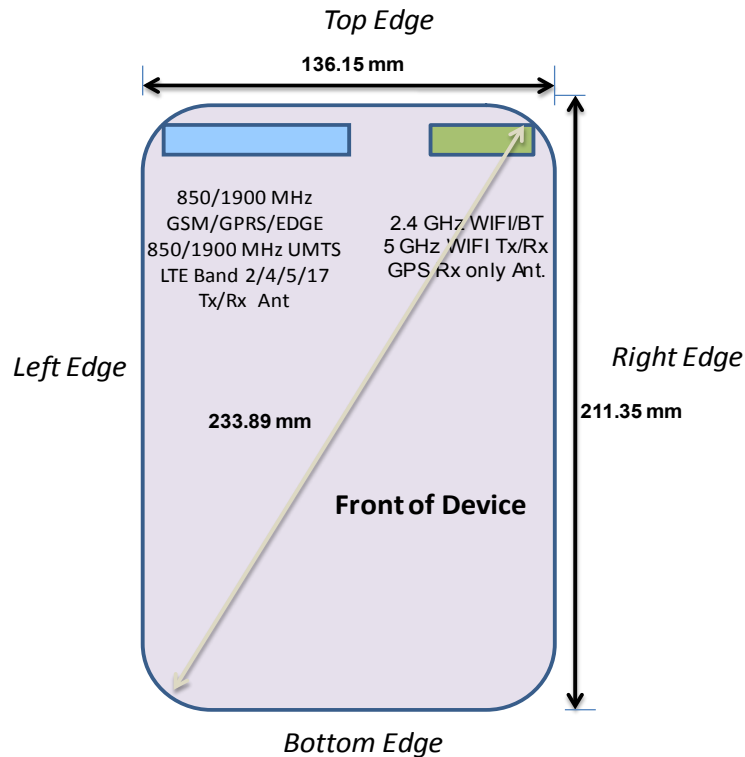
Mode / Band		Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots
GSM/GPRS/EDGE 850	Maximum	28.0	26.5	24.5	23.0	27.5	25.0	24.0	22.5
	Nominal	27.5	26.0	24.0	22.5	27.0	24.5	23.5	22.0
GSM/GPRS/EDGE 1900	Maximum	21.5	19.5	18.0	16.5	20.5	19.0	17.5	16.0
	Nominal	21.0	19.0	17.5	16.0	20.0	18.5	17.0	15.5

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Mode / Band		Modulated Average (dBm)		
		3GPP Rel 99	3GPP Rel 5	3GPP Rel 6
		WCDMA	HSDPA	HSUPA
UMTS Band 5 (850 MHz)	Maximum	18.5	17.5	17.5
	Nominal	18.0	17.0	17.0
UMTS Band 2 (1900 MHz)	Maximum	13.5	12.5	12.5
	Nominal	13.0	12.0	12.0

Mode / Band		Modulated Average (dBm)
LTE Band 17	Maximum	20.5
	Nominal	20.0
LTE Band 5 (Cell)	Maximum	17.5
	Nominal	17.0
LTE Band 4 (AWS)	Maximum	15.5
	Nominal	15.0
LTE Band 2 (PCS)	Maximum	12.5
	Nominal	12.0

1.4 DUT Antenna Locations



Note: Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC Filing.

Figure 1-1
DUT Antenna Locations

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1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-2 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 1-2
Simultaneous Transmission Paths

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

Table 1-1
Simultaneous Transmission Scenarios

Ref.	Simultaneous Transmit Configurations	Body	Note
		FCC KDB 616217	
1	UMTS Data + 2.4 GHz WIFI	Yes	
2	GPRS/EDGE Data + 2.4 GHz WIFI	Yes	
3	LTE Data + 2.4 GHz WIFI	Yes	
4	UMTS Data + 2.4 GHz Bluetooth	Yes	
5	GPRS/EDGE Data+ 2.4 Bluetooth	Yes	
6	LTE data + 2.4 Bluetooth	Yes	
7	UMTS Data + 5 GHz WIFI	Yes	5 GHz WIFI Direct
8	GPRS/EDGE Data + 5 GHz WIFI	Yes	5 GHz WIFI Direct
9	LTE Data + 5 GHz WIFI	Yes	5 GHz WIFI Direct
Notes:			
1. Bluetooth and 2.4 GHz WLAN and 5 GHz share the same antenna path and cannot transmit simultaneously. 2. LTE and 2g/3g share the same antenna path and cannot transmit simultaneously			

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1.6 SAR Test Exclusions Applied

(A) WIFI/BT

Per FCC KDB 447498 D01 v05, the 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 LE (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth LE SAR was not required; $[(5/5) * \sqrt{2.441}] = 1.6 < 3.0$.

This device supports 20 MHz and 40 MHz Bandwidths for IEEE 802.11n for 5 GHz WIFI only. IEEE 802.11n was not evaluated for SAR since the average output power of 20 MHz and 40 MHz bandwidths was not more than 0.25 dB higher than the average output power of IEEE 802.11a.

(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 D01v02.

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 D05v02.

1.7 Guidance Applied

- FCC KDB Publication 941225 D01-D06 (2G/3G/4G)
- FCC KDB Publication 248227 D01v01r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04v01 (Tablet SAR Consideration)

1.8 Device Serial Numbers

Several samples were used with identical hardware 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.

	Body Reduced Power Serial Number	Body Max Power Serial Number
GSM/GPRS/EDGE 850	53	54
UMTS 850	53	54
GSM/GPRS/EDGE 1900	99	98
UMTS 1900	99	98
LTE Band 17	53	54
LTE Band 5 (Cell)	53	54
LTE Band 4 (AWS)	53	54
LTE Band 2 (PCS)	99	98
2.4 GHz WLAN	-	55
Bluetooth	-	55
5 GHz WLAN	-	55

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LTE INFORMATION

LTE Information			
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Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 17 (706.5 - 713.5 MHz)		
	LTE Band 5 (Cell) (826.5 - 846.5 MHz)		
	LTE Band 4 (AWS) (1712.5 - 1752.5 MHz)		
	LTE Band 2 (PCS) (1852.5 - 1907.5 MHz)		
Channel Bandwidths	LTE Band 17: 5 MHz, 10 MHz		
	LTE Band 5 (Cell): 5 MHz, 10 MHz		
	LTE Band 4 (AWS): 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 2 (PCS): 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
LTE Band 4 (AWS): 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): 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	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE Transmitter and Antenna Implementation	This device uses 1 Tx/Rx antenna for LTE		
Description of LTE Tx and Ant. Implementation	GPRS/UMTS/LTE share the same transmitter		
Hotspot with LTE+WIFI	YES		
LTE MPR Permanently implemented per 3GPP TS 36.101	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		
Conducted power Table provided for 1RB (low, mid and high offset), 50% RB (low, mid, and high offset), and 100% RB	YES		

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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 [24]. 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:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1).
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1). 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. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. 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.

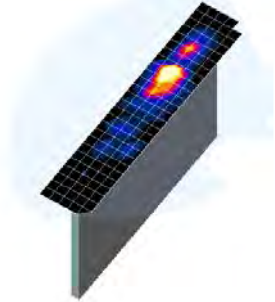


Figure 4-1
Sample SAR Area Scan

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

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		
				$\Delta z_{\text{zoom}}(n)$	$\Delta z_{\text{zoom}}(1)^*$	
≤ 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

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5 SAR TESTING PROCEDURES

5.1 SAR Testing for Tablet per KDB Publication 616217 D04v01

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

5.2 Additional Test Positions due to Proximity Sensor Considerations

This device uses a proximity sensor to reduce data powers in tablet-device use conditions.

While the device is touching the user on the antenna, the capacitive proximity sensor activates and thus reduces the maximum output power allowed. However, when the device is moved beyond the sensor triggering distance, the sensors de-activate and thus maximum output power is no longer limited. Therefore, an additional exposure condition 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 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. Since the capacitive proximity sensor activation distance for the back side of the device is 16 mm, a conservative distance of 15 mm was tested for SAR on the back side at maximum power. Since the capacitive proximity sensor activation distance for the top edge of the device is 16 mm, a conservative distance of 15 mm was tested for SAR on the top edge, at maximum power. Sensor triggering distance summary data is included in Appendix G. The capacitive proximity sensor does not trigger power reduction from the front of the device.

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 antenna.

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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 were performed using a base station simulator under digital average power.

7.1 Measured and Reported SAR

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

7.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01 "SAR Measurement Procedures for 3G Devices" v02, October 2007.

The device was 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 were 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 was 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 deviated by more than 5%, the SAR test and drift measurements were repeated.

7.3 SAR Measurement Conditions for UMTS

7.3.1 Output Power Verification

Maximum output power is measured on the High, Middle and Low channels for each applicable transmission band according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all "1s".

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 (release 5), using the appropriate RMC with TPC (transmit power control) set to all "1s" or applying the required inner loop power control procedures to maintain maximum output power while HSUPA is active. Results for all applicable physical channel configurations (DPCCH, DPDCHn and spreading codes, HS-DPCCH etc) are tabulated in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

7.3.2 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all "1s".

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7.3.3 Procedures Used to Establish RF Signal for SAR HSDPA Data Devices

The following procedures are applicable to HSDPA data devices operating under 3GPP Release 5. Body exposure conditions are typically applicable to these devices, including handsets and data modems operating in various electronic devices. HSDPA operates in conjunction with UMTS and requires an active DPCCH. The default test configuration is to measure SAR in UMTS without HSDPA, with an established radio link between the DUT and a communication test set with 12.2 kbps RMC mode configured in Test Loop Mode 1; and tested with HSDPA with FRC and a 12.2 kbps RMC using the highest SAR configuration in UMTS. SAR is selectively confirmed for other physical channel configurations according to output power, exposure conditions and device operating capabilities. Maximum output power is verified according to 3GPP TS 23.121 (Release 5) and SAR must be measured according to these maximum output conditions.

7.3.4 SAR Measurement Conditions for HSUPA Data Devices

SAR for body exposure configurations are measured according to the 'Body SAR Measurements' procedures in the 'WCDMA Handsets' section of the KDB 941225 D01 FCC 3G document. In addition, Body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least ¼ dB higher of that measured without HSPA in 12.2 kbps RMC mode or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. 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 with power control algorithm 2, according to the highest body SAR configuration in 12.2 kbps RMC without HSPA. When VOIP is applicable for head exposure, SAR is not required when the maximum output of each RF channel with HSPA is less than ¼ dB higher than that measured using 12.2 kbps RMC; otherwise, the same HSPA configuration used for body measurements should be used to test for head exposure.

Due to inner loop power control requirements in HSPA, a commercial communication test set should be used for the output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and EDCH configurations for HSPA should be configured according to the β values indicated below as well as other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Devices' sections of the FCC 3G document.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	$\beta_{hs}^{(1)}$	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM ⁽²⁾ (dB)	MPR (dB)	AG ⁽⁴⁾ Index	E-TFCI
1	11/15 ⁽³⁾	15/15 ⁽³⁾	64	11/15 ⁽³⁾	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1} : 47/15 β_{ed2} : 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 ⁽⁴⁾	15/15 ⁽⁴⁾	64	15/15 ⁽⁴⁾	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$.

Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.

Note 6: β_{ed} can not be set directly; it is set by Absolute Grant Value.

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7.4 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was 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.

7.4.1 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.

7.4.2 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.

7.4.3 A-MPR

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

7.4.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

- 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.

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7.5 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g/n transmitters. 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 D01v01r02 for more details.

7.5.1 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. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

7.5.2 Frequency Channel Configurations [27]

For 2.4 GHz, the highest average RF output power channel between the low, mid and high channel at the lowest data rate was selected for SAR evaluation in 802.11b mode. 802.11g/n modes and higher data rates for 802.11b were additionally evaluated for SAR if the output power of the respective mode was 0.25 dB or higher than the powers of the SAR configurations tested in the 802.11b mode.

For 5 GHz, the highest average RF output power channel across the default test channels at the lowest data rate was selected for SAR evaluation in 802.11a. When the adjacent channels are higher in power than the default channels, these “required channels” were considered instead of the default channels for SAR testing. 802.11n modes and higher data rates for 802.11a/n were evaluated only if the respective mode was 0.25 dB or higher than the 802.11a mode.

If the maximum extrapolated peak SAR of the zoom scan for the highest output channel was less than 1.6 W/kg or if the 1g averaged SAR was less than 0.8 W/kg, SAR testing was not required for the other test channels in the band.

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8 RF CONDUCTED POWERS

8.1 GSM Conducted Powers

Table 8-1
Maximum GPRS/EDGE Average RF Conducted Powers
Representing Capacitive Sensor Inactive

		Maximum Burst-Averaged Output Power							
		GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	32.81	31.50	29.90	28.04	27.77	25.40	23.67	22.73
	190	32.27	30.85	29.33	27.61	27.50	24.99	23.21	22.14
	251	32.70	31.21	29.77	27.93	27.56	25.21	23.37	22.33
GSM 1900	512	30.23	28.21	27.10	25.84	25.96	24.36	23.23	22.26
	661	30.16	28.49	27.25	25.83	26.01	24.60	23.41	22.34
	810	30.44	28.61	27.62	26.13	26.59	25.02	23.63	22.56
		Calculated Maximum Frame-Averaged Output Power							
		GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	23.78	25.48	25.64	25.03	18.74	19.38	19.41	19.72
	190	23.24	24.83	25.07	24.60	18.47	18.97	18.95	19.13
	251	23.67	25.19	25.51	24.92	18.53	19.19	19.11	19.32
GSM 1900	512	21.20	22.19	22.84	22.83	16.93	18.34	18.97	19.25
	661	21.13	22.47	22.99	22.82	16.98	18.58	19.15	19.33
	810	21.41	22.59	23.36	23.12	17.56	19.00	19.37	19.55

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Table 8-2
Reduced GPRS/EDGE Average RF Conducted Powers
Representing Capacitive Sensor Active

		Maximum Burst-Averaged Output Power							
		GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	27.92	26.33	24.50	22.82	27.20	25.00	23.77	22.47
	190	27.49	25.83	24.03	22.57	26.27	24.70	23.40	22.10
	251	27.62	26.10	24.28	22.61	26.88	24.75	23.55	22.24
GSM 1900	512	20.92	19.21	17.53	16.16	20.30	18.63	16.91	15.26
	661	20.95	19.20	17.50	16.20	20.46	18.61	16.98	15.45
	810	21.17	19.43	17.83	16.43	20.50	18.95	17.30	15.62
		Calculated Maximum Frame-Averaged Output Power							
		GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	18.89	20.31	20.24	19.81	18.17	18.98	19.51	19.46
	190	18.46	19.81	19.77	19.56	17.24	18.68	19.14	19.09
	251	18.59	20.08	20.02	19.60	17.85	18.73	19.29	19.23
GSM 1900	512	11.89	13.19	13.27	13.15	11.27	12.61	12.65	12.25
	661	11.92	13.18	13.24	13.19	11.43	12.59	12.72	12.44
	810	12.14	13.41	13.57	13.42	11.47	12.93	13.04	12.61

Note:

- Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
- The bolded GPRS modes were selected for SAR testing according to the highest frame-averaged output power table according to KDB 941225 D03v01.
- GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
- EDGE (8-PSK) output powers were measured with MCS7 on the base station simulator. MCS7 coding scheme was used to measure the output powers for EDGE since investigation has shown that choosing MCS7 coding scheme will ensure 8-PSK modulation. It has been shown that MCS levels that produce 8PSK modulation do not have an impact on output power.
- This device does not support evolved EDGE (eEDGE)

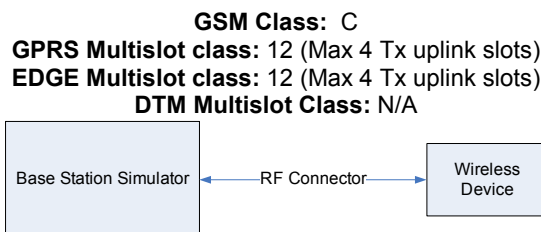


Figure 8-1
Power Measurement Setup

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8.2 UMTS Conducted Powers

Table 8-3
Maximum UMTS Average RF Conducted Powers
Representing Capacitive Sensor Inactive

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.33	21.99	22.02	22.15	21.57	22.06	-
6	HSDPA	Subtest 1	21.25	20.90	21.09	21.25	20.70	21.09	0
6		Subtest 2	21.33	20.97	21.06	21.18	20.88	21.20	0
6		Subtest 3	20.81	20.44	20.77	20.61	20.06	20.47	0.5
6		Subtest 4	20.80	20.48	20.64	20.74	20.19	20.36	0.5
6	HSUPA	Subtest 1	21.43	20.66	20.79	21.12	20.50	20.61	0
6		Subtest 2	19.14	19.10	19.21	19.50	18.90	19.24	2
6		Subtest 3	20.14	20.43	20.24	20.50	20.13	20.17	1
6		Subtest 4	20.45	20.16	20.00	20.11	20.00	19.45	2
6		Subtest 5	21.09	21.10	21.11	21.24	21.40	21.30	0

Table 8-4
Reduced UMTS Average RF Conducted Powers
Representing Capacitive Sensor Active

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	18.17	18.13	18.17	12.97	12.50	13.21	-
6	HSDPA	Subtest 1	17.28	17.31	17.34	11.93	11.47	12.12	0
6		Subtest 2	17.24	17.21	17.35	11.75	11.31	11.97	0
6		Subtest 3	16.78	16.70	16.88	11.25	10.82	11.43	0.5
6		Subtest 4	16.77	16.86	16.94	11.35	10.90	11.57	0.5
6	HSUPA	Subtest 1	17.04	17.01	17.15	11.68	11.40	12.06	0
6		Subtest 2	16.11	16.32	16.09	10.89	10.47	11.13	2
6		Subtest 3	16.06	15.35	15.96	10.16	9.69	10.35	1
6		Subtest 4	16.59	16.54	16.58	11.34	10.89	11.49	2
6		Subtest 5	17.28	16.57	16.61	11.31	10.95	10.91	0

UMTS SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

This device does not support DC-HSDPA.

It is expected by the manufacturer that MPR for some HSUPA subtests may be up to 1 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.

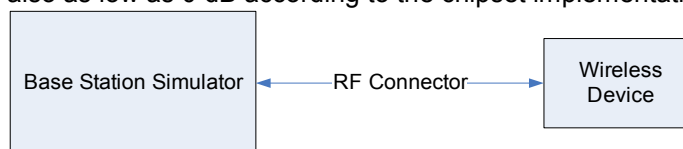


Figure 8-2
Power Measurement Setup

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8.3 LTE Conducted Powers

8.3.1 LTE Band 17

Table 8-5
Maximum LTE Band 17 Conducted Powers - 10 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	710.0	23790	10	QPSK	1	0	23.07	0	0
	710.0	23790	10	QPSK	1	25	23.00	0	0
	710.0	23790	10	QPSK	1	49	23.05	0	0
	710.0	23790	10	QPSK	25	0	22.44	1	0-1
	710.0	23790	10	QPSK	25	12	22.37	1	0-1
	710.0	23790	10	QPSK	25	25	22.35	1	0-1
	710.0	23790	10	QPSK	50	0	22.28	1	0-1
	710.0	23790	10	16QAM	1	0	22.17	1	0-1
	710.0	23790	10	16QAM	1	25	22.08	1	0-1
	710.0	23790	10	16QAM	1	49	22.21	1	0-1
	710.0	23790	10	16QAM	25	0	21.42	2	0-2
	710.0	23790	10	16QAM	25	12	21.38	2	0-2
	710.0	23790	10	16QAM	25	25	21.35	2	0-2
	710.0	23790	10	16QAM	50	0	21.24	2	0-2

Note: LTE Band 17 at 10 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing

Table 8-6
Reduced LTE Band 17 Conducted Powers - 10 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	710.0	23790	10	QPSK	1	0	20.22	0	0
	710.0	23790	10	QPSK	1	25	20.25	0	0
	710.0	23790	10	QPSK	1	49	20.19	0	0
	710.0	23790	10	QPSK	25	0	20.45	0	0-1
	710.0	23790	10	QPSK	25	12	20.16	0	0-1
	710.0	23790	10	QPSK	25	25	20.42	0	0-1
	710.0	23790	10	QPSK	50	0	20.23	0	0-1
	710.0	23790	10	16QAM	1	0	20.35	0	0-1
	710.0	23790	10	16QAM	1	25	20.36	0	0-1
	710.0	23790	10	16QAM	1	49	20.19	0	0-1
	710.0	23790	10	16QAM	25	0	20.20	0	0-2
	710.0	23790	10	16QAM	25	12	20.35	0	0-2
	710.0	23790	10	16QAM	25	25	20.30	0	0-2
	710.0	23790	10	16QAM	50	0	20.12	0	0-2

Note: LTE Band 17 at 10 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing

Table 8-7
Maximum LTE Band 17 Conducted Powers - 5 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	710.0	23790	5	QPSK	1	0	23.02	0	0
	710.0	23790	5	QPSK	1	12	22.82	0	0
	710.0	23790	5	QPSK	1	24	22.91	0	0
	710.0	23790	5	QPSK	12	0	22.44	1	0-1
	710.0	23790	5	QPSK	12	6	22.47	1	0-1
	710.0	23790	5	QPSK	12	13	22.40	1	0-1
	710.0	23790	5	QPSK	25	0	22.35	1	0-1
	710.0	23790	5	16-QAM	1	0	22.42	1	0-1
	710.0	23790	5	16-QAM	1	12	22.31	1	0-1
	710.0	23790	5	16-QAM	1	24	22.33	1	0-1
	710.0	23790	5	16-QAM	12	0	21.48	2	0-2
	710.0	23790	5	16-QAM	12	6	21.32	2	0-2
	710.0	23790	5	16-QAM	12	13	21.49	2	0-2
	710.0	23790	5	16-QAM	25	0	21.34	2	0-2

Note: LTE Band 17 at 5 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing

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Table 8-8
Reduced LTE Band 17 Conducted Powers - 5 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	710.0	23790	5	QPSK	1	0	20.22	0	0
	710.0	23790	5	QPSK	1	12	19.93	0	0
	710.0	23790	5	QPSK	1	24	20.06	0	0
	710.0	23790	5	QPSK	12	0	19.99	0	0-1
	710.0	23790	5	QPSK	12	6	19.80	0	0-1
	710.0	23790	5	QPSK	12	13	19.89	0	0-1
	710.0	23790	5	QPSK	25	0	19.87	0	0-1
	710.0	23790	5	16-QAM	1	0	20.00	0	0-1
	710.0	23790	5	16-QAM	1	12	20.12	0	0-1
	710.0	23790	5	16-QAM	1	24	19.89	0	0-1
	710.0	23790	5	16-QAM	12	0	19.95	0	0-2
	710.0	23790	5	16-QAM	12	6	19.82	0	0-2
	710.0	23790	5	16-QAM	12	13	19.98	0	0-2
	710.0	23790	5	16-QAM	25	0	19.80	0	0-2

Note: LTE Band 17 at 5 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing

8.3.2 LTE Band 5 (Cell)

Table 8-9
Maximum LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	836.5	20525	10	QPSK	1	0	22.60	0	0
	836.5	20525	10	QPSK	1	25	22.25	0	0
	836.5	20525	10	QPSK	1	49	22.03	0	0
	836.5	20525	10	QPSK	25	0	21.83	1	0-1
	836.5	20525	10	QPSK	25	12	21.66	1	0-1
	836.5	20525	10	QPSK	25	25	21.58	1	0-1
	836.5	20525	10	QPSK	50	0	21.55	1	0-1
	836.5	20525	10	16QAM	1	0	21.80	1	0-1
	836.5	20525	10	16QAM	1	25	21.64	1	0-1
	836.5	20525	10	16QAM	1	49	21.59	1	0-1
	836.5	20525	10	16QAM	25	0	20.76	2	0-2
	836.5	20525	10	16QAM	25	12	20.68	2	0-2
	836.5	20525	10	16QAM	25	25	20.56	2	0-2
	836.5	20525	10	16QAM	50	0	20.54	2	0-2

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

Table 8-10
Reduced LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	836.5	20525	10	QPSK	1	0	16.50	0	0
	836.5	20525	10	QPSK	1	25	17.22	0	0
	836.5	20525	10	QPSK	1	49	16.88	0	0
	836.5	20525	10	QPSK	25	0	16.98	0	0-1
	836.5	20525	10	QPSK	25	12	17.24	0	0-1
	836.5	20525	10	QPSK	25	25	17.23	0	0-1
	836.5	20525	10	QPSK	50	0	17.17	0	0-1
	836.5	20525	10	16QAM	1	0	16.85	0	0-1
	836.5	20525	10	16QAM	1	25	17.15	0	0-1
	836.5	20525	10	16QAM	1	49	16.70	0	0-1
	836.5	20525	10	16QAM	25	0	17.00	0	0-2
	836.5	20525	10	16QAM	25	12	17.01	0	0-2
	836.5	20525	10	16QAM	25	25	17.06	0	0-2
	836.5	20525	10	16QAM	50	0	16.88	0	0-2

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

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Table 8-11
Maximum LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	826.5	20425	5	QPSK	1	0	22.53	0	0
	826.5	20425	5	QPSK	1	12	22.56	0	0
	826.5	20425	5	QPSK	1	24	22.57	0	0
	826.5	20425	5	QPSK	12	0	21.69	1	0-1
	826.5	20425	5	QPSK	12	6	21.75	1	0-1
	826.5	20425	5	QPSK	12	13	21.74	1	0-1
	826.5	20425	5	QPSK	25	0	21.56	1	0-1
	826.5	20425	5	16-QAM	1	0	21.54	1	0-1
	826.5	20425	5	16-QAM	1	12	21.48	1	0-1
	826.5	20425	5	16-QAM	1	24	21.49	1	0-1
	826.5	20425	5	16-QAM	12	0	20.71	2	0-2
	826.5	20425	5	16-QAM	12	6	20.65	2	0-2
Mid	826.5	20425	5	16-QAM	12	13	20.61	2	0-2
	826.5	20425	5	16-QAM	25	0	20.65	2	0-2
	836.5	20525	5	QPSK	1	0	22.27	0	0
	836.5	20525	5	QPSK	1	12	22.24	0	0
	836.5	20525	5	QPSK	1	24	22.20	0	0
	836.5	20525	5	QPSK	12	0	21.75	1	0-1
	836.5	20525	5	QPSK	12	6	21.65	1	0-1
	836.5	20525	5	QPSK	12	13	21.66	1	0-1
	836.5	20525	5	QPSK	25	0	21.63	1	0-1
	836.5	20525	5	16-QAM	1	0	21.86	1	0-1
	836.5	20525	5	16-QAM	1	12	21.78	1	0-1
	836.5	20525	5	16-QAM	1	24	21.79	1	0-1
	836.5	20525	5	16-QAM	12	0	20.83	2	0-2
	836.5	20525	5	16-QAM	12	6	20.63	2	0-2
	836.5	20525	5	16-QAM	12	13	20.66	2	0-2
	836.5	20525	5	16-QAM	25	0	20.60	2	0-2
High	846.5	20625	5	QPSK	1	0	22.59	0	0
	846.5	20625	5	QPSK	1	12	22.51	0	0
	846.5	20625	5	QPSK	1	24	22.57	0	0
	846.5	20625	5	QPSK	12	0	21.70	1	0-1
	846.5	20625	5	QPSK	12	6	21.78	1	0-1
	846.5	20625	5	QPSK	12	13	21.75	1	0-1
	846.5	20625	5	QPSK	25	0	21.69	1	0-1
	846.5	20625	5	16-QAM	1	0	21.61	1	0-1
	846.5	20625	5	16-QAM	1	12	21.62	1	0-1
	846.5	20625	5	16-QAM	1	24	21.59	1	0-1
	846.5	20625	5	16-QAM	12	0	20.55	2	0-2
	846.5	20625	5	16-QAM	12	6	20.53	2	0-2
	846.5	20625	5	16-QAM	12	13	20.47	2	0-2
	846.5	20625	5	16-QAM	25	0	20.47	2	0-2

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Table 8-12
Reduced LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	826.5	20425	5	QPSK	1	0	17.26	0	0
	826.5	20425	5	QPSK	1	12	17.21	0	0
	826.5	20425	5	QPSK	1	24	17.16	0	0
	826.5	20425	5	QPSK	12	0	17.21	0	0-1
	826.5	20425	5	QPSK	12	6	17.15	0	0-1
	826.5	20425	5	QPSK	12	13	16.95	0	0-1
	826.5	20425	5	QPSK	25	0	16.87	0	0-1
	826.5	20425	5	16-QAM	1	0	17.23	0	0-1
	826.5	20425	5	16-QAM	1	12	17.20	0	0-1
	826.5	20425	5	16-QAM	1	24	17.11	0	0-1
	826.5	20425	5	16-QAM	12	0	17.30	0	0-2
	826.5	20425	5	16-QAM	12	6	17.29	0	0-2
Mid	826.5	20425	5	16-QAM	12	13	17.25	0	0-2
	826.5	20425	5	16-QAM	25	0	17.40	0	0-2
	836.5	20525	5	QPSK	1	0	16.98	0	0
	836.5	20525	5	QPSK	1	12	17.13	0	0
	836.5	20525	5	QPSK	1	24	17.25	0	0
	836.5	20525	5	QPSK	12	0	17.20	0	0-1
	836.5	20525	5	QPSK	12	6	17.26	0	0-1
	836.5	20525	5	QPSK	12	13	17.15	0	0-1
	836.5	20525	5	QPSK	25	0	17.20	0	0-1
	836.5	20525	5	16-QAM	1	0	17.17	0	0-1
	836.5	20525	5	16-QAM	1	12	17.06	0	0-1
	836.5	20525	5	16-QAM	1	24	17.09	0	0-1
	836.5	20525	5	16-QAM	12	0	16.87	0	0-2
	836.5	20525	5	16-QAM	12	6	17.30	0	0-2
	836.5	20525	5	16-QAM	12	13	17.24	0	0-2
	836.5	20525	5	16-QAM	25	0	16.99	0	0-2
High	846.5	20625	5	QPSK	1	0	16.90	0	0
	846.5	20625	5	QPSK	1	12	17.10	0	0
	846.5	20625	5	QPSK	1	24	17.31	0	0
	846.5	20625	5	QPSK	12	0	17.21	0	0-1
	846.5	20625	5	QPSK	12	6	17.22	0	0-1
	846.5	20625	5	QPSK	12	13	17.30	0	0-1
	846.5	20625	5	QPSK	25	0	17.06	0	0-1
	846.5	20625	5	16-QAM	1	0	17.16	0	0-1
	846.5	20625	5	16-QAM	1	12	17.09	0	0-1
	846.5	20625	5	16-QAM	1	24	16.78	0	0-1
	846.5	20625	5	16-QAM	12	0	16.82	0	0-2
	846.5	20625	5	16-QAM	12	6	17.03	0	0-2
	846.5	20625	5	16-QAM	12	13	17.00	0	0-2
	846.5	20625	5	16-QAM	25	0	16.50	0	0-2

8.3.3 LTE Band 4 (AWS)

Table 8-13
Maximum LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	1732.5	20175	20	QPSK	1	0	23.51	0	0
	1732.5	20175	20	QPSK	1	50	23.56	0	0
	1732.5	20175	20	QPSK	1	99	23.50	0	0
	1732.5	20175	20	QPSK	50	0	22.79	1	0-1
	1732.5	20175	20	QPSK	50	25	22.76	1	0-1
	1732.5	20175	20	QPSK	50	50	22.73	1	0-1
	1732.5	20175	20	QPSK	100	0	22.73	1	0-1
	1732.5	20175	20	16QAM	1	0	22.71	1	0-1
	1732.5	20175	20	16QAM	1	50	22.78	1	0-1
	1732.5	20175	20	16QAM	1	99	22.77	1	0-1
	1732.5	20175	20	16QAM	50	0	21.61	2	0-2
	1732.5	20175	20	16QAM	50	25	21.60	2	0-2
	1732.5	20175	20	16QAM	50	50	21.90	2	0-2
	1732.5	20175	20	16QAM	100	0	21.60	2	0-2

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

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Table 8-14
Reduced LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Mid	1732.5	20175	20	QPSK	1	0	15.50	0	0
	1732.5	20175	20	QPSK	1	50	15.42	0	0
	1732.5	20175	20	QPSK	1	99	15.43	0	0
	1732.5	20175	20	QPSK	50	0	15.50	0	0-1
	1732.5	20175	20	QPSK	50	25	15.36	0	0-1
	1732.5	20175	20	QPSK	50	50	15.40	0	0-1
	1732.5	20175	20	QPSK	100	0	15.32	0	0-1
	1732.5	20175	20	16QAM	1	0	15.33	0	0-1
	1732.5	20175	20	16QAM	1	50	15.26	0	0-1
	1732.5	20175	20	16QAM	1	99	15.40	0	0-1
	1732.5	20175	20	16QAM	50	0	15.23	0	0-2
	1732.5	20175	20	16QAM	50	25	15.22	0	0-2
	1732.5	20175	20	16QAM	50	50	15.37	0	0-2
	1732.5	20175	20	16QAM	100	0	15.40	0	0-2

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

Table 8-15
Maximum LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1717.5	20025	15	QPSK	1	0	23.19	0	0
	1717.5	20025	15	QPSK	1	36	23.21	0	0
	1717.5	20025	15	QPSK	1	74	23.35	0	0
	1717.5	20025	15	QPSK	36	0	22.60	1	0-1
	1717.5	20025	15	QPSK	36	18	22.58	1	0-1
	1717.5	20025	15	QPSK	36	37	22.59	1	0-1
	1717.5	20025	15	QPSK	75	0	22.62	1	0-1
	1717.5	20025	15	16QAM	1	0	22.82	1	0-1
	1717.5	20025	15	16QAM	1	36	22.67	1	0-1
	1717.5	20025	15	16QAM	1	74	22.68	1	0-1
	1717.5	20025	15	16QAM	36	0	21.54	2	0-2
	1717.5	20025	15	16QAM	36	18	21.61	2	0-2
	1717.5	20025	15	16QAM	36	37	21.50	2	0-2
	1717.5	20025	15	16QAM	75	0	21.74	2	0-2
Mid	1732.5	20175	15	QPSK	1	0	23.24	0	0
	1732.5	20175	15	QPSK	1	36	23.29	0	0
	1732.5	20175	15	QPSK	1	74	23.34	0	0
	1732.5	20175	15	QPSK	36	0	22.71	1	0-1
	1732.5	20175	15	QPSK	36	18	22.72	1	0-1
	1732.5	20175	15	QPSK	36	37	22.64	1	0-1
	1732.5	20175	15	QPSK	75	0	22.64	1	0-1
	1732.5	20175	15	16QAM	1	0	22.82	1	0-1
	1732.5	20175	15	16QAM	1	36	22.94	1	0-1
	1732.5	20175	15	16QAM	1	74	22.73	1	0-1
	1732.5	20175	15	16QAM	36	0	21.68	2	0-2
	1732.5	20175	15	16QAM	36	18	21.82	2	0-2
	1732.5	20175	15	16QAM	36	37	21.45	2	0-2
	1732.5	20175	15	16QAM	75	0	21.70	2	0-2
High	1747.5	20325	15	QPSK	1	0	23.23	0	0
	1747.5	20325	15	QPSK	1	36	23.23	0	0
	1747.5	20325	15	QPSK	1	74	23.06	0	0
	1747.5	20325	15	QPSK	36	0	22.55	1	0-1
	1747.5	20325	15	QPSK	36	18	22.44	1	0-1
	1747.5	20325	15	QPSK	36	37	22.50	1	0-1
	1747.5	20325	15	QPSK	75	0	22.46	1	0-1
	1747.5	20325	15	16QAM	1	0	22.92	1	0-1
	1747.5	20325	15	16QAM	1	36	22.72	1	0-1
	1747.5	20325	15	16QAM	1	74	22.81	1	0-1
	1747.5	20325	15	16QAM	36	0	21.56	2	0-2
	1747.5	20325	15	16QAM	36	18	21.38	2	0-2
	1747.5	20325	15	16QAM	36	37	21.44	2	0-2
	1747.5	20325	15	16QAM	75	0	21.35	2	0-2

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Table 8-16
Reduced LTE Band 4 (AWS) Conducted Powers- 15 MHz Bandwidth
Representing Capacitive Sensor active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1717.5	20025	15	QPSK	1	0	15.49	0	0
	1717.5	20025	15	QPSK	1	36	15.43	0	0
	1717.5	20025	15	QPSK	1	74	15.47	0	0
	1717.5	20025	15	QPSK	36	0	15.31	0	0-1
	1717.5	20025	15	QPSK	36	18	15.34	0	0-1
	1717.5	20025	15	QPSK	36	37	15.37	0	0-1
	1717.5	20025	15	QPSK	75	0	15.39	0	0-1
	1717.5	20025	15	16QAM	1	0	15.47	0	0-1
	1717.5	20025	15	16QAM	1	36	15.42	0	0-1
	1717.5	20025	15	16QAM	1	74	15.37	0	0-1
	1717.5	20025	15	16QAM	36	0	15.24	0	0-2
	1717.5	20025	15	16QAM	36	18	15.20	0	0-2
	1717.5	20025	15	16QAM	36	37	15.23	0	0-2
	1717.5	20025	15	16QAM	75	0	15.47	0	0-2
Mid	1732.5	20175	15	QPSK	1	0	15.44	0	0
	1732.5	20175	15	QPSK	1	36	15.43	0	0
	1732.5	20175	15	QPSK	1	74	15.27	0	0
	1732.5	20175	15	QPSK	36	0	15.30	0	0-1
	1732.5	20175	15	QPSK	36	18	15.42	0	0-1
	1732.5	20175	15	QPSK	36	37	15.21	0	0-1
	1732.5	20175	15	QPSK	75	0	15.26	0	0-1
	1732.5	20175	15	16QAM	1	0	15.41	0	0-1
	1732.5	20175	15	16QAM	1	36	15.22	0	0-1
	1732.5	20175	15	16QAM	1	74	15.23	0	0-1
	1732.5	20175	15	16QAM	36	0	15.42	0	0-2
	1732.5	20175	15	16QAM	36	18	15.23	0	0-2
	1732.5	20175	15	16QAM	36	37	15.36	0	0-2
	1732.5	20175	15	16QAM	75	0	15.20	0	0-2
High	1747.5	20325	15	QPSK	1	0	15.48	0	0
	1747.5	20325	15	QPSK	1	36	15.46	0	0
	1747.5	20325	15	QPSK	1	74	15.43	0	0
	1747.5	20325	15	QPSK	36	0	15.39	0	0-1
	1747.5	20325	15	QPSK	36	18	15.37	0	0-1
	1747.5	20325	15	QPSK	36	37	15.30	0	0-1
	1747.5	20325	15	QPSK	75	0	15.39	0	0-1
	1747.5	20325	15	16QAM	1	0	15.31	0	0-1
	1747.5	20325	15	16QAM	1	36	15.43	0	0-1
	1747.5	20325	15	16QAM	1	74	15.35	0	0-1
	1747.5	20325	15	16QAM	36	0	15.32	0	0-2
	1747.5	20325	15	16QAM	36	18	15.37	0	0-2
	1747.5	20325	15	16QAM	36	37	15.34	0	0-2
	1747.5	20325	15	16QAM	75	0	15.30	0	0-2

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Table 8-17
Maximum LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1715	20000	10	QPSK	1	0	23.29	0	0
	1715	20000	10	QPSK	1	25	23.34	0	0
	1715	20000	10	QPSK	1	49	23.28	0	0
	1715	20000	10	QPSK	25	0	22.66	1	0-1
	1715	20000	10	QPSK	25	12	22.82	1	0-1
	1715	20000	10	QPSK	25	25	22.79	1	0-1
	1715	20000	10	QPSK	50	0	22.62	1	0-1
	1715	20000	10	16QAM	1	0	22.77	1	0-1
	1715	20000	10	16QAM	1	25	22.86	1	0-1
	1715	20000	10	16QAM	1	49	22.86	1	0-1
	1715	20000	10	16QAM	25	0	21.77	2	0-2
	1715	20000	10	16QAM	25	12	21.85	2	0-2
	1715	20000	10	16QAM	25	25	21.87	2	0-2
	1715	20000	10	16QAM	50	0	21.54	2	0-2
	1732.5	20175	10	QPSK	1	0	23.24	0	0
	1732.5	20175	10	QPSK	1	25	23.55	0	0
Mid	1732.5	20175	10	QPSK	1	49	23.45	0	0
	1732.5	20175	10	QPSK	25	0	22.82	1	0-1
	1732.5	20175	10	QPSK	25	12	22.76	1	0-1
	1732.5	20175	10	QPSK	25	25	22.90	1	0-1
	1732.5	20175	10	QPSK	50	0	22.81	1	0-1
	1732.5	20175	10	16QAM	1	0	22.90	1	0-1
	1732.5	20175	10	16QAM	1	25	22.94	1	0-1
	1732.5	20175	10	16QAM	1	49	22.79	1	0-1
	1732.5	20175	10	16QAM	25	0	21.65	2	0-2
	1732.5	20175	10	16QAM	25	12	21.97	2	0-2
	1732.5	20175	10	16QAM	25	25	21.58	2	0-2
	1732.5	20175	10	16QAM	50	0	21.84	2	0-2
High	1750	20350	10	QPSK	1	0	23.14	0	0
	1750	20350	10	QPSK	1	25	23.05	0	0
	1750	20350	10	QPSK	1	49	23.14	0	0
	1750	20350	10	QPSK	25	0	22.50	1	0-1
	1750	20350	10	QPSK	25	12	22.49	1	0-1
	1750	20350	10	QPSK	25	25	22.62	1	0-1
	1750	20350	10	QPSK	50	0	22.43	1	0-1
	1750	20350	10	16QAM	1	0	22.37	1	0-1
	1750	20350	10	16QAM	1	25	22.42	1	0-1
	1750	20350	10	16QAM	1	49	22.30	1	0-1
	1750	20350	10	16QAM	25	0	21.47	2	0-2
	1750	20350	10	16QAM	25	12	21.60	2	0-2
	1750	20350	10	16QAM	25	25	21.64	2	0-2
	1750	20350	10	16QAM	50	0	21.53	2	0-2

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Table 8-18
Reduced LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1715	20000	10	QPSK	1	0	15.50	0	0
	1715	20000	10	QPSK	1	25	15.13	0	0
	1715	20000	10	QPSK	1	49	14.73	0	0
	1715	20000	10	QPSK	25	0	15.50	0	0-1
	1715	20000	10	QPSK	25	12	15.22	0	0-1
	1715	20000	10	QPSK	25	25	15.11	0	0-1
	1715	20000	10	QPSK	50	0	15.02	0	0-1
	1715	20000	10	16QAM	1	0	14.94	0	0-1
	1715	20000	10	16QAM	1	25	15.50	0	0-1
	1715	20000	10	16QAM	1	49	15.06	0	0-1
	1715	20000	10	16QAM	25	0	15.00	0	0-2
	1715	20000	10	16QAM	25	12	15.24	0	0-2
	1715	20000	10	16QAM	25	25	15.21	0	0-2
	1715	20000	10	16QAM	50	0	15.10	0	0-2
Mid	1732.5	20175	10	QPSK	1	0	14.85	0	0
	1732.5	20175	10	QPSK	1	25	15.48	0	0
	1732.5	20175	10	QPSK	1	49	15.14	0	0
	1732.5	20175	10	QPSK	25	0	15.41	0	0-1
	1732.5	20175	10	QPSK	25	12	15.47	0	0-1
	1732.5	20175	10	QPSK	25	25	15.45	0	0-1
	1732.5	20175	10	QPSK	50	0	15.49	0	0-1
	1732.5	20175	10	16QAM	1	0	14.70	0	0-1
	1732.5	20175	10	16QAM	1	25	15.38	0	0-1
	1732.5	20175	10	16QAM	1	49	15.00	0	0-1
	1732.5	20175	10	16QAM	25	0	15.22	0	0-2
	1732.5	20175	10	16QAM	25	12	15.41	0	0-2
	1732.5	20175	10	16QAM	25	25	15.26	0	0-2
	1732.5	20175	10	16QAM	50	0	15.31	0	0-2
High	1750	20350	10	QPSK	1	0	14.86	0	0
	1750	20350	10	QPSK	1	25	15.22	0	0
	1750	20350	10	QPSK	1	49	14.50	0	0
	1750	20350	10	QPSK	25	0	15.26	0	0-1
	1750	20350	10	QPSK	25	12	15.34	0	0-1
	1750	20350	10	QPSK	25	25	15.05	0	0-1
	1750	20350	10	QPSK	50	0	15.08	0	0-1
	1750	20350	10	16QAM	1	0	14.83	0	0-1
	1750	20350	10	16QAM	1	25	15.17	0	0-1
	1750	20350	10	16QAM	1	49	14.50	0	0-1
	1750	20350	10	16QAM	25	0	15.06	0	0-2
	1750	20350	10	16QAM	25	12	15.10	0	0-2
	1750	20350	10	16QAM	25	25	14.84	0	0-2
	1750	20350	10	16QAM	50	0	14.86	0	0-2

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Table 8-19
Maximum LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1712.5	19975	5	QPSK	1	0	23.15	0	0
	1712.5	19975	5	QPSK	1	12	23.36	0	0
	1712.5	19975	5	QPSK	1	24	23.28	0	0
	1712.5	19975	5	QPSK	12	0	22.66	1	0-1
	1712.5	19975	5	QPSK	12	6	22.71	1	0-1
	1712.5	19975	5	QPSK	12	13	22.83	1	0-1
	1712.5	19975	5	QPSK	25	0	22.61	1	0-1
	1712.5	19975	5	16-QAM	1	0	22.96	1	0-1
	1712.5	19975	5	16-QAM	1	12	22.99	1	0-1
	1712.5	19975	5	16-QAM	1	24	22.96	1	0-1
	1712.5	19975	5	16-QAM	12	0	21.51	2	0-2
	1712.5	19975	5	16-QAM	12	6	21.71	2	0-2
	1712.5	19975	5	16-QAM	12	13	21.89	2	0-2
	1712.5	19975	5	16-QAM	25	0	21.71	2	0-2
Mid	1732.5	20175	5	QPSK	1	0	23.52	0	0
	1732.5	20175	5	QPSK	1	12	23.40	0	0
	1732.5	20175	5	QPSK	1	24	23.46	0	0
	1732.5	20175	5	QPSK	12	0	22.80	1	0-1
	1732.5	20175	5	QPSK	12	6	22.95	1	0-1
	1732.5	20175	5	QPSK	12	13	22.76	1	0-1
	1732.5	20175	5	QPSK	25	0	22.90	1	0-1
	1732.5	20175	5	16-QAM	1	0	22.64	1	0-1
	1732.5	20175	5	16-QAM	1	12	22.71	1	0-1
	1732.5	20175	5	16-QAM	1	24	22.65	1	0-1
	1732.5	20175	5	16-QAM	12	0	21.77	2	0-2
	1732.5	20175	5	16-QAM	12	6	21.86	2	0-2
	1732.5	20175	5	16-QAM	12	13	21.81	2	0-2
	1732.5	20175	5	16-QAM	25	0	21.80	2	0-2
High	1752.5	20375	5	QPSK	1	0	23.30	0	0
	1752.5	20375	5	QPSK	1	12	23.20	0	0
	1752.5	20375	5	QPSK	1	24	23.13	0	0
	1752.5	20375	5	QPSK	12	0	22.66	1	0-1
	1752.5	20375	5	QPSK	12	6	22.64	1	0-1
	1752.5	20375	5	QPSK	12	13	22.63	1	0-1
	1752.5	20375	5	QPSK	25	0	22.54	1	0-1
	1752.5	20375	5	16-QAM	1	0	22.87	1	0-1
	1752.5	20375	5	16-QAM	1	12	22.82	1	0-1
	1752.5	20375	5	16-QAM	1	24	22.77	1	0-1
	1752.5	20375	5	16-QAM	12	0	21.64	2	0-2
	1752.5	20375	5	16-QAM	12	6	21.62	2	0-2
	1752.5	20375	5	16-QAM	12	13	21.63	2	0-2
	1752.5	20375	5	16-QAM	25	0	21.66	2	0-2

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Table 8-20
Reduced LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1712.5	19975	5	QPSK	1	0	15.21	0	0
	1712.5	19975	5	QPSK	1	12	15.27	0	0
	1712.5	19975	5	QPSK	1	24	15.06	0	0
	1712.5	19975	5	QPSK	12	0	15.10	0	0-1
	1712.5	19975	5	QPSK	12	6	15.22	0	0-1
	1712.5	19975	5	QPSK	12	13	15.24	0	0-1
	1712.5	19975	5	QPSK	25	0	15.36	0	0-1
	1712.5	19975	5	16-QAM	1	0	15.34	0	0-1
	1712.5	19975	5	16-QAM	1	12	15.21	0	0-1
	1712.5	19975	5	16-QAM	1	24	15.30	0	0-1
	1712.5	19975	5	16-QAM	12	0	15.07	0	0-2
	1712.5	19975	5	16-QAM	12	6	15.10	0	0-2
	1712.5	19975	5	16-QAM	12	13	15.11	0	0-2
	1712.5	19975	5	16-QAM	25	0	15.22	0	0-2
Mid	1732.5	20175	5	QPSK	1	0	15.34	0	0
	1732.5	20175	5	QPSK	1	12	15.50	0	0
	1732.5	20175	5	QPSK	1	24	15.30	0	0
	1732.5	20175	5	QPSK	12	0	15.47	0	0-1
	1732.5	20175	5	QPSK	12	6	15.50	0	0-1
	1732.5	20175	5	QPSK	12	13	15.49	0	0-1
	1732.5	20175	5	QPSK	25	0	15.48	0	0-1
	1732.5	20175	5	16-QAM	1	0	15.10	0	0-1
	1732.5	20175	5	16-QAM	1	12	15.34	0	0-1
	1732.5	20175	5	16-QAM	1	24	15.11	0	0-1
	1732.5	20175	5	16-QAM	12	0	15.28	0	0-2
	1732.5	20175	5	16-QAM	12	6	15.44	0	0-2
	1732.5	20175	5	16-QAM	12	13	15.26	0	0-2
	1732.5	20175	5	16-QAM	25	0	15.23	0	0-2
High	1752.5	20375	5	QPSK	1	0	15.45	0	0
	1752.5	20375	5	QPSK	1	12	15.25	0	0
	1752.5	20375	5	QPSK	1	24	15.31	0	0
	1752.5	20375	5	QPSK	12	0	15.39	0	0-1
	1752.5	20375	5	QPSK	12	6	15.20	0	0-1
	1752.5	20375	5	QPSK	12	13	15.36	0	0-1
	1752.5	20375	5	QPSK	25	0	15.41	0	0-1
	1752.5	20375	5	16-QAM	1	0	15.08	0	0-1
	1752.5	20375	5	16-QAM	1	12	15.09	0	0-1
	1752.5	20375	5	16-QAM	1	24	15.20	0	0-1
	1752.5	20375	5	16-QAM	12	0	15.09	0	0-2
	1752.5	20375	5	16-QAM	12	6	15.10	0	0-2
	1752.5	20375	5	16-QAM	12	13	15.20	0	0-2
	1752.5	20375	5	16-QAM	25	0	15.21	0	0-2

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LTE Band 2 (PCS)

Table 8-21
Maximum LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1860	18700	20	QPSK	1	0	22.50	0	0
	1860	18700	20	QPSK	1	49	22.61	0	0
	1860	18700	20	QPSK	1	99	22.69	0	0
	1860	18700	20	QPSK	50	0	21.62	1	0-1
	1860	18700	20	QPSK	50	25	21.64	1	0-1
	1860	18700	20	QPSK	50	50	21.61	1	0-1
	1860	18700	20	QPSK	100	0	21.57	1	0-1
	1860	18700	20	16QAM	1	0	21.30	1	0-1
	1860	18700	20	16QAM	1	49	21.35	1	0-1
	1860	18700	20	16QAM	1	99	21.40	1	0-1
	1860	18700	20	16QAM	50	0	20.50	2	0-2
	1860	18700	20	16QAM	50	25	20.78	2	0-2
	1860	18700	20	16QAM	50	50	20.54	2	0-2
	1860	18700	20	16QAM	100	0	20.79	2	0-2
	1880.0	18900	20	QPSK	1	0	22.97	0	0
	1880.0	18900	20	QPSK	1	49	22.65	0	0
	1880.0	18900	20	QPSK	1	99	22.69	0	0
Mid	1880.0	18900	20	QPSK	50	0	21.74	1	0-1
	1880.0	18900	20	QPSK	50	25	21.91	1	0-1
	1880.0	18900	20	QPSK	50	50	21.67	1	0-1
	1880.0	18900	20	QPSK	100	0	21.68	1	0-1
	1880.0	18900	20	16QAM	1	0	21.95	1	0-1
	1880.0	18900	20	16QAM	1	49	21.71	1	0-1
	1880.0	18900	20	16QAM	1	99	21.72	1	0-1
	1880.0	18900	20	16QAM	50	0	20.72	2	0-2
	1880.0	18900	20	16QAM	50	25	20.66	2	0-2
	1880.0	18900	20	16QAM	50	50	20.57	2	0-2
	1880.0	18900	20	16QAM	100	0	20.67	2	0-2
	1900	19100	20	QPSK	1	0	23.00	0	0
	1900	19100	20	QPSK	1	49	22.76	0	0
	1900	19100	20	QPSK	1	99	22.59	0	0
	1900	19100	20	QPSK	50	0	21.90	1	0-1
	1900	19100	20	QPSK	50	25	21.58	1	0-1
	1900	19100	20	QPSK	50	50	21.53	1	0-1
	1900	19100	20	QPSK	100	0	21.64	1	0-1
High	1900	19100	20	16QAM	1	0	21.61	1	0-1
	1900	19100	20	16QAM	1	49	21.43	1	0-1
	1900	19100	20	16QAM	1	99	21.08	1	0-1
	1900	19100	20	16QAM	50	0	20.80	2	0-2
	1900	19100	20	16QAM	50	25	20.64	2	0-2
	1900	19100	20	16QAM	50	50	20.58	2	0-2
	1900	19100	20	16QAM	100	0	20.73	2	0-2

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Table 8-22
Reduced LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1860	18700	20	QPSK	1	0	12.00	0	0
	1860	18700	20	QPSK	1	59	12.29	0	0
	1860	18700	20	QPSK	1	99	12.03	0	0
	1860	18700	20	QPSK	50	0	12.30	0	0-1
	1860	18700	20	QPSK	50	25	12.50	0	0-1
	1860	18700	20	QPSK	50	50	12.33	0	0-1
	1860	18700	20	QPSK	100	0	12.29	0	0-1
	1860	18700	20	16QAM	1	0	11.90	0	0-1
	1860	18700	20	16QAM	1	59	12.28	0	0-1
	1860	18700	20	16QAM	1	99	12.40	0	0-1
	1860	18700	20	16QAM	50	0	12.13	0	0-2
	1860	18700	20	16QAM	50	25	12.15	0	0-2
	1860	18700	20	16QAM	50	50	12.13	0	0-2
	1860	18700	20	16QAM	100	0	12.11	0	0-2
Mid	1880.0	18900	20	QPSK	1	0	11.75	0	0
	1880.0	18900	20	QPSK	1	59	12.15	0	0
	1880.0	18900	20	QPSK	1	99	11.84	0	0
	1880.0	18900	20	QPSK	50	0	12.23	0	0-1
	1880.0	18900	20	QPSK	50	25	12.21	0	0-1
	1880.0	18900	20	QPSK	50	50	12.20	0	0-1
	1880.0	18900	20	QPSK	100	0	12.14	0	0-1
	1880.0	18900	20	16QAM	1	0	11.54	0	0-1
	1880.0	18900	20	16QAM	1	59	12.09	0	0-1
	1880.0	18900	20	16QAM	1	99	11.98	0	0-1
	1880.0	18900	20	16QAM	50	0	11.84	0	0-2
	1880.0	18900	20	16QAM	50	25	12.03	0	0-2
	1880.0	18900	20	16QAM	50	50	12.05	0	0-2
	1880.0	18900	20	16QAM	100	0	11.96	0	0-2
High	1900	19100	20	QPSK	1	0	12.00	0	0
	1900	19100	20	QPSK	1	59	12.30	0	0
	1900	19100	20	QPSK	1	99	11.77	0	0
	1900	19100	20	QPSK	50	0	12.47	0	0-1
	1900	19100	20	QPSK	50	25	12.43	0	0-1
	1900	19100	20	QPSK	50	50	12.32	0	0-1
	1900	19100	20	QPSK	100	0	12.29	0	0-1
	1900	19100	20	16QAM	1	0	11.97	0	0-1
	1900	19100	20	16QAM	1	59	12.27	0	0-1
	1900	19100	20	16QAM	1	99	11.89	0	0-1
	1900	19100	20	16QAM	50	0	12.27	0	0-2
	1900	19100	20	16QAM	50	25	12.38	0	0-2
	1900	19100	20	16QAM	50	50	12.25	0	0-2
	1900	19100	20	16QAM	100	0	12.23	0	0-2

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Table 8-23
Maximum LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1857.5	18675	15	QPSK	1	0	22.71	0	0
	1857.5	18675	15	QPSK	1	36	22.63	0	0
	1857.5	18675	15	QPSK	1	74	22.51	0	0
	1857.5	18675	15	QPSK	36	0	21.87	1	0-1
	1857.5	18675	15	QPSK	36	18	21.74	1	0-1
	1857.5	18675	15	QPSK	36	37	21.87	1	0-1
	1857.5	18675	15	QPSK	75	0	21.64	1	0-1
	1857.5	18675	15	16QAM	1	0	21.63	1	0-1
	1857.5	18675	15	16QAM	1	36	21.99	1	0-1
	1857.5	18675	15	16QAM	1	74	21.75	1	0-1
	1857.5	18675	15	16QAM	36	0	20.73	2	0-2
	1857.5	18675	15	16QAM	36	18	20.87	2	0-2
	1857.5	18675	15	16QAM	36	37	20.91	2	0-2
	1857.5	18675	15	16QAM	75	0	20.87	2	0-2
	1880.0	18900	15	QPSK	1	0	22.53	0	0
	1880.0	18900	15	QPSK	1	36	22.52	0	0
	1880.0	18900	15	QPSK	1	74	22.62	0	0
Mid	1880.0	18900	15	QPSK	36	0	21.79	1	0-1
	1880.0	18900	15	QPSK	36	18	21.97	1	0-1
	1880.0	18900	15	QPSK	36	37	21.94	1	0-1
	1880.0	18900	15	QPSK	75	0	21.80	1	0-1
	1880.0	18900	15	16QAM	1	0	21.19	1	0-1
	1880.0	18900	15	16QAM	1	36	21.97	1	0-1
	1880.0	18900	15	16QAM	1	74	21.50	1	0-1
	1880.0	18900	15	16QAM	36	0	20.67	2	0-2
	1880.0	18900	15	16QAM	36	18	20.18	2	0-2
	1880.0	18900	15	16QAM	36	37	20.69	2	0-2
	1880.0	18900	15	16QAM	75	0	20.75	2	0-2
High	1902.5	19125	15	QPSK	1	0	22.55	0	0
	1902.5	19125	15	QPSK	1	36	22.61	0	0
	1902.5	19125	15	QPSK	1	74	22.51	0	0
	1902.5	19125	15	QPSK	36	0	21.87	1	0-1
	1902.5	19125	15	QPSK	36	18	21.69	1	0-1
	1902.5	19125	15	QPSK	36	37	21.87	1	0-1
	1902.5	19125	15	QPSK	75	0	21.75	1	0-1
	1902.5	19125	15	16QAM	1	0	21.67	1	0-1
	1902.5	19125	15	16QAM	1	36	21.39	1	0-1
	1902.5	19125	15	16QAM	1	74	21.74	1	0-1
	1902.5	19125	15	16QAM	36	0	20.98	2	0-2
	1902.5	19125	15	16QAM	36	18	20.90	2	0-2
	1902.5	19125	15	16QAM	36	37	20.90	2	0-2
	1902.5	19125	15	16QAM	75	0	20.72	2	0-2

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Table 8-24
Reduced LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1857.5	18675	15	QPSK	1	0	11.78	0	0
	1857.5	18675	15	QPSK	1	36	12.03	0	0
	1857.5	18675	15	QPSK	1	74	12.23	0	0
	1857.5	18675	15	QPSK	36	0	12.11	0	0-1
	1857.5	18675	15	QPSK	36	18	12.23	0	0-1
	1857.5	18675	15	QPSK	36	37	12.17	0	0-1
	1857.5	18675	15	QPSK	75	0	12.26	0	0-1
	1857.5	18675	15	16QAM	1	0	12.09	0	0-1
	1857.5	18675	15	16QAM	1	36	12.07	0	0-1
	1857.5	18675	15	16QAM	1	74	12.20	0	0-1
	1857.5	18675	15	16QAM	36	0	12.15	0	0-2
	1857.5	18675	15	16QAM	36	18	12.17	0	0-2
	1857.5	18675	15	16QAM	36	37	12.26	0	0-2
	1857.5	18675	15	16QAM	75	0	12.20	0	0-2
	1880.0	18900	15	QPSK	1	0	11.51	0	0
	1880.0	18900	15	QPSK	1	36	12.22	0	0
	1880.0	18900	15	QPSK	1	74	11.63	0	0
Mid	1880.0	18900	15	QPSK	36	0	12.03	0	0-1
	1880.0	18900	15	QPSK	36	18	12.29	0	0-1
	1880.0	18900	15	QPSK	36	37	12.10	0	0-1
	1880.0	18900	15	QPSK	75	0	12.07	0	0-1
	1880.0	18900	15	16QAM	1	0	11.50	0	0-1
	1880.0	18900	15	16QAM	1	36	12.09	0	0-1
	1880.0	18900	15	16QAM	1	74	11.58	0	0-1
	1880.0	18900	15	16QAM	36	0	11.86	0	0-2
	1880.0	18900	15	16QAM	36	18	11.95	0	0-2
	1880.0	18900	15	16QAM	36	37	11.87	0	0-2
	1880.0	18900	15	16QAM	75	0	12.37	0	0-2
	1902.5	19125	15	QPSK	1	0	11.87	0	0
	1902.5	19125	15	QPSK	1	36	11.55	0	0
	1902.5	19125	15	QPSK	1	74	12.26	0	0
	1902.5	19125	15	QPSK	36	0	12.11	0	0-1
	1902.5	19125	15	QPSK	36	18	12.21	0	0-1
	1902.5	19125	15	QPSK	36	37	12.20	0	0-1
	1902.5	19125	15	QPSK	75	0	12.27	0	0-1
High	1902.5	19125	15	16QAM	1	0	12.12	0	0-1
	1902.5	19125	15	16QAM	1	36	12.10	0	0-1
	1902.5	19125	15	16QAM	1	74	12.23	0	0-1
	1902.5	19125	15	16QAM	36	0	12.33	0	0-2
	1902.5	19125	15	16QAM	36	18	12.31	0	0-2
	1902.5	19125	15	16QAM	36	37	12.25	0	0-2
	1902.5	19125	15	16QAM	75	0	12.45	0	0-2

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Table 8-25
Maximum LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1855	18650	10	QPSK	1	0	22.83	0	0
	1855	18650	10	QPSK	1	25	22.67	0	0
	1855	18650	10	QPSK	1	49	22.65	0	0
	1855	18650	10	QPSK	25	0	21.90	1	0-1
	1855	18650	10	QPSK	25	12	21.54	1	0-1
	1855	18650	10	QPSK	25	25	21.61	1	0-1
	1855	18650	10	QPSK	50	0	21.79	1	0-1
	1855	18650	10	16QAM	1	0	21.89	1	0-1
	1855	18650	10	16QAM	1	25	21.42	1	0-1
	1855	18650	10	16QAM	1	49	22.00	1	0-1
	1855	18650	10	16QAM	25	0	20.96	2	0-2
	1855	18650	10	16QAM	25	12	20.84	2	0-2
	1855	18650	10	16QAM	25	25	20.65	2	0-2
	1855	18650	10	16QAM	50	0	20.18	2	0-2
	1880.0	18900	10	QPSK	1	0	22.51	0	0
	1880.0	18900	10	QPSK	1	25	22.54	0	0
Mid	1880.0	18900	10	QPSK	1	49	22.57	0	0
	1880.0	18900	10	QPSK	25	0	21.94	1	0-1
	1880.0	18900	10	QPSK	25	12	21.84	1	0-1
	1880.0	18900	10	QPSK	25	25	21.93	1	0-1
	1880.0	18900	10	QPSK	50	0	21.88	1	0-1
	1880.0	18900	10	16QAM	1	0	21.97	1	0-1
	1880.0	18900	10	16QAM	1	25	21.32	1	0-1
	1880.0	18900	10	16QAM	1	49	21.87	1	0-1
	1880.0	18900	10	16QAM	25	0	20.37	2	0-2
	1880.0	18900	10	16QAM	25	12	20.88	2	0-2
	1880.0	18900	10	16QAM	25	25	20.80	2	0-2
	1880.0	18900	10	16QAM	50	0	20.97	2	0-2
High	1905	19150	10	QPSK	1	0	22.52	0	0
	1905	19150	10	QPSK	1	25	22.62	0	0
	1905	19150	10	QPSK	1	49	22.50	0	0
	1905	19150	10	QPSK	25	0	21.87	1	0-1
	1905	19150	10	QPSK	25	12	21.76	1	0-1
	1905	19150	10	QPSK	25	25	21.76	1	0-1
	1905	19150	10	QPSK	50	0	21.99	1	0-1
	1905	19150	10	16QAM	1	0	21.84	1	0-1
	1905	19150	10	16QAM	1	25	21.84	1	0-1
	1905	19150	10	16QAM	1	49	21.58	1	0-1
	1905	19150	10	16QAM	25	0	20.87	2	0-2
	1905	19150	10	16QAM	25	12	20.36	2	0-2
	1905	19150	10	16QAM	25	25	20.62	2	0-2
	1905	19150	10	16QAM	50	0	20.97	2	0-2

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Table 8-26
Reduced LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1855	18650	10	QPSK	1	0	12.03	0	0
	1855	18650	10	QPSK	1	25	12.12	0	0
	1855	18650	10	QPSK	1	49	12.03	0	0
	1855	18650	10	QPSK	25	0	12.12	0	0-1
	1855	18650	10	QPSK	25	12	12.31	0	0-1
	1855	18650	10	QPSK	25	25	12.45	0	0-1
	1855	18650	10	QPSK	50	0	12.16	0	0-1
	1855	18650	10	16QAM	1	0	12.10	0	0-1
	1855	18650	10	16QAM	1	25	12.25	0	0-1
	1855	18650	10	16QAM	1	49	12.30	0	0-1
	1855	18650	10	16QAM	25	0	12.45	0	0-2
	1855	18650	10	16QAM	25	12	12.36	0	0-2
	1855	18650	10	16QAM	25	25	12.16	0	0-2
	1855	18650	10	16QAM	50	0	12.50	0	0-2
	1880.0	18900	10	QPSK	1	0	11.77	0	0
	1880.0	18900	10	QPSK	1	25	11.77	0	0
	1880.0	18900	10	QPSK	1	49	12.02	0	0
Mid	1880.0	18900	10	QPSK	25	0	12.11	0	0-1
	1880.0	18900	10	QPSK	25	12	12.00	0	0-1
	1880.0	18900	10	QPSK	25	25	12.14	0	0-1
	1880.0	18900	10	QPSK	50	0	12.13	0	0-1
	1880.0	18900	10	16QAM	1	0	12.20	0	0-1
	1880.0	18900	10	16QAM	1	25	12.06	0	0-1
	1880.0	18900	10	16QAM	1	49	12.02	0	0-1
	1880.0	18900	10	16QAM	25	0	12.22	0	0-2
	1880.0	18900	10	16QAM	25	12	12.03	0	0-2
	1880.0	18900	10	16QAM	25	25	12.21	0	0-2
	1880.0	18900	10	16QAM	50	0	12.02	0	0-2
High	1905	19150	10	QPSK	1	0	12.06	0	0
	1905	19150	10	QPSK	1	25	12.10	0	0
	1905	19150	10	QPSK	1	49	12.23	0	0
	1905	19150	10	QPSK	25	0	12.21	0	0-1
	1905	19150	10	QPSK	25	12	12.25	0	0-1
	1905	19150	10	QPSK	25	25	12.23	0	0-1
	1905	19150	10	QPSK	50	0	12.09	0	0-1
	1905	19150	10	16QAM	1	0	12.33	0	0-1
	1905	19150	10	16QAM	1	25	12.45	0	0-1
	1905	19150	10	16QAM	1	49	12.09	0	0-1
	1905	19150	10	16QAM	25	0	12.25	0	0-2
	1905	19150	10	16QAM	25	12	12.20	0	0-2
	1905	19150	10	16QAM	25	25	12.13	0	0-2
	1905	19150	10	16QAM	50	0	12.33	0	0-2

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Table 8-27
Maximum LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth
Representing Capacitive Sensor Inactive

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1852.5	18625	5	QPSK	1	0	22.19	0	0
	1852.5	18625	5	QPSK	1	12	22.60	0	0
	1852.5	18625	5	QPSK	1	24	22.58	0	0
	1852.5	18625	5	QPSK	12	0	21.79	1	0-1
	1852.5	18625	5	QPSK	12	6	21.35	1	0-1
	1852.5	18625	5	QPSK	12	13	21.50	1	0-1
	1852.5	18625	5	QPSK	25	0	21.60	1	0-1
	1852.5	18625	5	16-QAM	1	0	21.78	1	0-1
	1852.5	18625	5	16-QAM	1	12	21.60	1	0-1
	1852.5	18625	5	16-QAM	1	24	21.64	1	0-1
	1852.5	18625	5	16-QAM	12	0	20.89	2	0-2
	1852.5	18625	5	16-QAM	12	6	20.78	2	0-2
	1852.5	18625	5	16-QAM	12	13	20.61	2	0-2
	1852.5	18625	5	16-QAM	25	0	20.65	2	0-2
	1880.0	18900	5	QPSK	1	0	22.53	0	0
Mid	1880.0	18900	5	QPSK	1	12	22.57	0	0
	1880.0	18900	5	QPSK	1	24	22.55	0	0
	1880.0	18900	5	QPSK	12	0	21.90	1	0-1
	1880.0	18900	5	QPSK	12	6	21.87	1	0-1
	1880.0	18900	5	QPSK	12	13	21.91	1	0-1
	1880.0	18900	5	QPSK	25	0	21.65	1	0-1
	1880.0	18900	5	16-QAM	1	0	22.00	1	0-1
	1880.0	18900	5	16-QAM	1	12	21.93	1	0-1
	1880.0	18900	5	16-QAM	1	24	21.96	1	0-1
	1880.0	18900	5	16-QAM	12	0	20.53	2	0-2
	1880.0	18900	5	16-QAM	12	6	20.80	2	0-2
	1880.0	18900	5	16-QAM	12	13	20.55	2	0-2
	1880.0	18900	5	16-QAM	25	0	20.88	2	0-2
	1907.5	19175	5	QPSK	1	0	22.74	0	0
	1907.5	19175	5	QPSK	1	12	22.51	0	0
	1907.5	19175	5	QPSK	1	24	22.53	0	0
High	1907.5	19175	5	QPSK	12	0	22.00	1	0-1
	1907.5	19175	5	QPSK	12	6	21.88	1	0-1
	1907.5	19175	5	QPSK	12	13	21.84	1	0-1
	1907.5	19175	5	QPSK	25	0	21.77	1	0-1
	1907.5	19175	5	16-QAM	1	0	21.74	1	0-1
	1907.5	19175	5	16-QAM	1	12	21.85	1	0-1
	1907.5	19175	5	16-QAM	1	24	21.93	1	0-1
	1907.5	19175	5	16-QAM	12	0	20.97	2	0-2
	1907.5	19175	5	16-QAM	12	6	20.90	2	0-2
	1907.5	19175	5	16-QAM	12	13	20.78	2	0-2
	1907.5	19175	5	16-QAM	25	0	20.83	2	0-2

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Table 8-28
Reduced LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth
Representing Capacitive Sensor Active

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1852.5	18625	5	QPSK	1	0	11.97	0	0
	1852.5	18625	5	QPSK	1	12	12.06	0	0
	1852.5	18625	5	QPSK	1	24	12.14	0	0
	1852.5	18625	5	QPSK	12	0	12.30	0	0-1
	1852.5	18625	5	QPSK	12	6	12.11	0	0-1
	1852.5	18625	5	QPSK	12	13	12.12	0	0-1
	1852.5	18625	5	QPSK	25	0	12.34	0	0-1
	1852.5	18625	5	16-QAM	1	0	12.21	0	0-1
	1852.5	18625	5	16-QAM	1	12	12.10	0	0-1
	1852.5	18625	5	16-QAM	1	24	12.05	0	0-1
	1852.5	18625	5	16-QAM	12	0	11.97	0	0-2
	1852.5	18625	5	16-QAM	12	6	11.99	0	0-2
	1852.5	18625	5	16-QAM	12	13	12.41	0	0-2
	1852.5	18625	5	16-QAM	25	0	12.33	0	0-2
	1880.0	18900	5	QPSK	1	0	11.97	0	0
	1880.0	18900	5	QPSK	1	12	12.29	0	0
Mid	1880.0	18900	5	QPSK	1	24	12.03	0	0
	1880.0	18900	5	QPSK	12	0	12.22	0	0-1
	1880.0	18900	5	QPSK	12	6	12.35	0	0-1
	1880.0	18900	5	QPSK	12	13	12.34	0	0-1
	1880.0	18900	5	QPSK	25	0	12.23	0	0-1
	1880.0	18900	5	16-QAM	1	0	11.76	0	0-1
	1880.0	18900	5	16-QAM	1	12	12.15	0	0-1
	1880.0	18900	5	16-QAM	1	24	11.85	0	0-1
	1880.0	18900	5	16-QAM	12	0	12.01	0	0-2
	1880.0	18900	5	16-QAM	12	6	12.14	0	0-2
	1880.0	18900	5	16-QAM	12	13	12.03	0	0-2
	1880.0	18900	5	16-QAM	25	0	11.95	0	0-2
High	1907.5	19175	5	QPSK	1	0	11.93	0	0
	1907.5	19175	5	QPSK	1	12	12.03	0	0
	1907.5	19175	5	QPSK	1	24	12.01	0	0
	1907.5	19175	5	QPSK	12	0	12.15	0	0-1
	1907.5	19175	5	QPSK	12	6	12.16	0	0-1
	1907.5	19175	5	QPSK	12	13	12.31	0	0-1
	1907.5	19175	5	QPSK	25	0	12.25	0	0-1
	1907.5	19175	5	16-QAM	1	0	12.10	0	0-1
	1907.5	19175	5	16-QAM	1	12	12.16	0	0-1
	1907.5	19175	5	16-QAM	1	24	12.13	0	0-1
	1907.5	19175	5	16-QAM	12	0	12.25	0	0-2
	1907.5	19175	5	16-QAM	12	6	12.06	0	0-2
	1907.5	19175	5	16-QAM	12	13	12.20	0	0-2
	1907.5	19175	5	16-QAM	25	0	12.21	0	0-2

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8.4 Bluetooth/WLAN Conducted Powers

Table 8-29
IEEE 802.11b Average RF Power

Mode	Freq	Channel	802.11b (2.4 GHz) Conducted Power [dBm]			
			Data Rate [Mbps]			
	[MHz]		1	2	5.5	11
802.11b	2412	1*	14.02	13.94	14.13	14.00
802.11b	2437	6*	13.43	13.42	13.53	13.61
802.11b	2462	11*	13.40	13.51	13.53	13.51

Table 8-30
IEEE 802.11g Average RF Power

Mode	Freq	Channel	802.11g (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6	9	12	18	24	36	48	54
802.11g	2412	1	10.71	10.69	10.66	10.60	10.60	10.65	10.61	10.72
802.11g	2437	6	10.23	10.13	10.26	10.14	10.23	10.17	10.17	10.19
802.11g	2462	11	10.10	10.08	10.11	10.06	10.09	10.01	10.00	10.04

Table 8-31
IEEE 802.11n Average RF Power

Mode	Freq	Channel	802.11n (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6.5	13	20	26	39	52	58	65
802.11n	2412	1	9.54	9.49	9.46	9.47	9.44	9.41	9.42	9.45
802.11n	2437	6	8.95	9.05	9.05	9.01	8.95	8.96	8.93	8.96
802.11n	2462	11	8.97	8.83	8.81	8.76	8.85	8.84	8.88	8.84

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Table 8-32
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	802.11a (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	7.62	7.61	7.63	7.56	7.62	7.50	7.61	7.51
802.11a	5200	40	7.61	7.62	7.64	7.63	7.65	7.54	7.68	7.58
802.11a	5220	44	7.73	7.87	7.81	7.78	7.79	7.63	7.67	7.54
802.11a	5240	48*	7.67	7.75	7.68	7.70	7.65	7.63	7.73	7.62
802.11a	5260	52*	7.71	7.78	7.72	7.74	7.70	7.81	7.65	7.69
802.11a	5280	56	7.72	7.75	7.66	7.76	7.69	7.73	7.72	7.79
802.11a	5300	60	7.95	7.73	7.84	7.73	7.89	7.74	7.72	7.66
802.11a	5320	64*	7.83	7.87	7.84	7.79	7.77	7.83	7.81	7.76
802.11a	5500	100	7.73	7.83	7.81	7.79	7.80	7.66	7.65	7.71
802.11a	5520	104*	7.84	7.85	7.74	7.76	7.77	7.69	7.76	7.69
802.11a	5540	108	7.85	7.82	7.80	7.74	7.94	7.77	7.83	7.75
802.11a	5560	112	7.85	7.96	7.83	7.81	7.87	7.78	7.80	7.85
802.11a	5580	116*	7.86	7.94	7.95	7.88	7.81	7.81	7.84	7.82
802.11a	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5660	132	8.00	7.97	7.98	7.90	7.89	7.88	7.90	7.94
802.11a	5680	136*	7.93	7.91	7.89	7.87	7.98	7.80	7.92	7.80
802.11a	5700	140	7.90	8.00	8.00	7.96	7.97	7.94	7.95	8.00
802.11a	5745	149*	7.94	7.97	7.90	8.00	7.89	7.96	7.92	7.84
802.11a	5765	153	8.00	7.88	7.83	7.88	8.00	7.96	7.99	7.96
802.11a	5785	157*	7.99	7.92	7.95	8.00	7.95	7.98	7.90	7.87
802.11a	5805	161*	7.98	7.97	7.98	7.98	7.95	7.94	7.86	8.00
802.11a	5825	165	7.99	7.93	8.00	7.85	7.98	7.96	7.98	7.97

Per FCC KDB Publication 443999 and RSS-210 A9.2(3), transmission on channels which overlap the 5600-5650 MHz is prohibited as a client. This device does not transmit any beacons or initiate any transmissions in 5.3 and 5.5 GHz Band.

(*) – indicates default channels per KDB Publication 248227 D01v01r02. When the adjacent channels are higher in power then the default channels, these “required channels” are considered for SAR testing instead of the default channels.

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Table 8-33
IEEE 802.11n Average RF Power – 20 MHz Bandwidth

Mode	Freq [MHz]	Channel	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	20	26	39	52	58	65
802.11n	5180	36	7.37	7.41	7.35	7.28	7.11	7.31	7.39	7.24
802.11n	5200	40	7.36	7.48	7.41	7.45	7.30	7.40	7.32	7.23
802.11n	5220	44	7.50	7.35	7.48	7.29	7.43	7.40	7.46	7.44
802.11n	5240	48	7.37	7.50	7.49	7.49	7.50	7.46	7.49	7.40
802.11n	5260	52	7.50	7.47	7.38	7.42	7.46	7.50	7.41	7.31
802.11n	5280	56	7.48	7.47	7.50	7.50	7.46	7.49	7.47	7.46
802.11n	5300	60	7.47	7.50	7.45	7.43	7.50	7.41	7.45	7.50
802.11n	5320	64	7.49	7.43	7.50	7.50	7.48	7.50	7.46	7.46
802.11n	5500	100	7.60	7.65	7.69	7.59	7.42	7.39	7.52	7.48
802.11n	5520	104	7.64	7.54	7.50	7.40	7.49	7.46	7.42	7.48
802.11n	5540	108	7.60	7.51	7.47	7.66	7.67	7.66	7.47	7.57
802.11n	5560	112	7.57	7.63	7.62	7.78	7.74	7.55	7.67	7.55
802.11n	5580	116	7.74	7.61	7.70	7.61	7.74	7.69	7.51	7.57
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	7.74	7.78	7.75	7.75	7.63	7.71	7.80	7.70
802.11n	5680	136	7.81	7.82	7.77	7.74	7.70	7.80	7.72	7.72
802.11n	5700	140	7.71	7.82	7.82	7.76	7.85	7.85	7.77	7.76
802.11n	5745	149	7.75	7.69	7.71	7.78	7.72	7.63	7.68	7.65
802.11n	5765	153	7.92	7.80	7.82	7.73	7.70	7.87	7.66	7.67
802.11n	5785	157	7.91	7.97	7.73	7.73	7.72	7.80	7.72	7.69
802.11n	5805	161	7.78	7.83	7.95	7.89	7.78	7.78	7.70	7.75
802.11n	5825	165	7.85	7.83	7.83	7.97	7.72	7.81	7.73	7.74

Table 8-34
IEEE 802.11n Average RF Power – 40 MHz Bandwidth

Mode	Freq [MHz]	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			13.5/15	27/30	40.5/45	54/60	81/90	108/120	121.5/135	135/150
802.11n	5190	38	6.71	6.68	6.67	6.64	6.79	6.74	6.72	6.54
802.11n	5230	46	6.87	6.86	6.76	6.73	6.74	6.67	6.69	6.73
802.11n	5270	54	6.81	6.79	6.83	6.78	6.79	6.74	6.75	6.77
802.11n	5310	62	7.09	6.91	6.90	6.88	6.94	6.82	6.88	6.86
802.11n	5510	102	7.00	6.94	6.94	6.92	6.91	6.84	6.78	6.74
802.11n	5550	110	7.01	7.03	6.96	6.98	6.91	6.92	6.90	6.88
802.11n	5590	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5630	126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5670	134	7.23	7.21	7.14	7.17	7.15	7.12	7.15	7.06
802.11n	5755	151	7.19	7.17	7.20	7.17	7.18	7.15	7.08	7.12
802.11n	5795	159	7.30	7.24	7.18	7.14	7.19	7.16	7.10	7.11

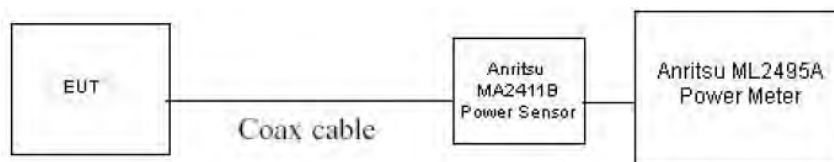


Figure 8-3
Power Measurement Setup

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Table 8-35
Bluetooth RF Conducted Powers

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Peak Conducted Power		Avg Conducted Power	
			[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	10.40	10.967	10.21	10.493
2441	1.0	39	11.25	13.348	11.03	12.685
2480	1.0	78	9.87	9.698	9.59	9.095
2402	2.0	0	9.23	8.377	7.00	5.012
2441	2.0	39	10.73	11.833	7.76	5.970
2480	2.0	78	8.73	7.468	6.27	4.239
2402	3.0	0	9.61	9.141	7.07	5.092
2441	3.0	39	10.52	11.272	7.83	6.061
2480	3.0	78	9.08	8.097	6.33	4.297

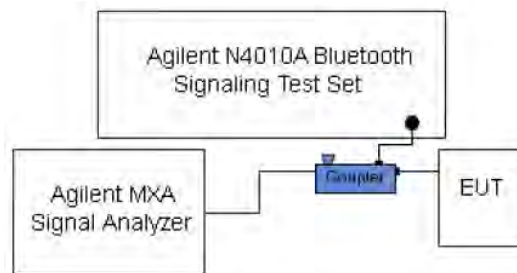


Figure 8-4
Power Measurement Setup

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes:

- For 2.4 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11b were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
- For 5 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11a were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11n 20 MHz and 40 MHz) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
- When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the reported 1g averaged SAR is <0.8 W/kg, SAR testing on other channels is not required. Otherwise, the other default (or corresponding required) test channels were additionally tested using the lowest data rate.
- The bolded data rate and channel above were tested for SAR.

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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
4/10/2013	740B	24.3	680	0.918	56.119	0.958	55.804	-4.18%	0.56%
			695	0.929	55.943	0.959	55.745	-3.13%	0.36%
			710	0.943	55.863	0.960	55.687	-1.77%	0.32%
			725	0.957	55.631	0.961	55.629	-0.42%	0.00%
			740	0.969	55.538	0.963	55.570	0.62%	-0.06%
4/5/2013	835B	22.0	755	0.985	55.399	0.964	55.512	2.18%	-0.20%
			820	0.970	52.824	0.969	55.258	0.10%	-4.40%
			835	0.978	52.575	0.970	55.200	0.82%	-4.76%
			850	0.996	52.600	0.988	55.154	0.81%	-4.63%
			820	0.975	54.387	0.969	55.258	0.62%	-1.58%
4/9/2013	835B	22.7	835	0.992	54.349	0.970	55.200	2.27%	-1.54%
			850	1.005	54.287	0.988	55.154	1.72%	-1.57%
			820	1.001	54.145	0.969	55.258	3.30%	-2.01%
4/19/2013	835B	22.5	835	1.016	54.026	0.970	55.200	4.74%	-2.13%
			850	1.031	53.804	0.988	55.154	4.35%	-2.45%
			1710	1.413	52.398	1.460	53.540	-3.22%	-2.13%
4/11/2013	1750B	22.9	1750	1.457	52.275	1.490	53.430	-2.21%	-2.16%
			1790	1.498	52.149	1.510	53.330	-0.79%	-2.21%
			1850	1.511	51.073	1.520	53.300	-0.59%	-4.18%
4/22/2013	1900B	21.4	1880	1.547	50.917	1.520	53.300	1.78%	-4.47%
			1910	1.577	50.830	1.520	53.300	3.62%	-4.63%
			1850	1.509	52.571	1.520	53.300	-0.72%	-1.37%
4/30/2013	1900B	23.0	1880	1.545	52.576	1.520	53.300	1.64%	-1.36%
			1910	1.575	52.476	1.520	53.300	3.75%	-1.55%
			1850	1.456	52.124	1.520	53.300	-4.21%	-2.21%
5/7/2013	1900B	22.1	1880	1.483	52.070	1.520	53.300	-2.43%	-2.31%
			1910	1.531	51.990	1.520	53.300	0.72%	-2.46%
			2401	1.980	50.761	1.903	52.765	4.05%	-3.80%
4/9/2013	2450B	23.0	2450	2.038	50.579	1.950	52.700	4.51%	-4.02%
			2499	2.110	50.396	2.019	52.638	4.51%	-4.26%
			2401	1.906	51.173	1.903	52.765	0.16%	-3.02%
4/22/2013	2450B	22.4	2450	1.967	51.010	1.950	52.700	0.87%	-3.21%
			2499	2.029	50.877	2.019	52.638	0.50%	-3.35%
			5180	5.293	49.611	5.276	49.041	0.32%	1.16%
04/08/2013	5200B-5800B	22.8	5200	5.393	49.513	5.299	49.014	1.77%	1.02%
			5220	5.423	49.295	5.323	48.987	1.88%	0.63%
			5280	5.487	49.367	5.393	48.879	1.74%	1.00%
			5300	5.507	49.296	5.416	48.851	1.68%	0.91%
			5500	5.817	48.758	5.650	48.580	2.96%	0.37%
			5540	5.905	48.776	5.696	48.526	3.67%	0.52%
			5580	5.897	48.540	5.743	48.471	2.68%	0.14%
			5600	5.891	48.302	5.766	48.444	2.17%	-0.29%
			5660	6.071	48.337	5.837	48.363	4.01%	-0.05%
			5765	6.158	47.958	5.959	48.220	3.34%	-0.54%
			5785	6.253	48.086	5.982	48.242	4.53%	-0.32%
			5800	6.260	48.078	6.000	48.200	4.33%	-0.25%
			5825	6.291	48.150	6.029	48.132	4.35%	0.04%

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 IEEE 1528 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

System Verification TARGET & MEASURED											
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 (%)
750	BODY	04/10/2013	24.4	23.4	0.100	1003	3209	0.882	8.830	8.820	-0.11%
835	BODY	04/05/2013	24.2	23.1	0.100	4d119	3287	1.010	9.560	10.100	5.65%
835	BODY	04/09/2013	23.9	23.0	0.100	4d026	3287	0.974	9.580	9.740	1.67%
835	BODY	04/19/2013	24.9	22.5	0.100	4d132	3209	0.996	9.360	9.960	6.41%
1750	BODY	04/11/2013	24.1	23.2	0.100	1051	3920	3.700	37.600	37.000	-1.60%
1900	BODY	04/22/2013	21.9	20.7	0.100	5d148	3288	4.250	40.800	42.500	4.17%
1900	BODY	04/30/2013	23.8	23.2	0.100	5d148	3920	4.190	40.800	41.900	2.70%
1900	BODY	05/07/2013	23.9	20.2	0.100	5d080	3287	4.090	40.300	40.900	1.49%
2450	BODY	04/09/2013	24.3	24.0	0.100	719	3022	5.510	51.600	55.100	6.78%
2450	BODY	04/22/2013	21.8	21.4	0.100	797	3258	4.730	49.600	47.300	-4.64%
5200	BODY	04/08/2013	24.5	23.2	0.100	1057	3589	7.410	75.500	74.100	-1.85%
5300	BODY	04/08/2013	24.5	23.3	0.100	1057	3589	7.250	75.300	72.500	-3.72%
5500	BODY	04/08/2013	24.5	23.3	0.100	1057	3589	7.870	80.800	78.700	-2.60%
5600	BODY	04/08/2013	24.6	23.4	0.100	1057	3589	8.120	80.300	81.200	1.12%
5800	BODY	04/08/2013	24.6	23.4	0.100	1057	3589	7.660	75.100	76.600	2.00%

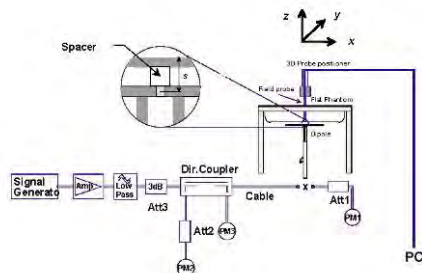


Figure 9-1
System Verification Setup Diagram



Figure 9-2
System Verification Setup Photo

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10 SAR DATA SUMMARY

10.1 Standalone Body SAR Data

Table 10-1
GPRS/UMTS Body SAR:

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR(1g)	Scaling Factor	Scaled SAR(1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
824.20	128	GSM 850	GPRS	30.0	29.90	-0.21	15 mm	54	3	1:2.76	back	0.925	1.023	0.946	
836.60	190	GSM 850	GPRS	30.0	29.33	0.01	15 mm	54	3	1:2.76	back	0.851	1.167	0.993	
848.80	251	GSM 850	GPRS	30.0	29.77	-0.03	15 mm	54	3	1:2.76	back	1.030	1.054	1.086	A2
824.20	128	GSM 850	GPRS	26.5	26.33	-0.03	0 mm	53	2	1:4.15	back	0.907	1.040	0.943	
836.60	190	GSM 850	GPRS	26.5	25.83	0.01	0 mm	53	2	1:4.15	back	0.815	1.167	0.951	
848.80	251	GSM 850	GPRS	26.5	26.10	0.12	0 mm	53	2	1:4.15	back	0.919	1.096	1.007	
824.20	128	GSM 850	GPRS	30.0	29.90	-0.03	15 mm	54	3	1:2.76	top	0.797	1.023	0.815	
836.60	190	GSM 850	GPRS	30.0	29.33	-0.15	15 mm	54	3	1:2.76	top	0.665	1.167	0.776	
848.80	251	GSM 850	GPRS	30.0	29.77	-0.03	15 mm	54	3	1:2.76	top	0.804	1.054	0.847	
824.20	128	GSM 850	GPRS	26.5	26.33	-0.06	0 mm	53	2	1:4.15	top	0.819	1.040	0.852	
836.60	190	GSM 850	GPRS	26.5	25.83	0.12	0 mm	53	2	1:4.15	top	0.733	1.167	0.855	
848.80	251	GSM 850	GPRS	26.5	26.10	0.04	0 mm	53	2	1:4.15	top	0.756	1.096	0.829	
824.20	128	GSM 850	GPRS	30.0	29.90	-0.18	0 mm	54	3	1:2.76	left	0.392	1.023	0.401	
848.80	251	GSM 850	GPRS	30.0	29.77	0.03	15 mm	54	3	1:2.76	back	0.899	1.054	0.948	
836.60	4183	UMTS 850	RMC	22.5	21.99	-0.11	15 mm	54	N/A	1:1	back	0.425	1.125	0.478	
826.40	4132	UMTS 850	RMC	18.5	18.17	0.00	0 mm	53	N/A	1:1	back	0.766	1.079	0.827	A3
836.60	4183	UMTS 850	RMC	18.5	18.13	-0.02	0 mm	53	N/A	1:1	back	0.759	1.089	0.827	
846.60	4233	UMTS 850	RMC	18.5	18.17	-0.09	0 mm	53	N/A	1:1	back	0.654	1.079	0.706	
836.60	4183	UMTS 850	RMC	22.5	21.99	0.02	15 mm	54	N/A	1:1	top	0.407	1.125	0.458	
836.60	4183	UMTS 850	RMC	18.5	18.13	-0.02	0 mm	53	N/A	1:1	top	0.593	1.089	0.646	
836.60	4183	UMTS 850	RMC	22.5	21.99	-0.03	0 mm	54	N/A	1:1	left	0.202	1.125	0.227	
1909.80	810	GSM 1900	GPRS	28.0	27.62	0.11	15 mm	98	3	1:2.76	back	0.644	1.091	0.703	
1850.20	512	GSM 1900	GPRS	18.0	17.53	-0.03	0 mm	99	3	1:2.76	back	0.732	1.114	0.815	
1880.00	661	GSM 1900	GPRS	18.0	17.50	-0.01	0 mm	99	3	1:2.76	back	0.726	1.122	0.815	
1909.80	810	GSM 1900	GPRS	18.0	17.83	0.03	0 mm	99	3	1:2.76	back	0.763	1.040	0.794	
1850.20	512	GSM 1900	GPRS	28.0	27.10	-0.04	15 mm	98	3	1:2.76	top	0.840	1.230	1.033	
1880.00	661	GSM 1900	GPRS	28.0	27.25	-0.01	15 mm	98	3	1:2.76	top	0.906	1.189	1.077	A6
1909.80	810	GSM 1900	GPRS	28.0	27.62	0.06	15 mm	98	3	1:2.76	top	0.820	1.091	0.895	
1880.00	661	GSM 1900	GPRS	18.0	17.50	-0.04	0 mm	99	3	1:2.76	top	0.618	1.122	0.693	
1909.80	810	GSM 1900	GPRS	28.0	27.62	0.04	0 mm	98	3	1:2.76	left	0.639	1.091	0.697	
1852.40	9262	UMTS 1900	RMC	22.5	22.15	0.07	15 mm	98	N/A	1:1	back	0.622	1.084	0.674	
1852.40	9262	UMTS 1900	RMC	13.5	12.97	-0.02	0 mm	99	N/A	1:1	back	0.696	1.130	0.786	
1880.00	9400	UMTS 1900	RMC	13.5	12.50	0.04	0 mm	99	N/A	1:1	back	0.723	1.259	0.910	
1907.60	9538	UMTS 1900	RMC	13.5	13.21	0.07	0 mm	99	N/A	1:1	back	0.792	1.069	0.847	
1852.40	9262	UMTS 1900	RMC	22.5	22.15	0.01	15 mm	98	N/A	1:1	top	0.707	1.084	0.766	
1880.00	9400	UMTS 1900	RMC	22.5	21.57	0.11	15 mm	98	N/A	1:1	top	0.861	1.239	1.067	
1907.60	9538	UMTS 1900	RMC	22.5	22.06	0.04	15 mm	98	N/A	1:1	top	0.832	1.107	0.921	
1907.60	9538	UMTS 1900	RMC	13.5	13.21	-0.01	0 mm	99	N/A	1:1	top	0.735	1.069	0.786	
1852.40	9262	UMTS 1900	RMC	22.5	22.15	-0.04	0 mm	98	N/A	1:1	left	0.775	1.084	0.840	
1880.00	9400	UMTS 1900	RMC	22.5	21.57	-0.07	0 mm	98	N/A	1:1	left	0.826	1.239	1.023	
1907.60	9538	UMTS 1900	RMC	22.5	22.06	0.00	0 mm	98	N/A	1:1	left	0.978	1.107	1.083	A7
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 17 Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR[dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR(1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
710.00	23790	Mid	LTE Band 17	10	23.5	23.07	-0.04	0	54	QPSK	1	0	15 mm	back	1:1	0.295	1.104	0.326	
710.00	23790	Mid	LTE Band 17	10	22.5	22.44	-0.02	1	54	QPSK	25	0	15 mm	back	1:1	0.268	1.014	0.272	
710.00	23790	Mid	LTE Band 17	10	20.5	20.25	-0.02	0	53	QPSK	1	25	0 mm	back	1:1	0.580	1.059	0.614	
710.00	23790	Mid	LTE Band 17	10	20.5	20.45	0.13	0	53	QPSK	25	0	0 mm	back	1:1	0.591	1.012	0.598	A1
710.00	23790	Mid	LTE Band 17	10	23.5	23.07	-0.06	0	54	QPSK	1	0	15 mm	top	1:1	0.193	1.104	0.213	
710.00	23790	Mid	LTE Band 17	10	22.5	22.44	0.02	1	54	QPSK	25	0	15 mm	top	1:1	0.175	1.014	0.177	
710.00	23790	Mid	LTE Band 17	10	20.5	20.25	0.08	0	53	QPSK	1	25	0 mm	top	1:1	0.372	1.059	0.394	
710.00	23790	Mid	LTE Band 17	10	20.5	20.45	0.01	0	53	QPSK	25	0	0 mm	top	1:1	0.413	1.012	0.418	
710.00	23790	Mid	LTE Band 17	10	23.5	23.07	0.02	0	54	QPSK	1	0	0 mm	left	1:1	0.155	1.104	0.171	
710.00	23790	Mid	LTE Band 17	10	22.5	22.44	0.08	1	54	QPSK	25	0	0 mm	left	1:1	0.152	1.014	0.154	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

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

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR[dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR(1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.60	-0.02	0	54	QPSK	1	0	15 mm	back	1:1	0.530	1.096	0.581	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.83	-0.02	1	54	QPSK	25	0	15 mm	back	1:1	0.430	1.040	0.447	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.5	17.22	0.06	0	53	QPSK	1	25	0 mm	back	1:1	0.551	1.067	0.588	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.5	17.24	-0.02	0	53	QPSK	25	12	0 mm	back	1:1	0.552	1.062	0.586	A4
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.60	0.10	0	54	QPSK	1	0	15 mm	top	1:1	0.384	1.096	0.421	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.83	0.13	1	54	QPSK	25	0	15 mm	top	1:1	0.330	1.040	0.343	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.5	17.22	0.18	0	53	QPSK	1	25	0 mm	top	1:1	0.275	1.067	0.293	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.5	17.24	-0.03	0	53	QPSK	25	12	0 mm	top	1:1	0.285	1.062	0.303	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.60	-0.02	0	54	QPSK	1	0	0 mm	left	1:1	0.339	1.096	0.372	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.0	21.83	0.10	1	54	QPSK	25	0	0 mm	left	1:1	0.229	1.040	0.238	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

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

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR(1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.56	0.13	0	54	QPSK	1	50	15 mm	back	1:1	0.530	1.107	0.587	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.79	0.15	1	54	QPSK	50	0	15 mm	back	1:1	0.513	1.050	0.539	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	15.5	15.50	-0.16	0	53	QPSK	1	0	0 mm	back	1:1	0.497	1.000	0.497	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	15.5	15.50	0.20	0	53	QPSK	50	0	0 mm	back	1:1	0.598	1.000	0.598	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.56	0.02	0	54	QPSK	1	50	15 mm	top	1:1	0.712	1.107	0.788	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.79	0.03	1	54	QPSK	50	0	15 mm	top	1:1	0.633	1.050	0.665	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	15.5	15.50	0.02	0	53	QPSK	1	0	0 mm	top	1:1	0.625	1.000	0.625	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	15.5	15.50	0.03	0	53	QPSK	50	0	0 mm	top	1:1	0.763	1.000	0.763	A5
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.56	-0.08	0	54	QPSK	1	50	0 mm	left	1:1	0.448	1.107	0.496	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.79	0.05	1	54	QPSK	50	0	0 mm	left	1:1	0.420	1.050	0.441	
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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Table 10-5
LTE Band 2 (PCS) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR[dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	23.00	-0.06	0	98	QPSK	1	0	15 mm	back	1:1	0.729	1.000	0.729	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.91	-0.05	1	98	QPSK	50	25	15 mm	back	1:1	0.674	1.021	0.688	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.30	-0.12	0	99	QPSK	1	49	0 mm	back	1:1	0.670	1.047	0.701	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.50	0.10	0	99	QPSK	50	25	0 mm	back	1:1	0.581	1.000	0.581	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.69	0.10	0	98	QPSK	1	99	15 mm	Top	1:1	0.844	1.074	0.906	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.0	22.97	-0.02	0	98	QPSK	1	0	15 mm	Top	1:1	0.926	1.007	0.932	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	23.00	-0.15	0	98	QPSK	1	0	15 mm	Top	1:1	0.907	1.000	0.907	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.91	-0.02	1	98	QPSK	50	25	15 mm	Top	1:1	0.703	1.021	0.718	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.68	0.03	1	98	QPSK	100	0	15 mm	Top	1:1	0.859	1.076	0.924	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.30	0.01	0	99	QPSK	1	49	0 mm	top	1:1	0.638	1.047	0.668	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.50	-0.03	0	99	QPSK	50	25	0 mm	top	1:1	0.620	1.000	0.620	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.69	-0.03	0	98	QPSK	1	99	0 mm	left	1:1	1.000	1.074	1.074	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.0	22.97	0.04	0	98	QPSK	1	0	0 mm	left	1:1	0.962	1.007	0.969	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	23.00	0.14	0	98	QPSK	1	0	0 mm	left	1:1	1.090	1.000	1.090	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	21.64	-0.01	1	98	QPSK	50	25	0 mm	left	1:1	0.873	1.086	0.948	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.91	0.05	1	98	QPSK	50	25	0 mm	left	1:1	0.916	1.021	0.935	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.0	21.90	0.01	1	98	QPSK	50	0	0 mm	left	1:1	1.060	1.023	1.084	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.68	0.05	1	98	QPSK	100	0	0 mm	left	1:1	1.010	1.076	1.087	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	23.00	0.03	0	98	QPSK	1	0	0 mm	left	1:1	1.090	1.000	1.090	A8
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Note: Blue entries represent variability measurements.

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Table 10-6
WLAN Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR(1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	14.5	14.02	0.07	0 mm	55	1	back	1:1	0.645	1.117	0.720	
2437	6	IEEE 802.11b	DSSS	14.5	13.43	0.08	0 mm	55	1	back	1:1	0.648	1.279	0.829	A9
2462	11	IEEE 802.11b	DSSS	14.5	13.40	-0.08	0 mm	55	1	back	1:1	0.645	1.288	0.831	
2412	1	IEEE 802.11b	DSSS	14.5	14.02	-0.05	0 mm	55	1	top	1:1	0.509	1.117	0.569	
2412	1	IEEE 802.11b	DSSS	14.5	14.02	-0.20	0 mm	55	1	right	1:1	0.023	1.117	0.026	
5765	153	IEEE 802.11a	OFDM	8.0	8.00	0.16	0 mm	55	6	back	1:1	0.803	1.000	0.803	
5785	157	IEEE 802.11a	OFDM	8.0	7.99	0.10	0 mm	55	6	back	1:1	0.806	1.002	0.808	A11
5825	165	IEEE 802.11a	OFDM	8.0	7.99	0.09	0 mm	55	6	back	1:1	0.738	1.002	0.739	
5765	153	IEEE 802.11a	OFDM	8.0	8.00	-0.10	0 mm	55	6	top	1:1	0.251	1.000	0.251	
5765	153	IEEE 802.11a	OFDM	8.0	8.00	0.00	0 mm	55	6	right	1:1	0.000	1.000	0.000	
5785	157	IEEE 802.11a	OFDM	8.0	7.99	0.06	0 mm	55	6	back	1:1	0.731	1.002	0.732	
5180	36	IEEE 802.11a	OFDM	8.0	7.62	0.08	0 mm	55	6	back	1:1	0.454	1.091	0.495	
5220	44	IEEE 802.11a	OFDM	8.0	7.73	-0.10	0 mm	55	6	back	1:1	0.475	1.064	0.505	
5220	44	IEEE 802.11a	OFDM	8.0	7.73	-0.02	0 mm	55	6	top	1:1	0.204	1.064	0.217	
5220	44	IEEE 802.11a	OFDM	8.0	7.73	-0.04	0 mm	55	6	right	1:1	0.113	1.064	0.120	
5280	56	IEEE 802.11a	OFDM	8.0	7.72	0.00	0 mm	55	6	back	1:1	0.606	1.067	0.647	
5300	60	IEEE 802.11a	OFDM	8.0	7.95	0.10	0 mm	55	6	back	1:1	0.616	1.012	0.623	
5300	60	IEEE 802.11a	OFDM	8.0	7.95	-0.02	0 mm	55	6	top	1:1	0.217	1.012	0.220	
5300	60	IEEE 802.11a	OFDM	8.0	7.95	-0.07	0 mm	55	6	right	1:1	0.116	1.012	0.117	
5540	108	IEEE 802.11a	OFDM	8.0	7.85	0.02	0 mm	55	6	back	1:1	0.767	1.035	0.794	
5580	116	IEEE 802.11a	OFDM	8.0	7.86	0.17	0 mm	55	6	back	1:1	0.799	1.033	0.825	
5660	132	IEEE 802.11a	OFDM	8.0	8.00	0.10	0 mm	55	6	back	1:1	0.887	1.000	0.887	A10
5660	132	IEEE 802.11a	OFDM	8.0	8.00	-0.14	0 mm	55	6	top	1:1	0.249	1.000	0.249	
5660	132	IEEE 802.11a	OFDM	8.0	8.00	0.00	0 mm	55	6	right	1:1	0.000	1.000	0.000	
5660	132	IEEE 802.11a	OFDM	8.0	8.00	0.15	0 mm	55	6	back	1:1	0.883	1.000	0.883	
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.

Table 10-7
Bluetooth Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR(1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2441	39	Bluetooth	PHSS	11.5	11.03	0.11	0 mm	55	1	back	1:1	0.132	1.114	0.147	
2441	39	Bluetooth	PHSS	11.5	11.03	-0.01	0 mm	55	1	top	1:1	0.187	1.114	0.208	A12
2441	39	Bluetooth	PHSS	11.5	11.03	-0.01	0 mm	55	1	right	1:1	0.000	1.114	0.000	
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 616217 and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 12 for variability analysis.
7. Per FCC KDB 616217 D04 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v05 was applied to determine SAR test exclusion for adjacent edge configurations. SAR tests were required for top and left edges for the main antenna, top and right edges for the WLAN/BT antenna.

GSM Test Notes:

1. Justification for reduced test configurations per KDB Publication 941225 D03v01: The source-based time-averaged output power was evaluated for all multi-slot operations. The multi-slot configuration with the highest frame averaged output power was evaluated for SAR.
2. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel must be used.

UMTS Notes:

1. UMTS mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v02. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel must be used.

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LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r01. Implementation of the general test procedures can be found in Section 7.4.4.
2. MPR is implemented by the manufacturer for device operating at max power with the capacitive sensor inactive. 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.

WLAN/Bluetooth Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 5 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11n 20 MHz and 40 MHz bandwidths) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. WIFI transmission was verified using an uncalibrated spectrum analyzer.
4. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is >1.6 W/kg or the reported 1g averaged SAR is >0.8 W/kg, SAR testing on other default channels was required.
5. There is not proximity sensor power reduction mechanism applied for WIFI/BT modes.

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11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

11.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤ 1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2 2), 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	Configuration	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
		[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth LE	Touching*	2441	7.00	5	0.208

Note:

1. For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.
2. (*) – Per FCC KDB Publication 447498, when the test separation distance is < 5 mm, a distance of 5 mm is applied to determine estimated SAR.

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11.3 Body SAR Simultaneous Transmission Analysis

Table 11-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.007	0.831	See note 1	0.03	Body SAR	Back	0.827	0.831	See note 1	0.03
	Top	0.855	0.569	1.424	N/A		Top	0.646	0.569	1.215	N/A
	Bottom	0.400	0.400	0.800	N/A		Bottom	0.400	0.400	0.800	N/A
	Right	0.400	0.026	0.426	N/A		Right	0.400	0.026	0.426	N/A
	Left	0.401	0.400	0.801	N/A		Left	0.227	0.400	0.627	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.815	0.831	See note 1	0.02	Body SAR	Back	0.910	0.831	See note 1	0.03
	Top	0.693	0.569	1.262	N/A		Top	0.786	0.569	1.355	N/A
	Bottom	0.400	0.400	0.800	N/A		Bottom	0.400	0.400	0.800	N/A
	Right	0.400	0.026	0.426	N/A		Right	0.400	0.026	0.426	N/A
	Left	0.697	0.400	1.097	N/A		Left	1.083	0.400	1.483	N/A
Simult Tx	Configuration	LTE Band 17 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)		Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
Body SAR	Back	0.614	0.831	1.445		Body SAR	Back	0.588	0.831	1.419	
	Top	0.418	0.569	0.987			Top	0.303	0.569	0.872	
	Bottom	0.400	0.400	0.800			Bottom	0.400	0.400	0.800	
	Right	0.400	0.026	0.426			Right	0.400	0.026	0.426	
	Left	0.171	0.400	0.571			Left	0.372	0.400	0.772	
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)		Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
Body SAR	Back	0.598	0.831	1.429		Body SAR	Back	0.701	0.831	1.532	
	Top	0.763	0.569	1.332			Top	0.668	0.569	1.237	
	Bottom	0.400	0.400	0.800			Bottom	0.400	0.400	0.800	
	Right	0.400	0.026	0.426			Right	0.400	0.026	0.426	
	Left	0.496	0.400	0.896			Left	1.090	0.400	1.490	

Table 11-3
Simultaneous Transmission Scenario with 5 GHz WLAN (Body SAR at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.007	0.887	See note 1	0.03	Body SAR	Back	0.827	0.887	See note 1	0.03
	Top	0.855	0.251	1.106	N/A		Top	0.646	0.251	0.897	N/A
	Bottom	0.400	0.400	0.800	N/A		Bottom	0.400	0.400	0.800	N/A
	Right	0.400	0.120	0.520	N/A		Right	0.400	0.120	0.520	N/A
	Left	0.401	0.400	0.801	N/A		Left	0.227	0.400	0.627	N/A
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.815	0.887	See note 1	0.03	Body SAR	Back	0.910	0.887	See note 1	0.03
	Top	0.693	0.251	0.944	N/A		Top	0.786	0.251	1.037	N/A
	Bottom	0.400	0.400	0.800	N/A		Bottom	0.400	0.400	0.800	N/A
	Right	0.400	0.120	0.520	N/A		Right	0.400	0.120	0.520	N/A
	Left	0.697	0.400	1.097	N/A		Left	1.083	0.400	1.483	N/A

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Simult Tx	Configuration	LTE Band 17 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.614	0.887	1.501	Body SAR	Back	0.588	0.887	1.475
	Top	0.418	0.251	0.669		Top	0.303	0.251	0.554
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.120	0.520		Right	0.400	0.120	0.520
	Left	0.171	0.400	0.571		Left	0.372	0.400	0.772
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.598	0.887	1.485	Body SAR	Back	0.701	0.887	1.588
	Top	0.763	0.251	1.014		Top	0.668	0.251	0.919
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.120	0.520		Right	0.400	0.120	0.520
	Left	0.496	0.400	0.896		Left	1.090	0.400	1.490

Table 11-4
Simultaneous Transmission Scenario with Bluetooth (Body at 0 mm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.007	0.208	1.215	Body SAR	Back	0.827	0.208	1.035
	Top	0.855	0.208	1.063		Top	0.646	0.208	0.854
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.208	0.608		Right	0.400	0.208	0.608
	Left	0.401	0.400	0.801		Left	0.227	0.400	0.627
Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.815	0.208	1.023	Body SAR	Back	0.910	0.208	1.118
	Top	0.693	0.208	0.901		Top	0.786	0.208	0.994
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.208	0.608		Right	0.400	0.208	0.608
	Left	0.697	0.400	1.097		Left	1.083	0.400	1.483
Simult Tx	Configuration	LTE Band 17 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.614	0.208	0.822	Body SAR	Back	0.588	0.208	0.796
	Top	0.418	0.208	0.626		Top	0.303	0.208	0.511
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.208	0.608		Right	0.400	0.208	0.608
	Left	0.171	0.400	0.571		Left	0.372	0.400	0.772
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.598	0.208	0.806	Body SAR	Back	0.701	0.208	0.909
	Top	0.763	0.208	0.971		Top	0.668	0.208	0.876
	Bottom	0.400	0.400	0.800		Bottom	0.400	0.400	0.800
	Right	0.400	0.208	0.608		Right	0.400	0.208	0.608
	Left	0.496	0.400	0.896		Left	1.090	0.400	1.490

Note: Estimated Bluetooth LE SAR was used in the above table to evaluate back, top and right edges for simultaneous transmission scenarios.

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Table 11-5
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Back at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	1.086	<0.831	see note 1	<.03
Back Side	UMTS 850	0.478	<0.831	<1.309	N/A
Back Side	GSM 1900	0.703	<0.831	<1.534	N/A
Back Side	UMTS 1900	0.674	<0.831	<1.505	N/A
Back Side	LTE Band 17	0.326	<0.831	<1.157	N/A
Back Side	LTE Band 5 (Cell)	0.581	<0.831	<1.412	N/A
Back Side	LTE Band 4 (AWS)	0.587	<0.831	<1.418	N/A
Back Side	LTE Band 2 (PCS)	0.729	<0.831	<1.560	N/A

Table 11-6
Simultaneous Transmission Scenario with 5 GHz WLAN (Back at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	GSM 850	1.086	<0.887	see note 1	<.04
Back Side	UMTS 850	0.478	<0.887	<1.365	N/A
Back Side	GSM 1900	0.703	<0.887	<1.590	N/A
Back Side	UMTS 1900	0.674	<0.887	<1.561	N/A
Back Side	LTE Band 17	0.326	<0.887	<1.213	N/A
Back Side	LTE Band 5 (Cell)	0.581	<0.887	<1.468	N/A
Back Side	LTE Band 4 (AWS)	0.587	<0.887	<1.474	N/A
Back Side	LTE Band 2 (PCS)	0.729	<0.887	see note 1	<.03

Table 11-7
Simultaneous Transmission Scenario with Bluetooth (Back at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	1.086	<0.147	<1.233
Back Side	UMTS 850	0.478	<0.147	<0.625
Back Side	GSM 1900	0.703	<0.147	<0.850
Back Side	UMTS 1900	0.674	<0.147	<0.821
Back Side	LTE Band 17	0.326	<0.147	<0.473
Back Side	LTE Band 5 (Cell)	0.581	<0.147	<0.728
Back Side	LTE Band 4 (AWS)	0.587	<0.147	<0.734
Back Side	LTE Band 2 (PCS)	0.729	<0.147	<0.876

Note: Measured Bluetooth SAR was used in the above table to evaluate back at 15 mm for simultaneous transmission scenarios.

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Table 11-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Top at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	GSM 850	0.847	<0.569	<1.416	N/A
Top Edge	UMTS 850	0.458	<0.569	<1.027	N/A
Top Edge	GSM 1900	1.077	<0.569	see note 1	<.03
Top Edge	UMTS 1900	1.067	<0.569	see note 1	<.03
Top Edge	LTE Band 17	0.213	<0.569	<0.782	N/A
Top Edge	LTE Band 5 (Cell)	0.421	<0.569	<0.990	N/A
Top Edge	LTE Band 4 (AWS)	0.788	<0.569	<1.357	N/A
Top Edge	LTE Band 2 (PCS)	0.932	<0.569	<1.501	N/A

Table 11-9
Simultaneous Transmission Scenario with 5 GHz WLAN (Top at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Top Edge	GSM 850	0.847	<.251	<1.098
Top Edge	UMTS 850	0.458	<.251	<0.709
Top Edge	GSM 1900	1.077	<.251	<1.328
Top Edge	UMTS 1900	1.067	<.251	<1.318
Top Edge	LTE Band 17	0.213	<.251	<0.464
Top Edge	LTE Band 5 (Cell)	0.421	<.251	<0.672
Top Edge	LTE Band 4 (AWS)	0.788	<.251	<1.039
Top Edge	LTE Band 2 (PCS)	0.932	<.251	<1.183

Table 11-10
Simultaneous Transmission Scenario with Bluetooth (Top at 15 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Top Edge	GSM 850	0.847	<.208	<1.055
Top Edge	UMTS 850	0.458	<.208	<0.666
Top Edge	GSM 1900	1.077	<.208	<1.285
Top Edge	UMTS 1900	1.067	<.208	<1.275
Top Edge	LTE Band 17	0.213	<.208	<0.421
Top Edge	LTE Band 5 (Cell)	0.421	<.208	<0.629
Top Edge	LTE Band 4 (AWS)	0.788	<.208	<0.996
Top Edge	LTE Band 2 (PCS)	0.932	<.208	<1.140

Note: Measured Bluetooth SAR was used in the above table to evaluate top edge at 15 mm for simultaneous transmission scenarios.

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Note:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not higher than 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.
2. For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.
3. For SAR summations for body back at 15 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. "<" denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
4. For SAR summations for body top at 15 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. "<" denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
5. The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct / WIFI Display capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

11.4 SPLSR Evaluation and Analysis

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

$$\text{Distance}_{T_{X1} - T_{X2}} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

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

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with GPRS 850 MHz antenna operating at limited output power with 2.4 GHz WIFI.

Table 11-11
Peak SAR Locations for Body Back Side at 0 mm GPRS 850 MHz and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 850 MHz	25.50	1.50
IEEE 802.11b	-66.20	-0.80

Figure 11-1
Peak SAR Locations of 2.4 GHz WLAN and GPRS 850 MHz

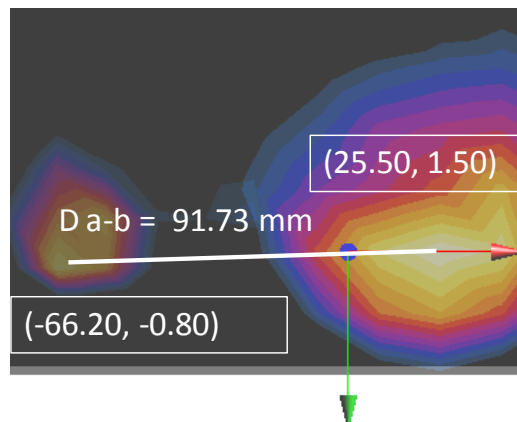


Table 11-12
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850 MHz	IEEE 802.11b	1.007	0.831	1.838	91.73	0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with UMTS 850 MHz antenna operating at limited output power with 2.4 GHz WIFI.

Table 11-13
Peak SAR Locations for Body Back Side at 0 mm UMTS 850 MHz and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
UMTS 850 MHz	5.00	0.00
IEEE 801.11b	-66.20	-0.80

Figure 11-2
Peak SAR Locations of 2.4 GHz WLAN and UMTS 850 MHz

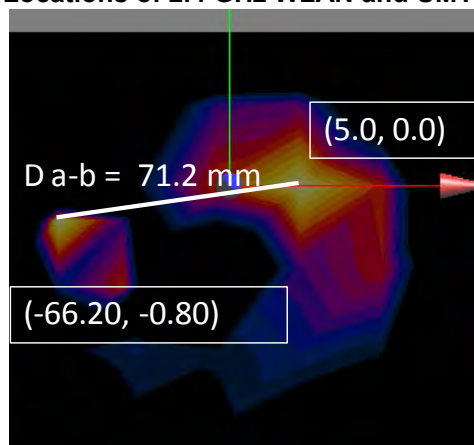


Table 11-14
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 850 MHz	IEEE 801.11b	0.827	0.831	1.658	71.2	0.03

FCC ID: A3LSGHI467		SAR EVALUATION REPORT			Reviewed by: Quality Manager
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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with GPRS 1900 MHz antenna operating at limited output power with 2.4 GHz WIFI.

Table 11-15
Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 MHz and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz	23.00	0.00
IEEE 802.11b	-66.20	-0.80

Figure 11-3
Peak SAR Locations of 2.4 GHz WLAN and GPRS 1900 MHz

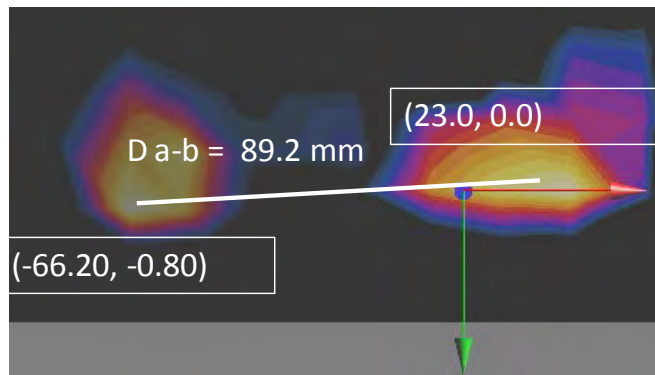


Table 11-16
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz	IEEE 802.11b	0.815	0.831	1.646	89.2	0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with UMTS 1900 MHz antenna operating at limited output power with 2.4 GHz WIFI.

Table 11-17
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 MHz and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz	23.00	0.00
IEEE 802.11b	-66.20	-0.80

Figure 11-4
Peak SAR Locations of 2.4 GHz WLAN and UMTS 1900 MHz

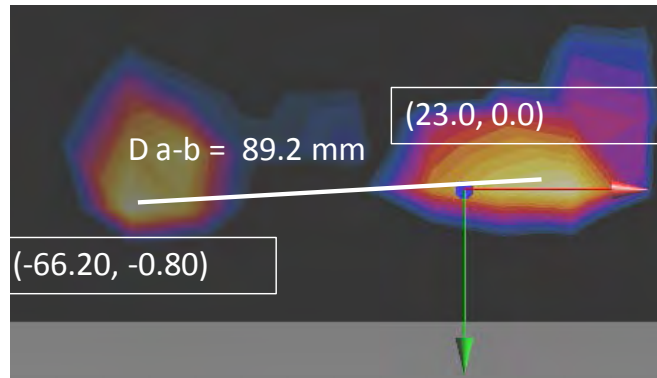


Table 11-18
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D _{a-b}	(a+b) ^{1.5} /D _{a-b}
UMTS 1900 MHz	IEEE 802.11b	0.91	0.831	1.741	89.2	0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with GPRS 850 MHz antenna operating at limited output power with 5 GHz WIFI.

Table 11-19
Peak SAR Locations for Body Back Side at 0 mm GPRS 850 MHz and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 850 MHz	25.50	1.50
IEEE 802.11a	-59.90	-7.99

Figure 11-5
Peak SAR Location of 5 GHz WLAN and GRPS 850 MHz

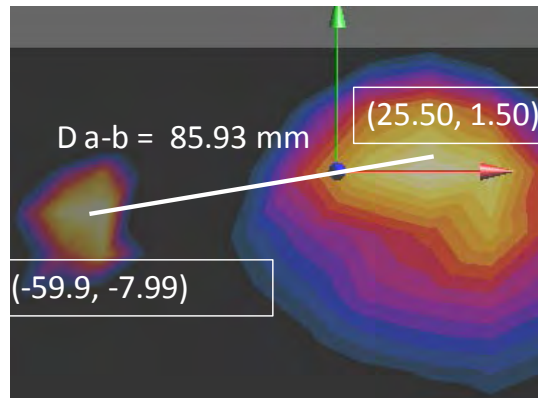


Table 11-20
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850 MHz	IEEE 802.11a	1.007	0.887	1.894	85.93	0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with UMTS 850 MHz antenna operating at limited output power with 5 GHz WIFI.

Table 11-20
Peak SAR Locations for Body Back Side at 0 mm UMTS 850 MHz and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
UMTS 850 MHz	5.00	0.00
IEEE 801.11a	-59.90	-7.99

Figure 11-6
Peak SAR Location of 5 GHz WLAN and UMTS 850 MHz

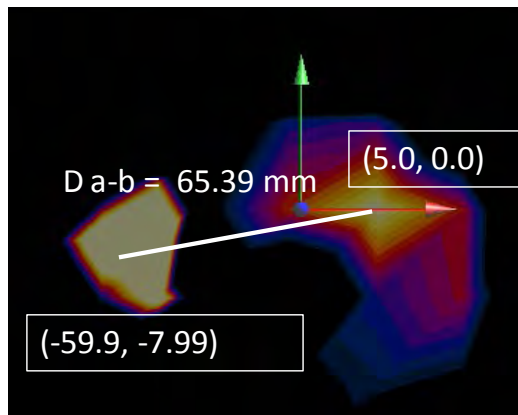


Table 11-21
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D _{a-b}	(a+b) ^{1.5} /D _{a-b}
UMTS 850 MHz	IEEE 801.11a	0.827	0.887	1.714	65.39	0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with GPRS 1900 MHz antenna operating at limited output power with 5 GHz WIFI.

Table 11-22
Peak SAR Locations for Body Back Side at 0 mm GPRS 1900 MHz and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz	23.00	0.00
IEEE 802.11a	-59.90	-7.99

Figure 11-7
Peak SAR Location of 5 GHz WLAN and GPRS 1900 MHz

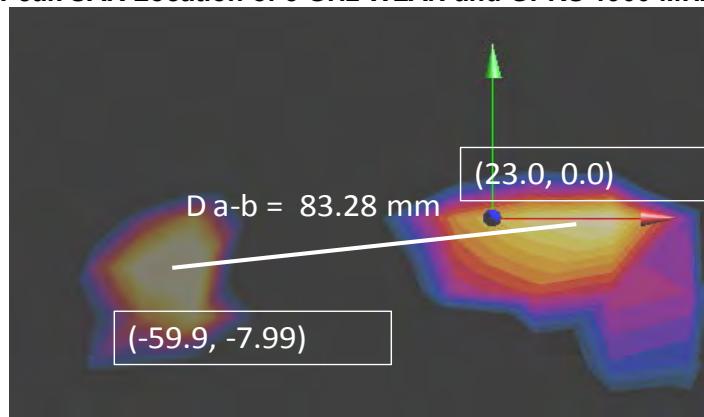


Table 11-23
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz	IEEE 802.11a	0.815	0.887	1.702	83.28	0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0 mm with UMTS 1900 MHz antenna operating at limited output power with 5 GHz WIFI.

Table 11-24
Peak SAR Locations for Body Back Side at 0 mm UMTS 1900 MHz and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz	23.00	0.00
IEEE 802.11a	-59.90	-7.99

Figure 11-8
Peak SAR Location of 5 GHz WLAN and UMTS 1900 MHz

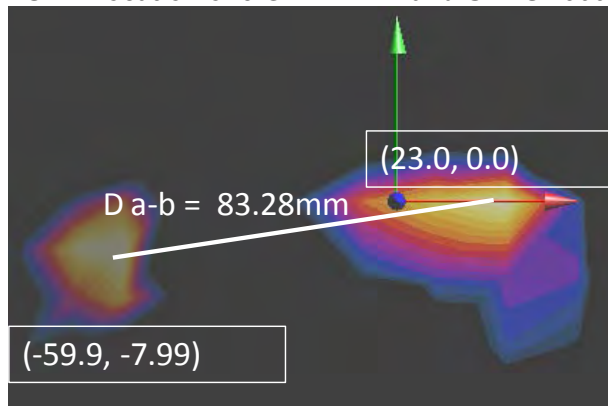


Table 11-25
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
UMTS 1900 MHz	IEEE 802.11a	0.91	0.887	1.797	83.28	0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 15 mm with GPRS 850 MHz antenna operating at maximum output power with 2.4 GHz WIFI.

Table 11-26
Peak SAR Locations for Body Back Side at 15 mm GPRS 850 MHz and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 850 MHz	12.90	13.00
IEEE 802.11b	-66.20	-0.80

Figure 11-9
Peak SAR Location of 2.4 GHz WLAN and GPRS 850 MHz

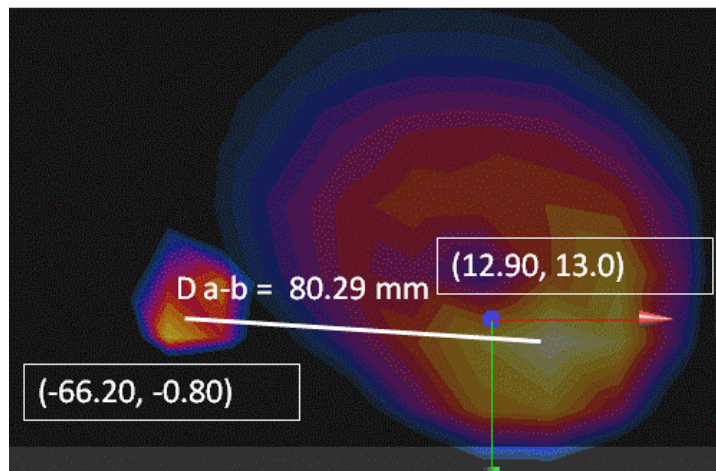


Table 11-27
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850 MHz	IEEE 802.11b	1.086	<0.831	<1.917	80.29	<0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 15 mm with GPRS 850 MHz antenna operating at maximum output power with 5 GHz WIFI.

Table 11-28
Peak SAR Locations for Body Back Side at 15 mm GPRS 850 MHz and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 850 MHz	12.90	13.00
IEEE 802.11a	-59.90	-7.99

Figure 11-10
Peak SAR Location of 5 GHz WLAN and GPRS 850 MHz

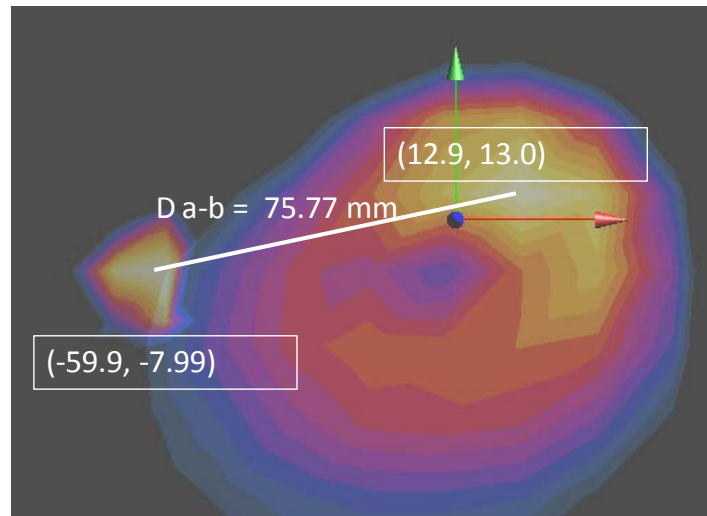


Table 11-29
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 850 MHz	IEEE 802.11a	1.086	<0.887	<1.973	75.77	<0.04

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 15 mm with LTE band 2 (PCS) antenna operating at maximum output power with 5 GHz WIFI.

Table 11-30
Peak SAR Locations for Body Back Side at 15 mm LTE Band 2 (PCS) and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
LTE Band 2 (PCS)	9.96	0.01
IEEE 802.11a	-59.90	-7.99

Figure 11-11
Peak SAR Location of 5 GHz WLAN and LTE Band 2 (PCS)

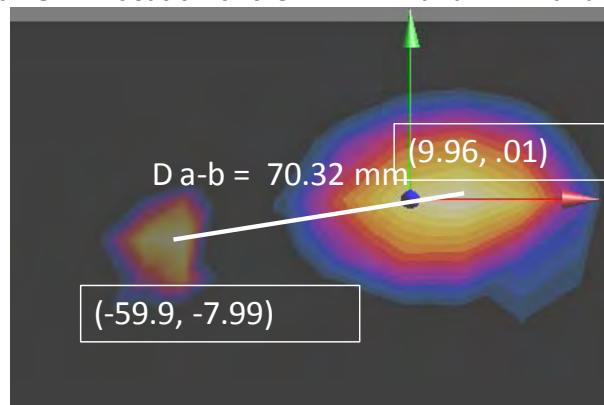


Table 11-31
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE Band 2 (PCS)	IEEE 802.11a	0.729	0.887	<1.616	70.32	<.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Top side configuration at a separation distance of 15 mm with GPRS 1900 MHz antenna operating at maximum output power with 2.4 GHz WIFI.

Table 11-32
Peak SAR Locations for Body Top Side at 15 mm GPRS 1900 MHz and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
GPRS 1900 MHz	-25.00	-33.00
IEEE 802.11b	-22.50	43.80

Figure 11-12
Peak SAR Location of 2.4 GHz WLAN and GRPS 1900 MHz

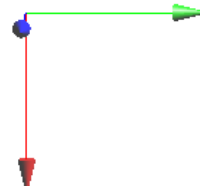
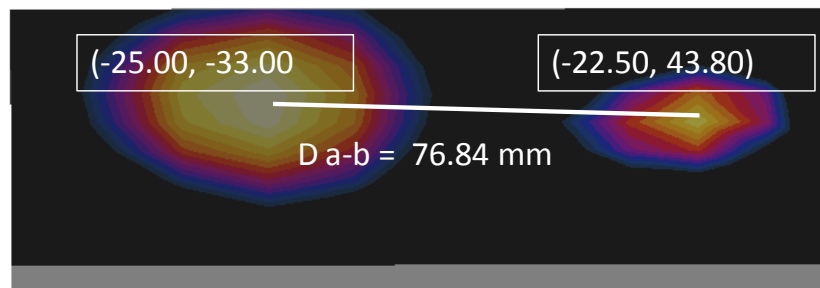


Table 11-33
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
GPRS 1900 MHz	IEEE 802.11b	1.077	<.569	<1.646	76.84	<0.03

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Top side configuration at a separation distance of 15 mm with UMTS 1900 MHz antenna operating at maximum output power with 2.4 GHz WIFI.

Table 11-34
Peak SAR Locations for Body Top Side at 15 mm UMTS 1900 MHz and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
UMTS 1900 MHz	-20.50	-31.00
IEEE 802.11b	-22.50	43.80

Figure 11-13
Peak SAR Location of 2.4 GHz WLAN and UMTS 1900 MHz

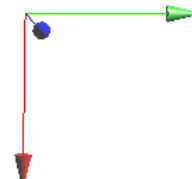
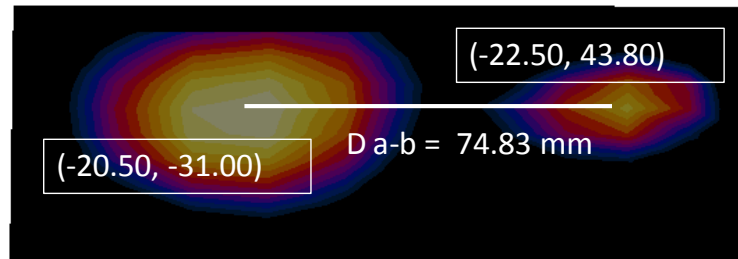


Table 11-35
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D _{a-b}	(a+b) ^{1.5} /D _{a-b}
UMTS 1900 MHz	IEEE 802.11b	1.067	<.569	<1.636	74.83	<0.03

11.5 Simultaneous Transmission Conclusion

The above numerical summed SAR and SPLSR analysis results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05.

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12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

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

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

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

Table 12-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS															
Band	FREQUENCY		Mode	Service	# of Time Slots	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.							(W/kg)	(W/kg)		(W/kg)		(W/kg)	
835	848.80	251	GSM 850	GPRS	3	N/A	back	15 mm	1.030	0.899	1.15	N/A	N/A	N/A	N/A
1900	1900.00	19100	LTE Band 2 (PCS)	QPSK, 1 RB, 0 RB Offset	N/A	N/A	left	0 mm	1.090	1.090	1.00	N/A	N/A	N/A	N/A
5800	5785.00	157	IEEE 802.11a	OFDM	N/A	6	back	0 mm	0.806	0.731	1.10	N/A	N/A	N/A	N/A
5600	5660.00	132	IEEE 802.11a	OFDM	N/A	6	back	0 mm	0.887	0.883	1.00	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 D01v01, the standard measurement uncertainty analysis per IEEE 1528-2003 was not required.

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13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/16/2013	Annual	4/16/2014	JP38020182
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/16/2013	Annual	4/16/2014	MY45470194
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/17/2013	Annual	4/17/2014	3629U00687
Agilent	85070E	Dielectric Probe Kit	2/14/2013	Annual	2/14/2014	MY44300633
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Agilent	N9020A	MXA Signal Analyzer	10/9/2012	Annual	10/9/2013	US46470561
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	551G4	5W, 800MHz-4.2GHz	CBT	N/A	CBT	21910
Anritsu	MA2481A	Power Sensor	2/14/2013	Annual	2/14/2014	5318
Anritsu	ML2438A	Power Meter	2/14/2013	Annual	2/14/2014	1190013
Anritsu	MT8820C	Radio Communication Tester	11/6/2012	Annual	11/6/2013	6200901190
Anritsu	MA24106A	USB Power Sensor	8/22/2012	Annual	8/22/2013	1231535
Anritsu	MA2481D	Universal Sensor	12/17/2012	Annual	12/17/2013	1204419
Anritsu	MA2411B	Pulse Power Sensor	12/4/2012	Annual	12/4/2013	1207364
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Control Company	36934-158	Wall-Mounted Thermometer	1/4/2012	Biennial	1/4/2014	122014497
Control Company	36934-158	Wall-Mounted Thermometer	1/4/2012	Biennial	1/4/2014	122014488
Control Company	4353	Long Stem Thermometer	9/25/2012	Biennial	9/25/2014	122541143
Control Company	4353	Long Stem Thermometer	9/25/2012	Biennial	9/25/2014	122541139
Fisher Scientific	15-078J	Thermometer	11/6/2012	Biennial	11/6/2014	122640025
Fisher Scientific	15-078J	Long Stem Thermometer	10/30/2012	Biennial	10/30/2014	122626059
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/10/2012	Annual	10/10/2013	1833460
Gigatronics	8651A	Universal Power Meter	10/10/2012	Annual	10/10/2013	8650319
Intelligent Weighing	PD-3000	Electronic Balance	6/29/2012	Annual	6/29/2013	120405017
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-53W2	Attenuator (3dB)	CBT	N/A	CBT	120
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2208-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	5/22/2012	Annual	5/22/2013	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	NRV-232	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Rohde & Schwarz	SMIQQ03B	Signal Generator	4/17/2013	Annual	4/17/2014	DE27259
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	10/7/2011	Biennial	10/7/2013	103962
Rohde & Schwarz	SME06	Signal Generator	10/11/2012	Annual	10/11/2013	832026
Rohde & Schwarz	ZVC	Vector Network Analyzer	5/18/2011	Biennial	5/18/2013	100056
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	9/26/2012	Annual	9/26/2013	108798
Seekonk	NC-100	Torque Wrench (8" lb)	11/29/2011	Triennial	11/29/2014	21053
SPEAG	D1900V2	1900 MHz SAR Dipole	7/20/2012	Annual	7/20/2013	5d080
SPEAG	D2450V2	2450 MHz SAR Dipole	8/23/2012	Annual	8/23/2013	719
SPEAG	D2450V2	2450 MHz SAR Dipole	1/8/2013	Annual	1/8/2014	797
SPEAG	D05GHzV2	5 GHz SAR Dipole	1/11/2013	Annual	1/11/2014	1057
SPEAG	D835V2	835 MHz SAR Dipole	8/23/2012	Annual	8/23/2013	4d026
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/6/2013	Annual	2/6/2014	649
SPEAG	ES3DV2	SAR Probe	8/28/2012	Annual	8/28/2013	3022
SPEAG	EX3DV4	SAR Probe	1/17/2013	Annual	1/17/2014	3589
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/15/2012	Annual	5/15/2013	859
SPEAG	ES3DV3	SAR Probe	3/15/2013	Annual	3/15/2014	3209
SPEAG	ES3DV3	SAR Probe	2/11/2013	Annual	2/11/2014	3258
SPEAG	D1750V2	1750 MHz SAR Dipole	4/24/2012	Annual	4/24/2013	1051
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/17/2013	Annual	1/17/2014	1272
SPEAG	D835V2	835 MHz SAR Dipole	4/20/2012	Annual	4/20/2013	4d119
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/19/2012	Annual	9/19/2013	1323
SPEAG	ES3DV3	SAR Probe	9/20/2012	Annual	9/20/2013	3288
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/13/2012	Annual	11/13/2013	1333
SPEAG	D835V2	835 MHz SAR Dipole	1/7/2013	Annual	1/7/2014	4d132
SPEAG	D1900V2	1900 MHz SAR Dipole	2/6/2013	Annual	2/6/2014	5d148
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/24/2012	Annual	8/24/2013	1322
SPEAG	ES3DV3	SAR Probe	11/15/2012	Annual	11/15/2013	3287
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/8/2013	Annual	3/8/2014	1334
SPEAG	EX3DV4	SAR Probe	2/27/2013	Annual	2/27/2014	3920
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/17/2013	Annual	4/17/2014	B010177
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859323
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859332
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886430
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886443
VWR	23226-658	Long Stem Thermometer	7/11/2012	Biennial	7/11/2014	122389330

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

Applicable for frequencies less than 3000 MHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c _i 1gm	c _i 10 gms	1gm u _i (± %)	10gms u _i (± %)	v _i
Measurement System									
Probe Calibration	E.2.1	6.0	N	1	1.0	1.0	6.0	6.0	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)							RSS	12.1	11.7
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.2	23.5
									299

The above measurement uncertainties are according to IEEE Std. 1528-2003

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Applicable for frequencies up to 6 GHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c _i 1gm	c _i 10 gms	1gm u _i (± %)	10gms u _i (± %)	v _i
Measurement System									
Probe Calibration	E.2.1	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)							RSS	12.4	12.0
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.7	24.0

The above measurement uncertainties are according to IEEE Std. 1528-2003

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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: A3LSGHI467; Type: Portable Tablet; Serial: 53

Communication System: LTE Band 17; Frequency: 710 MHz; Duty Cycle: 1:1

Medium: 695 Body Medium parameters used:

$f = 710 \text{ MHz}$; $\sigma = 0.943 \text{ S/m}$; $\epsilon_r = 55.863$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0 mm

Test Date: 04-10-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3209; ConvF(6.38, 6.38, 6.38); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0 Door; Type: QDOVA002BB; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.9 (7117)

Mode: LTE Band 17, Body SAR, Back side, Mid.ch
10 MHz Bandwidth, QPSK, 25 RB, 0 RB Offset

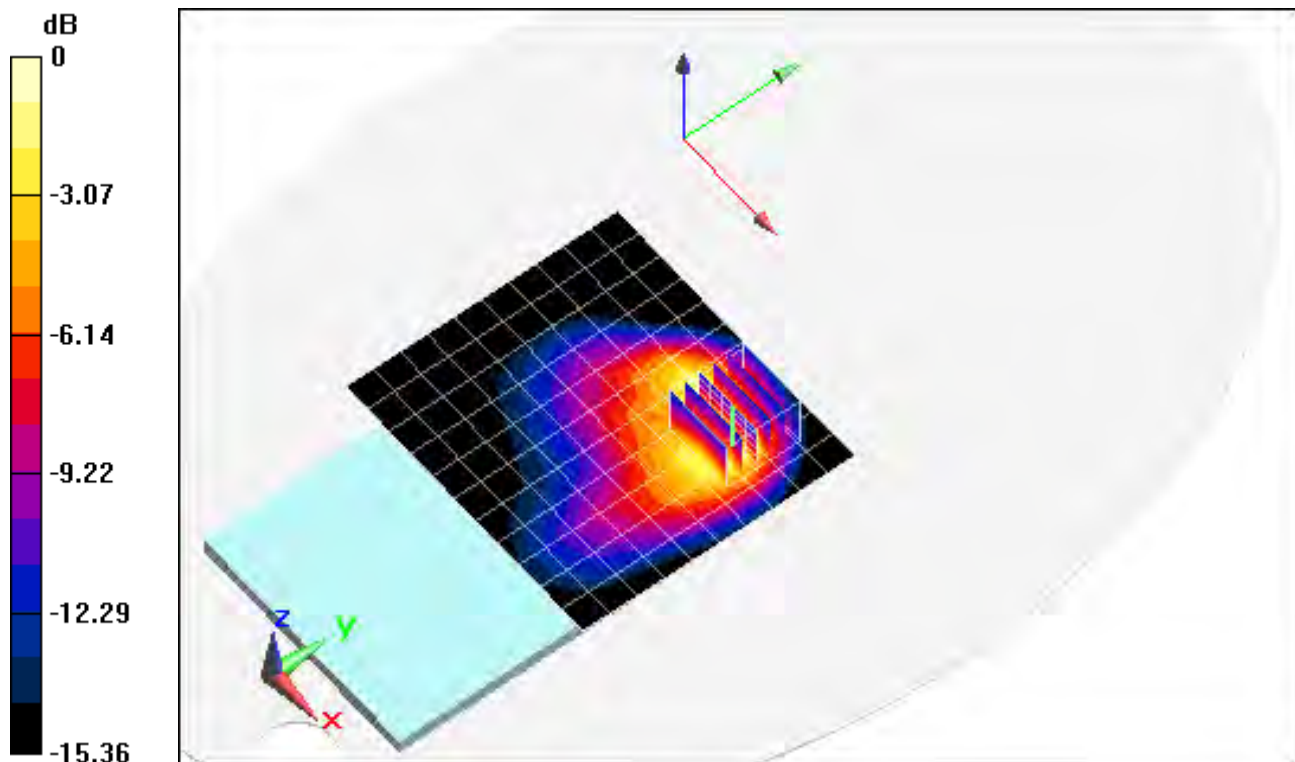
Area Scan (12x11x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 25.274 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 1.10 W/kg

SAR(1 g) = 0.591 W/kg; SAR(10 g) = 0.334 W/kg



0 dB = 0.624 W/kg = -2.05 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 54

Communication System: GSM850 GPRS; 3 Tx slots; Frequency: 848.8 MHz; Duty Cycle: 1:2.76

Medium: 835 Body Medium parameters used (interpolated):

$f = 848.8 \text{ MHz}$; $\sigma = 0.995 \text{ S/m}$; $\epsilon_r = 52.598$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 15 mm

Test Date: 04-05-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3287; ConvF(6.06, 6.06, 6.06); Calibrated: 11/15/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/13/2012

Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

Mode: GPRS 850, Body SAR, Back side, High ch, 3 Tx Slots

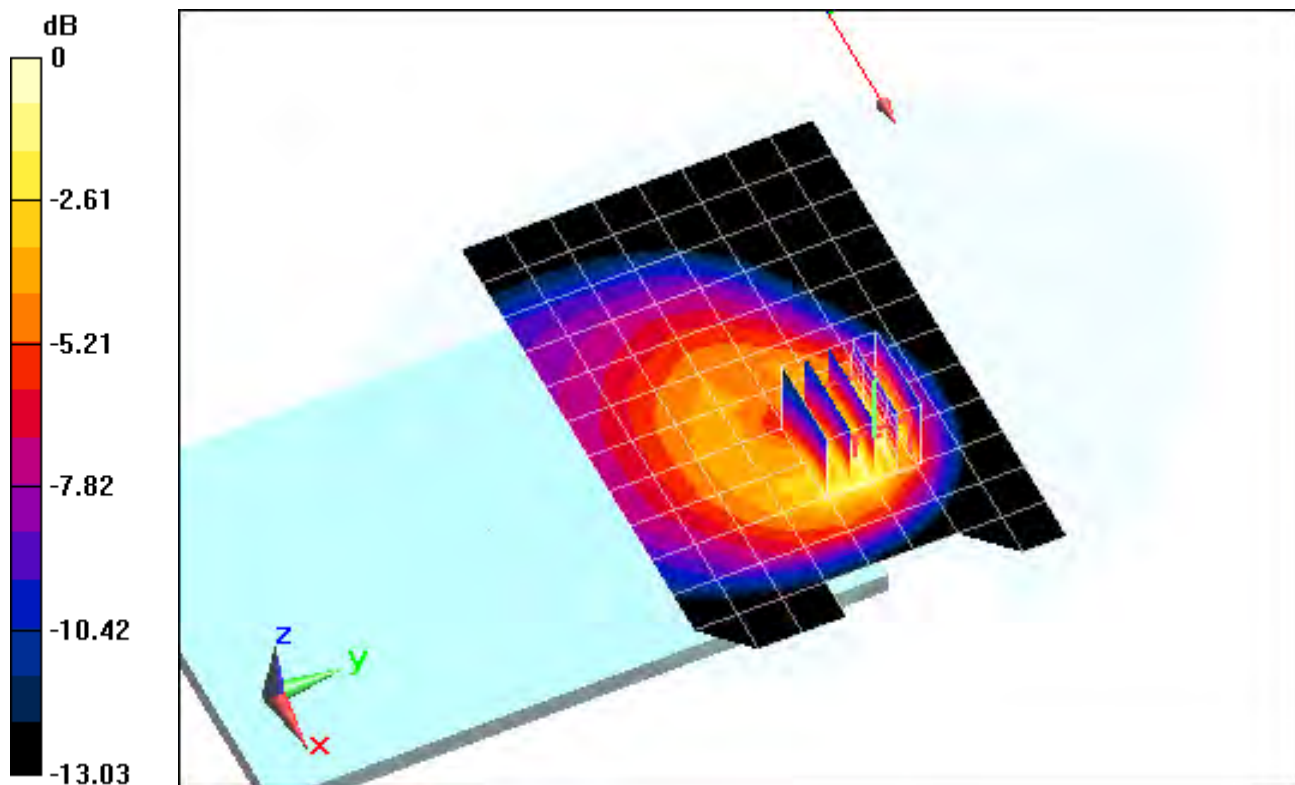
Area Scan (13x9x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 33.336 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.57 W/kg

SAR(1 g) = 1.03 W/kg; SAR(10 g) = 0.638 W/kg



0 dB = 1.08 W/kg = 0.33 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 53

Communication System: Frequency: 826.4 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 826.4 \text{ MHz}$; $\sigma = 1.007 \text{ S/m}$; $\epsilon_r = 54.094$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 0 mm

Test Date: 04-19-2013; Ambient Temp: 24.9°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0 Door; Type: QDOVA002BB; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Mode: UMTS 850, Body SAR, Back side, Low ch

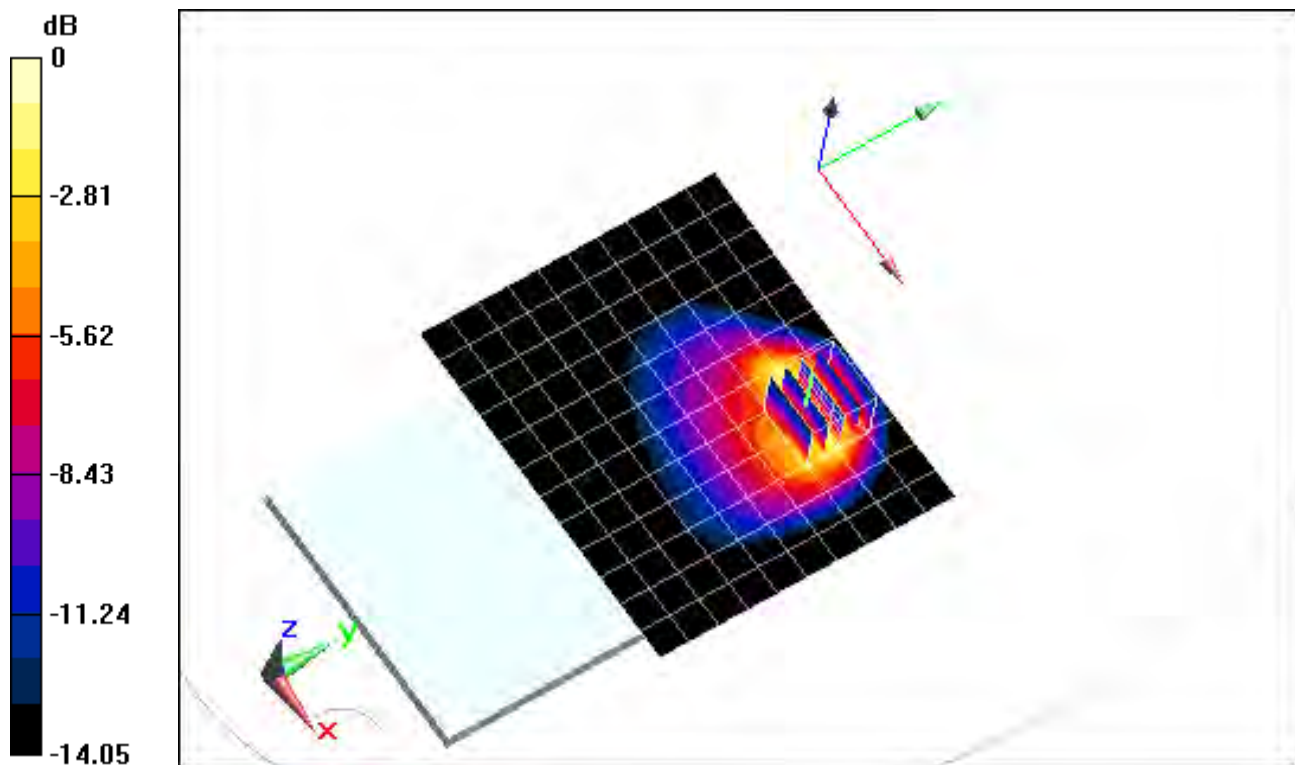
Area Scan (13x11x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 29.038 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 1.42 W/kg

SAR(1 g) = 0.766 W/kg



0 dB = 0.857 W/kg = -0.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 53

Communication System: LTE BAND 5; Frequency: 836.5 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 0.993 \text{ S/m}$; $\epsilon_r = 54.343$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0 mm

Test Date: 04-09-2013; Ambient Temp: 23.9°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3287; ConvF(6.06, 6.06, 6.06); Calibrated: 11/15/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/13/2012

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

Mode: LTE Band 5 (Cell), Body SAR, Back side, Mid.ch
10 MHz Bandwidth, QPSK, 25 RB, 12 RB Offset

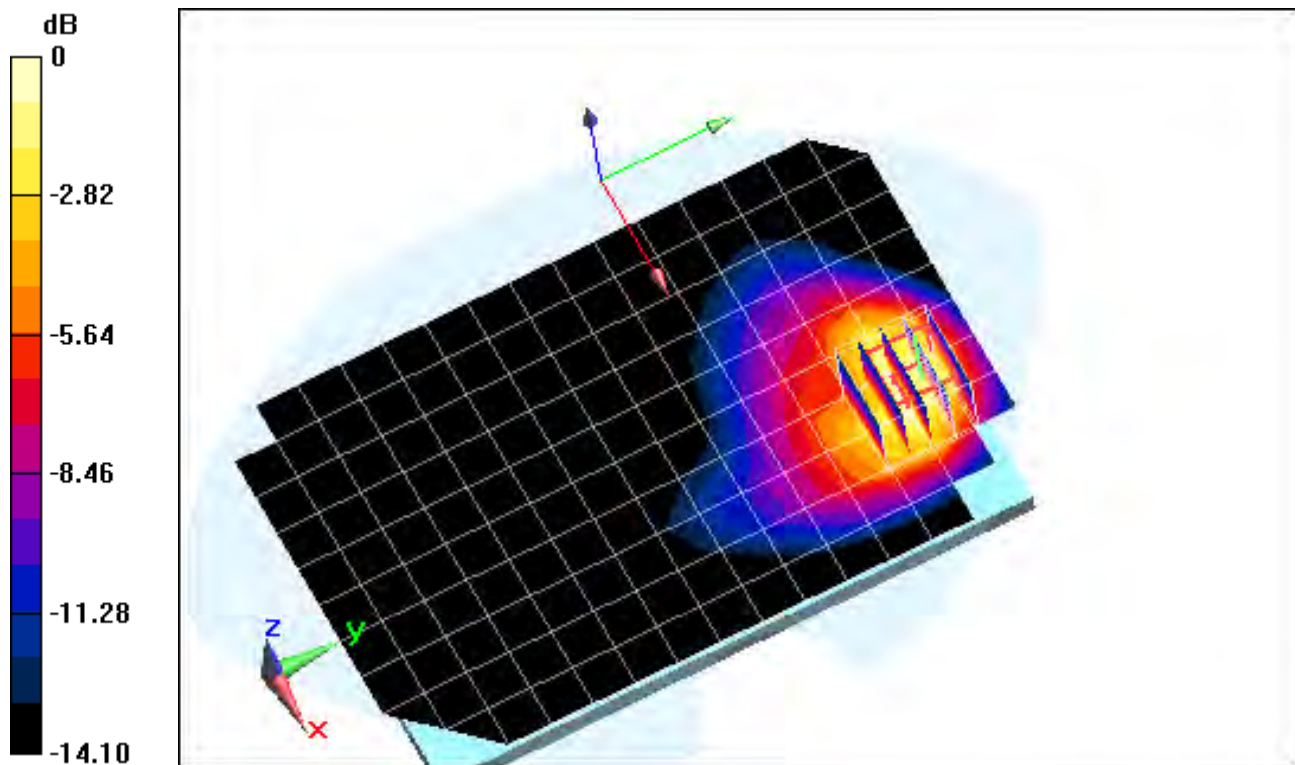
Area Scan (11x16x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 24.034 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.990 W/kg

SAR(1 g) = 0.552 W/kg; SAR(10 g) = 0.303 W/kg



0 dB = 0.571 W/kg = -2.43 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 53

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

Medium: 1750 Body Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.438 \text{ S/m}$; $\epsilon_r = 52.329$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0 mm

Test Date: 04-11-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(7.59, 7.59, 7.59); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Mode: LTE Band 4 (AWS), Body SAR, Top Edge, Mid.ch.
20 MHz Bandwidth, QPSK, 50 RB, 0 RB Offset**

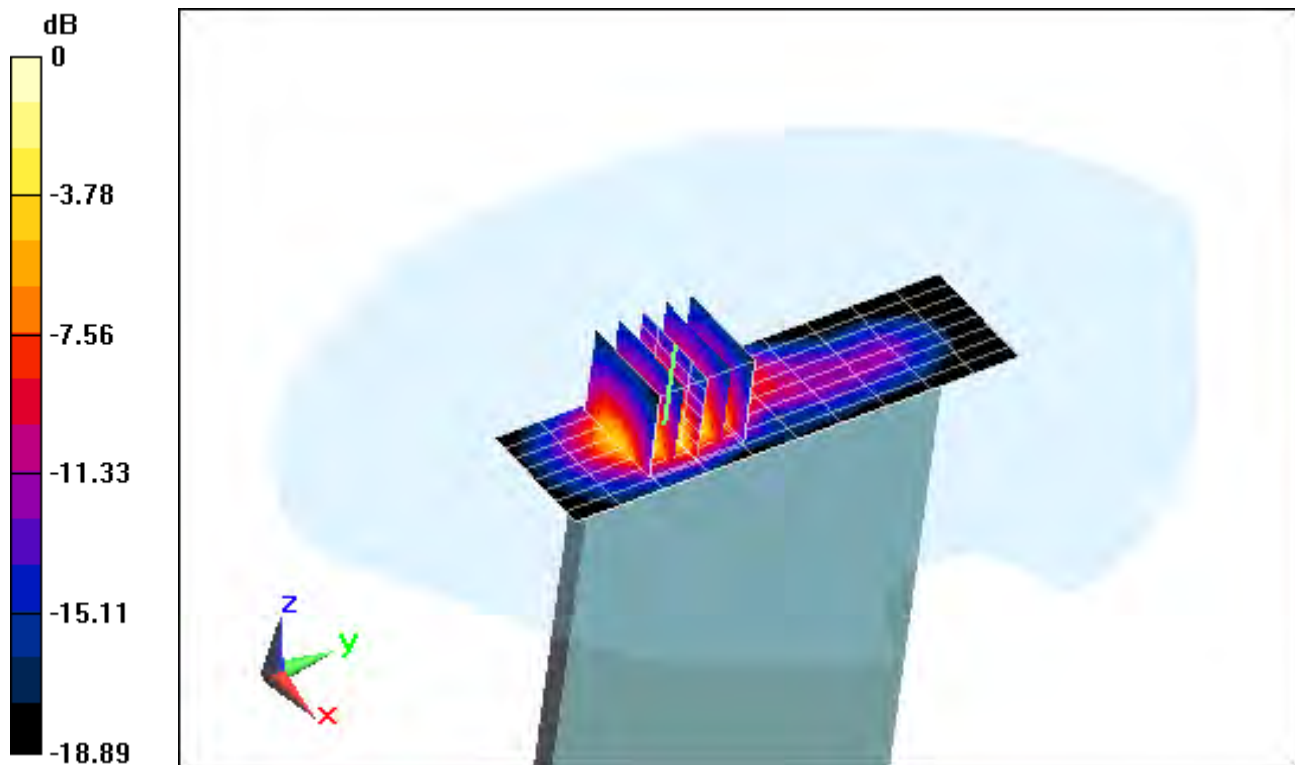
Area Scan (9x11x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 24.913 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.61 W/kg

SAR(1 g) = 0.763 W/kg



0 dB = 0.891 W/kg = -0.50 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 98

Communication System: GSM GPRS; 3 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:2.76

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.547 \text{ S/m}$; $\epsilon_r = 50.917$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 15 mm

Test Date: 04-22-2013; Ambient Temp: 21.9°C; Tissue Temp: 20.7°C

Probe: ES3DV3 - SN3288; ConvF(4.89, 4.89, 4.89); Calibrated: 9/20/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/19/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Mode: GPRS 1900, Body SAR, Top Edge, Mid.ch, 3 Tx Slots

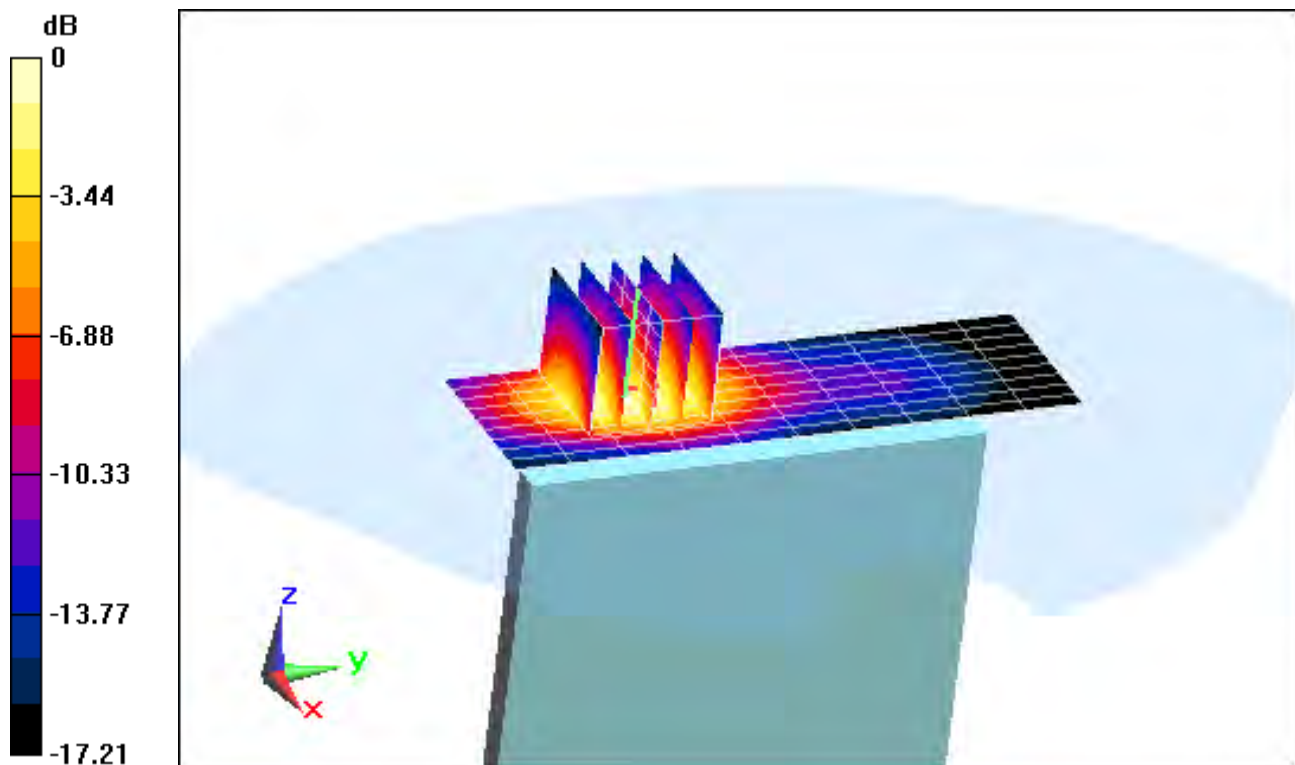
Area Scan (10x11x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 25.133 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 1.47 W/kg

SAR(1 g) = 0.906 W/kg



0 dB = 1.01 W/kg = 0.04 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 98

Communication System:, UMTS; Frequency: 1907.6 MHz; Duty Cycle: 1:1
1900 Body Medium parameters used (interpolated):

$f = 1907.6 \text{ MHz}$; $\sigma = 1.573 \text{ S/m}$; $\epsilon_r = 52.484$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0 mm

Test Date: 04-30-2013; Ambient Temp: 23.8°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Mode: UMTS 1900, Body SAR, Left Edge, High ch.

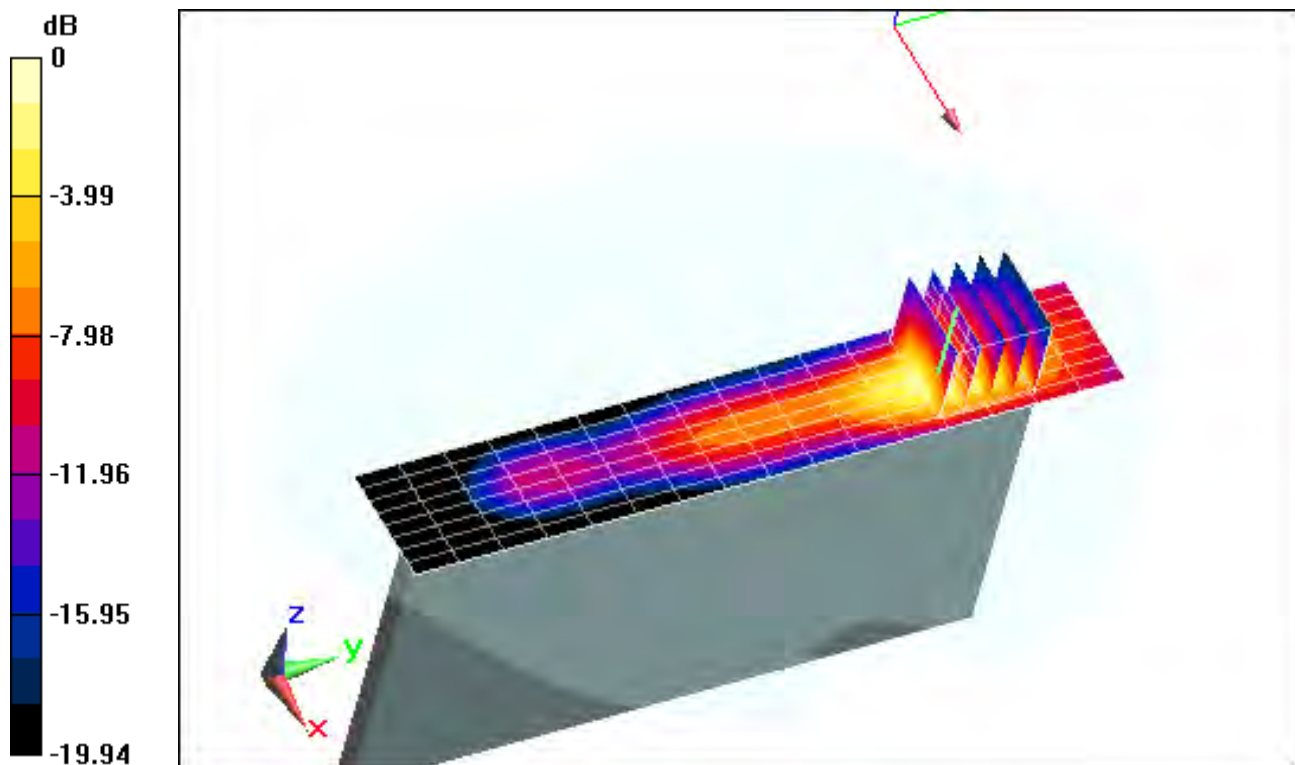
Area Scan (9x17x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 25.805 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 1.83 W/kg

SAR(1 g) = 0.978 W/kg



0 dB = 1.08 W/kg = 0.33 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 98

Communication System: LTE PCS20 Mhz; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.515 \text{ S/m}$; $\epsilon_r = 52.017$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0 mm

Test Date: 05-07-2013; Ambient Temp: 23.9°C; Tissue Temp: 20.2°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/13/2012

Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

Mode: LTE Band 2 (PCS), Body SAR, Left Edge, High ch
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

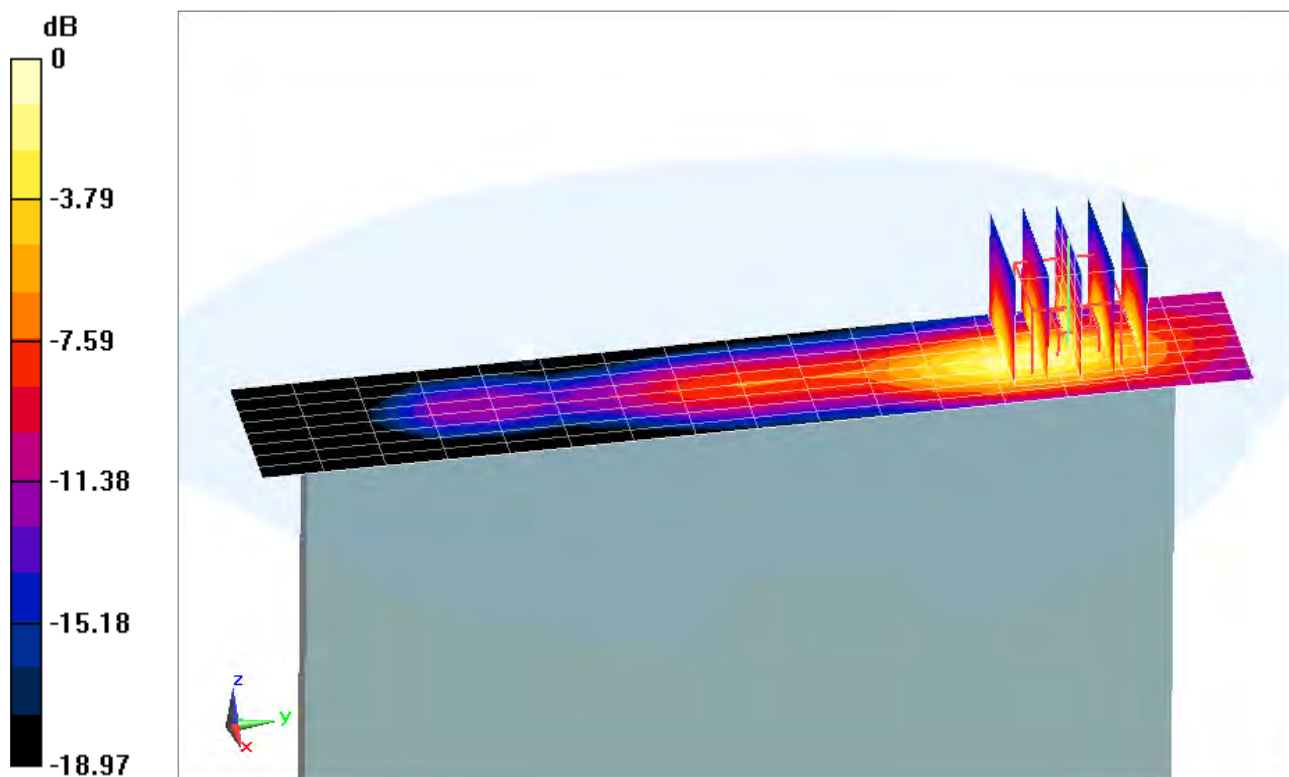
Area Scan (9x17x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 28.343 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 2.11 W/kg

SAR(1 g) = 1.09 W/kg; SAR(10 g) = 0.536 W/kg



0 dB = 1.24 W/kg = 0.93 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 55

Communication System: IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.951 \text{ S/m}$; $\epsilon_r = 51.053$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0 mm

Test Date: 04-22-2013; Ambient Temp: 21.8°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3258; ConvF(4.25, 4.25, 4.25); Calibrated: 2/11/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/15/2012

Phantom: SAM Front; Type: QD000P40CD; Serial: 1717

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Mode: IEEE 802.11b, Body SAR, Ch 06, 1 Mbps, Back Side

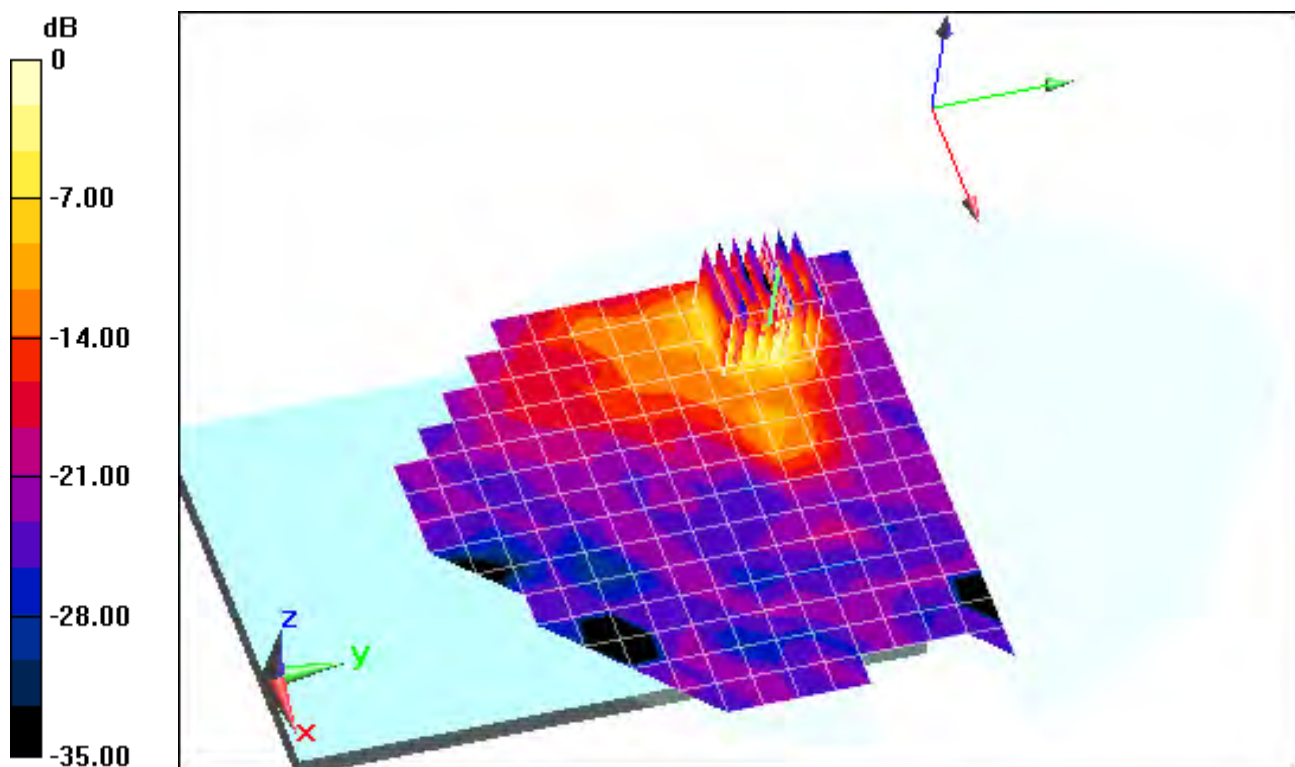
Area Scan (16x15x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 17.954 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 1.79 W/kg

SAR(1 g) = 0.648 W/kg



0 dB = 0.187 W/kg = -7.28 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 55

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5660 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5660 \text{ MHz}$; $\sigma = 6.071 \text{ S/m}$; $\epsilon_r = 48.337$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 0 mm

Test Date: 04-08-2013; Ambient Temp: 24.6°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(3.32, 3.32, 3.32); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

Mode: IEEE 802.11a, 5.5 GHz, Body SAR, Ch 132, 6 Mbps, Back Side

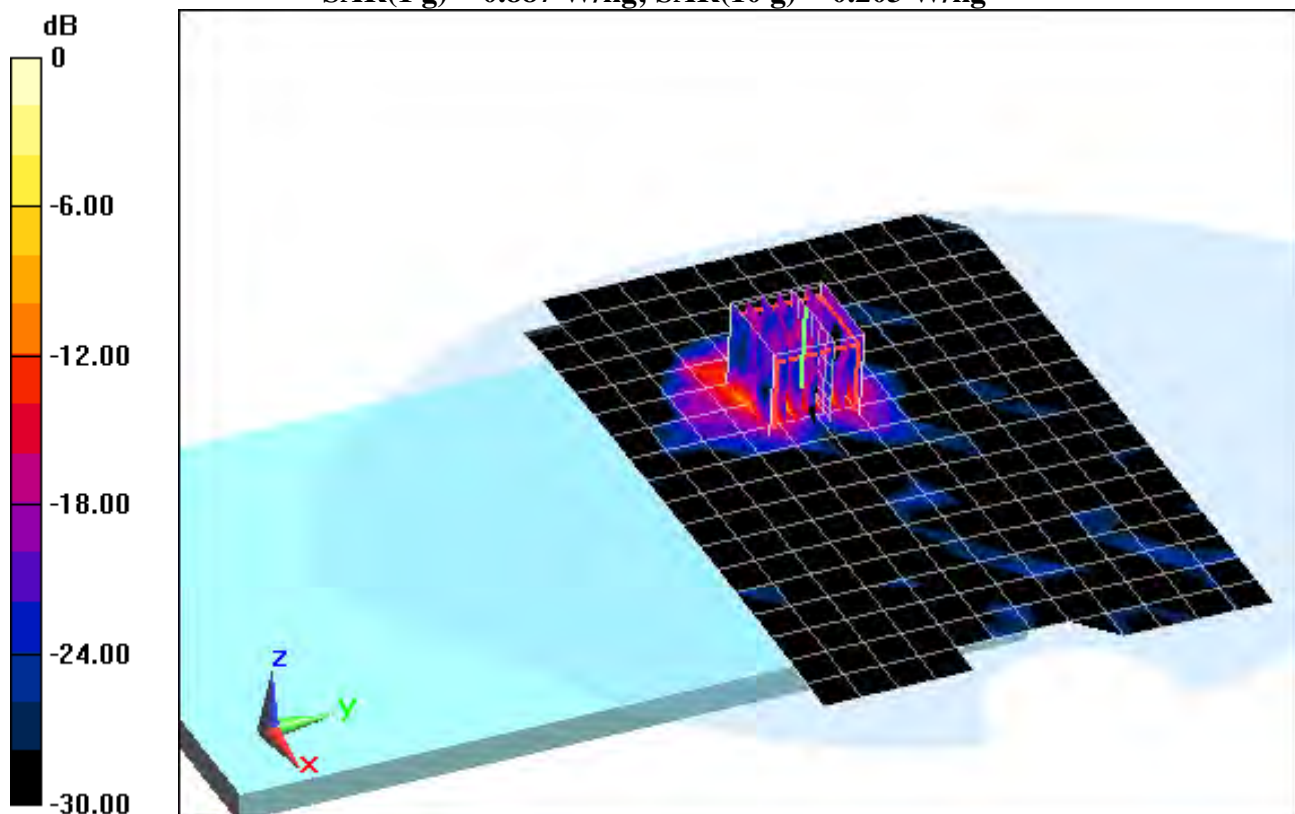
Area Scan (19x13x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

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 = 13.018 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 5.29 W/kg

SAR(1 g) = 0.887 W/kg; SAR(10 g) = 0.203 W/kg



0 dB = 2.92 W/kg = 4.65 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 55

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5785 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5785 \text{ MHz}$; $\sigma = 6.253 \text{ S/m}$; $\epsilon_r = 48.086$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 0 mm

Test Date: 04-08-2013; Ambient Temp: 24.6°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 157, 6 Mbps, Back Side

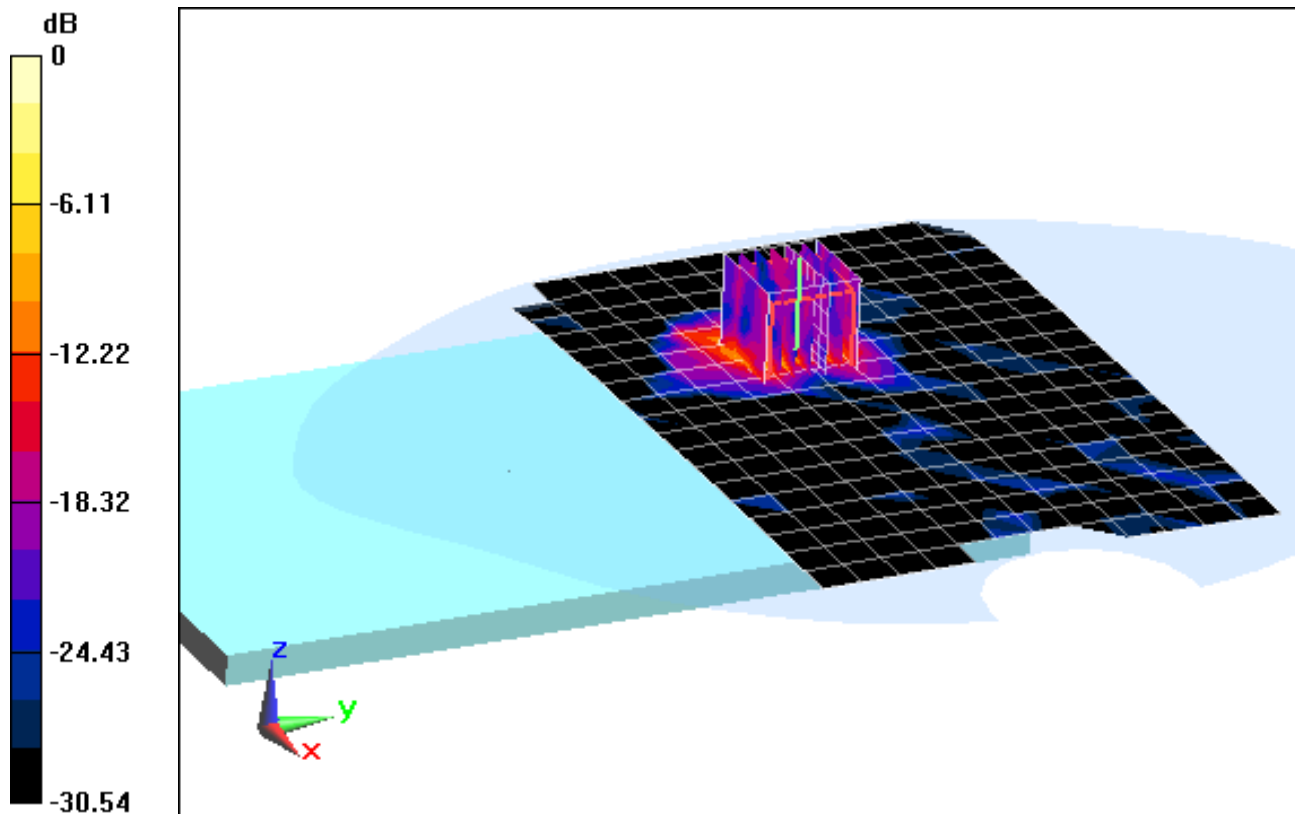
Area Scan (19x13x1): Measurement grid: dx=10mm, dy=10mm

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

Reference Value = 11.279 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 4.45 W/kg

SAR(1 g) = 0.806 W/kg; SAR(10 g) = 0.185 W/kg



0 dB = 2.56 W/kg = 4.08 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSGHI467; Type: Portable Tablet; Serial: 55

Communication System: Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2441 \text{ MHz}$; $\sigma = 2.027 \text{ S/m}$; $\epsilon_r = 50.612$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 0 mm

Test Date: 04-09-2013; Ambient Temp: 24.3°C; Tissue Temp: 24.0°C

Probe: ES3DV2 - SN3022; ConvF(3.97, 3.97, 3.97); Calibrated: 8/28/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

Mode: Bluetooth, Body SAR, Ch 39, 1 Mbps, Top Edge

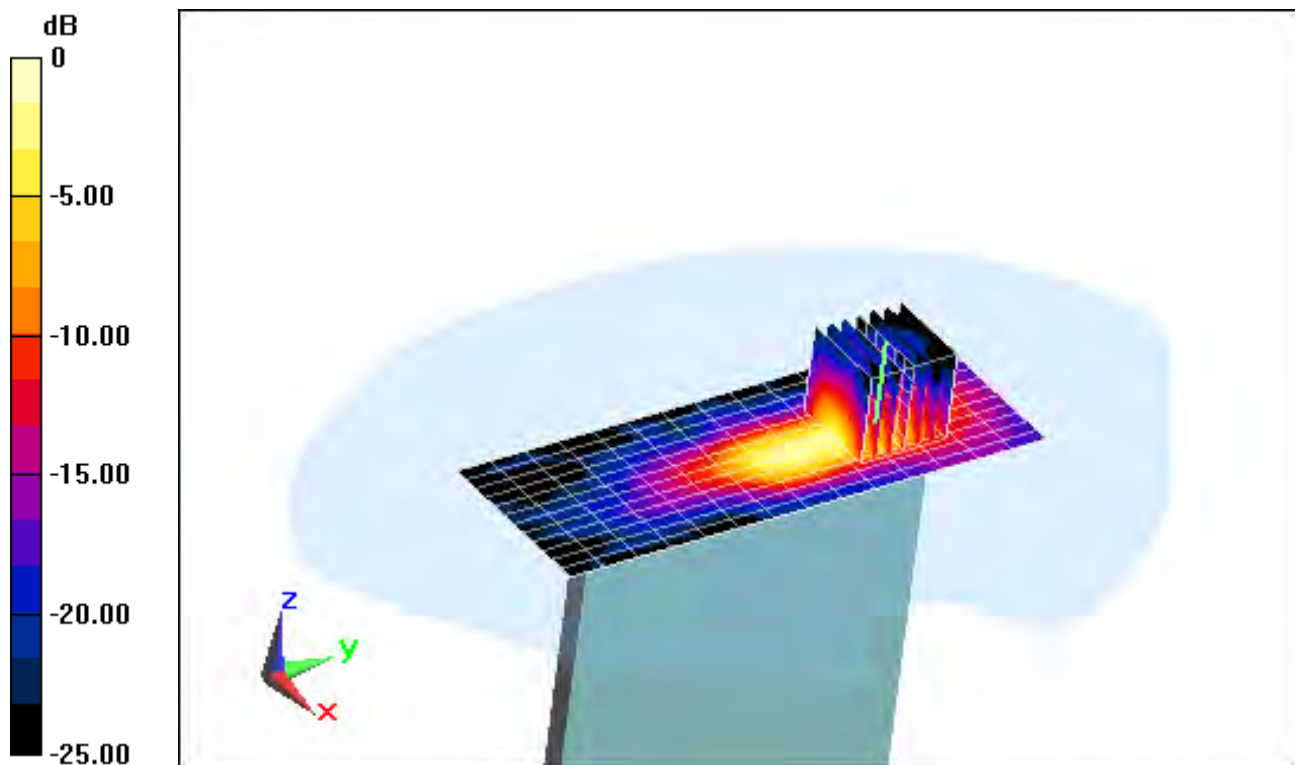
Area Scan (13x15x1): Measurement grid: dx=5mm, dy=12mm

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.724 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.509 W/kg

SAR(1 g) = 0.187 W/kg; SAR(10 g) = 0.072 W/kg



0 dB = 0.273 W/kg = -5.64 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1003

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 740 Body Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.98 \text{ S/m}$; $\epsilon_r = 55.445$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-10-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.4°C

Probe: ES3DV3 - SN3209; ConvF(6.38, 6.38, 6.38); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0 Door; Type: QDOVA002BB; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.9 (7117)

750 MHz System Verification

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

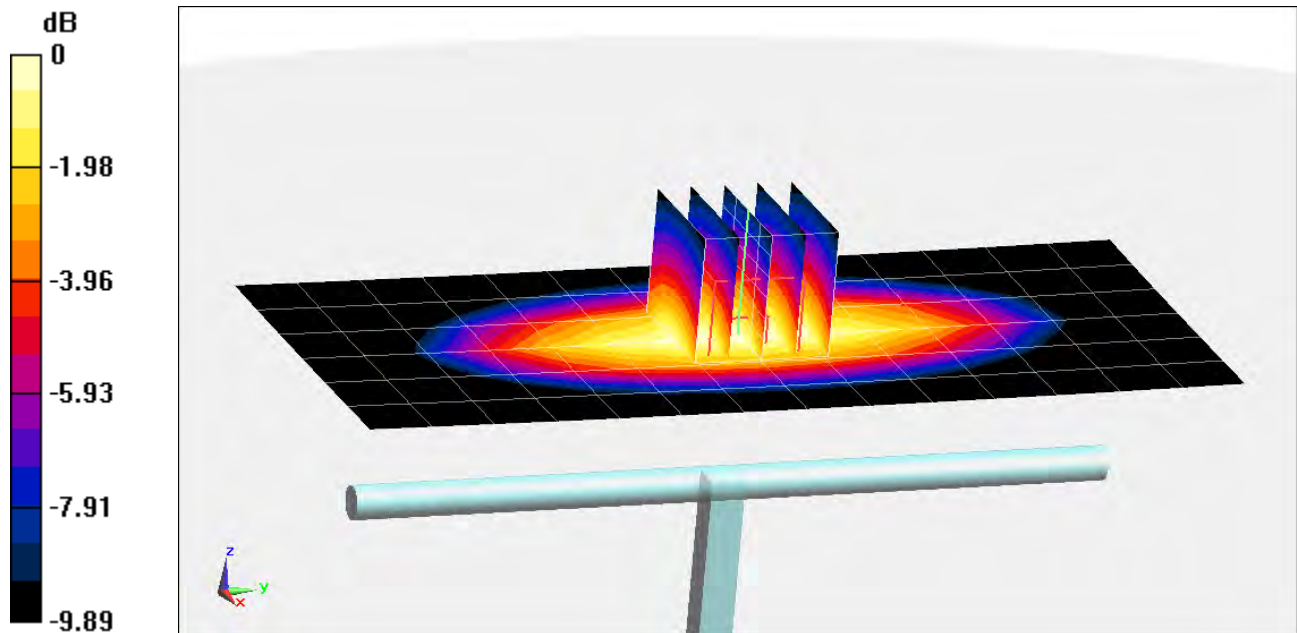
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.28 W/kg

SAR(1 g) = 0.882 W/kg; SAR(10 g) = 0.587 W/kg

Deviation = -0.11%



0 dB = 0.950 W/kg = -0.22 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.978 \text{ mho/m}$; $\epsilon_r = 52.575$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.5 cm

Test Date: 04-05-2013; Ambient Temp: 24.2°C; Tissue Temp: 23.1°C

Probe: ES3DV3 - SN3287; ConvF(6.06, 6.06, 6.06); Calibrated: 11/15/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/13/2012

Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

835MHz System Verification

Area Scan (7x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

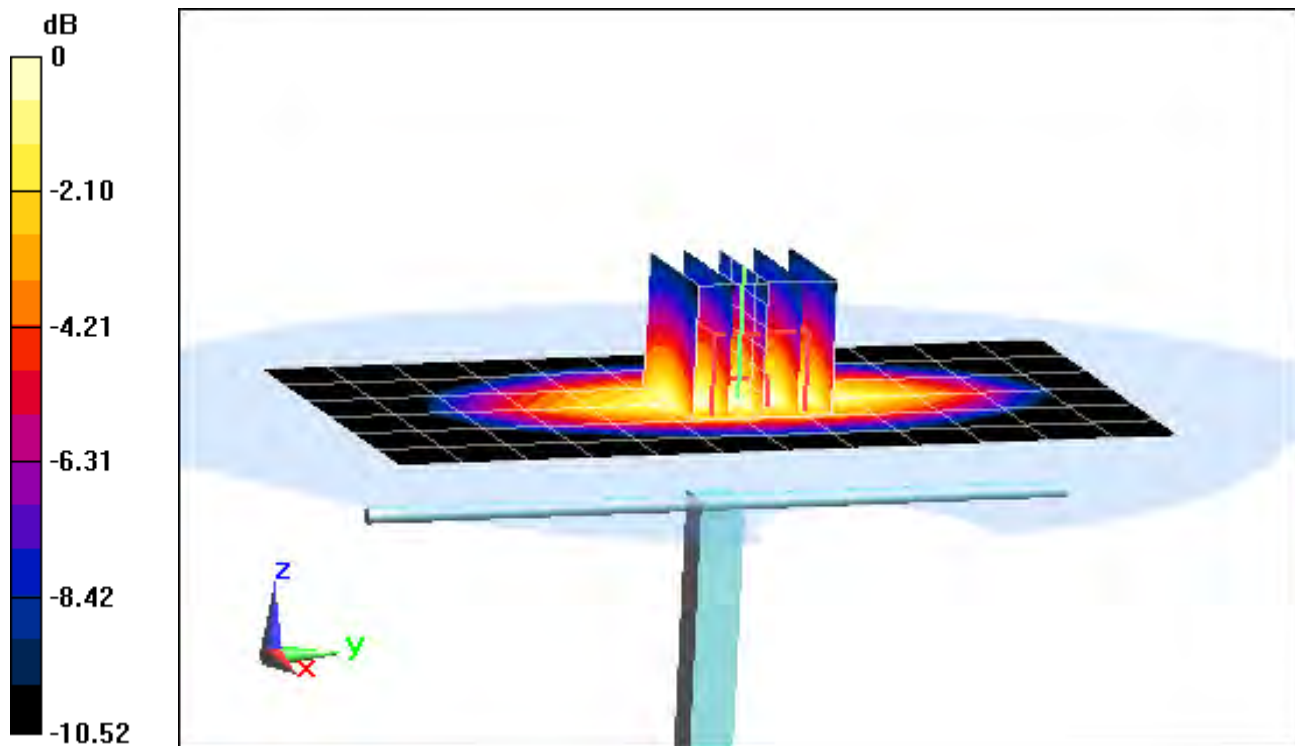
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.451 mW/g

SAR(1 g) = 1.01 mW/g; SAR(10 g) = 0.662 mW/g

Deviation: 5.65%



0 dB = 1.09 mW/g = 0.75 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d026

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.992 \text{ mho/m}$; $\epsilon_r = 54.349$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.5 cm

Test Date: 04-09-2013; Ambient Temp: 23.9°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3287; ConvF(6.06, 6.06, 6.06); Calibrated: 11/15/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/13/2012

Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

835MHz System Verification

Area Scan (7x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

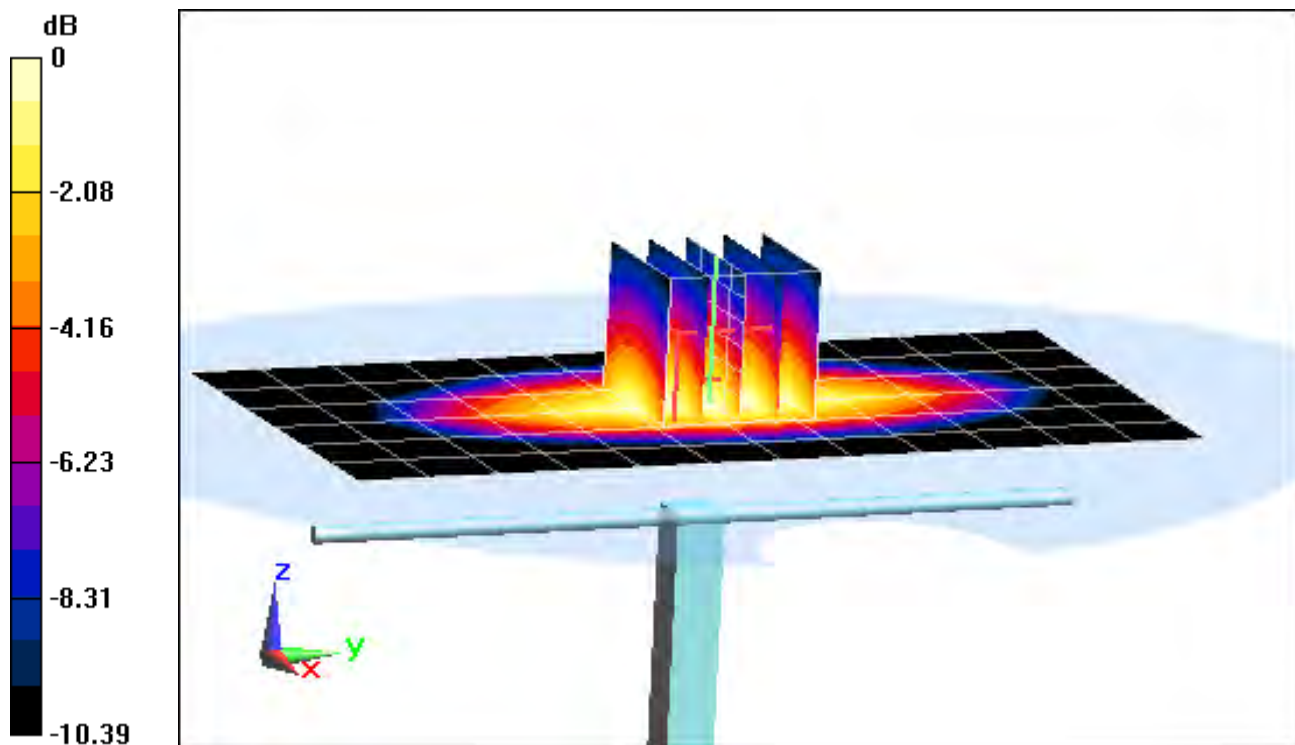
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.406 mW/g

SAR(1 g) = 0.974 mW/g; SAR(10 g) = 0.641 mW/g

Deviation: 1.67%



0 dB = 1.06 mW/g = 0.51 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d132

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 1.016 \text{ mho/m}$; $\epsilon_r = 54.026$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.5 cm

Test Date: 04-19-2013; Ambient Temp: 24.9°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/8/2013

Phantom: ELI v5.0 Door; Type: QDOVA002BB; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm

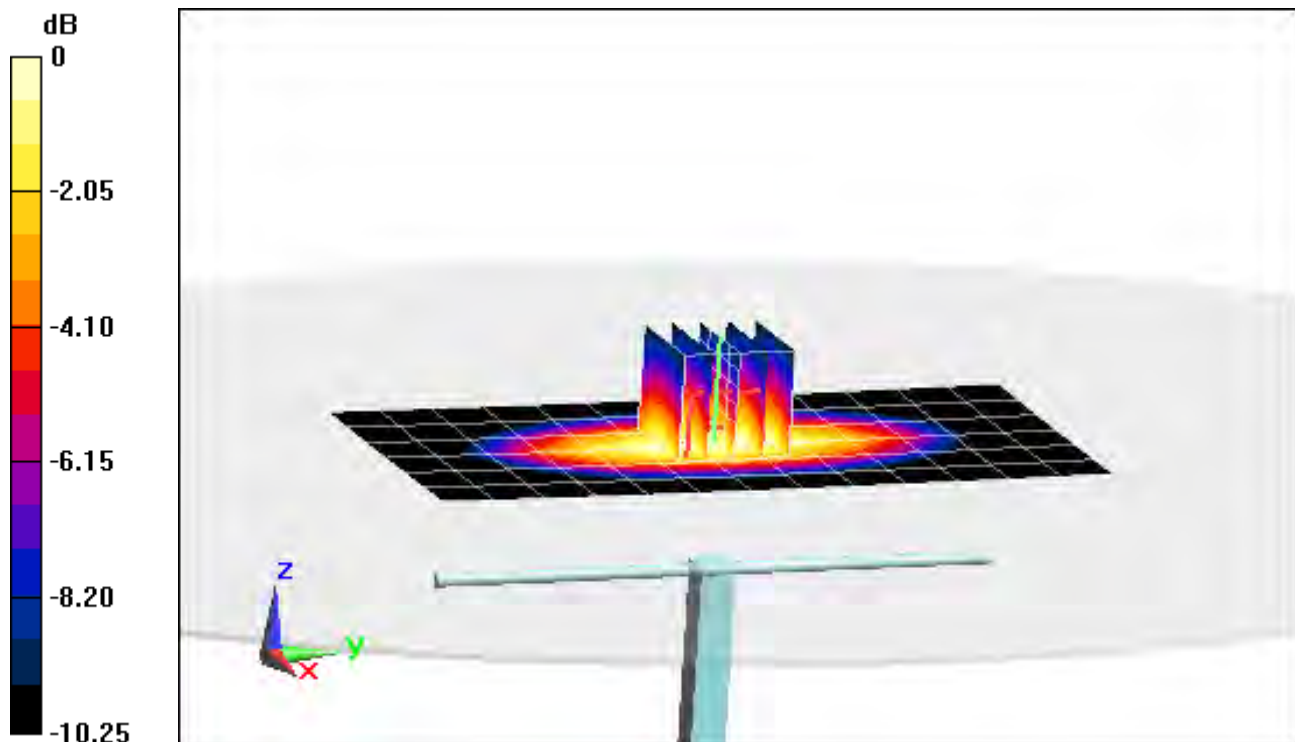
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.445 mW/g

SAR(1 g) = 0.996 mW/g; SAR(10 g) = 0.657 mW/g

Deviation: 6.41%



0 dB = 1.08 mW/g = 0.67 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.457 \text{ S/m}$; $\epsilon_r = 52.275$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-11-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(7.59, 7.59, 7.59); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

1750 MHz System Verification

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

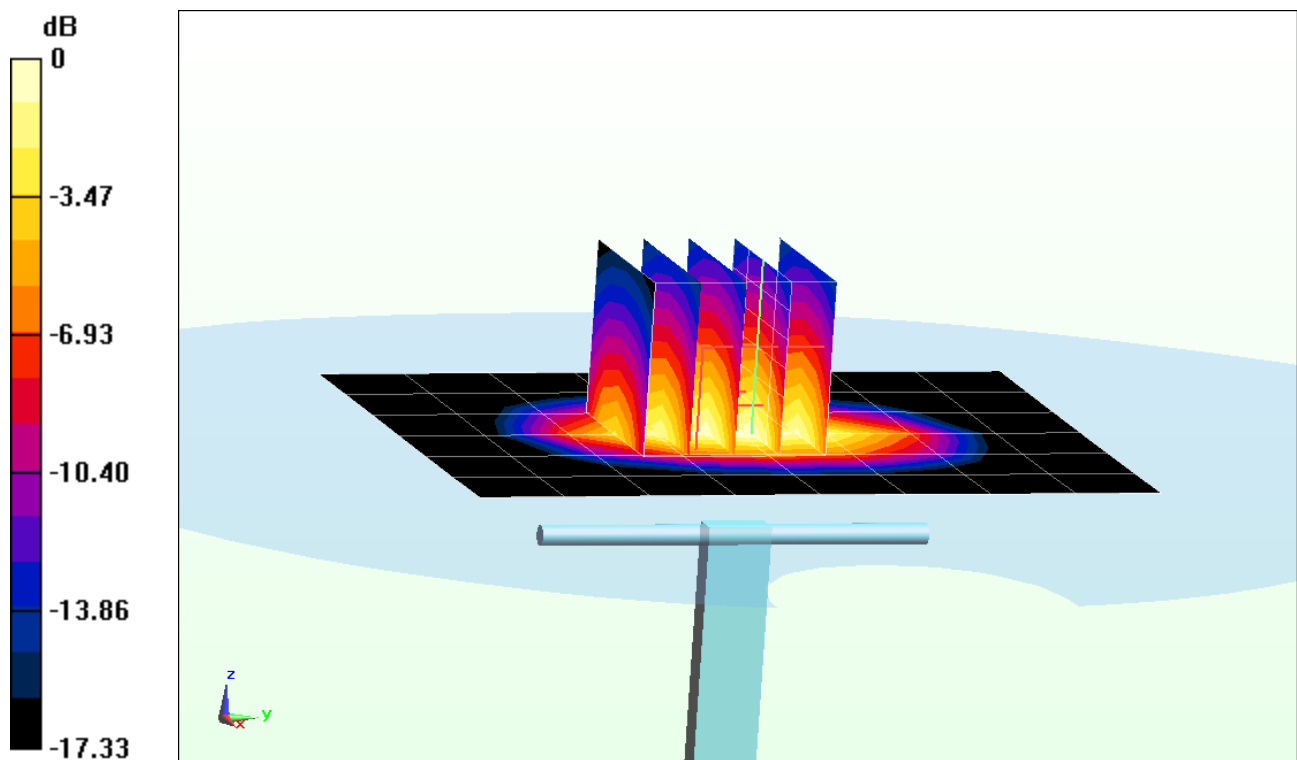
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.57 W/kg

SAR(1 g) = 3.7 W/kg

Deviation = -1.60%



PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.567 \text{ S/m}$; $\epsilon_r = 50.859$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-22-2013; Ambient Temp: 21.9°C; Tissue Temp: 20.7°C

Probe: ES3DV3 - SN3288; ConvF(4.89, 4.89, 4.89); Calibrated: 9/20/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/19/2012

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

1900 MHz System Verification

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

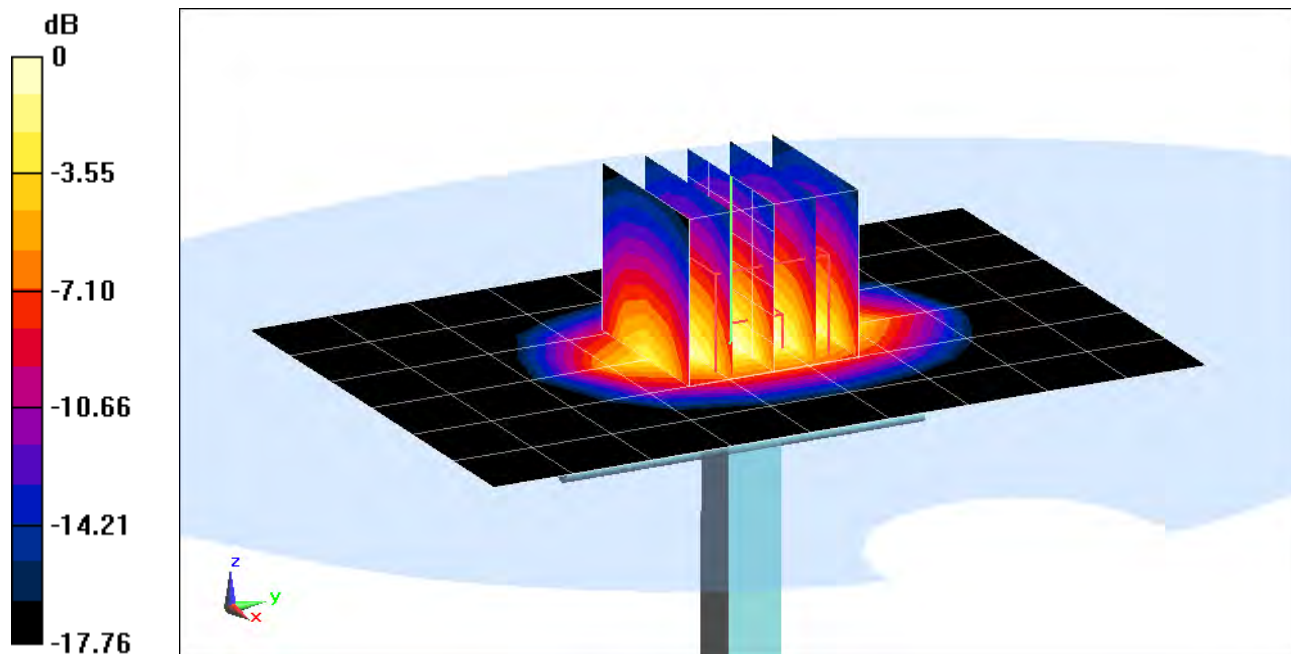
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power: 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.65 W/kg

SAR(1 g) = 4.25 W/kg; SAR(10 g) = 2.21 W/kg

Deviation: 4.17%



0 dB = 4.77 W/kg = 6.79 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.565 \text{ S/m}$; $\epsilon_r = 52.509$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 04-30-2013; Ambient Temp: 23.8°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 2/6/2013

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

1900 MHz System Verification

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

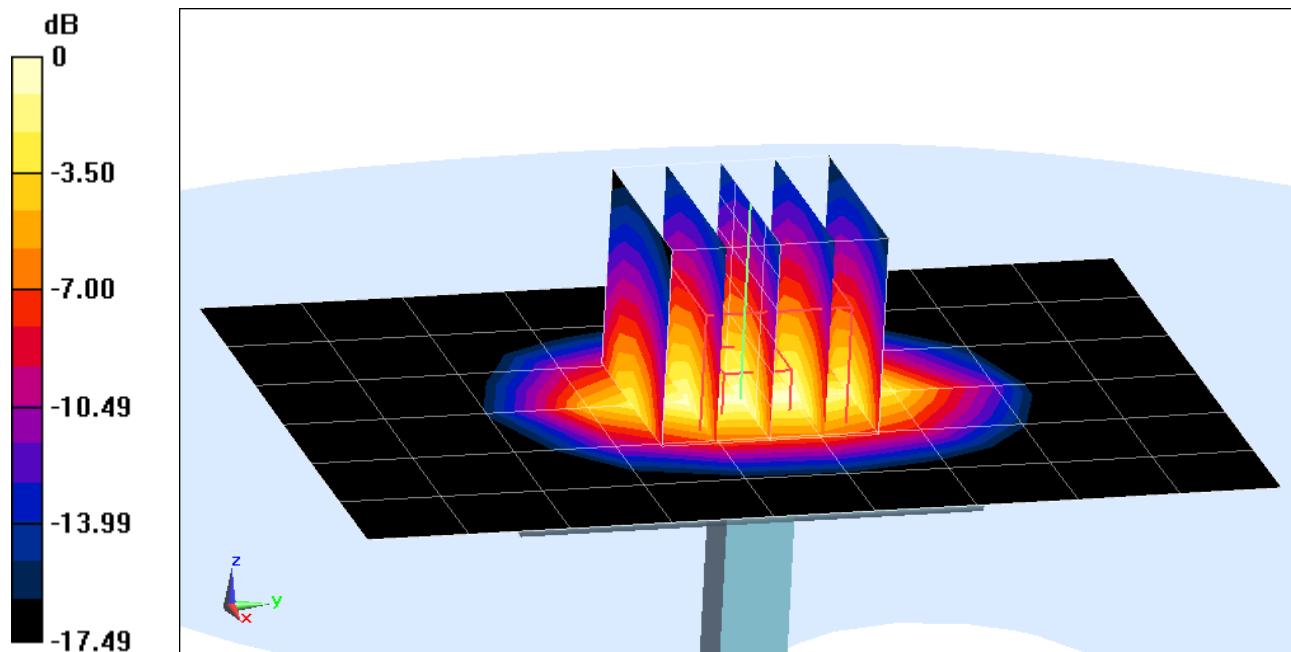
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.63 W/kg

SAR(1 g) = 4.19 W/kg; SAR(10 g) = 2.18 W/kg

Deviation = 2.70 %



0 dB = 4.69 W/kg = 6.71 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 1900 MHz; Type: D1900V2; Serial: 5d080

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.515 \text{ S/m}$; $\epsilon_r = 52.017$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-07-2013; Ambient Temp: 23.9°C; Tissue Temp: 20.2°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/13/2012

Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

1900MHz System Verification

Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm

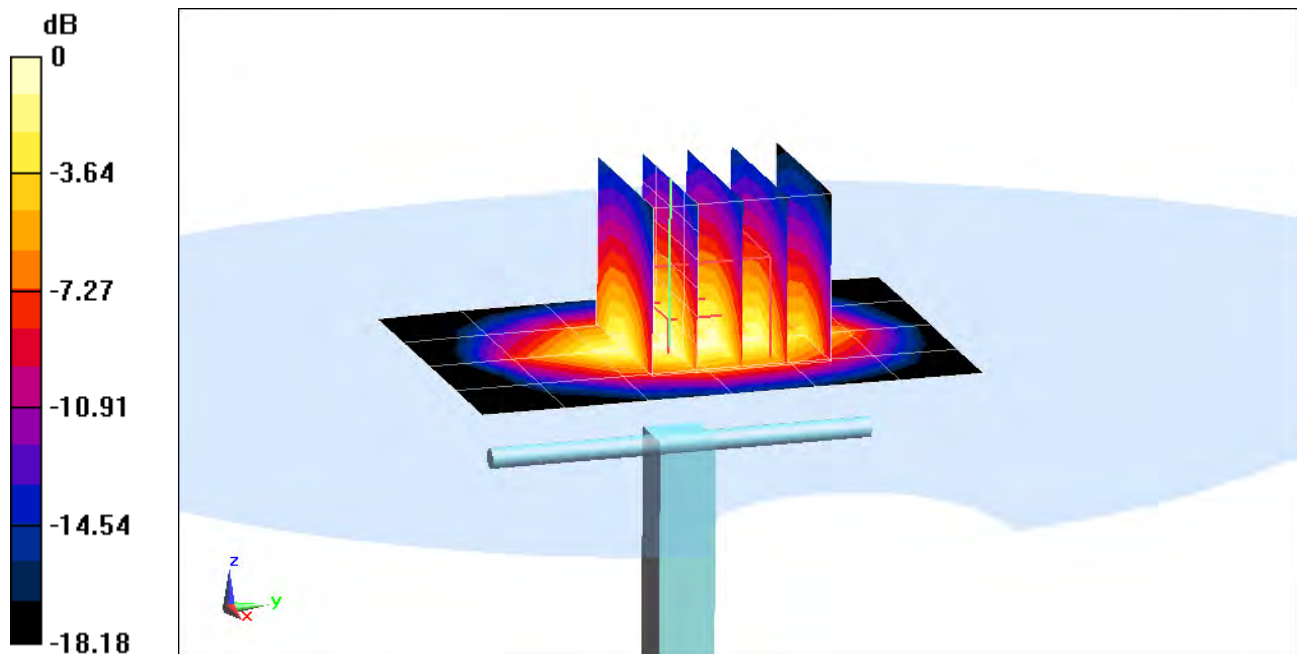
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 7.44 W/kg

SAR(1 g) = 4.09 W/kg; SAR(10 g) = 2.12 W/kg

Deviation = 1.49%



0 dB = 4.45 W/kg = 6.48 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.038 \text{ mho/m}$; $\epsilon_r = 50.579$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 04-09-2013; Ambient Temp: 24.3°C; Tissue Temp: 24.0°C

Probe: ES3DV2 - SN3022; ConvF(3.97, 3.97, 3.97); Calibrated: 8/28/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/24/2012

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

2450MHz System Verification

Area Scan (6x8x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

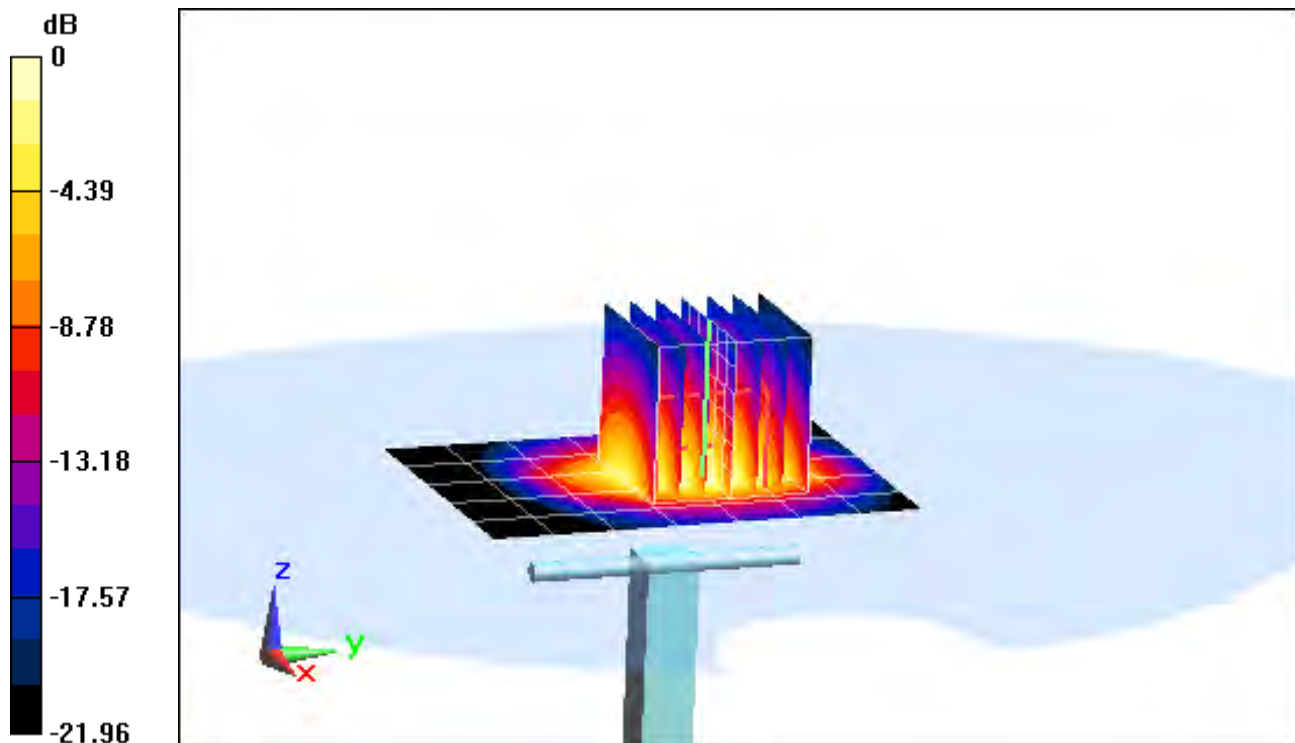
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 11.735 mW/g

SAR(1 g) = 5.51 mW/g; SAR(10 g) = 2.58 mW/g

Deviation: 6.78%



0 dB = 7.16 mW/g = 17.10 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 797

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.967 \text{ S/m}$; $\epsilon_r = 51.01$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 04-22-2013; Ambient Temp: 21.8°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3258; ConvF(4.25, 4.25, 4.25); Calibrated: 2/11/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/15/2012

Phantom: SAM Front; Type: QD000P40CD; Serial: 1717

Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

2450 MHz System Verification

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

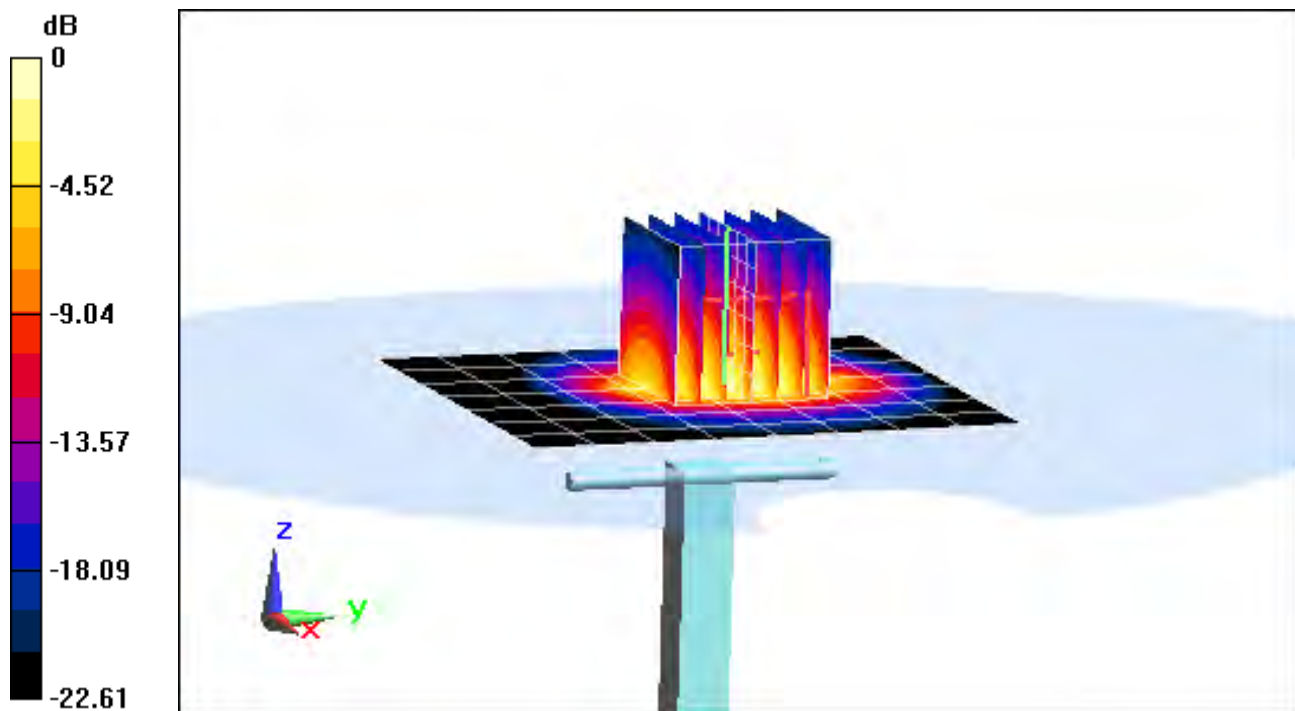
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 10.3 W/kg

SAR(1 g) = 4.73 W/kg; SAR(10 g) = 2.16 W/kg

Deviation: -4.64%



0 dB = 6.15 W/kg = 7.89 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1057

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 5.393 \text{ mho/m}$; $\epsilon_r = 49.513$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 04-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3589; ConvF(3.99, 3.99, 3.99); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

5200MHz System Verification

Area Scan (7x9x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

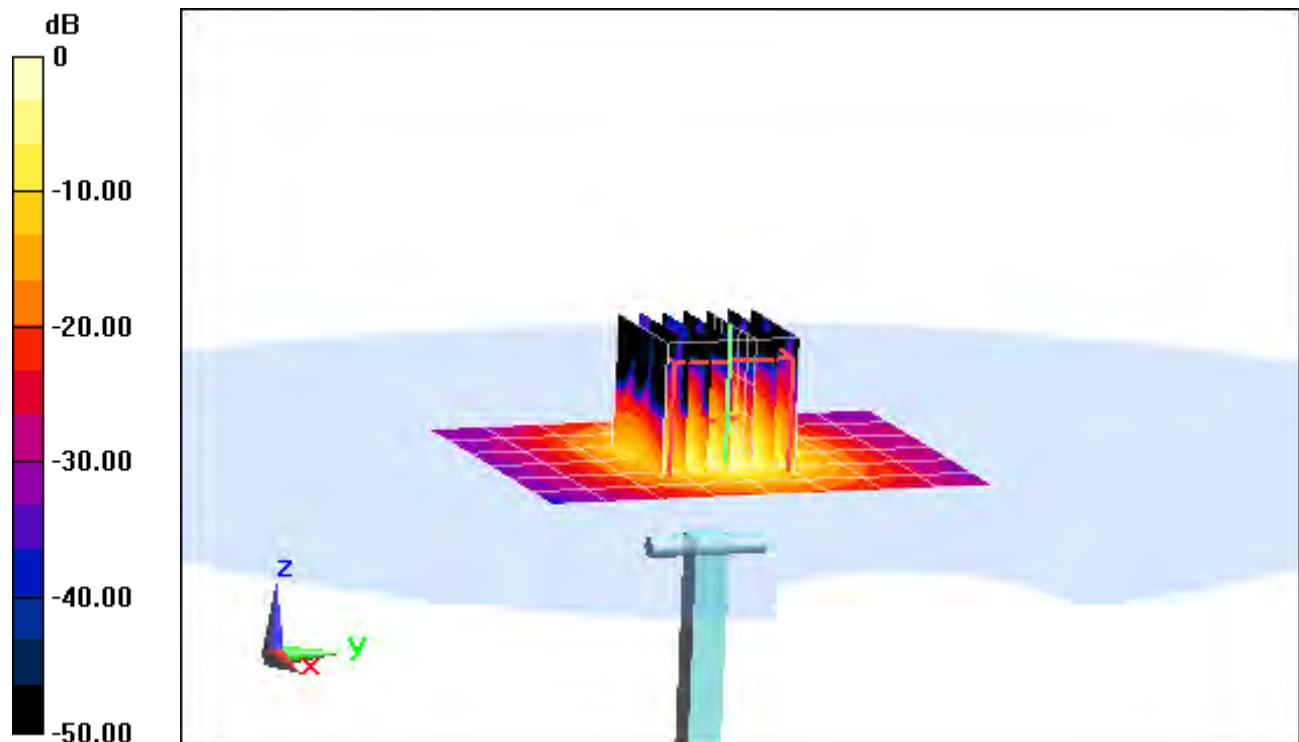
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 34.640 mW/g

SAR(1 g) = 7.41 mW/g; SAR(10 g) = 2.06 mW/g

Deviation: -1.85%



0 dB = 16.9 mW/g = 24.56 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1057

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.507 \text{ mho/m}$; $\epsilon_r = 49.296$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 04-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.3°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); Calibrated: 1/17/2013;

Sensor-Surface: 1.4 mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

5300MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

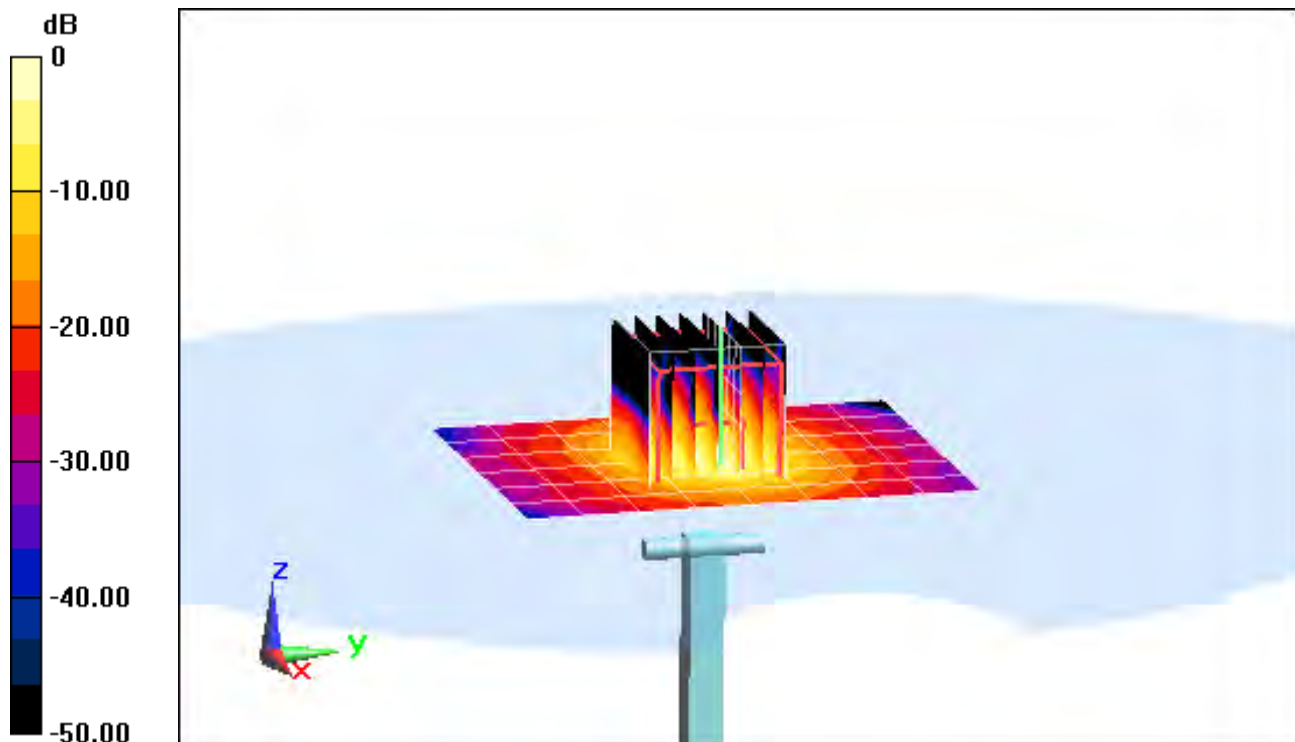
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 35.220 mW/g

SAR(1 g) = 7.25 mW/g; SAR(10 g) = 1.98 mW/g

Deviation: -3.72%



0 dB = 16.6 mW/g = 24.40 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1057

Communication System: CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 5.817 \text{ mho/m}$; $\epsilon_r = 48.758$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 04-08-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.3°C

Probe: EX3DV4 - SN3589; ConvF(3.52, 3.52, 3.52); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

5500MHz System Verification

Area Scan (7x9x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

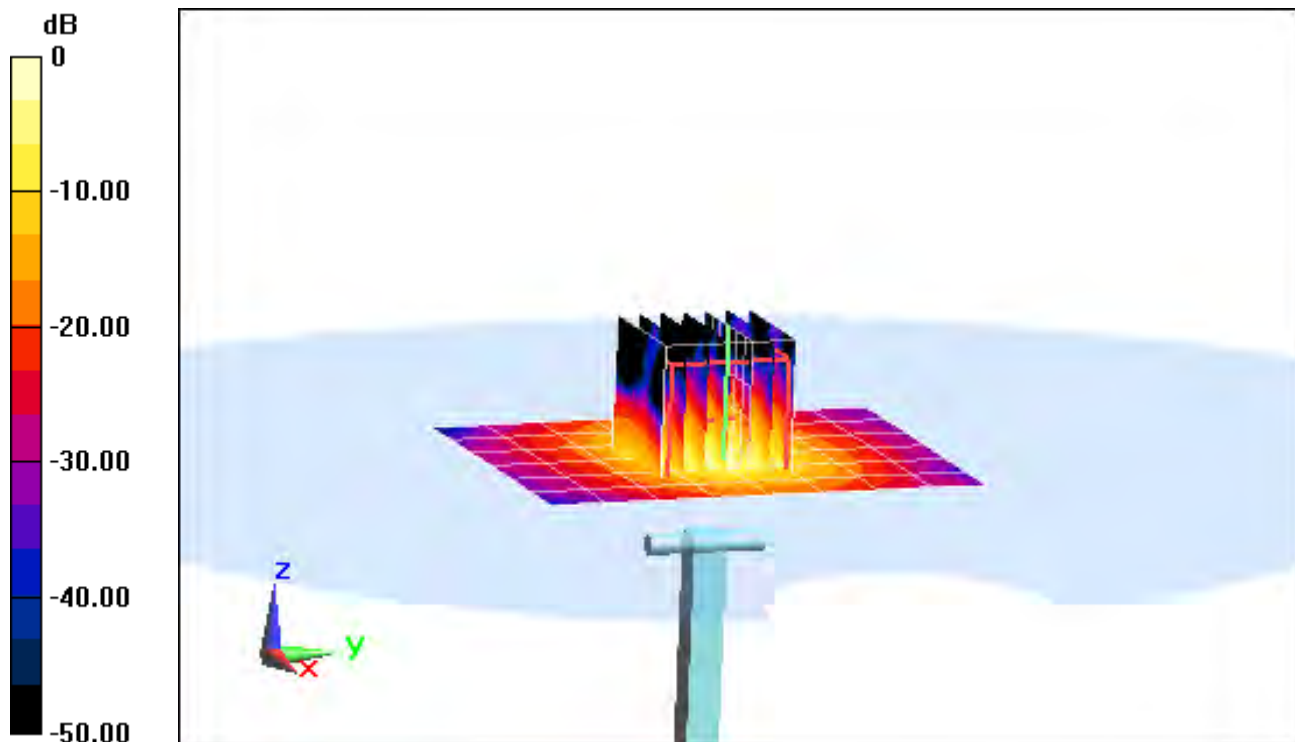
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 37.943 mW/g

SAR(1 g) = 7.87 mW/g; SAR(10 g) = 2.14 mW/g

Deviation: -2.60%



0 dB = 18.7 mW/g = 25.44 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1057

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.891 \text{ mho/m}$; $\epsilon_r = 48.302$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 04-08-2013; Ambient Temp: 24.6°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(3.32, 3.32, 3.32); Calibrated: 1/17/2013;

Sensor-Surface: 1.4 mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

5600MHz System Verification

Area Scan (7x9x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

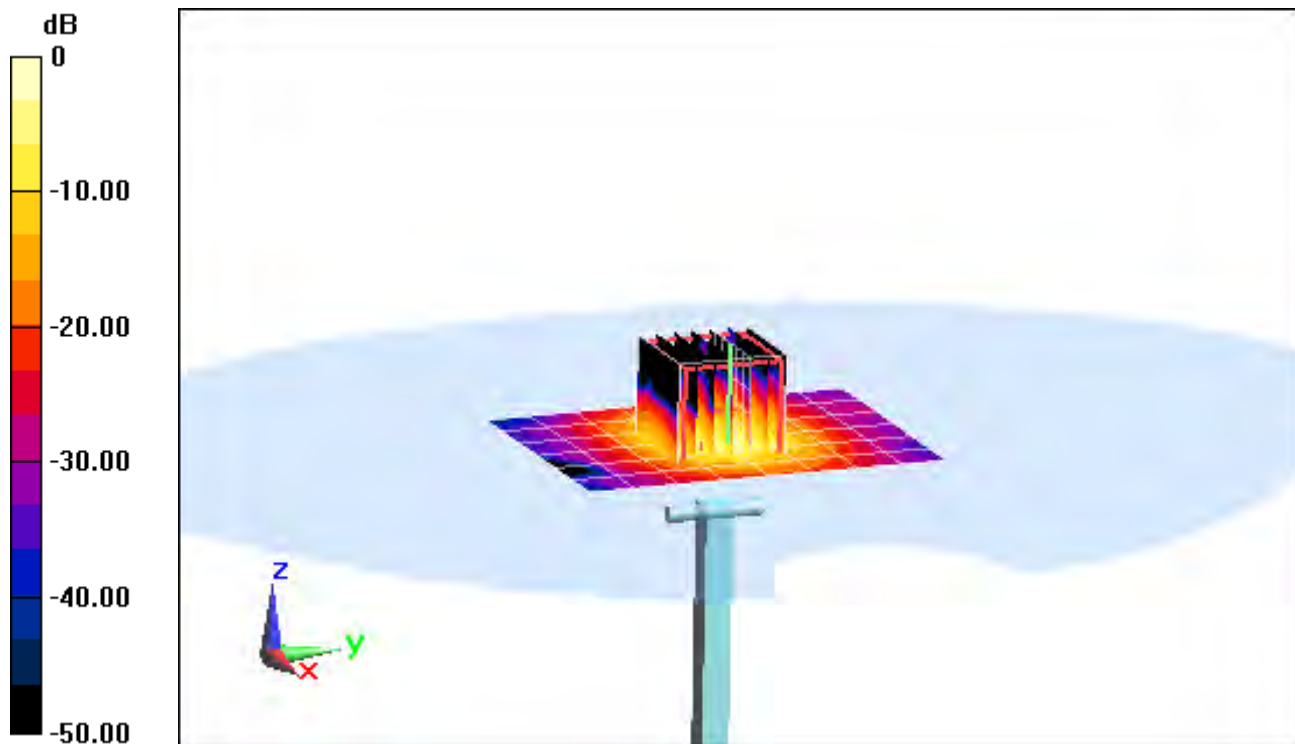
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio 1.4

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 39.042 mW/g

SAR(1 g) = 8.12 mW/g; SAR(10 g) = 2.21 mW/g

Deviation: 1.12%



0 dB = 19.2 mW/g = 25.67 dB mW/g

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1057

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.26 \text{ mho/m}$; $\epsilon_r = 48.078$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section Space: 1.0 cm

Test Date: 04-08-2013; Ambient Temp: 24.6°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/17/2013

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.9 (7117)

5800MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

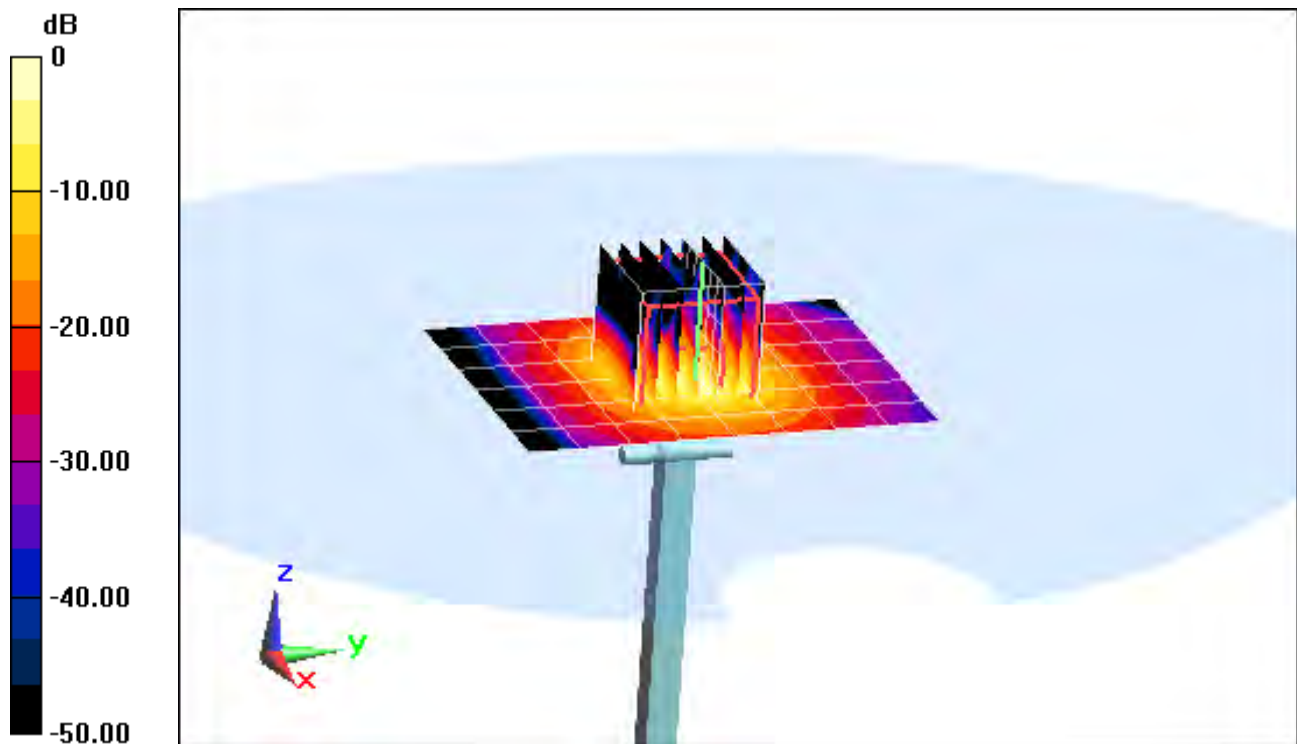
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 40.069 mW/g

SAR(1 g) = 7.66 mW/g; SAR(10 g) = 2.06 mW/g

Deviation: 2.00%



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 108**

Client **PC Test**

Certificate No: **D1750V2-1051_Apr12**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1051**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **April 24, 2012**

*✓KOK
5/4/12*

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	<i>[Signature]</i>

	Name	Function	Signature
Approved by:	Katja Pokovic	Technical Manager	<i>[Signature]</i>

Issued: April 24, 2012

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



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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.6 $\pm$ 6 %	1.35 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.03 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	36.6 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.83 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	19.5 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.9 $\pm$ 6 %	1.47 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.33 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	37.6 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.03 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.2 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.7 Ω - 0.2 j Ω
Return Loss	- 42.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.0 Ω + 0.0 j Ω
Return Loss	- 27.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.222 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	February 19, 2010

DASY5 Validation Report for Head TSL

Date: 24.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.35$ mho/m; $\epsilon_r = 40.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.22, 5.22, 5.22); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

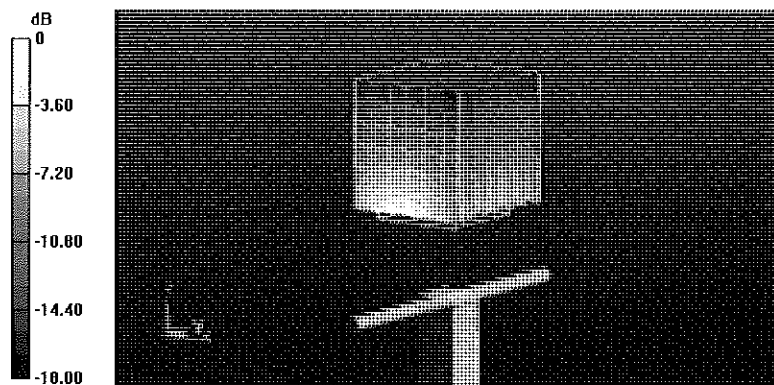
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.857 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 16.022 mW/g

SAR(1 g) = 9.03 mW/g; SAR(10 g) = 4.83 mW/g

Maximum value of SAR (measured) = 11.2 mW/g



0 dB = 11.2 mW/g = 20.98 dB mW/g

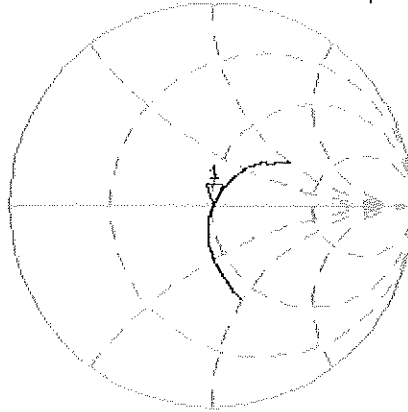
Impedance Measurement Plot for Head TSL

24 Apr 2012 09:49:22
[CH1] S11 1 U FS 1: 50.672 Ω -216.80 m Ω 419.50 pF 1 750.000 000 MHz

*
De l
Cor

Avg
16

H1 d

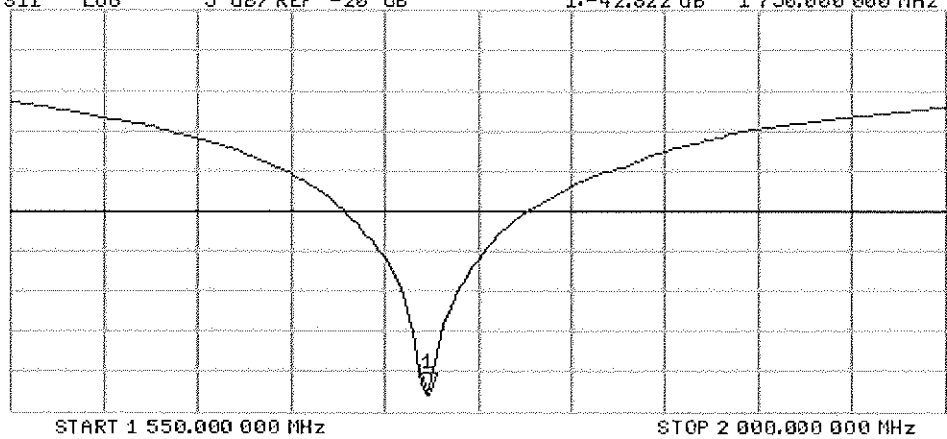


CH2 S11 LOG 5 dB/REF -20 dB 1:-42.822 dB 1 750.000 000 MHz

Cor

Avg
16

H1 d



DASY5 Validation Report for Body TSL

Date: 24.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.47$ mho/m; $\epsilon_r = 52.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.85, 4.85, 4.85); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

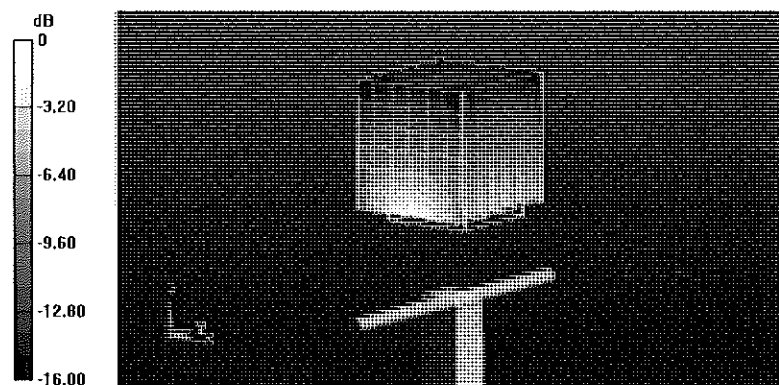
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.394 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 15.953 mW/g

SAR(1 g) = 9.33 mW/g; SAR(10 g) = 5.03 mW/g

Maximum value of SAR (measured) = 11.7 mW/g

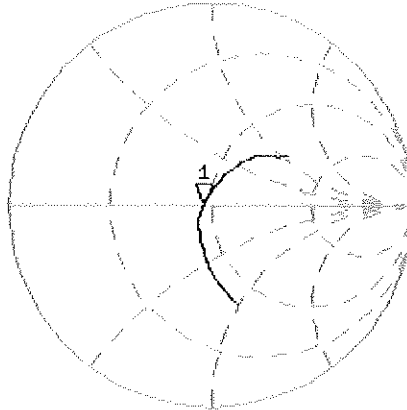


0 dB = 11.7 mW/g = 21.36 dB mW/g

Impedance Measurement Plot for Body TSL

24 Apr 2012 09:48:35
 [CH1] S11 1 U FS 1: 45.977 Ω 0.0020 Ω 177.41 fH 1 750.000 000 MHz

*
 Del
 Cor



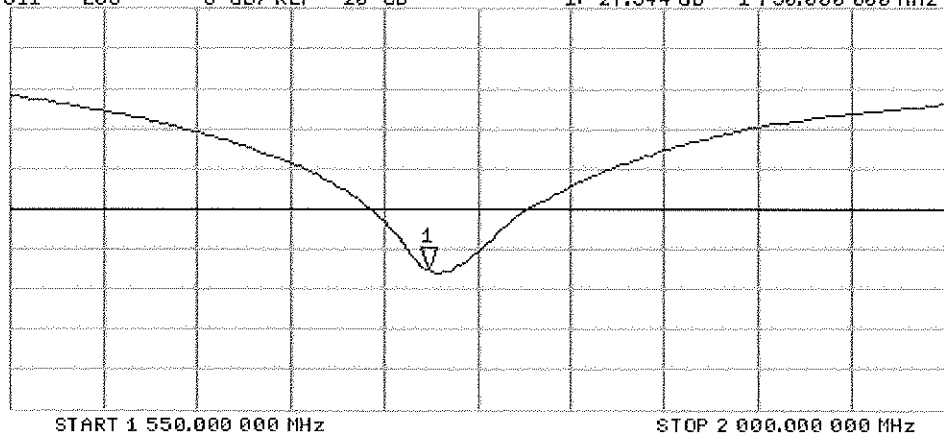
avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-27.544 dB 1 750.000 000 MHz

Cor

avg
 16

H1d





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Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **D1900V2-5d148_Feb13**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d148**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **February 06, 2013**

✓
KOK
2/21/13

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 EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Leif Klysner** Name: **Leif Klysner** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Technical Manager

Signature

Issued: February 6, 2013

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 108**

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.4 $\pm$ 6 %	1.38 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.9 $\pm$ 6 %	1.53 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.7 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 Ω + 5.9 j Ω
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω + 6.3 j Ω
Return Loss	- 23.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 06.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

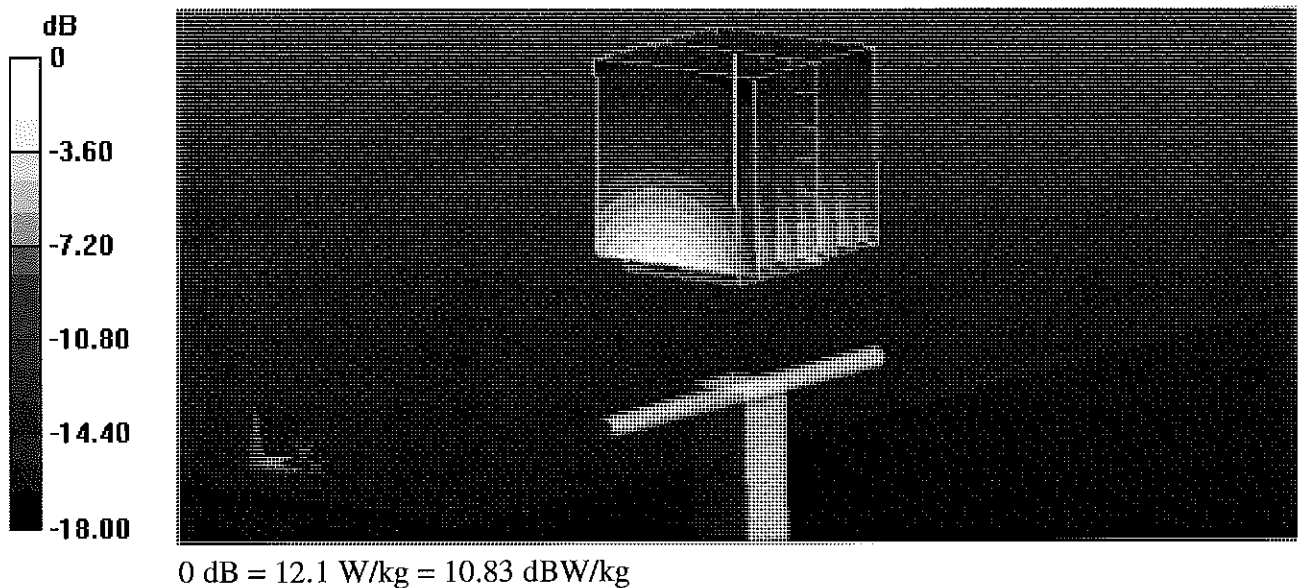
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.534 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.87 W/kg; SAR(10 g) = 5.18 W/kg

Maximum value of SAR (measured) = 12.1 W/kg



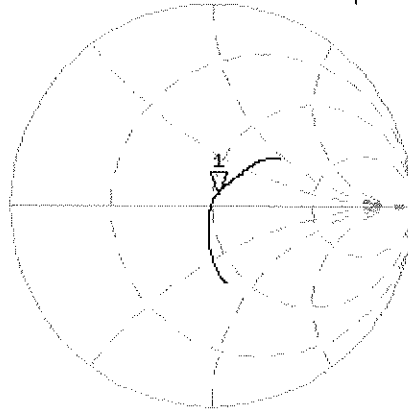
Impedance Measurement Plot for Head TSL

6 Feb 2013 09:25:10
 CH1 S11 1 U FS 1: 52.125 $\angle$ 5.8711 $\angle$ 491.80 μ H 1 900.000 000 MHz

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 Del
 CA

Avg
 16

H1d

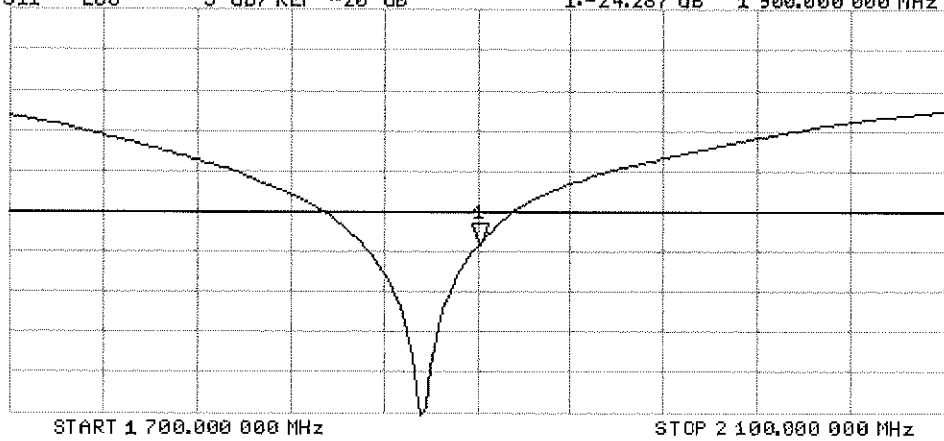


CH2 S11 LOG 5 dB/REF -20 dB 1: -24.287 dB 1 900.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 06.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.53$ S/m; $\epsilon_r = 51.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

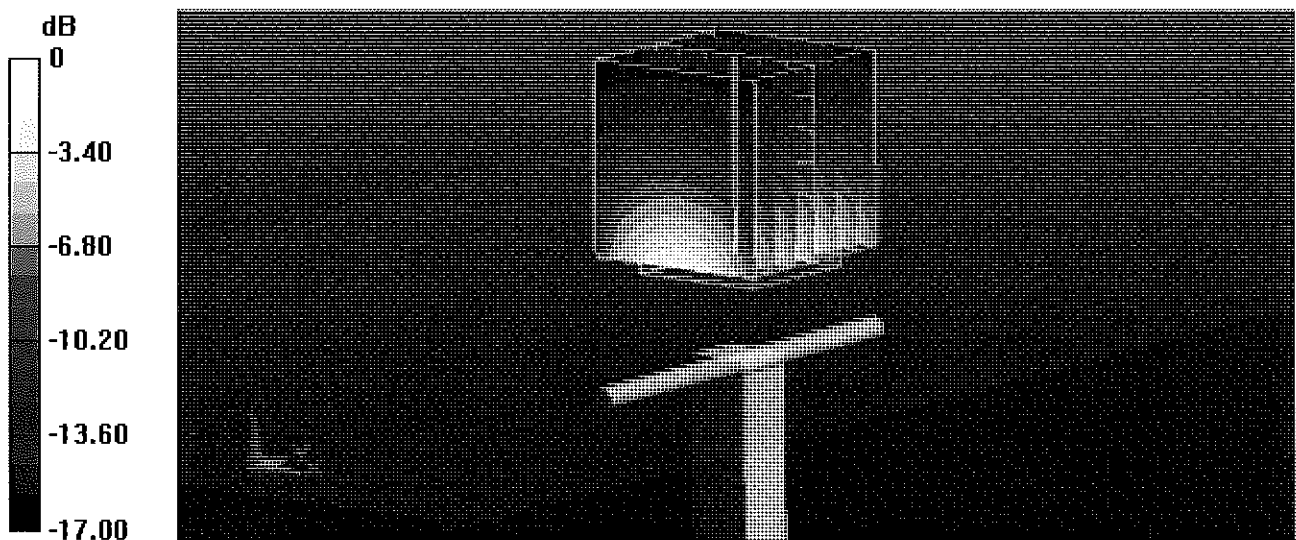
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.534 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 17.9 W/kg

SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.45 W/kg

Maximum value of SAR (measured) = 13.1 W/kg

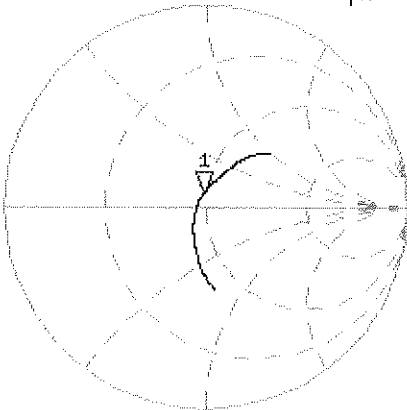


0 dB = 13.1 W/kg = 11.17 dBW/kg

Impedance Measurement Plot for Body TSL

6 Feb 2013 09:24:17
CH1 S11 1 U FS 1: 48.344 Ω 6.2715 Ω 525.34 μ H 1 900.000 000 MHz

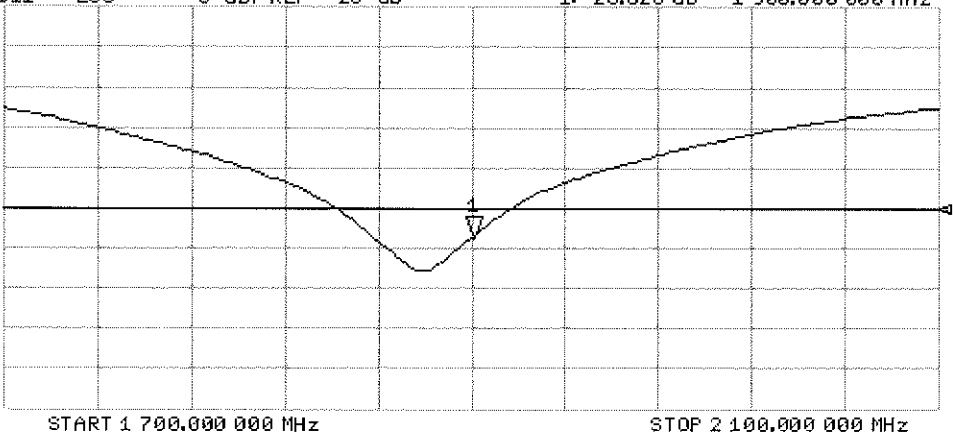
*
De1
CA



Avg
16
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-23.628 dB 1 900.000 000 MHz

CA
Avg
16
H1d





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d080_Jul12**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d080**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **July 20, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: **Dimce Iliev** Name: **Dimce Iliev** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Technical Manager

Signature

Issued: July 20, 2012

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



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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.9 $\pm$ 6 %	1.38 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.78 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.4 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.8 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.6 $\pm$ 6 %	1.52 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.3 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.35 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.4 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.9 \Omega + 5.7 j\Omega$
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$46.9 \Omega + 6.0 j\Omega$
Return Loss	- 23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.191 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 28, 2006

DASY5 Validation Report for Head TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d080

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ mho/m; $\epsilon_r = 39.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

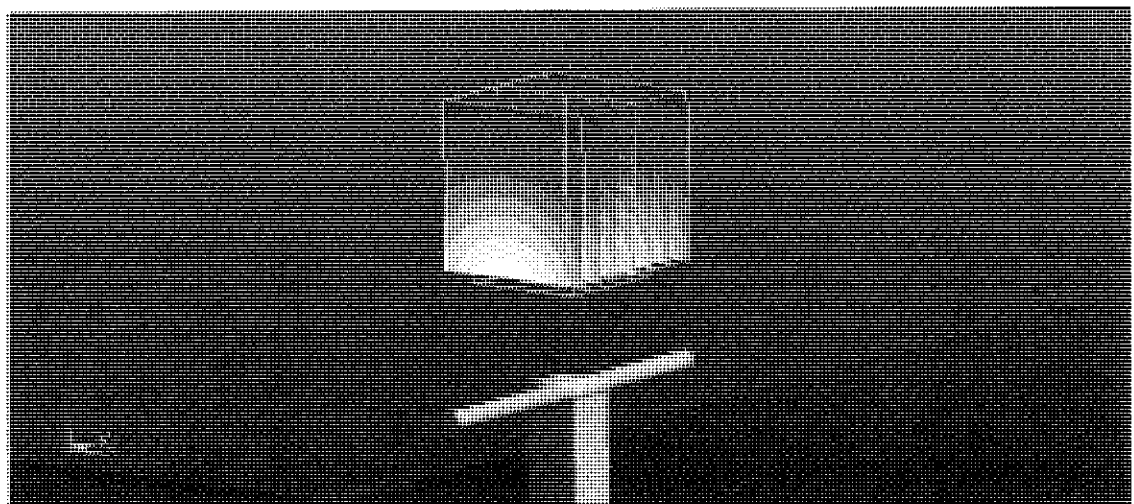
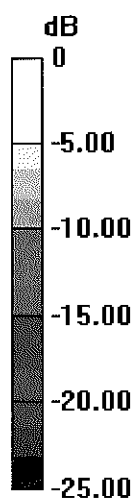
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.586 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 17.454 mW/g

SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.17 mW/g

Maximum value of SAR (measured) = 12.2 mW/g

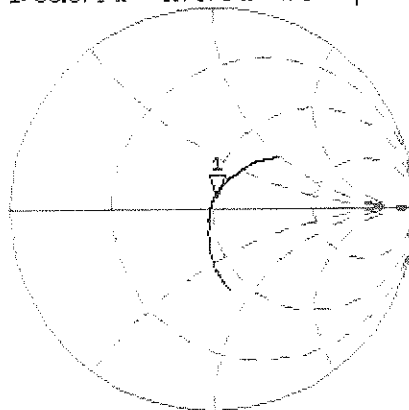


0 dB = 12.2 mW/g = 21.73 dB mW/g

Impedance Measurement Plot for Head TSL

18 Jul 2012 16:15:02
 [CH1] S11 1 U FS 1: 50.879 Ω 5.7070 Ω 478.05 pF 1 900.000 000 MHz

*
 Del
 Cor



Avg
 15

H1d

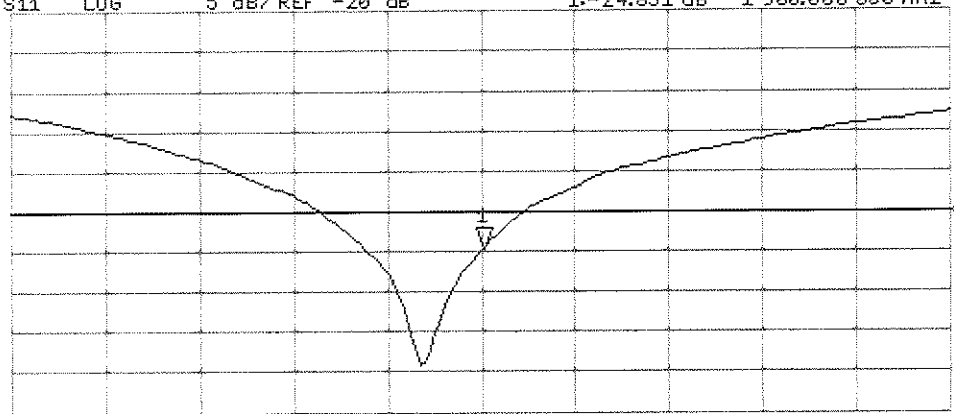
CH2 S11 LOG 5 dB/REF -20 dB 1: -24.851 dB 1 900.000 000 MHz

Del

Cor

Avg
 15

H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d080

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ mho/m; $\epsilon_r = 52.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

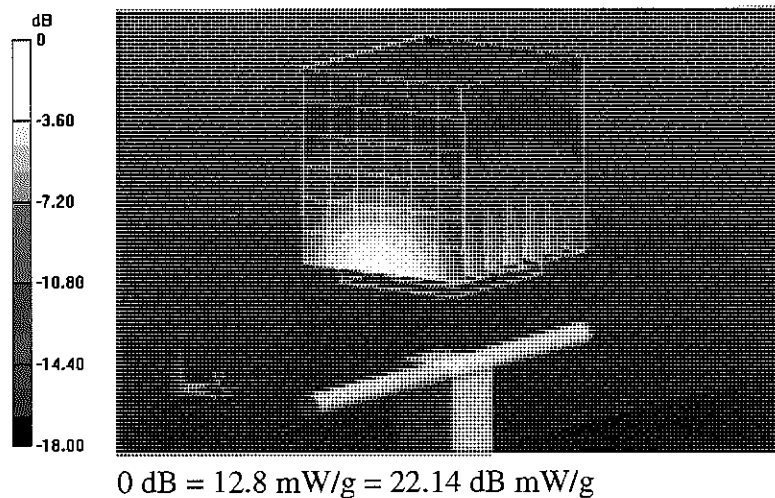
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.688 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 17.552 mW/g

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.35 mW/g

Maximum value of SAR (measured) = 12.8 mW/g



Impedance Measurement Plot for Body TSL

18 Jul 2012 16:16:11
CH1 S11 1 U FS 1: 46.941 Ω 6.0313 Ω 505.21 pF 1 900.000 000 MHz

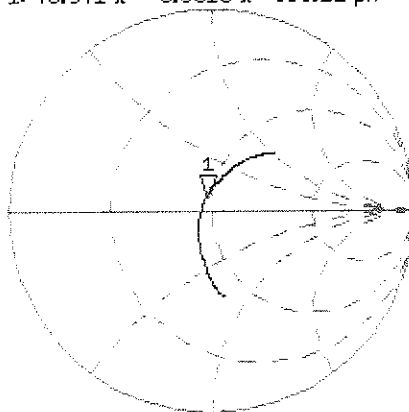
*

De1

Cor

Avg
16

H1d



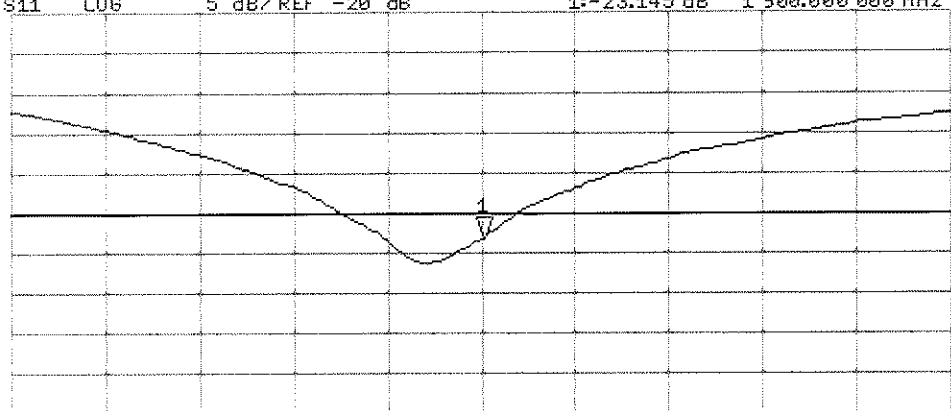
CH2 S11 L06 5 dB/REF -20 dB 1:-23.145 dB 1 900.000 000 MHz

De1

Cor

Avg
16

H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2450V2-719_Aug12**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 719**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 23, 2012**

✓ KOK
9/17/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: **Israe El-Naouq** Name: **Israe El-Naouq** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Israe El-Naouq
Katja Pokovic

Issued: August 23, 2012

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.2 $\pm$ 6 %	1.81 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.7 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.19 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.7 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.3 $\pm$ 6 %	1.99 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	51.6 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.16 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.4 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.4 \Omega + 3.8 j\Omega$
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.7 \Omega + 5.9 j\Omega$
Return Loss	- 24.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.81$ mho/m; $\epsilon_r = 39.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

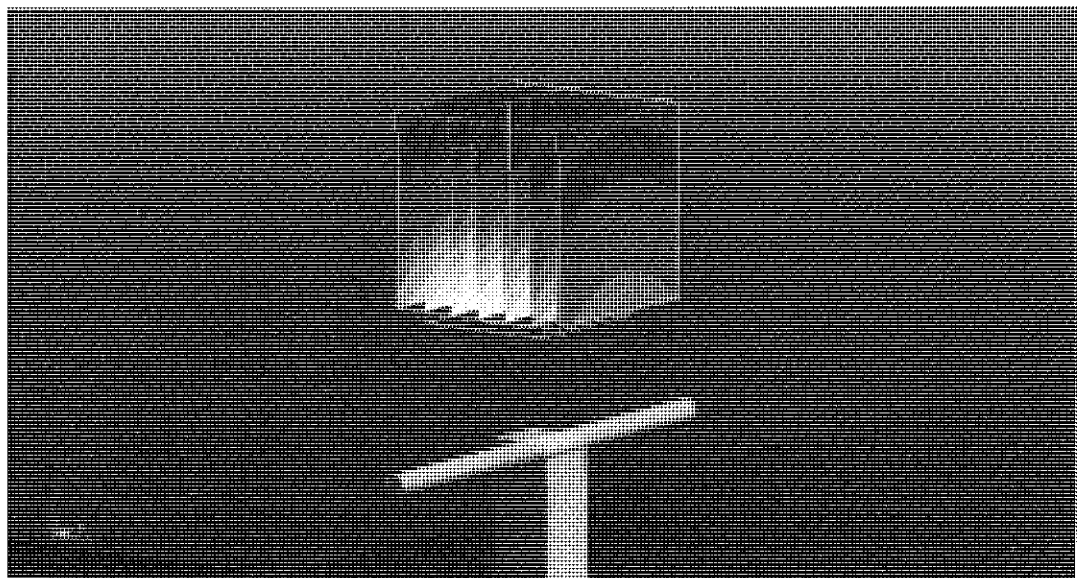
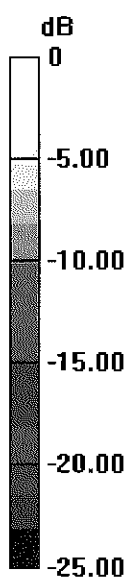
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.219 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.633 mW/g

SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.19 mW/g

Maximum value of SAR (measured) = 16.5 W/kg

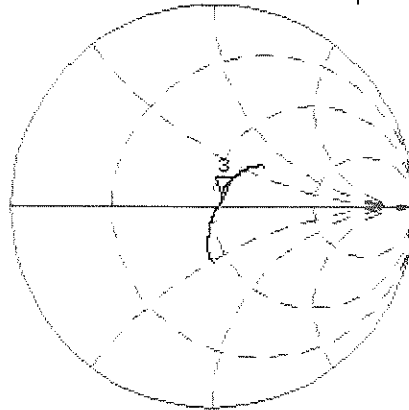


0 dB = 16.5 W/kg = 24.35 dB W/kg

Impedance Measurement Plot for Head TSL

22 Aug 2012 15:39:08
 CH1 S11 1 U FS 3: 54.416 Ω 3.7656 Ω 244.62 pH 2 450.000 000 MHz

*
 Del
 CA



Avg
 16

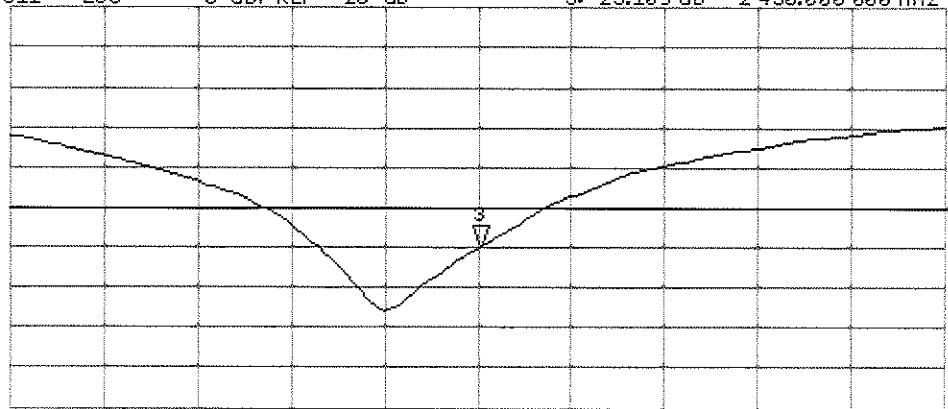
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3: -25.109 dB 2 450.000 000 MHz

CA

Avg
 16

H1d



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 22.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

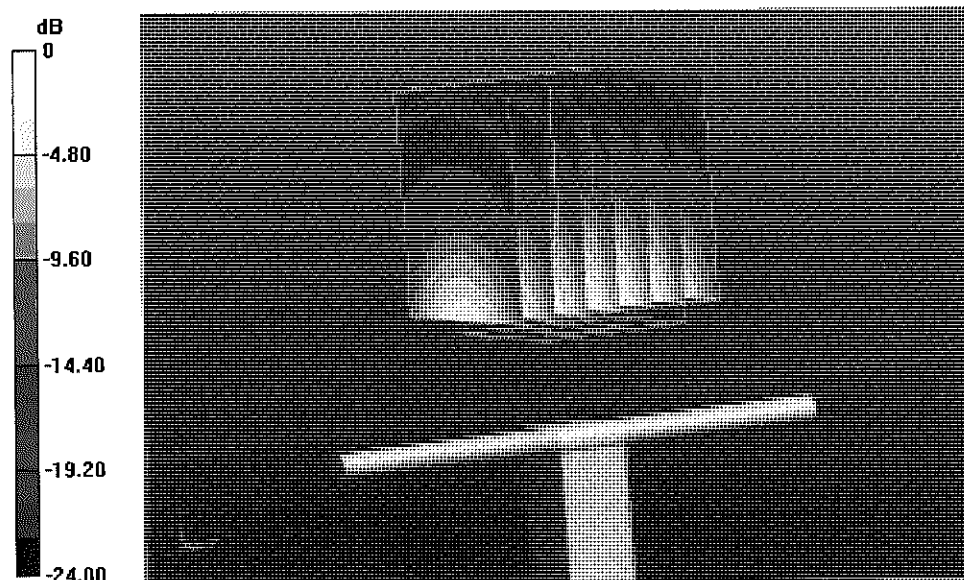
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.970 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.692 mW/g

SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.16 mW/g

Maximum value of SAR (measured) = 17.1 W/kg

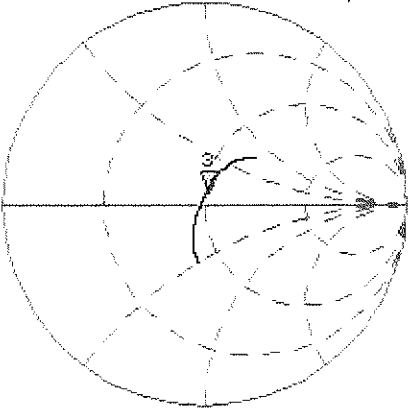


0 dB = 17.1 W/kg = 24.66 dB W/kg

Impedance Measurement Plot for Body TSL

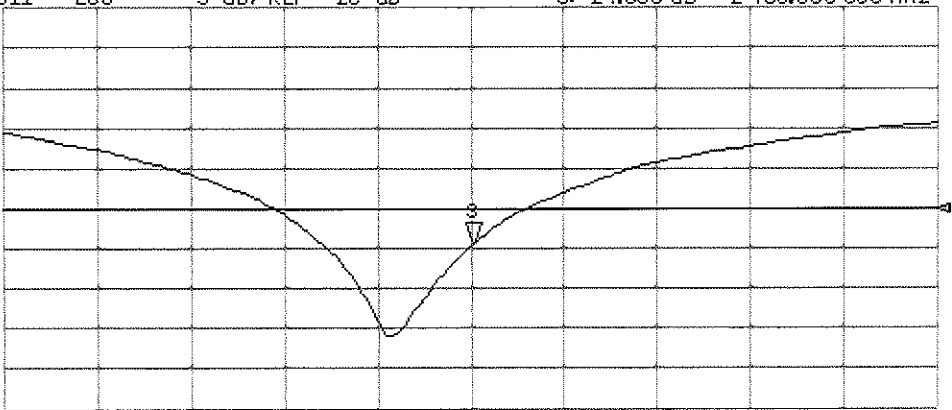
22 Aug 2012 15:38:22
[CH1] S11 1 U FS 3: 50.709 Ω 5.8906 Ω 382.66 pF 2 450.000 000 MHz

*
Del
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 3:-24.605 dB 2 450.000 000 MHz

CA
Avg
16
H1d



START 2 250.000 000 MHz STOP 2 650.000 000 MHz



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Client **PC Test**

Certificate No: **D2450V2-797_Jan13**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 797**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **January 08, 2013**

✓
KOK
1/28/13

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 EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: Name **Israe El-Naouq** Function **Laboratory Technician**

Signature

Israe El-Naouq

Approved by: **Katja Pokovic** Technical Manager

Katja Pokovic

Issued: January 8, 2013

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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.9 $\pm$ 6 %	1.85 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.5 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.5 $\pm$ 6 %	2.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	49.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.88 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.2 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.3 \Omega + 3.1 j\Omega$
Return Loss	- 27.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.1 \Omega + 4.9 j\Omega$
Return Loss	- 26.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 08.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 797

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ S/m; $\epsilon_r = 37.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/ $P_{in}=250$ mW, $d=10$ mm/Zoom Scan (7x7x7)/Cube 0:

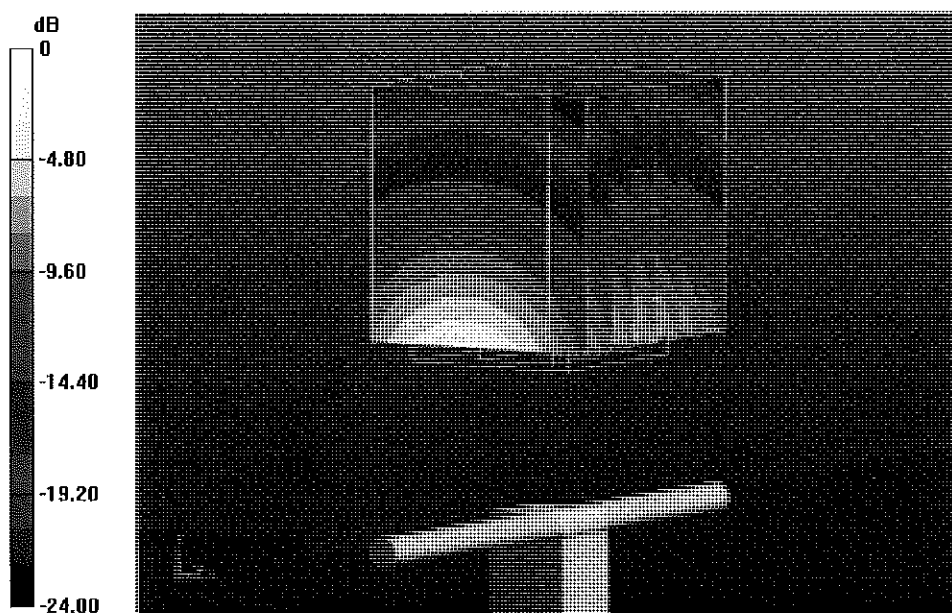
Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 99.154 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.2 W/kg

Maximum value of SAR (measured) = 17.0 W/kg

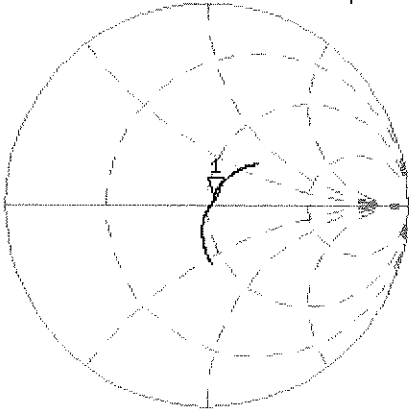


0 dB = 17.0 W/kg = 12.30 dBW/kg

Impedance Measurement Plot for Head TSL

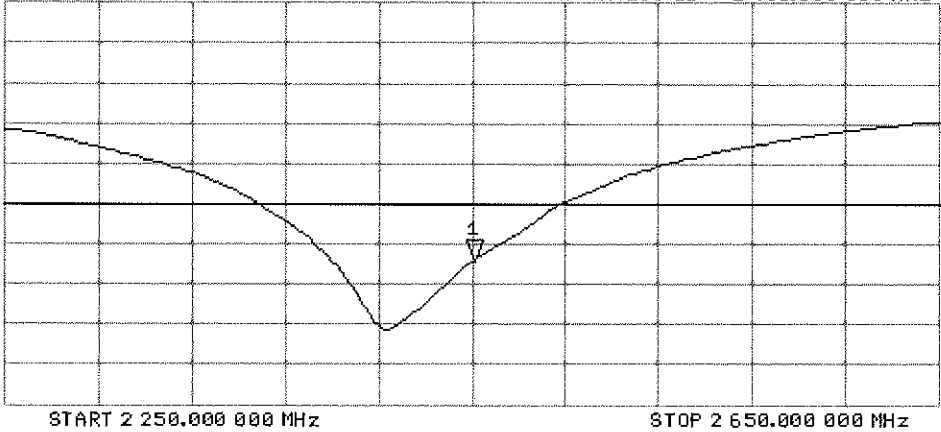
8 Jan 2013 12:37:14
CH1 S11 1 U FS 1: 53.346 $\angle$ 3.0762 $\angle$ 199.83 pH 2 450.000 000 MHz

*
De1
Cor
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -27.136 dB 2 450.000 000 MHz

Cor
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 08.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 797

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.01$ S/m; $\epsilon_r = 50.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

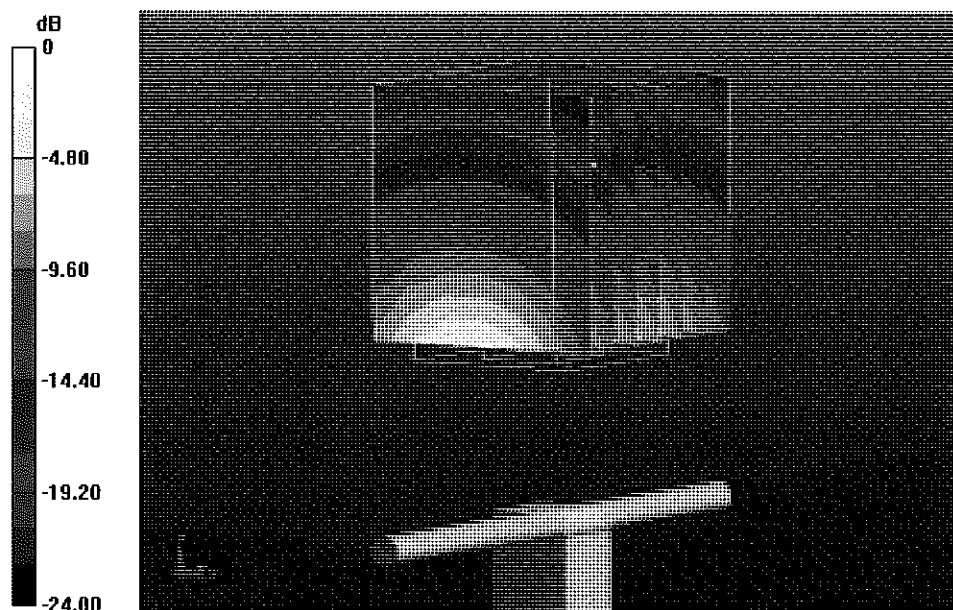
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.935 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.7 W/kg

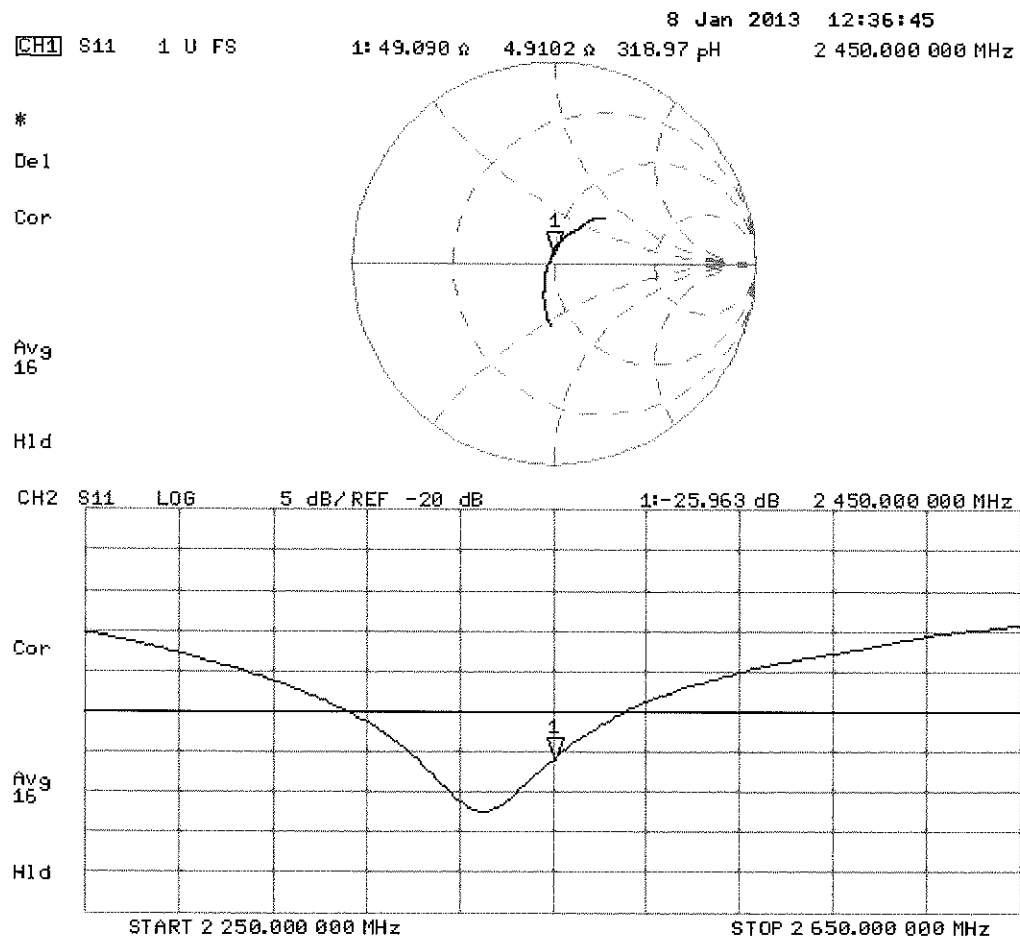
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.88 W/kg

Maximum value of SAR (measured) = 16.7 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

Impedance Measurement Plot for Body TSL





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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D5GHzV2-1057_Jan13**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1057**

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

Calibration date: **January 11, 2013**

✓
KOK
1/29/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Israe El-Naouq** Name: **Israe El-Naouq** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Function: **Technical Manager**

Signature
Israe El-Naouq
Katja Pokovic

Issued: January 11, 2013

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 108**

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

Calibration is Performed According to the Following Standards:

- IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.6 $\pm$ 6 %	4.50 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	75.9 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.4 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.60 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.9 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.79 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.1 ± 6 %	4.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.8 ± 6 %	5.09 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.42 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.55 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	5.81 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	5.94 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.3 W/kg ± 19.9 % (k=2)

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

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.0 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	50.5 Ω - 9.8 j Ω
Return Loss	- 20.3 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.5 Ω - 4.5 j Ω
Return Loss	- 26.4 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.6 Ω - 5.8 j Ω
Return Loss	- 24.8 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.9 Ω - 3.8 j Ω
Return Loss	- 25.6 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.5 Ω - 4.4 j Ω
Return Loss	- 26.1 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.3 Ω - 7.9 j Ω
Return Loss	- 22.0 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.7 Ω - 3.2 j Ω
Return Loss	- 29.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.2 Ω - 4.8 j Ω
Return Loss	- 26.2 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	53.6 Ω - 2.1 j Ω
Return Loss	- 27.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	53.3 Ω - 2.9 j Ω
Return Loss	- 27.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 27, 2006

DASY5 Validation Report for Head TSL

Date: 11.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.5$ S/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.6$ S/m; $\epsilon_r = 34.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.79$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.88$ S/m; $\epsilon_r = 34.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.09$ S/m; $\epsilon_r = 33.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(5.1, 5.1, 5.1); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.671 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.473 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 18.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.735 V/m; Power Drift = 0.08 dB

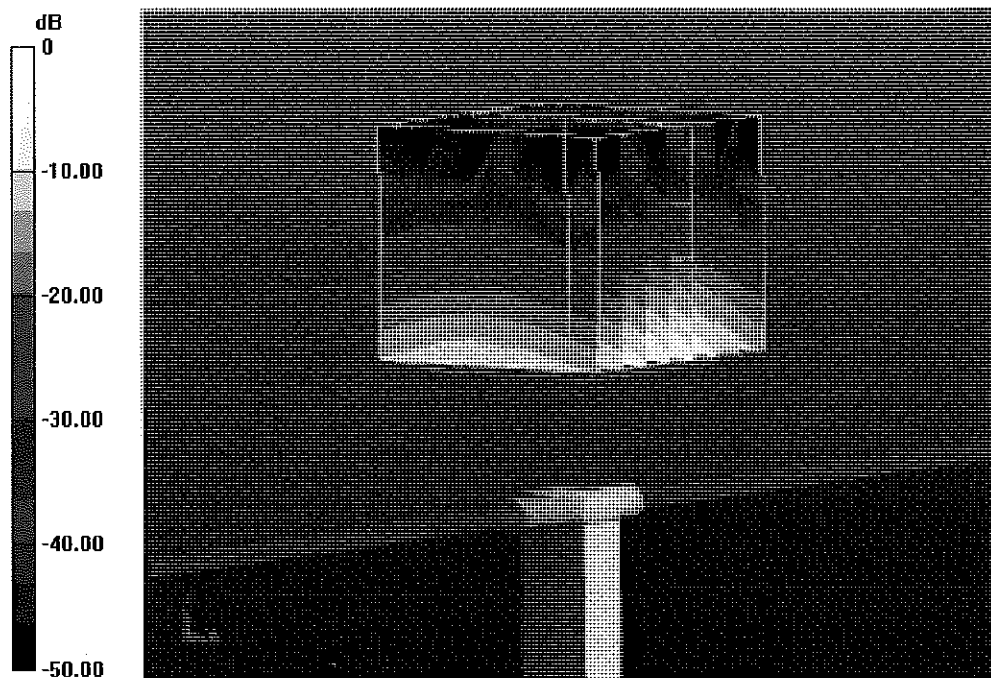
Peak SAR (extrapolated) = 33.2 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.28 W/kg

Maximum value of SAR (measured) = 20.1 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.848 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 33.5 W/kg
SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (measured) = 20.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.467 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 33.3 W/kg
SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg

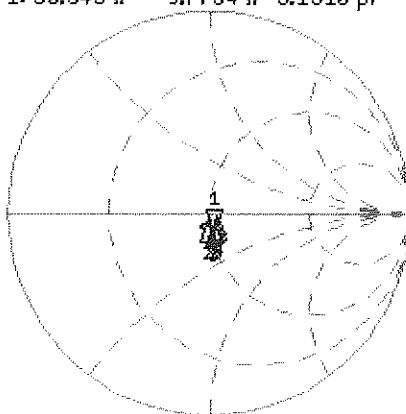
Impedance Measurement Plot for Head TSL

11 Jan 2013 09:26:56
 [CH1] S11 1 U FS 1: 50.543 Ω -9.7754 Ω 3.1310 pF 5 200.000 000 MHz

*
 Del
 CA

Avg
 16

H1 d



CH1 Markers

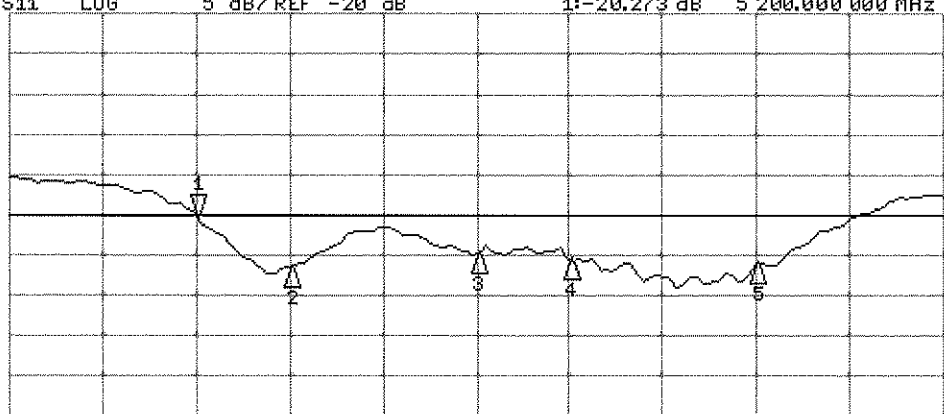
2: 48.508 Ω
 -4.4805 Ω
 5.30000 GHz
 3: 50.617 Ω
 -5.7559 Ω
 5.50000 GHz
 4: 53.891 Ω
 -3.8418 Ω
 5.60000 GHz
 5: 52.500 Ω
 -4.4160 Ω
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -20.273 dB 5 200.000 000 MHz

CA

Avg
 16

H1 d



CH2 Markers

2: -26.396 dB
 5.30000 GHz
 3: -24.818 dB
 5.50000 GHz
 4: -25.573 dB
 5.60000 GHz
 5: -26.115 dB
 5.80000 GHz

DASY5 Validation Report for Body TSL

Date: 10.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.42$ S/m; $\epsilon_r = 47$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.55$ S/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.81$ S/m; $\epsilon_r = 46.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.94$ S/m; $\epsilon_r = 46.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.21$ S/m; $\epsilon_r = 46$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated: 28.12.2012, ConvF(4.43, 4.43, 4.43); Calibrated: 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.074 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 30.4 W/kg

SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 18.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 58.924 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 30.9 W/kg

SAR(1 g) = 7.59 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 17.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.561 V/m; Power Drift = -0.01 dB

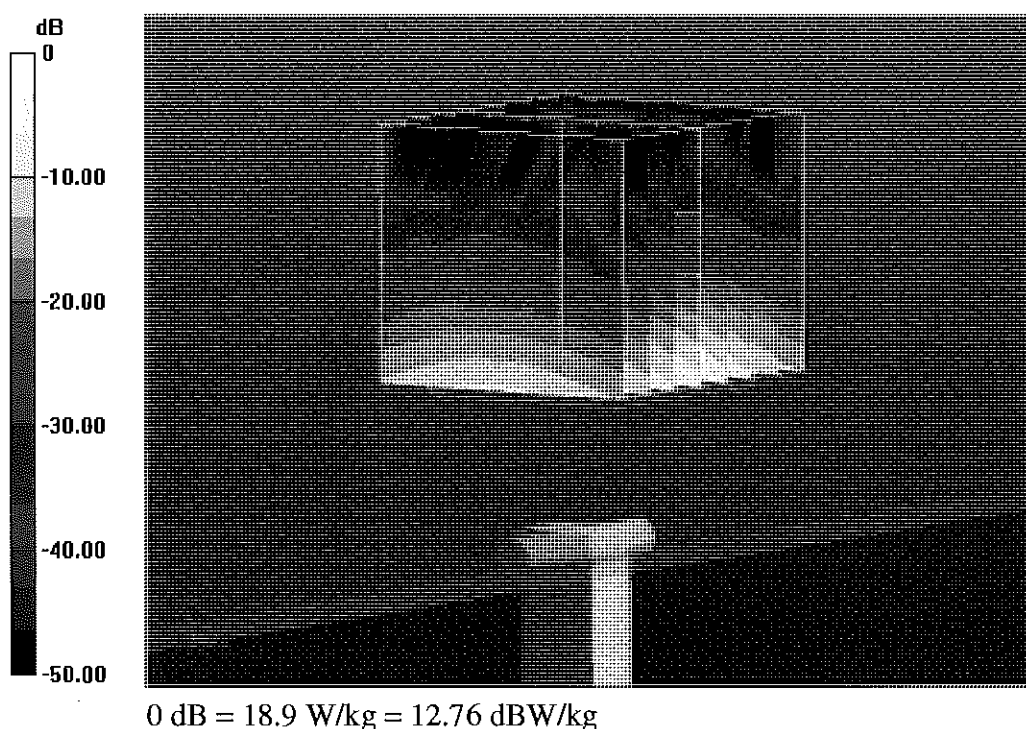
Peak SAR (extrapolated) = 35.3 W/kg

SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.26 W/kg

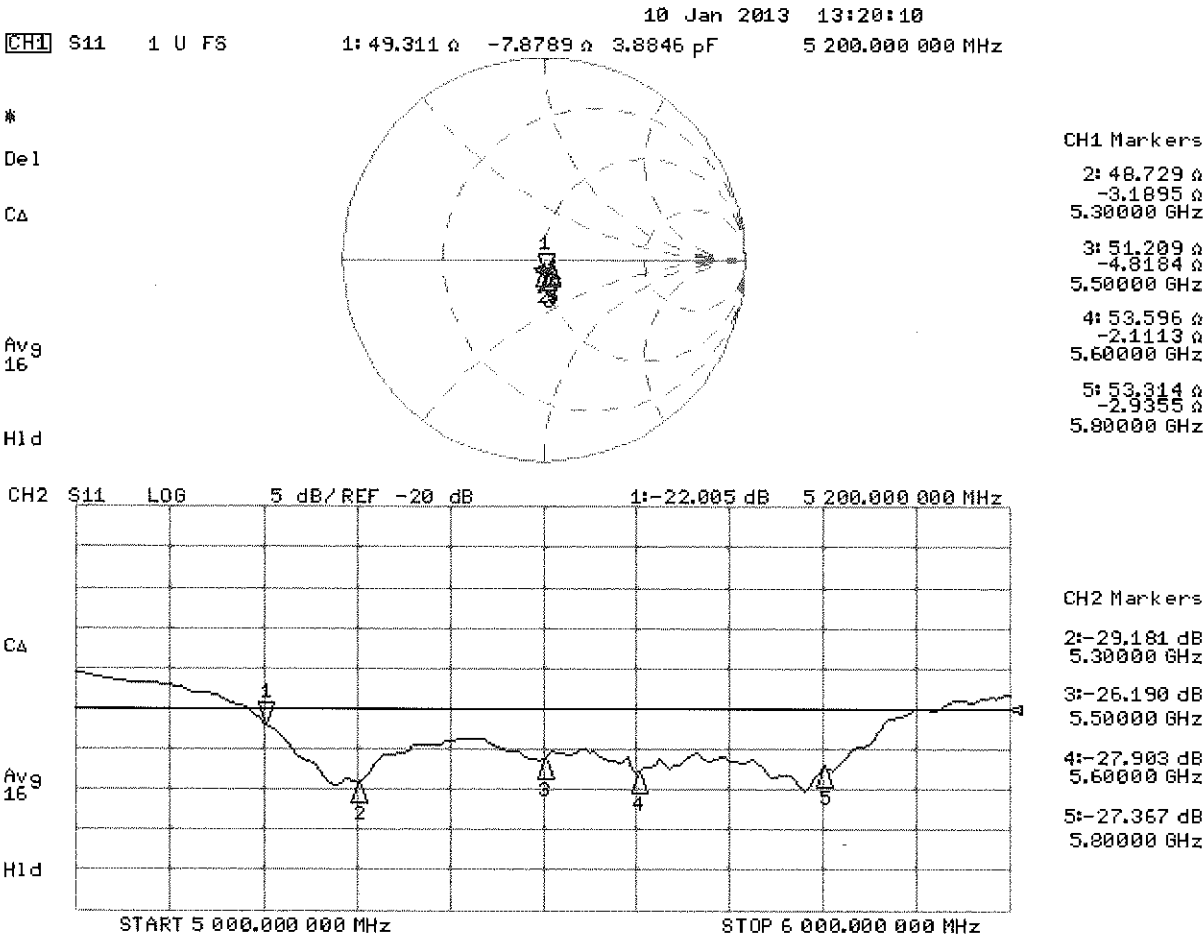
Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.884 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 36.3 W/kg
SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 20.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.753 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 35.6 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **D750V3-1003_Jan13**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1003**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **January 07, 2013**

✓ KOK
1/28/13

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 EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: January 8, 2013

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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.4 $\pm$ 6 %	0.89 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.46 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.51 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.8 $\pm$ 6 %	0.97 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.83 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.48 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.87 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.1 Ω - 0.2 j Ω
Return Loss	- 24.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 3.5 j Ω
Return Loss	- 29.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.043 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 21, 2009

DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1003

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.89 \text{ S/m}$; $\epsilon_r = 41.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 6.28, 6.28); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

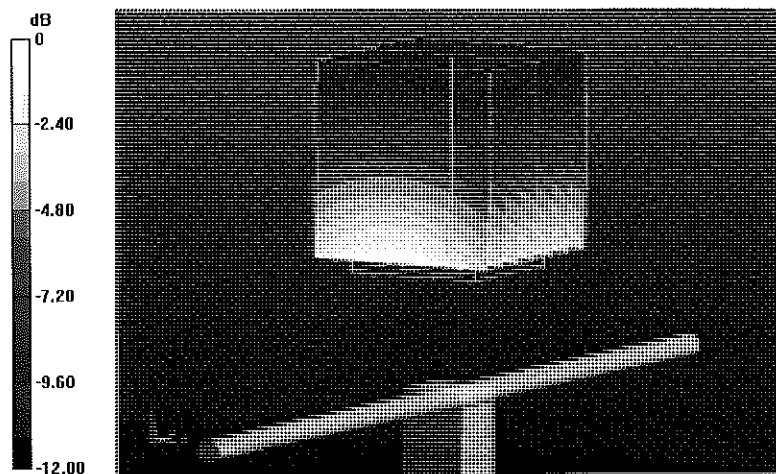
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.114 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.24 W/kg

SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.38 W/kg

Maximum value of SAR (measured) = 2.47 W/kg

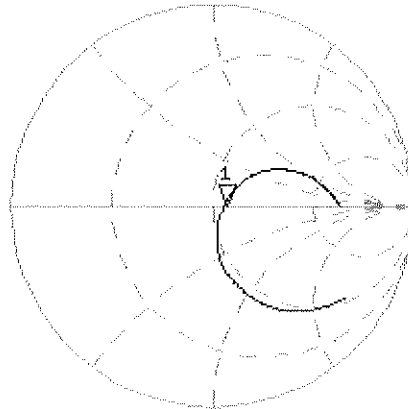


0 dB = 2.47 W/kg = 3.93 dBW/kg

Impedance Measurement Plot for Head TSL

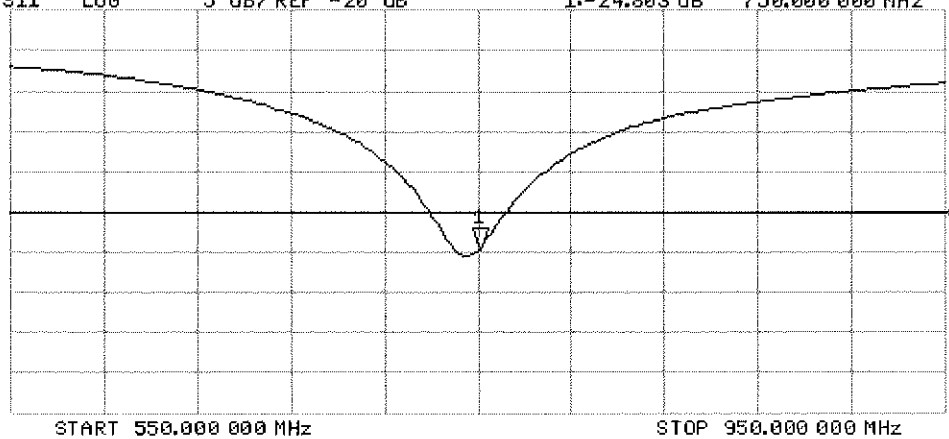
7 Jan 2013 12:55:14
 [CH1] S11 1 U FS 1: 56.100 Ω -179.69 m Ω 1.1810 nF 750.000 000 MHz

*
 De1
 Ca
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-24.803 dB 750.000 000 MHz

Ca
 Avg
 16
 H1d



DASY5 Validation Report for Body TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1003

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.97 \text{ S/m}$; $\epsilon_r = 54.8$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.11, 6.11, 6.11); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

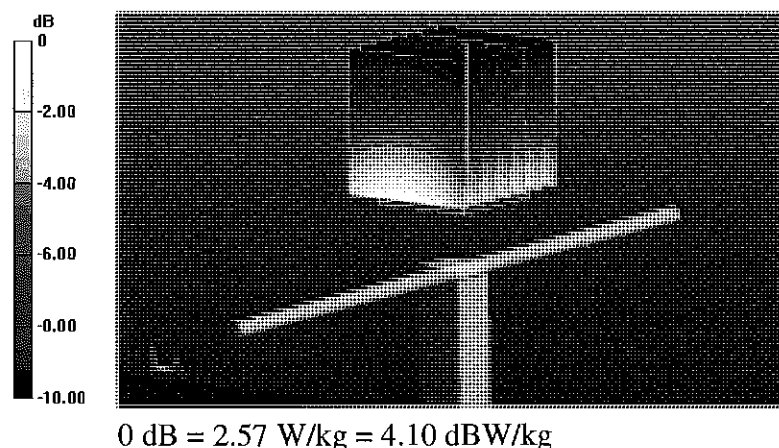
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 53.114 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.25 W/kg

SAR(1 g) = 2.23 W/kg; SAR(10 g) = 1.48 W/kg

Maximum value of SAR (measured) = 2.57 W/kg



0 dB = 2.57 W/kg = 4.10 dBW/kg

Impedance Measurement Plot for Body TSL

7 Jan 2013 09:57:48
CH1 S11 1 U FS 1: 49.564 Ω -3.4629 Ω 61.280 pF 750.000 000 MHz

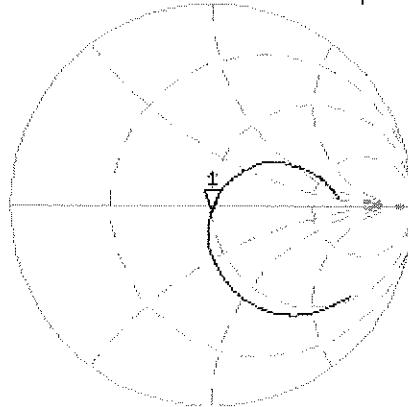
*

De1

Ca

Avg
16

H1 d

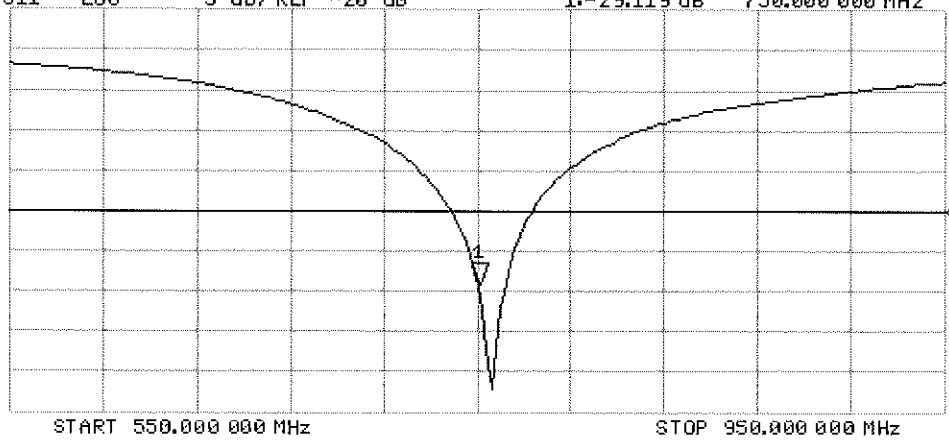


CH2 S11 LOG 5 dB/REF -20 dB 1:-29.119 dB 750.000 000 MHz

Ca

Avg
16

H1 d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d119_Apr12**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d119**

Calibration procedure(s) **QA CAL 05 v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **April 20, 2012**

✓ KOK
5/4/12

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 EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Israa El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 20, 2012

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Accreditation No.: **SCS 108**

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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.1 $\pm$ 6 %	0.90 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.42 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.55 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.19 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.5 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.56 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.31 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.3 Ω - 2.2 j Ω
Return Loss	- 32.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8 Ω - 4.3 j Ω
Return Loss	- 25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 20.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.9$ mho/m; $\epsilon_r = 41.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

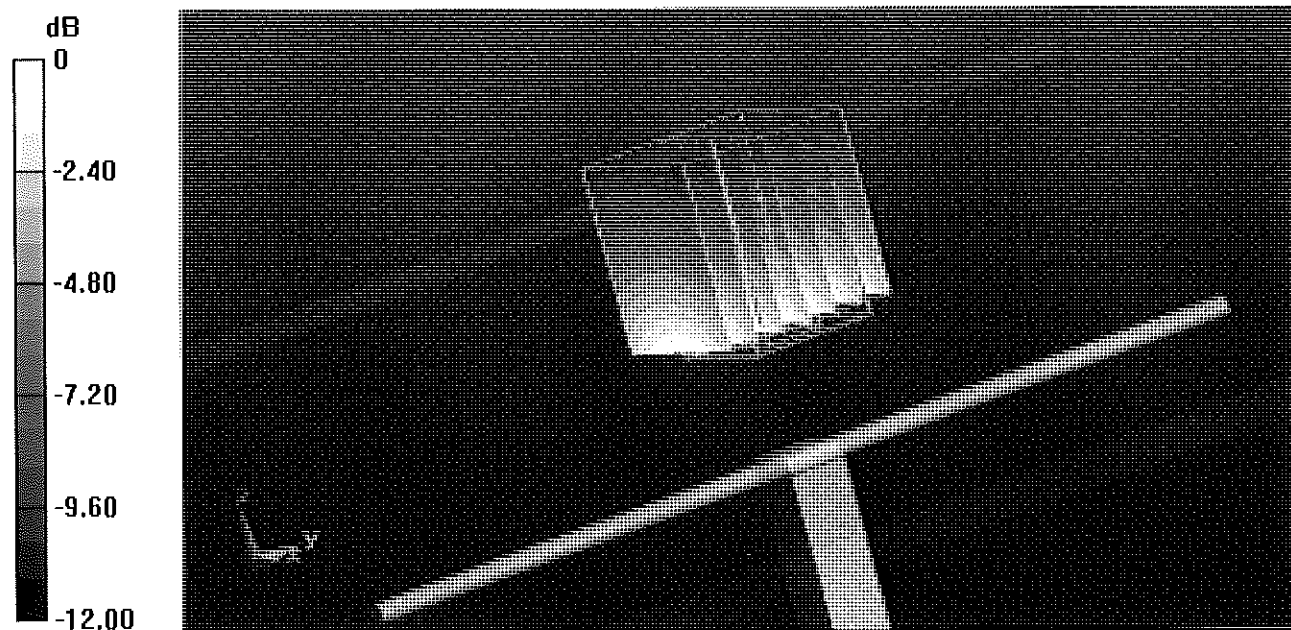
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.041 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.480 mW/g

SAR(1 g) = 2.36 mW/g; SAR(10 g) = 1.55 mW/g

Maximum value of SAR (measured) = 2.75 mW/g



0 dB = 2.75 mW/g = 8.79 dB mW/g

Impedance Measurement Plot for Head TSL

20 Apr 2012 09:34:14
[CH1] S11 1 U FS 1: 51.279 Ω -2.1582 Ω 88.316 pF 835.000 000 MHz

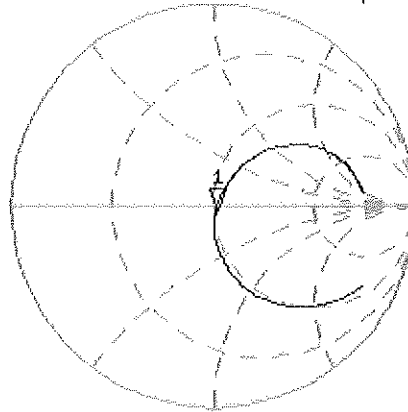
*

De1

Cor

Avg
16

H1d

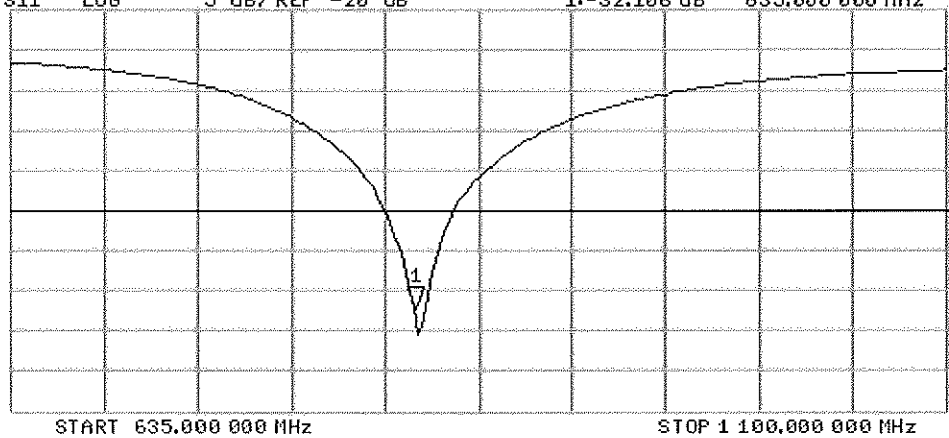


CH2 S11 LOG 5 dB/REF -20 dB 1: -32.106 dB 835.000 000 MHz

Cor

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 19.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 1.01$ mho/m; $\epsilon_r = 54.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

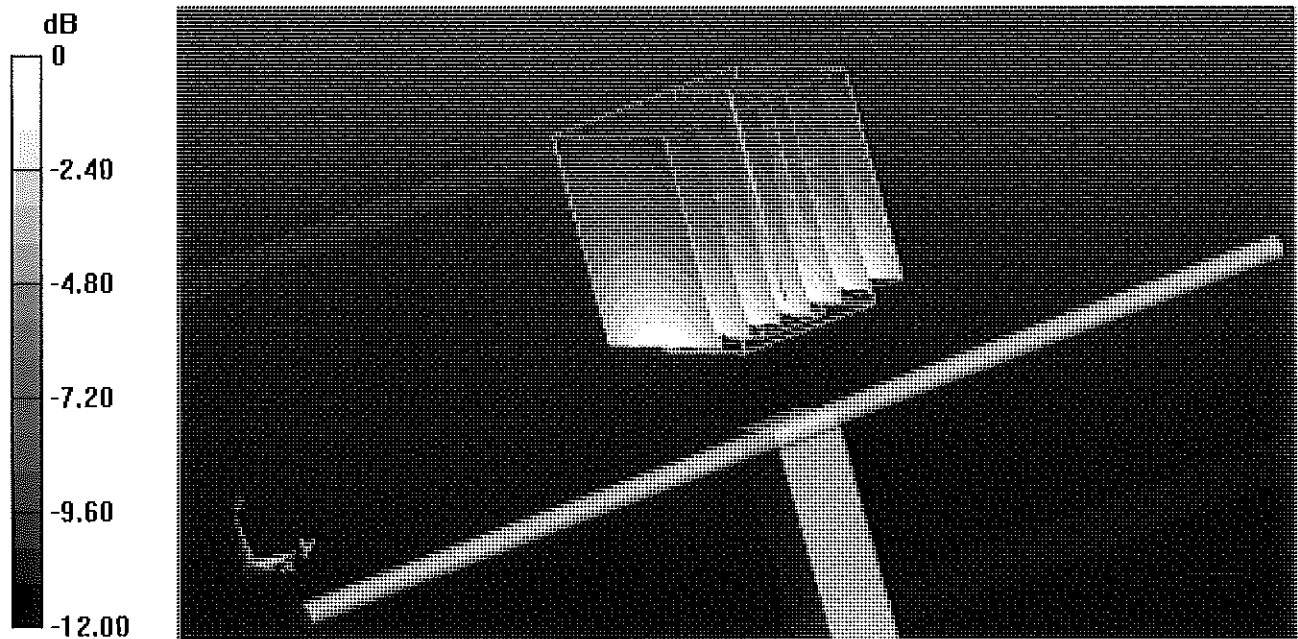
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.253 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.571 mW/g

SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.62 mW/g

Maximum value of SAR (measured) = 2.87 mW/g

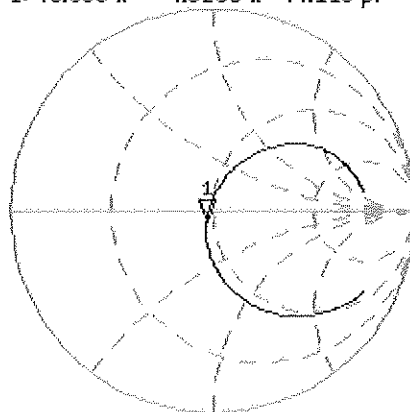


0 dB = 2.87 mW/g = 9.16 dB mW/g

Impedance Measurement Plot for Body TSL

19 Apr 2012 10:20:53
 [CH1] S11 1 U FS 1: 46.836 Ω -4.3203 Ω 44.118 pF 835.000 000 MHz

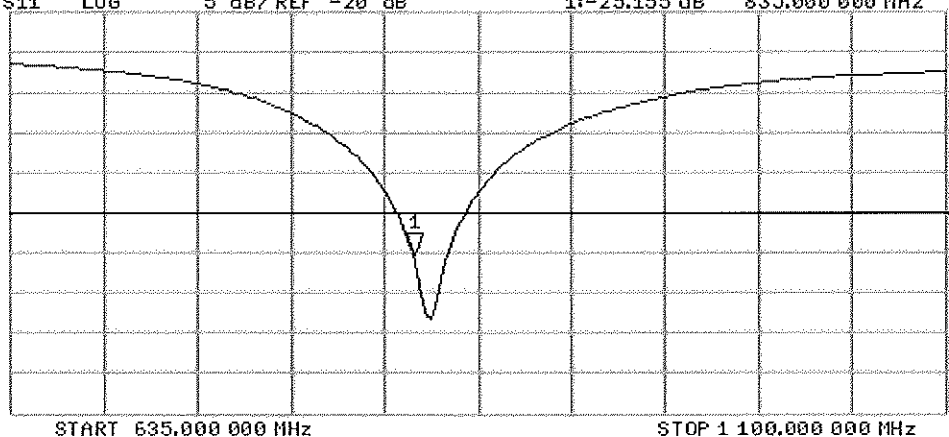
*
 Del
 Cor



Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.155 dB 835.000 000 MHz

Cor
 Avg
 16
 H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d132_Jan13**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d132**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **January 07, 2013**

✓ KOK
1/28/13

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: January 8, 2013

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	42.0 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.66 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.29 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.7 $\pm$ 6 %	0.99 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.36 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.20 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.2 \Omega + 1.3 j\Omega$
Return Loss	- 27.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.8 \Omega - 1.3 j\Omega$
Return Loss	- 34.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d132

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 42$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

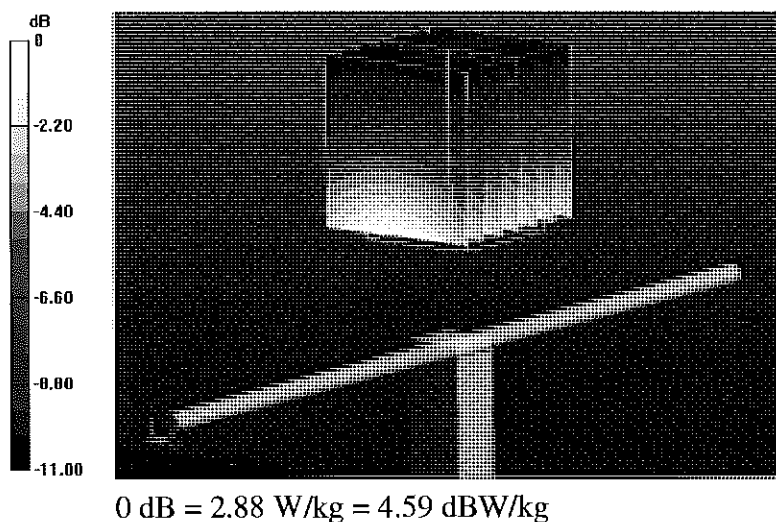
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.542 V/m; Power Drift = 0.07 dB

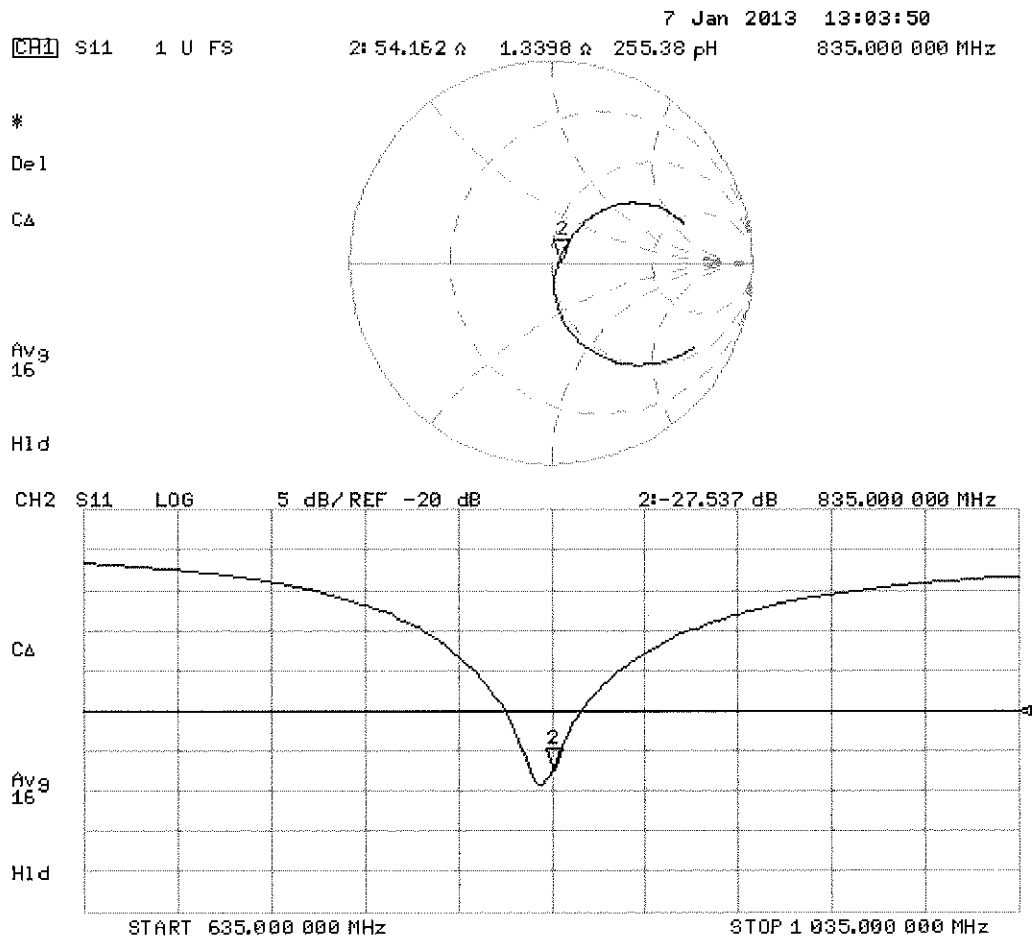
Peak SAR (extrapolated) = 3.71 W/kg

SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.88 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d132

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.99 \text{ S/m}$; $\epsilon_r = 54.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

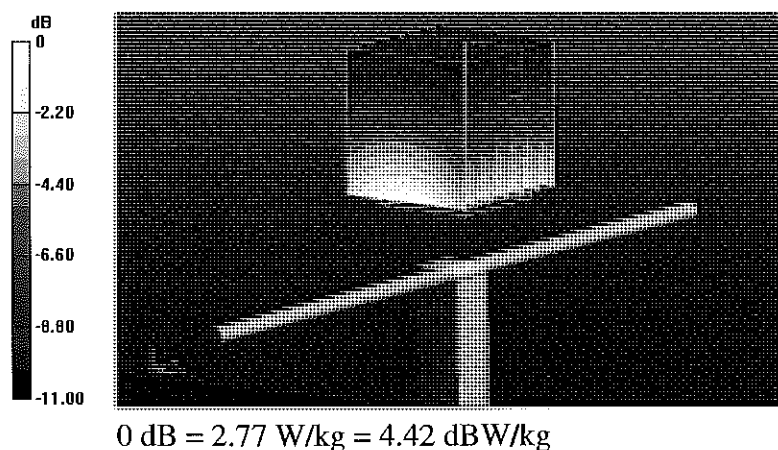
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.512 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 3.47 W/kg

SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.57 W/kg

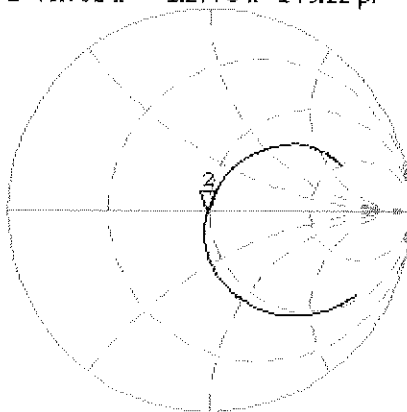
Maximum value of SAR (measured) = 2.77 W/kg



Impedance Measurement Plot for Body TSL

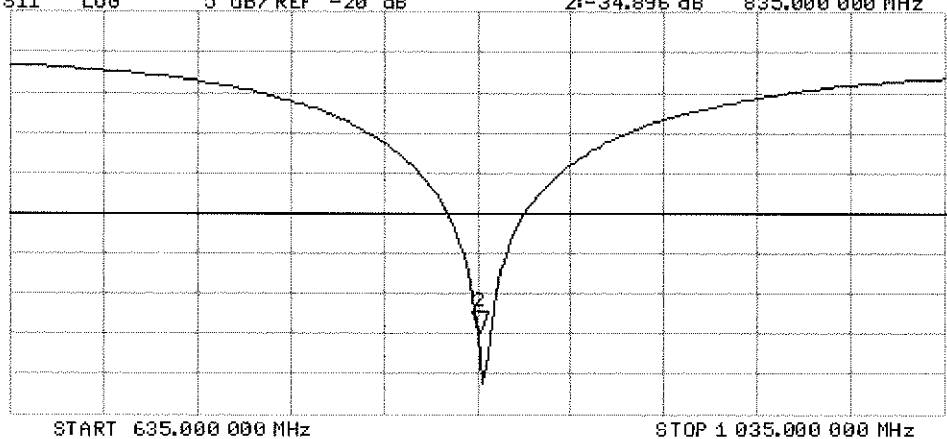
7 Jan 2013 10:07:01
 CH1 S11 1 U FS 2: 48.762 Ω -1.2773 Ω 149.22 pF 835.000 000 MHz

*
 Del
 CA
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 2: -34.896 dB 835.000 000 MHz

CA
 Avg
 16
 H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d026_Aug12**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d026**

Calibration procedure(s) **QA CAL-05.v8**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 23, 2012**

*1/OK
9/12/12*

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: **Israe El-Naouq** **Israe El-Naouq** **Israe El-Naouq**
 Name Function Laboratory Technician

Approved by: **Katja Pokovic** **Katja Pokovic** **Katja Pokovic**
 Name Function Technical Manager

Signature

Israe El-Naouq
Katja Pokovic

Issued: August 23, 2012

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.3 $\pm$ 6 %	0.90 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.39 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.12 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.2 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.58 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.33 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω - 3.4 j Ω
Return Loss	- 26.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 4.8 j Ω
Return Loss	- 26.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.389 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 17, 2004

DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.9$ mho/m; $\epsilon_r = 41.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:

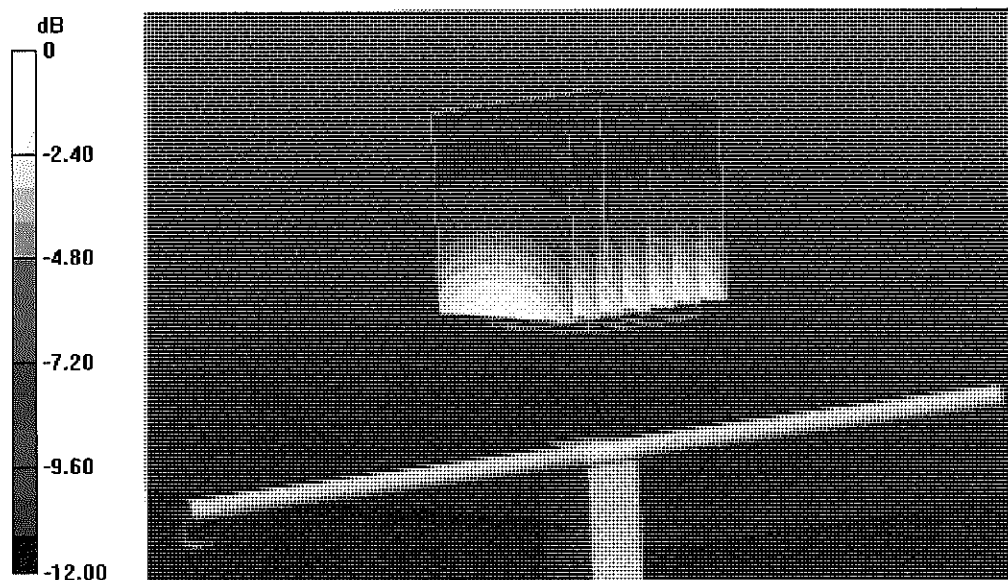
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.824 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.482 mW/g

SAR(1 g) = 2.35 mW/g; SAR(10 g) = 1.53 mW/g

Maximum value of SAR (measured) = 2.72 W/kg

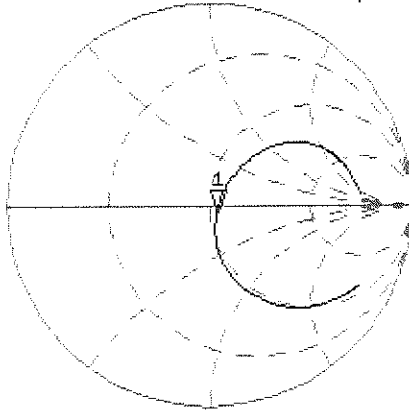


0 dB = 2.72 W/kg = 8.69 dB W/kg

Impedance Measurement Plot for Head TSL

23 Aug 2012 12:19:04
 CH1 S11 1 U FS 1: 53.662 $\angle$ -3.3516 $\angle$ 56.870 pF 835.000 000 MHz

*
 Del
 Cor



Avg
 15

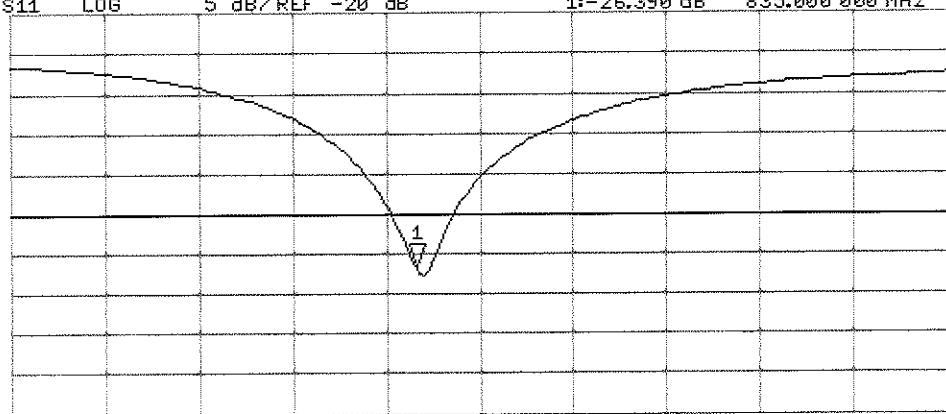
H1 d

CH2 S11 LOG 5 dB/REF -20 dB 1:-26.390 dB 835.000 000 MHz

Cor

Avg
 15

H1 d



START 635.000 000 MHz

STOP 1 100.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 1$ mho/m; $\epsilon_r = 53.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

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

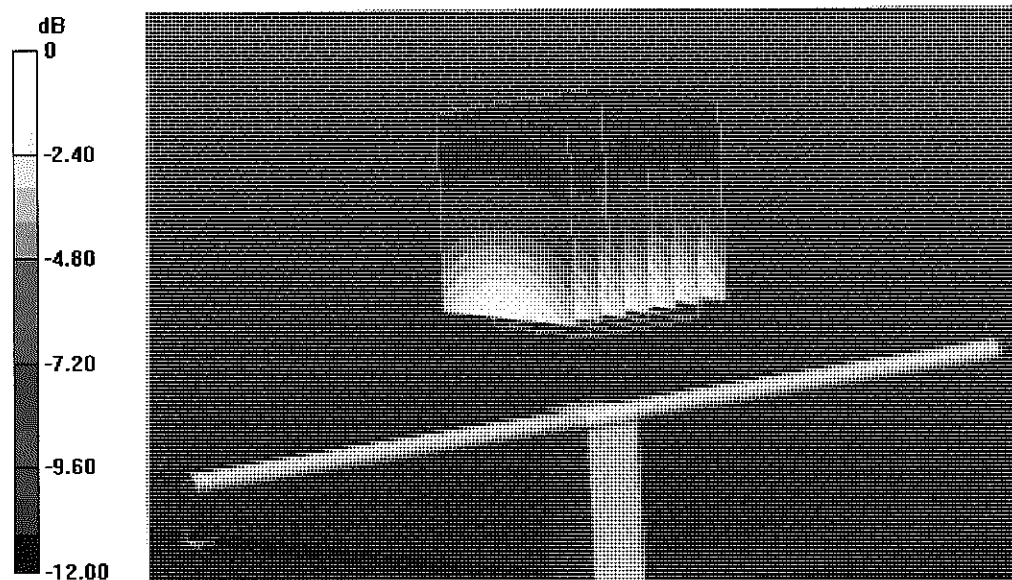
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.339 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.592 mW/g

SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.62 mW/g

Maximum value of SAR (measured) = 2.87 W/kg

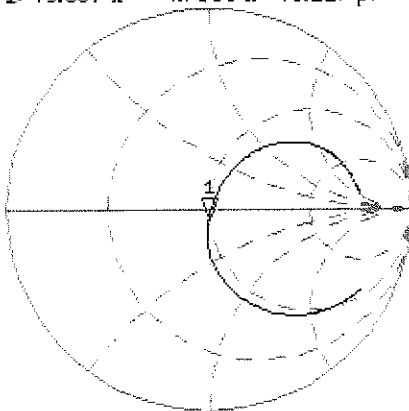


0 dB = 2.87 W/kg = 9.16 dB W/kg

Impedance Measurement Plot for Body TSL

23 Aug 2012 10:54:42
 [CH1] S11 1 U FS 1: 49.557 $\angle$ -4.7500 $\angle$ 40.127 pF 835.000 000 MHz

*
 Del
 Cor



Avg
 16

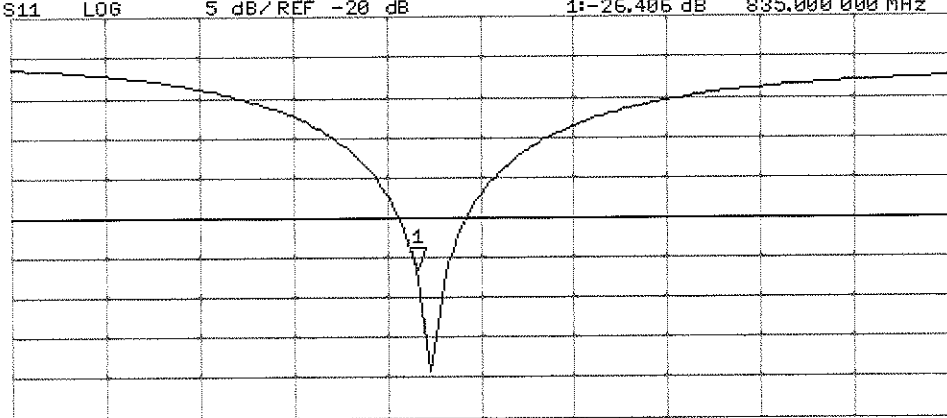
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -26.405 dB 835.000 000 MHz

Cor

Avg
 16

H1d



START 635.000 000 MHz

STOP 1 100.000 000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3022_Aug12**

CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **August 28, 2012**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: August 28, 2012

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



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Accreditation No.: **SCS 108**

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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	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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- 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}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ 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.

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 28, 2012

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	1.04	0.99	$\pm 10.1 \%$
DCP (mV) ^B	98.3	99.5	101.3	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	133.3	$\pm 2.7 \%$
			Y	0.00	0.00	1.00	140.3	
			Z	0.00	0.00	1.00	178.9	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: 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	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.30	6.30	6.30	0.30	1.72	± 12.0 %
835	41.5	0.90	6.03	6.03	6.03	0.35	1.63	± 12.0 %
1750	40.1	1.37	5.07	5.07	5.07	0.32	1.89	± 12.0 %
1900	40.0	1.40	4.86	4.86	4.86	0.40	1.57	± 12.0 %
2450	39.2	1.80	4.23	4.23	4.23	0.59	1.44	± 12.0 %
2600	39.0	1.96	4.10	4.10	4.10	0.67	1.37	± 12.0 %

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

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

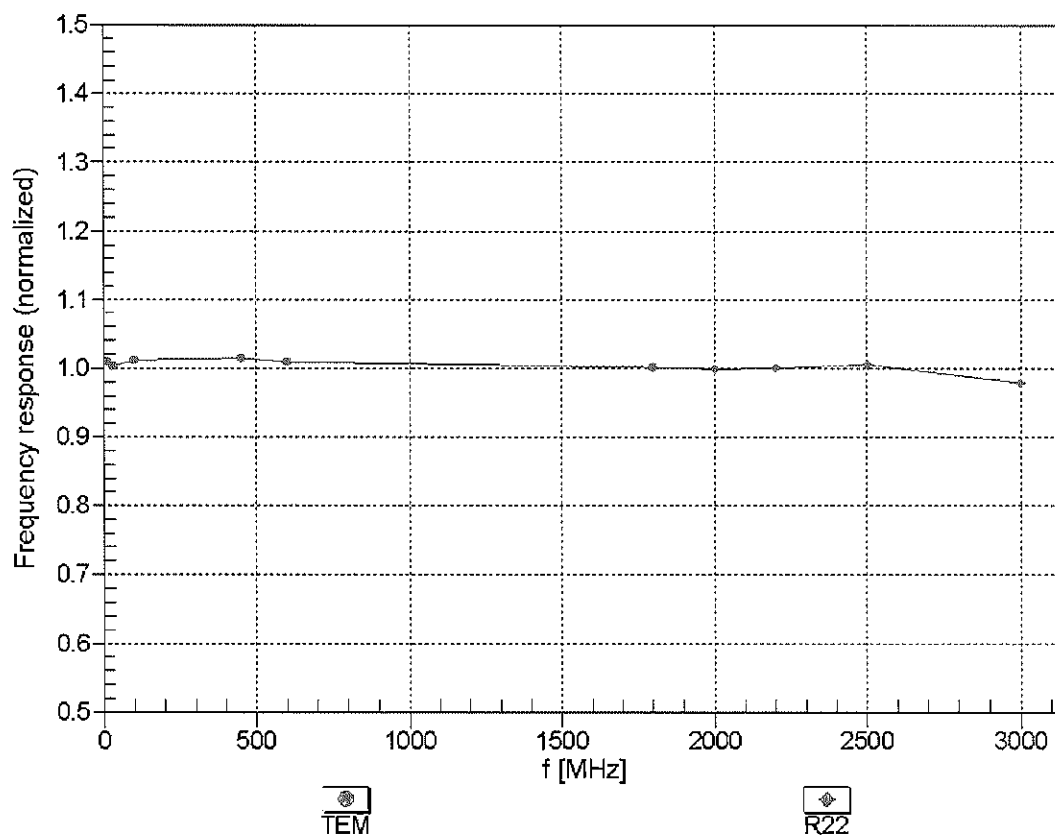
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.07	6.07	6.07	0.23	2.09	± 12.0 %
835	55.2	0.97	6.02	6.02	6.02	0.47	1.44	± 12.0 %
1750	53.4	1.49	4.70	4.70	4.70	0.46	1.55	± 12.0 %
1900	53.3	1.52	4.43	4.43	4.43	0.36	1.87	± 12.0 %
2450	52.7	1.95	3.97	3.97	3.97	0.65	1.06	± 12.0 %
2600	52.5	2.16	3.80	3.80	3.80	0.54	0.75	± 12.0 %

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

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

Frequency Response of E-Field

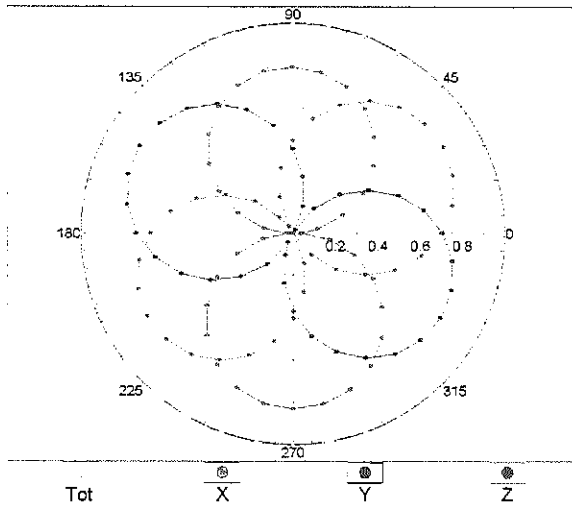
(TEM-Cell:ifi110 EXX, Waveguide: R22)



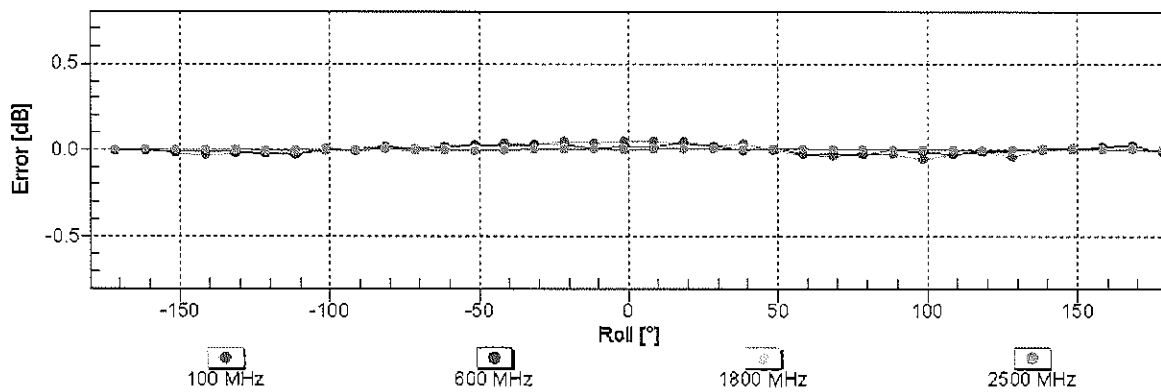
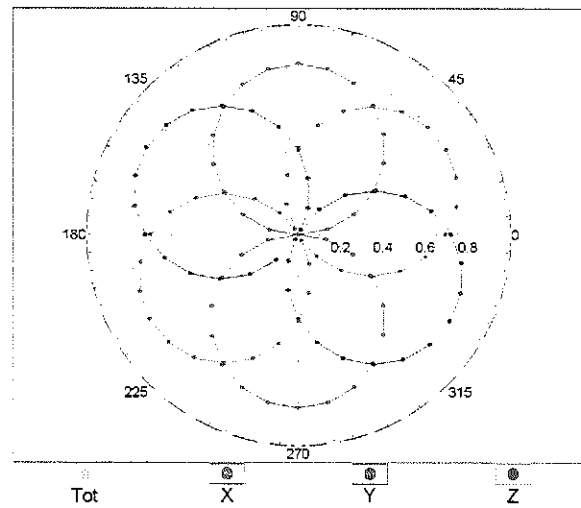
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

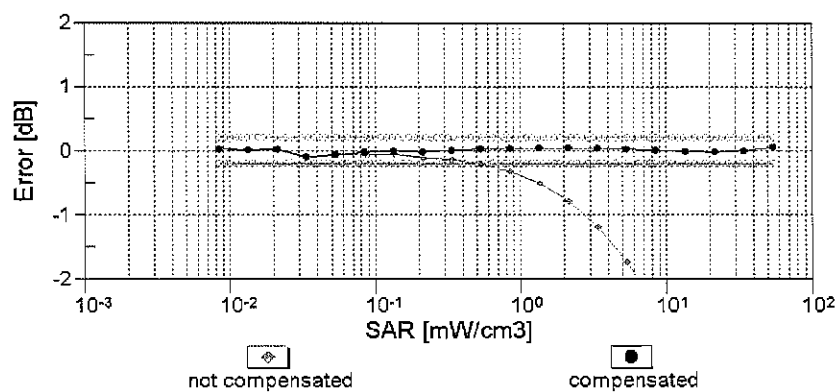
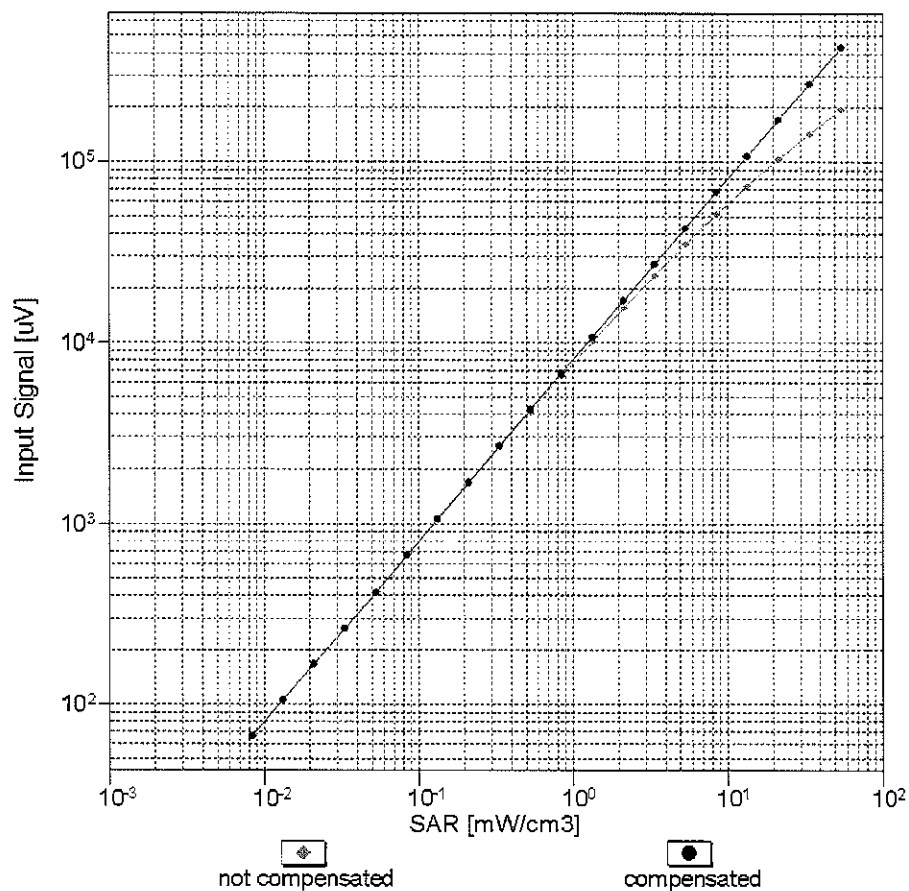


f=1800 MHz, R22



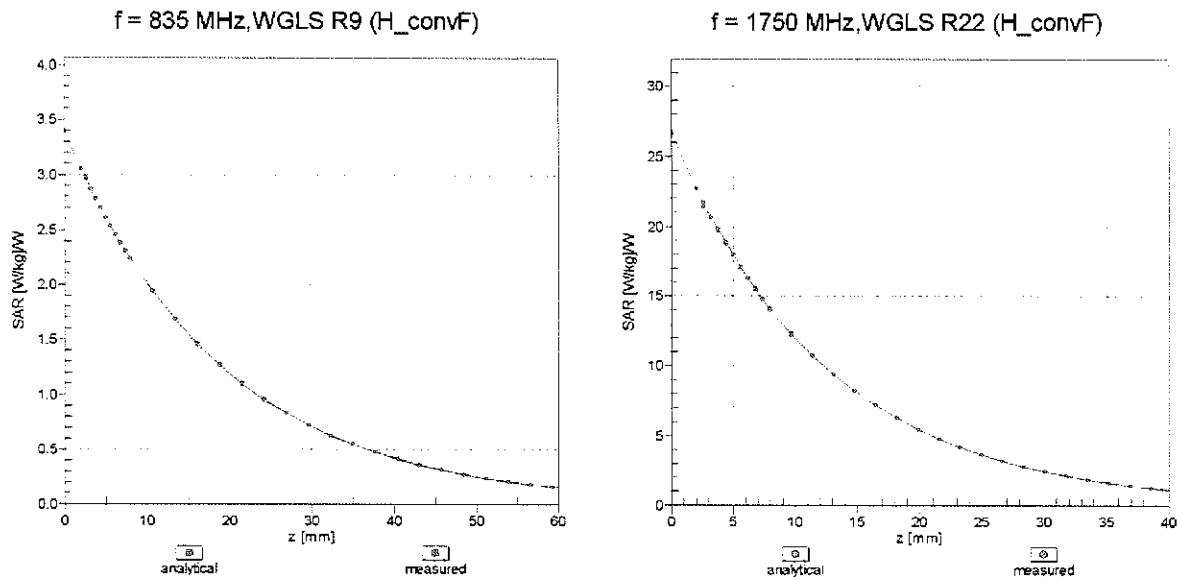
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



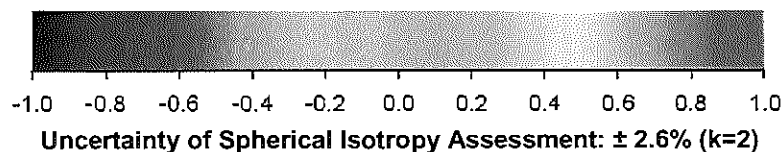
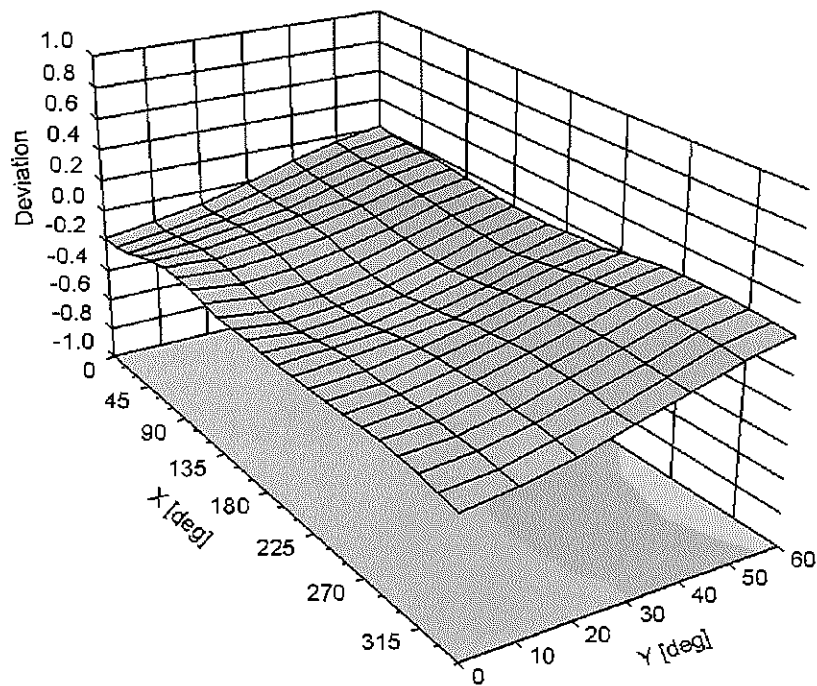
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: 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



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3209_Mar13**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3209**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **March 15, 2013**

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)

✓ KOK
3/24/13

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Israe El-Naouq	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: March 15, 2013
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Accreditation No.: **SCS 108**

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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., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- 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 E^2 -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.

Probe ES3DV3

SN:3209

Manufactured: October 14, 2008
Calibrated: March 15, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.35	1.33	1.14	$\pm 10.1 \%$
DCP (mV) ^B	99.2	97.8	98.3	

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	163.6	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		170.3	
		Z	0.0	0.0	1.0		158.7	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.74	6.74	6.74	0.76	1.18	± 12.0 %
835	41.5	0.90	6.46	6.46	6.46	0.31	1.81	± 12.0 %
1750	40.1	1.37	5.39	5.39	5.39	0.80	1.21	± 12.0 %
1900	40.0	1.40	5.21	5.21	5.21	0.78	1.26	± 12.0 %
2450	39.2	1.80	4.57	4.57	4.57	0.65	1.43	± 12.0 %
2600	39.0	1.96	4.43	4.43	4.43	0.75	1.36	± 12.0 %

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Body Tissue Simulating Media

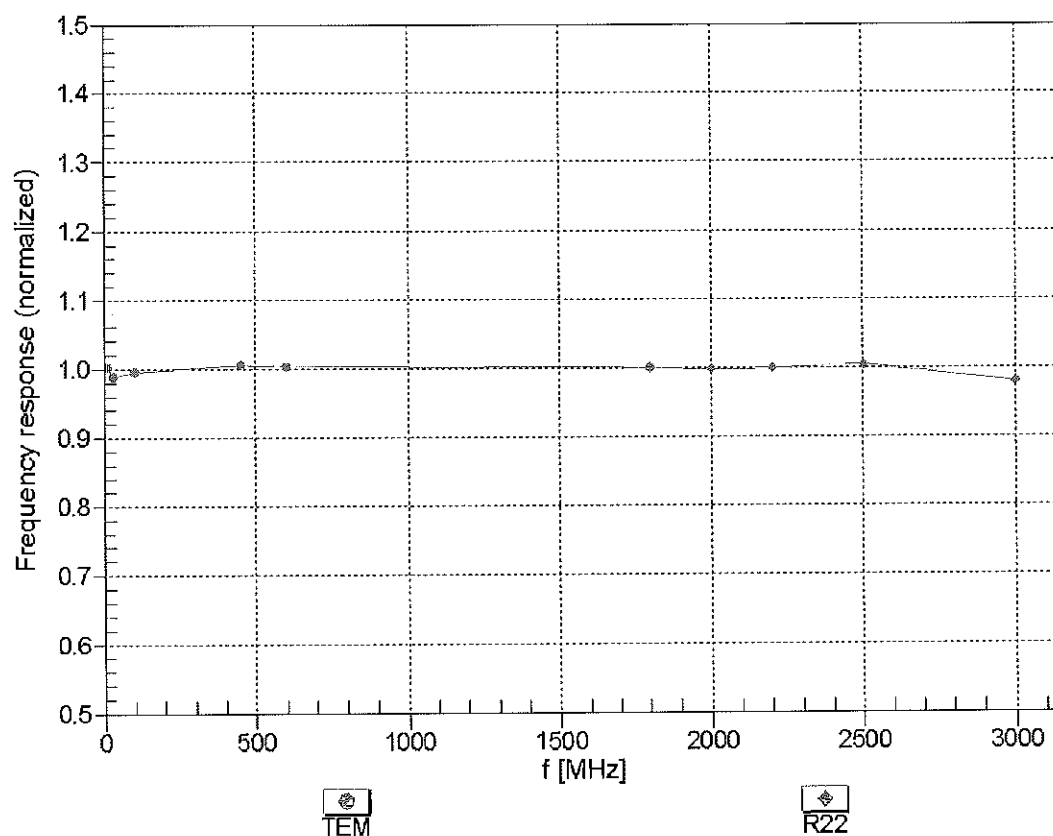
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.38	6.38	6.38	0.80	1.16	± 12.0 %
835	55.2	0.97	6.28	6.28	6.28	0.52	1.45	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.58	1.45	± 12.0 %
1900	53.3	1.52	4.77	4.77	4.77	0.70	1.36	± 12.0 %
2450	52.7	1.95	4.34	4.34	4.34	0.80	1.15	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.80	1.00	± 12.0 %

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

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

Frequency Response of E-Field

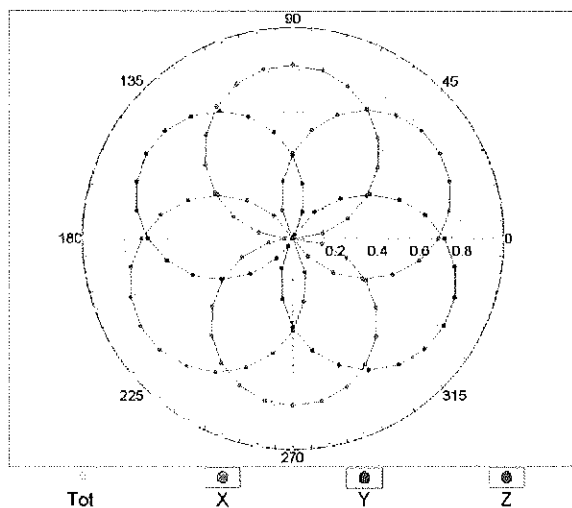
(TEM-Cell:ifi110 EXX, Waveguide: R22)



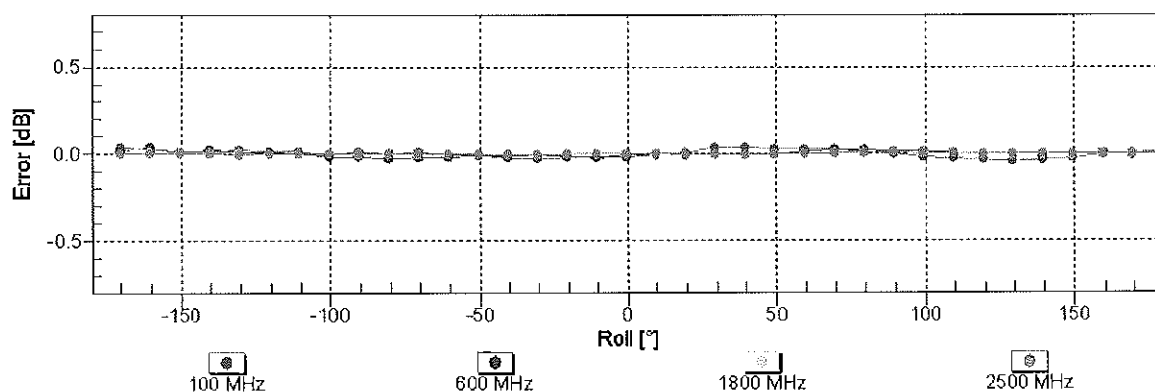
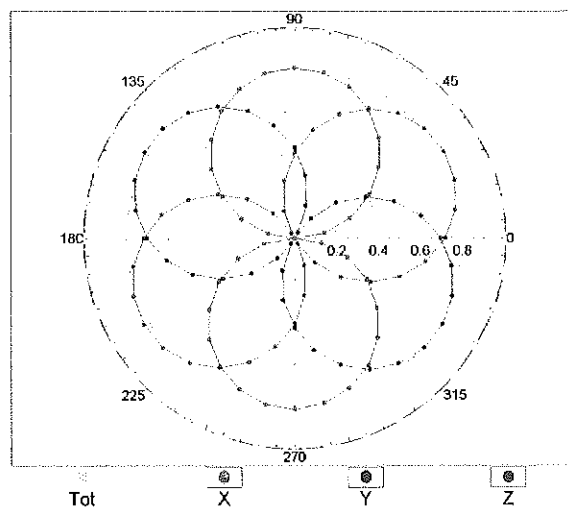
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

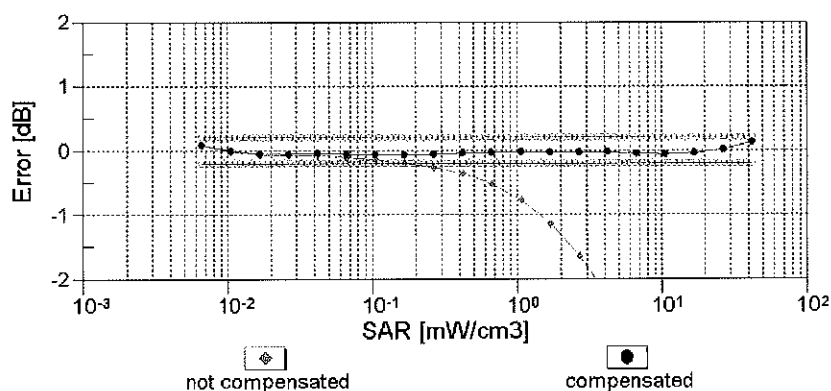
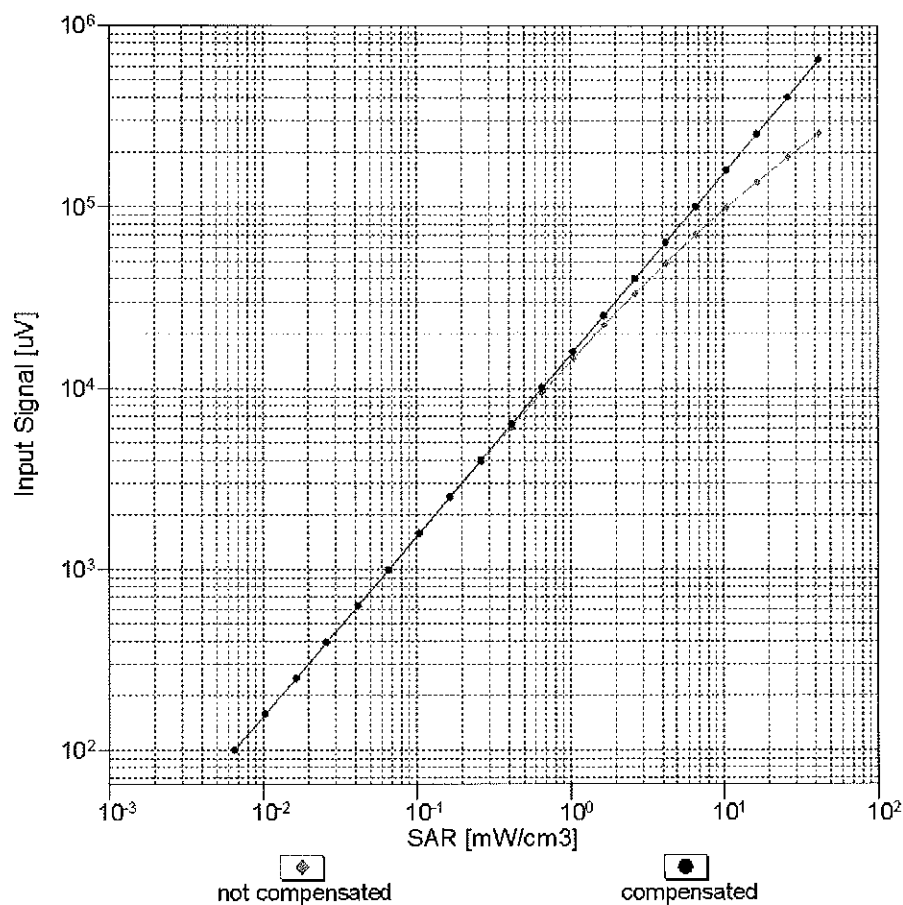
f=600 MHz,TEM



f=1800 MHz,R22

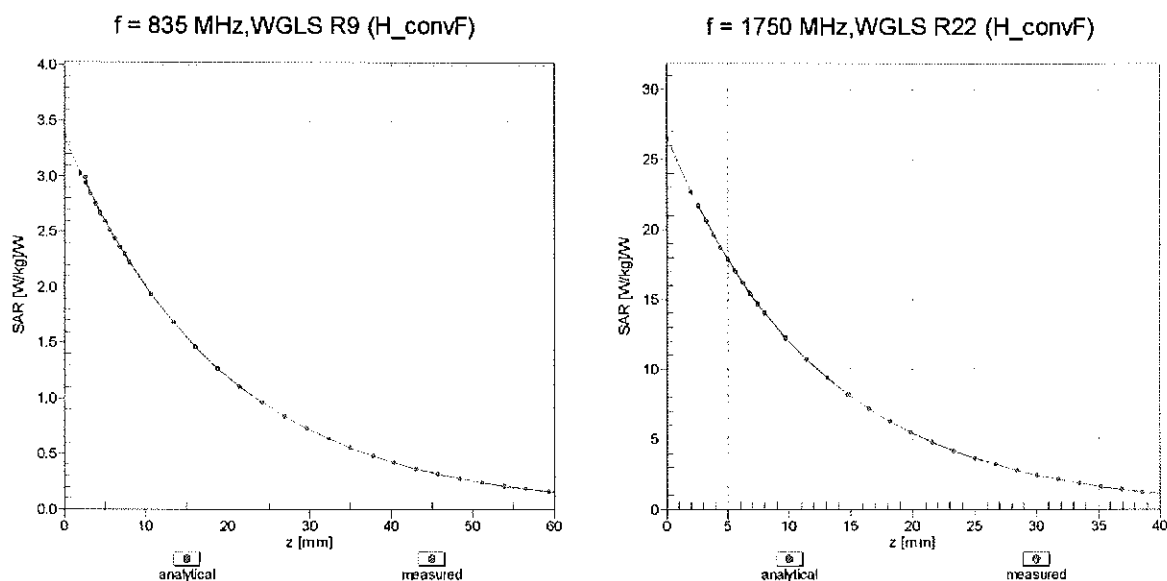
**Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)**

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



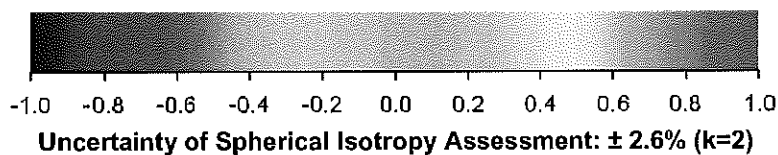
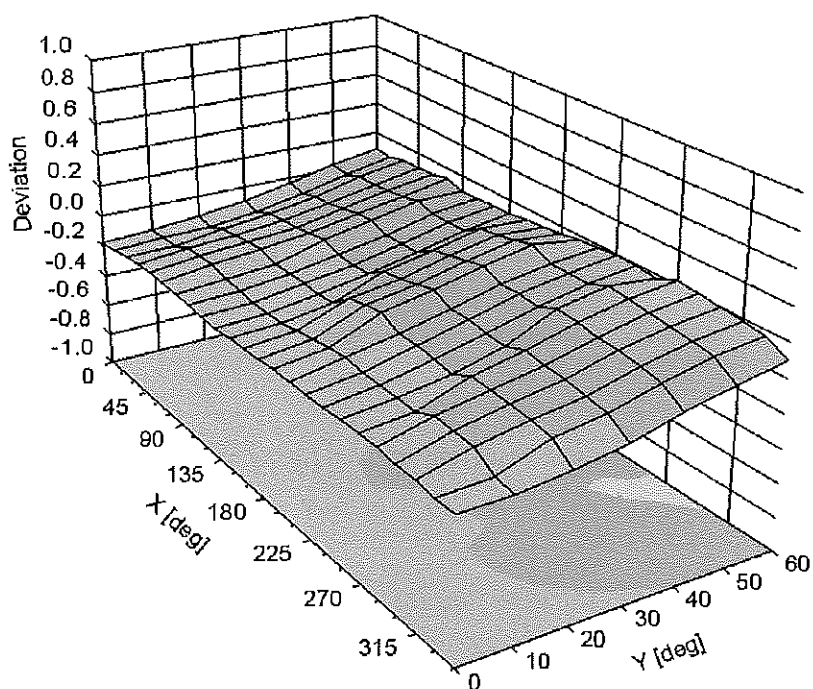
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-40.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3258_Feb13/2**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3258_Feb13)

Object **ES3DV3 - SN:3258**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **February 11, 2013**

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	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
			Issued: March 5, 2013
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 108**

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., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- 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 E^2 -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.

Probe ES3DV3

SN:3258

Manufactured: January 25, 2010
Calibrated: February 11, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.29	1.18	1.23	$\pm 10.1 \%$
DCP (mV) ^B	101.2	105.7	104.2	

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	162.4	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		151.3	
		Z	0.0	0.0	1.0		157.6	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter; uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.45	6.45	6.45	0.53	1.40	± 12.0 %
835	41.5	0.90	6.21	6.21	6.21	0.80	1.10	± 12.0 %
1750	40.1	1.37	5.23	5.23	5.23	0.62	1.30	± 12.0 %
1900	40.0	1.40	5.07	5.07	5.07	0.54	1.45	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.78	1.30	± 12.0 %
2600	39.0	1.96	4.32	4.32	4.32	0.80	1.29	± 12.0 %

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Calibration Parameter Determined in Body Tissue Simulating Media

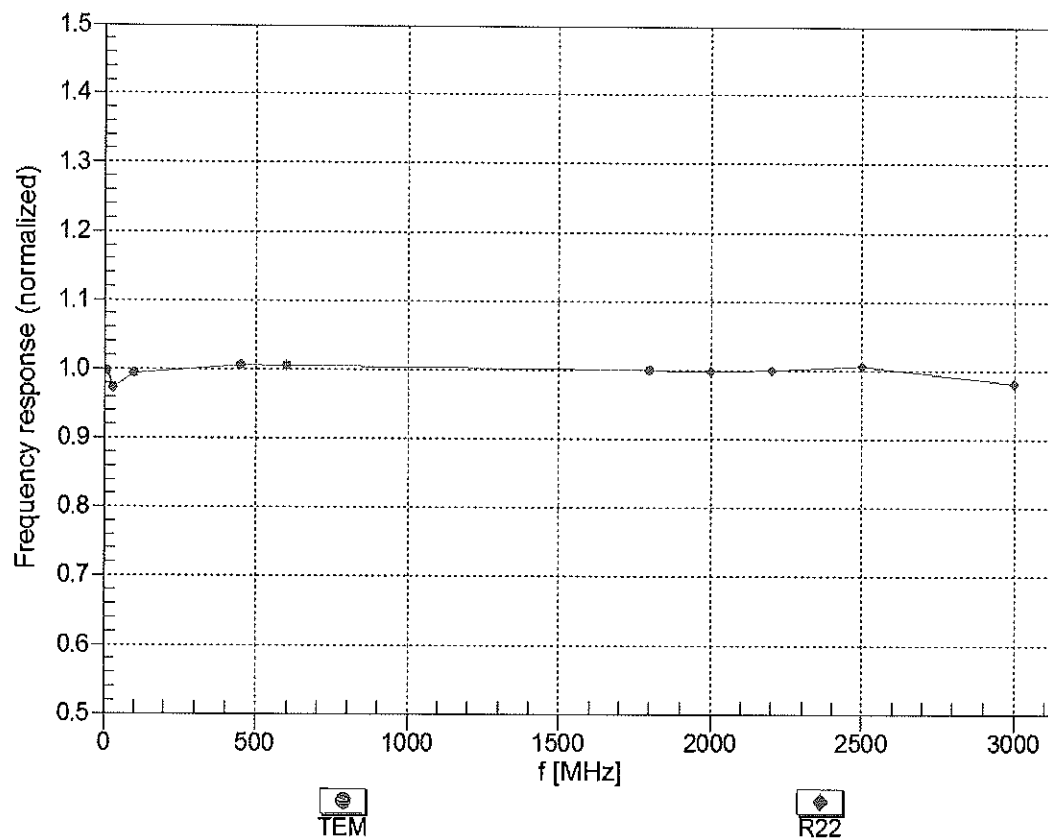
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.15	6.15	6.15	0.39	1.61	± 12.0 %
835	55.2	0.97	6.10	6.10	6.10	0.80	1.15	± 12.0 %
1750	53.4	1.49	4.91	4.91	4.91	0.42	1.69	± 12.0 %
1900	53.3	1.52	4.67	4.67	4.67	0.44	1.69	± 12.0 %
2450	52.7	1.95	4.25	4.25	4.25	0.80	1.02	± 12.0 %
2600	52.5	2.16	4.07	4.07	4.07	0.65	0.95	± 12.0 %

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

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

Frequency Response of E-Field

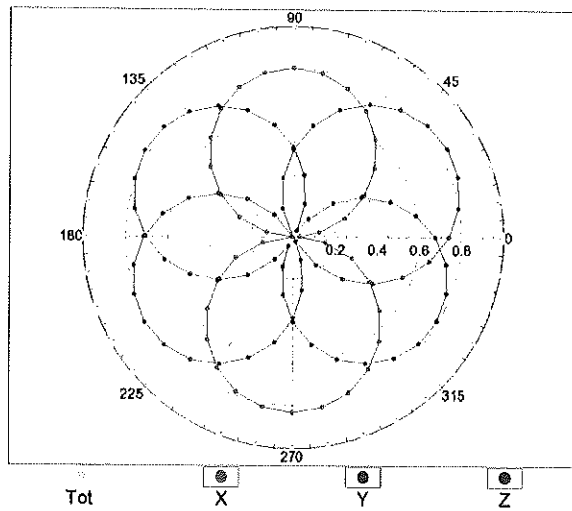
(TEM-Cell:ifi110 EXX, Waveguide: R22)



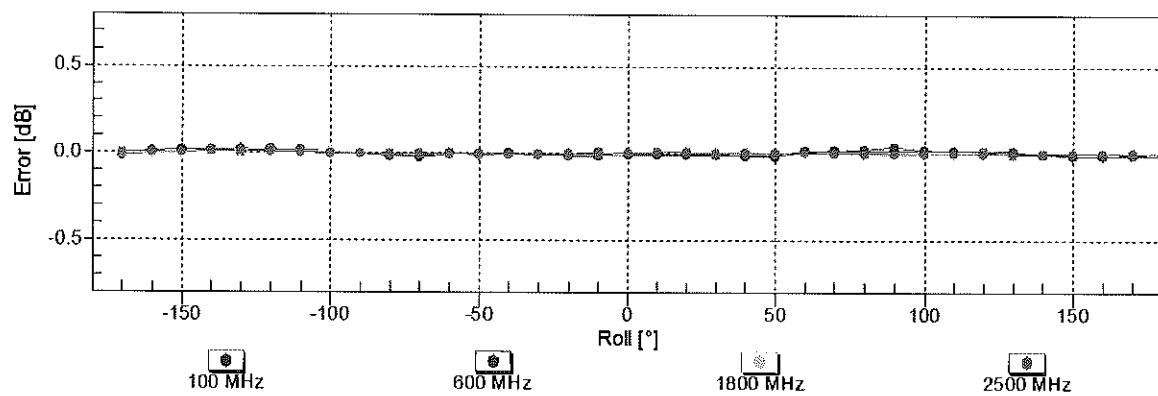
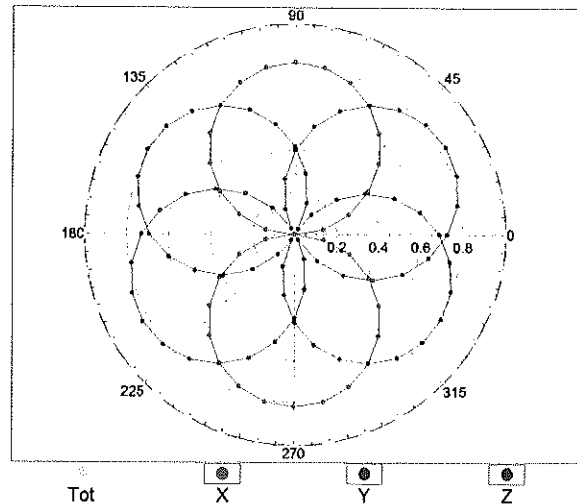
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

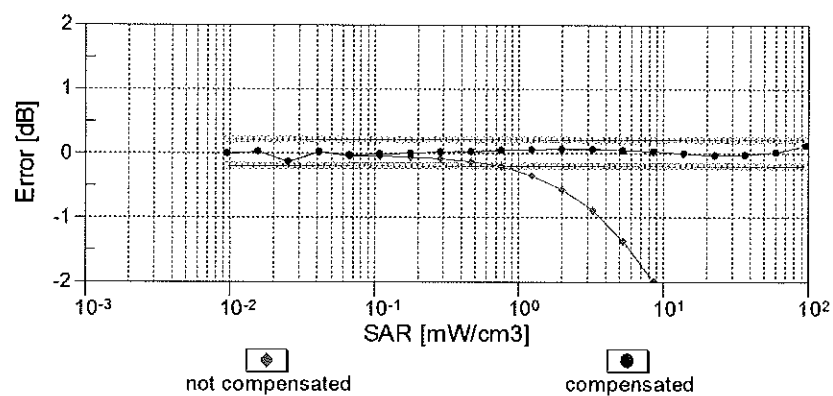
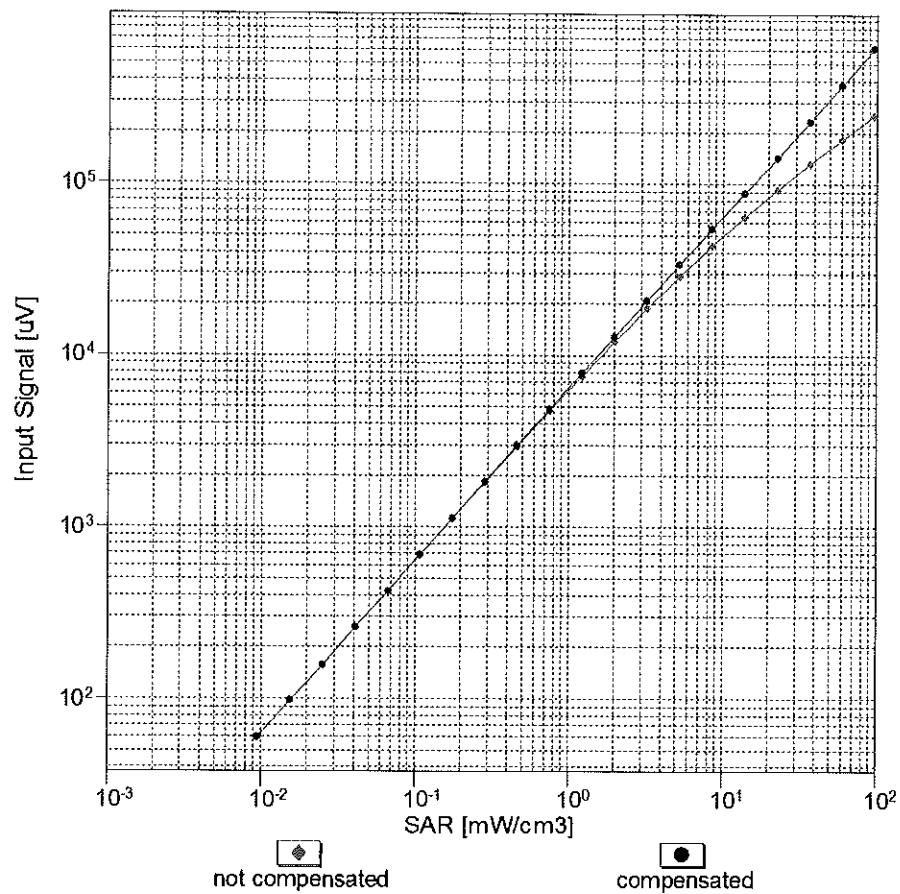


f=1800 MHz, R22



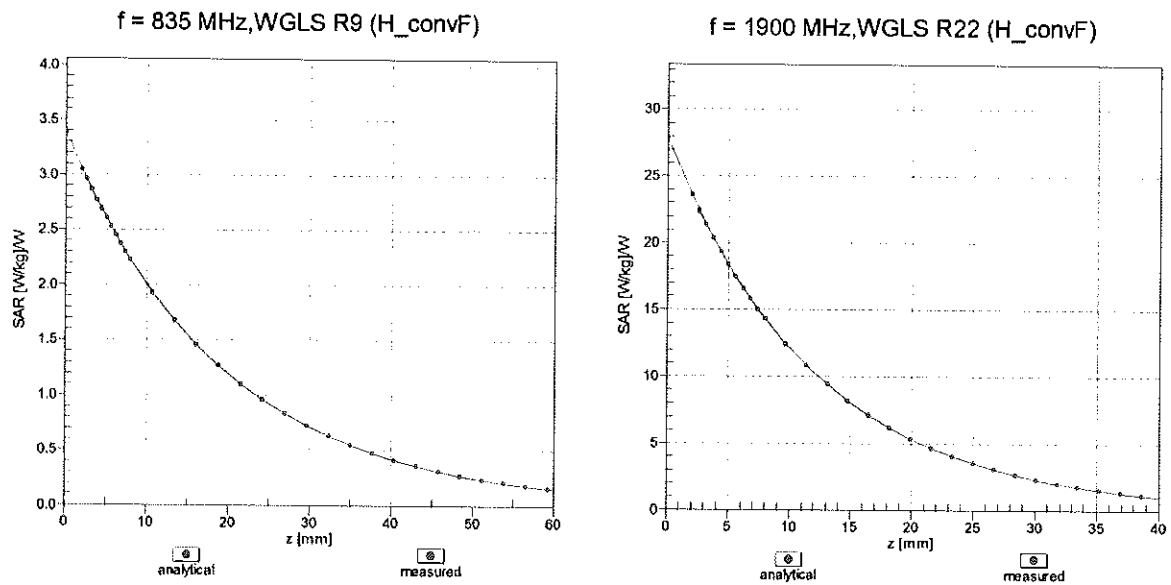
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



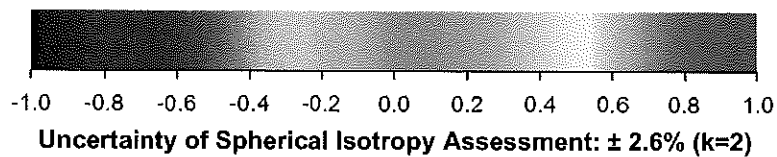
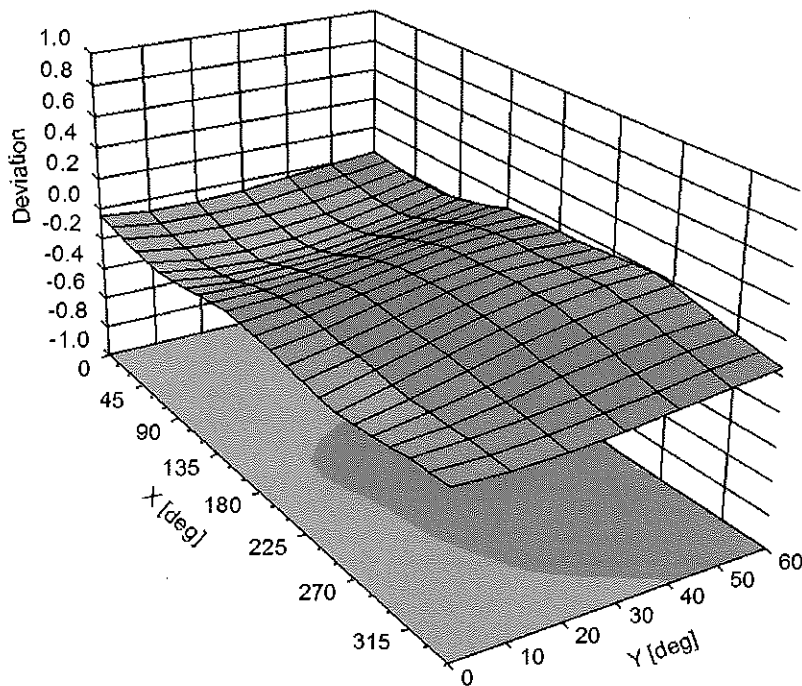
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	59.8
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



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Client **PC Test**

Certificate No: **ES3-3287_Nov12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3287**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **November 15, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: November 16, 2012

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



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Accreditation No.: **SCS 108**

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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	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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- 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}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ 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.

Probe ES3DV3

SN:3287

Manufactured: June 7, 2010
Calibrated: November 15, 2012

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 ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.31	1.25	1.25	$\pm 10.1 \%$
DCP (mV) ^B	102.9	103.6	101.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.0	0.0	1.0	116.8	$\pm 3.5 \%$
			Y	0.0	0.0	1.0	118.5	
			Z	0.0	0.0	1.0	154.1	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN: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	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.40	6.40	6.40	0.20	2.54	± 12.0 %
835	41.5	0.90	6.17	6.17	6.17	0.34	1.68	± 12.0 %
1750	40.1	1.37	5.16	5.16	5.16	0.63	1.30	± 12.0 %
1900	40.0	1.40	4.96	4.96	4.96	0.48	1.55	± 12.0 %
2450	39.2	1.80	4.30	4.30	4.30	0.79	1.31	± 12.0 %
2600	39.0	1.96	4.19	4.19	4.19	0.80	1.31	± 12.0 %

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

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

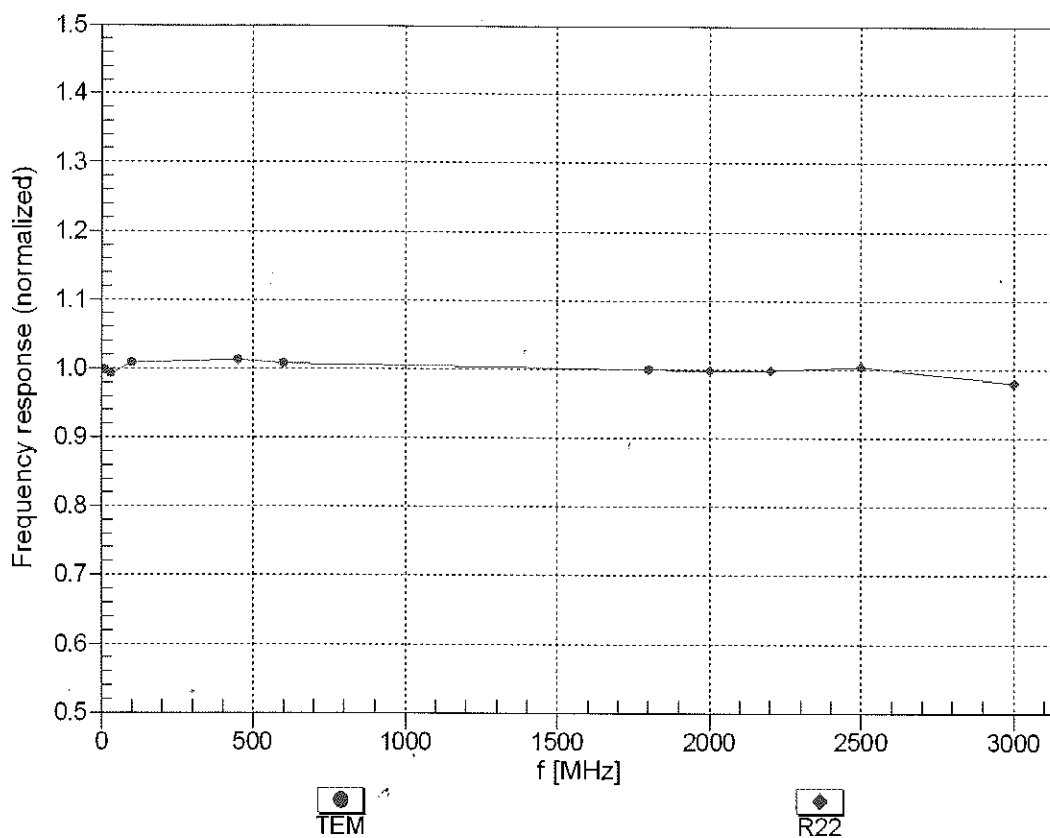
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.14	6.14	6.14	0.28	2.06	± 12.0 %
835	55.2	0.97	6.06	6.06	6.06	0.42	1.63	± 12.0 %
1750	53.4	1.49	4.86	4.86	4.86	0.43	1.64	± 12.0 %
1900	53.3	1.52	4.69	4.69	4.69	0.56	1.54	± 12.0 %
2450	52.7	1.95	4.29	4.29	4.29	0.80	1.02	± 12.0 %
2600	52.5	2.16	4.12	4.12	4.12	0.64	0.92	± 12.0 %

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

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

Frequency Response of E-Field

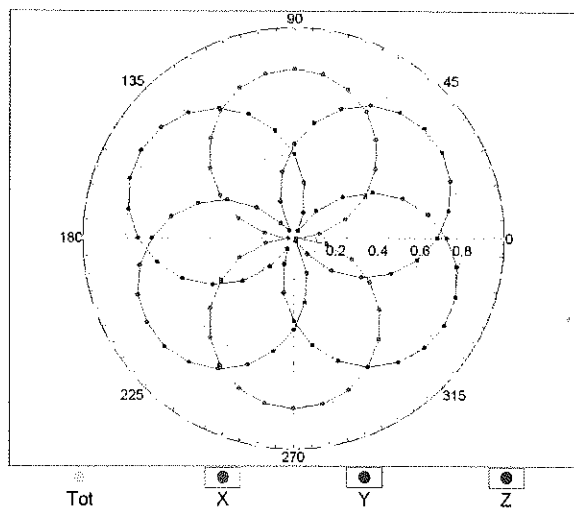
(TEM-Cell:ifi110 EXX, Waveguide: R22)



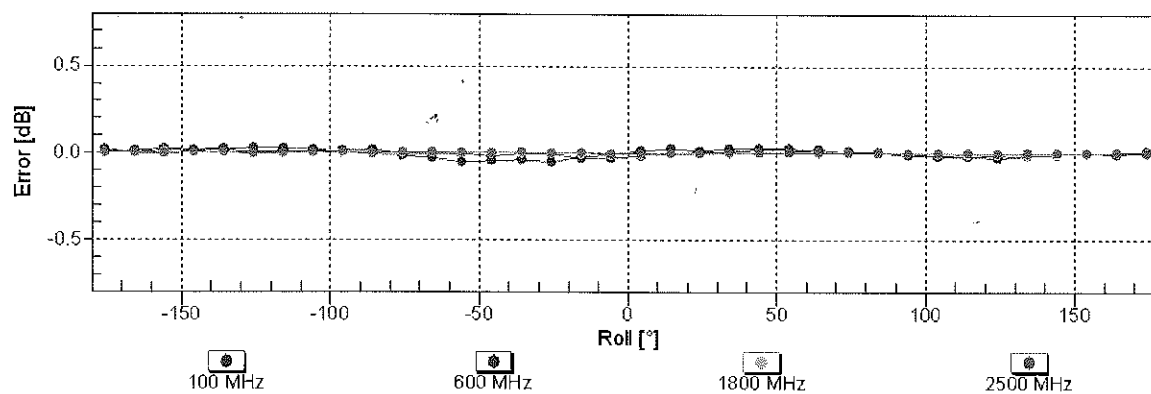
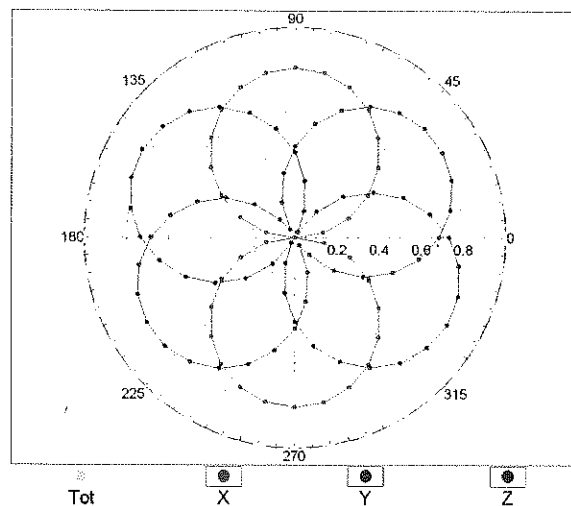
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

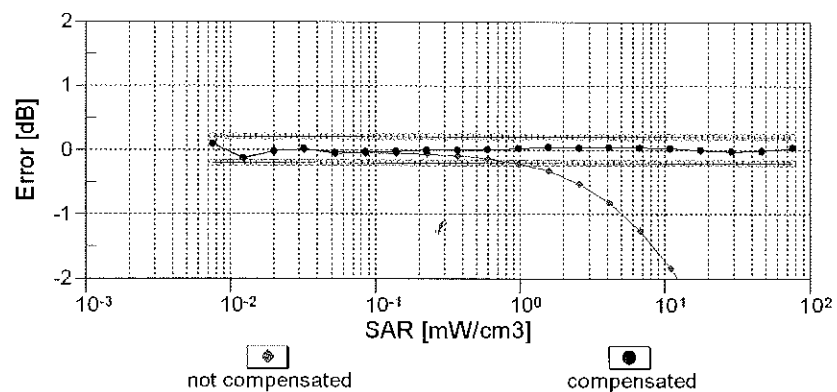
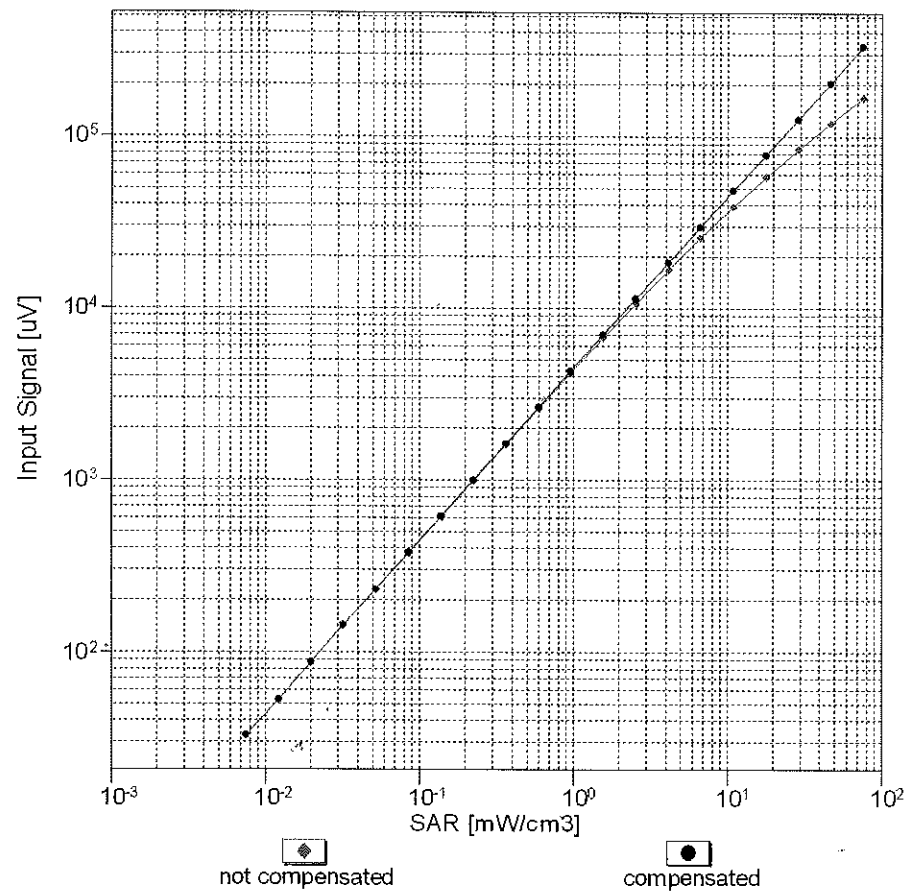


f=1800 MHz, R22



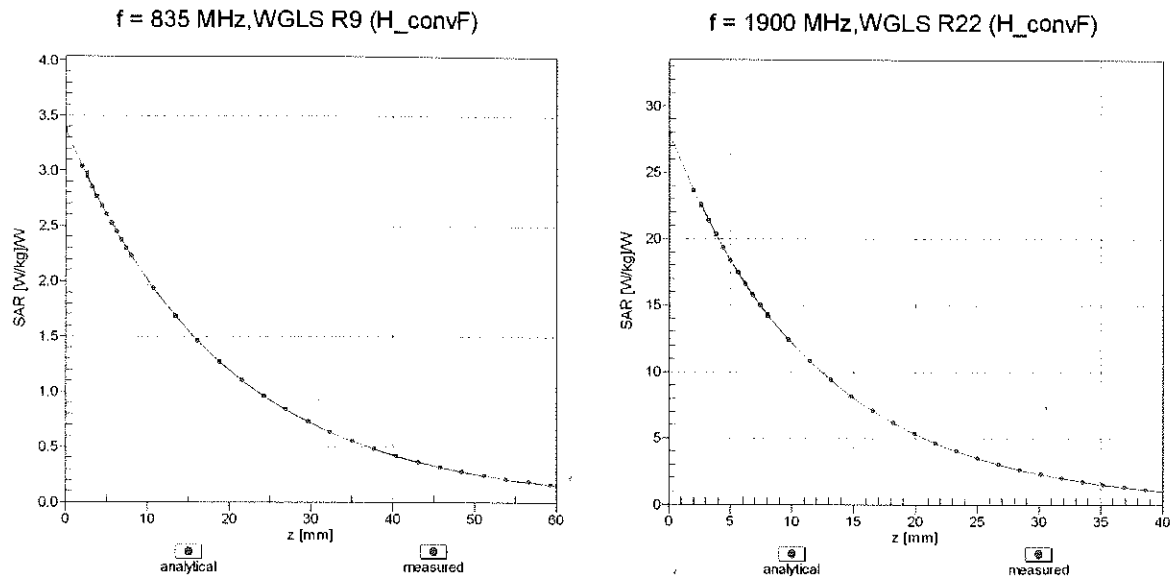
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)



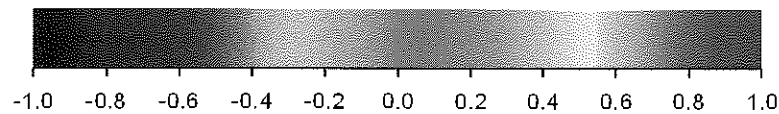
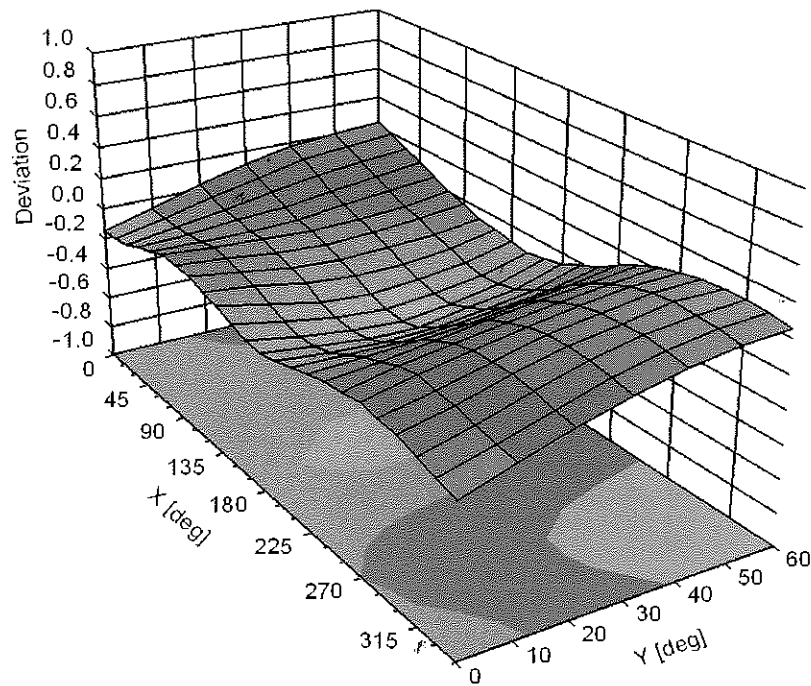
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

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:3287

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-15.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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



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

Accredited by the Swiss Accreditation Service (SAS)

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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3288_Sep12**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3288**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes**

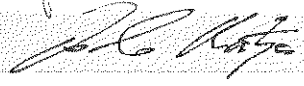
Calibration date: **September 20, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Technical Manager	
			Issued: September 20, 2012
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Accreditation No.: **SCS 108**

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	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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- 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}; VR_{x,y,z}; A, B, C** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ 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.

Probe ES3DV3

SN:3288

Manufactured: July 6, 2010
Calibrated: September 20, 2012

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	0.87	0.97	0.75	$\pm 10.1 \%$
DCP (mV) ^B	101.3	102.4	103.9	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	168.6	$\pm 3.3 \%$
			Y	0.00	0.00	1.00	132.2	
			Z	0.00	0.00	1.00	156.8	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN: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	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.67	6.67	6.67	0.80	1.14	± 12.0 %
835	41.5	0.90	6.41	6.41	6.41	0.76	1.18	± 12.0 %
1750	40.1	1.37	5.51	5.51	5.51	0.70	1.28	± 12.0 %
1900	40.0	1.40	5.28	5.28	5.28	0.80	1.22	± 12.0 %
2450	39.2	1.80	4.61	4.61	4.61	0.80	1.26	± 12.0 %
2600	39.0	1.96	4.45	4.45	4.45	0.80	1.31	± 12.0 %

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Calibration Parameter Determined in Body Tissue Simulating Media

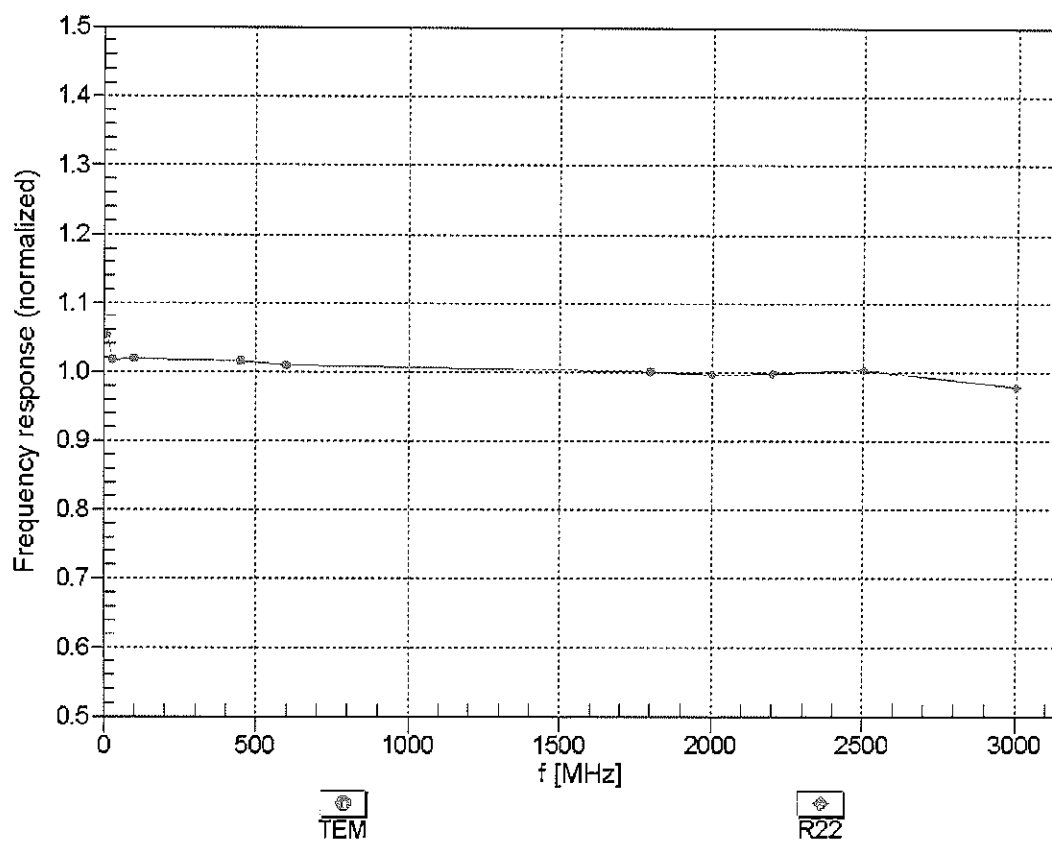
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.44	6.44	6.44	0.62	1.31	± 12.0 %
835	55.2	0.97	6.31	6.31	6.31	0.38	1.78	± 12.0 %
1750	53.4	1.49	5.18	5.18	5.18	0.64	1.43	± 12.0 %
1900	53.3	1.52	4.89	4.89	4.89	0.50	1.64	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.74	1.23	± 12.0 %
2600	52.5	2.16	4.09	4.09	4.09	0.80	1.07	± 12.0 %

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

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

Frequency Response of E-Field

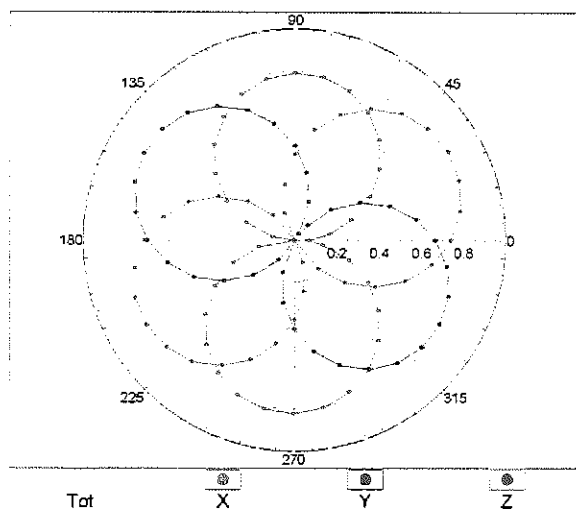
(TEM-Cell: ifi110 EXX, Waveguide: R22)



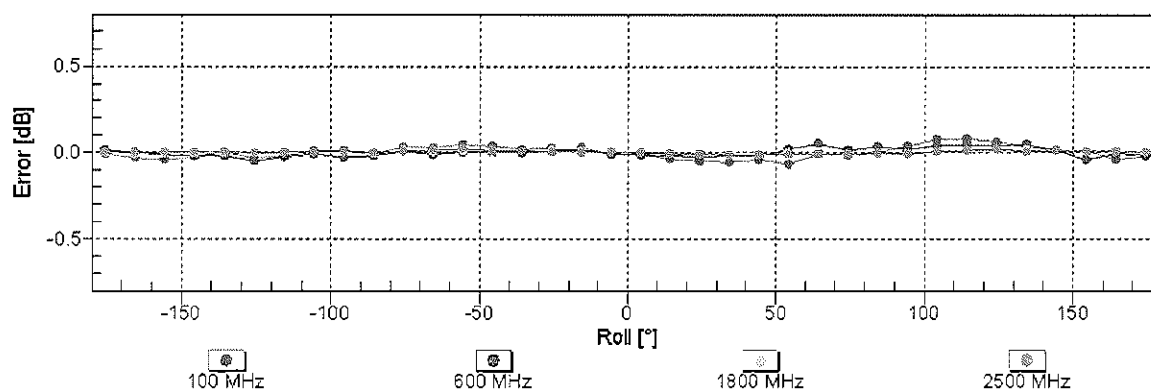
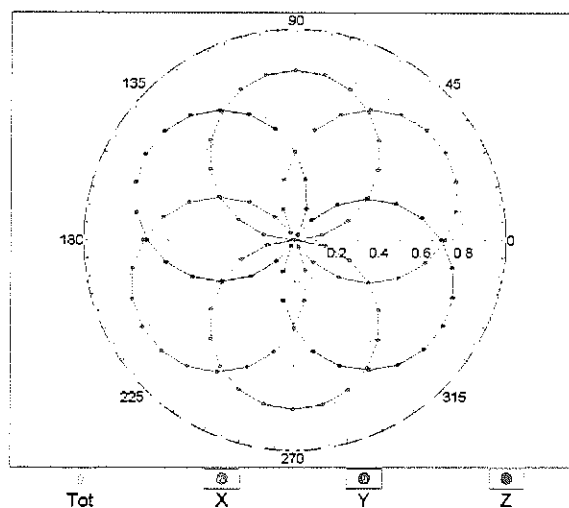
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

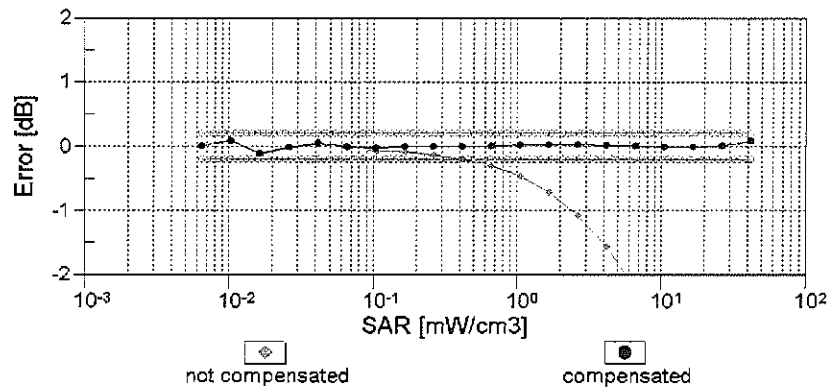
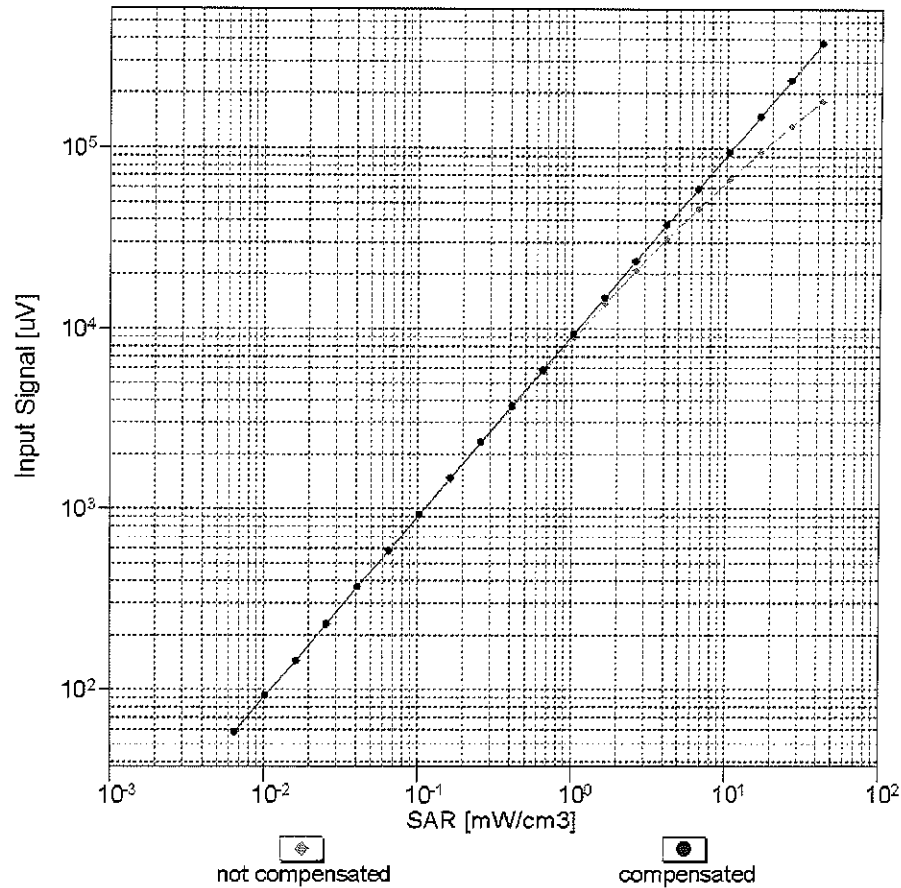


f=1800 MHz,R22



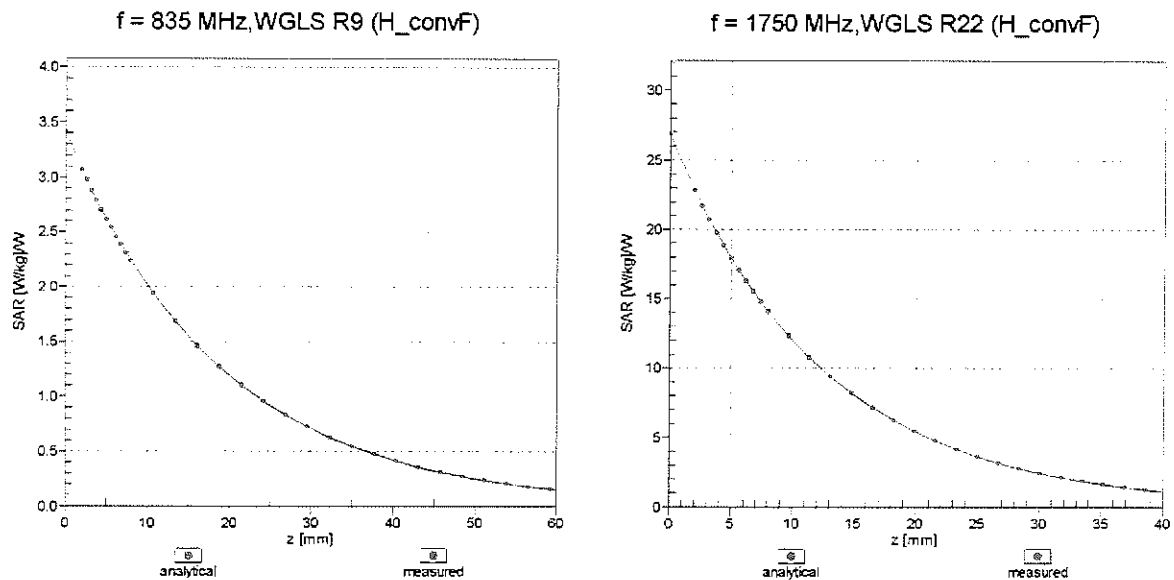
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



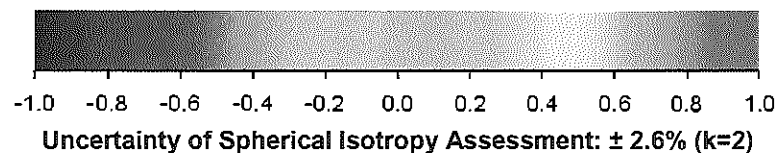
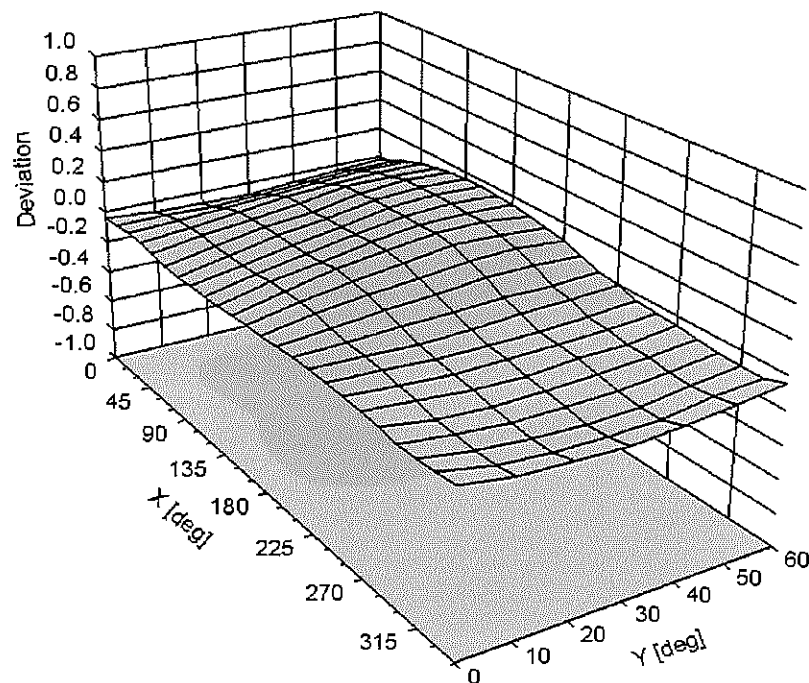
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

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 (°)	54.3
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



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Client **PC Test**

Certificate No: **EX3-3920_Feb13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3920**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **February 27, 2013**

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)

*✓ KOK
3/6/13*

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
			Issued: February 27, 2013

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 108**

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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., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- 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 E^2 -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.

Probe EX3DV4

SN:3920

Manufactured: December 18, 2012
Calibrated: February 27, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.34	0.50	0.50	$\pm 10.1 \%$
DCP (mV) ^B	101.2	101.0	99.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/ μV	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.3	$\pm 3.3 \%$
		Y	0.0	0.0	1.0		164.7	
		Z	0.0	0.0	1.0		161.4	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	9.86	9.86	9.86	0.19	1.39	± 12.0 %
835	41.5	0.90	9.58	9.58	9.58	0.77	0.54	± 12.0 %
1750	40.1	1.37	7.97	7.97	7.97	0.57	0.69	± 12.0 %
1900	40.0	1.40	7.73	7.73	7.73	0.54	0.73	± 12.0 %
2450	39.2	1.80	7.04	7.04	7.04	0.40	0.82	± 12.0 %
2600	39.0	1.96	6.80	6.80	6.80	0.49	0.76	± 12.0 %
5200	36.0	4.66	4.87	4.87	4.87	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.73	4.73	4.73	0.37	1.80	± 13.1 %
5500	35.6	4.96	4.52	4.52	4.52	0.39	1.80	± 13.1 %
5600	35.5	5.07	4.17	4.17	4.17	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.02	4.02	4.02	0.45	1.80	± 13.1 %

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Calibration Parameter Determined in Body Tissue Simulating Media

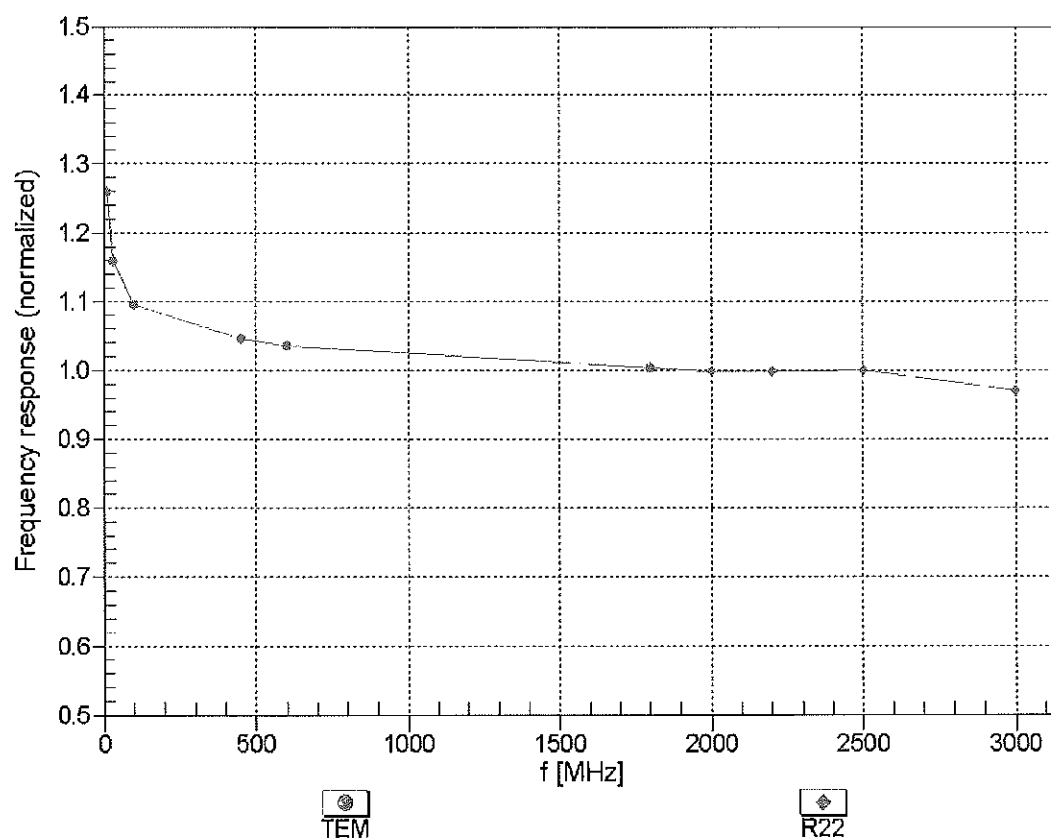
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	9.57	9.57	9.57	0.43	0.83	± 12.0 %
835	55.2	0.97	9.42	9.42	9.42	0.36	0.98	± 12.0 %
1750	53.4	1.49	7.59	7.59	7.59	0.43	0.78	± 12.0 %
1900	53.3	1.52	7.38	7.38	7.38	0.33	0.91	± 12.0 %
2450	52.7	1.95	7.07	7.07	7.07	0.80	0.55	± 12.0 %
2600	52.5	2.16	6.73	6.73	6.73	0.80	0.56	± 12.0 %
5200	49.0	5.30	4.23	4.23	4.23	0.51	1.90	± 13.1 %
5300	48.9	5.42	4.13	4.13	4.13	0.49	1.90	± 13.1 %
5500	48.6	5.65	3.63	3.63	3.63	0.52	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.49	1.90	± 13.1 %
5800	48.2	6.00	3.91	3.91	3.91	0.54	1.90	± 13.1 %

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

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

Frequency Response of E-Field

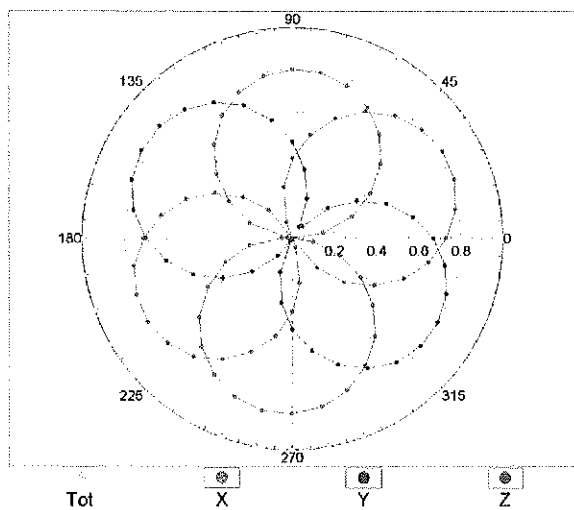
(TEM-Cell:ifi110 EXX, Waveguide: R22)



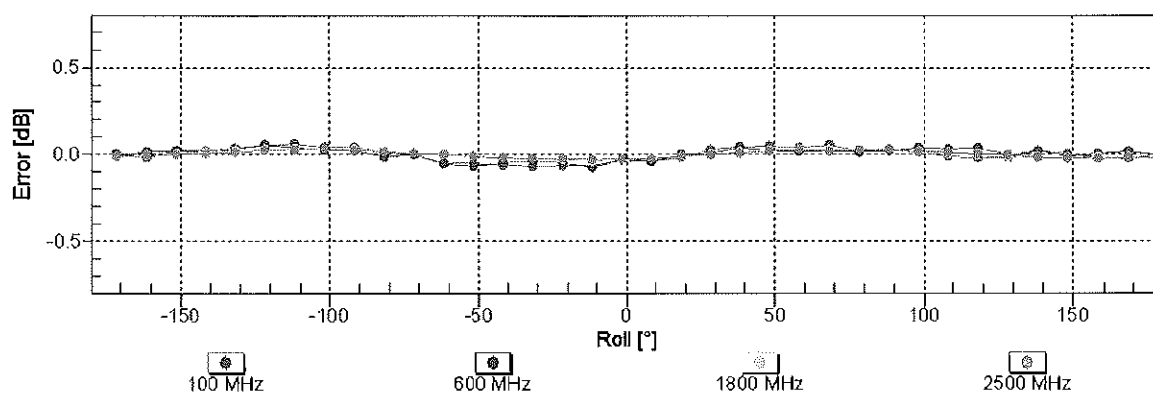
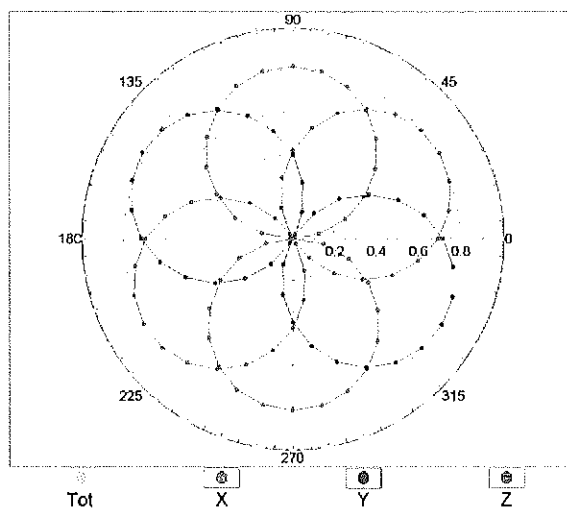
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

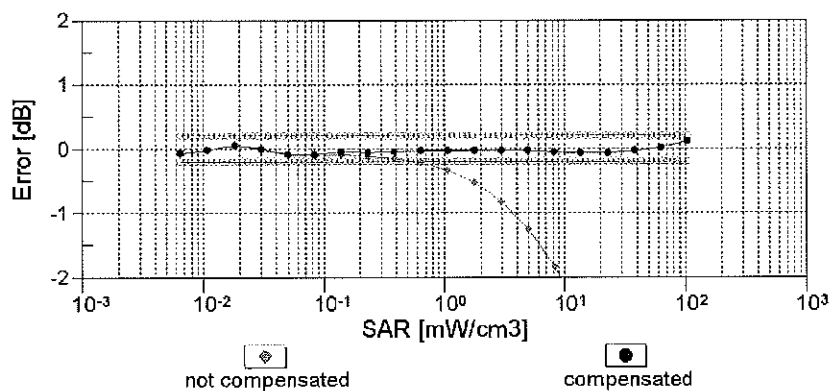
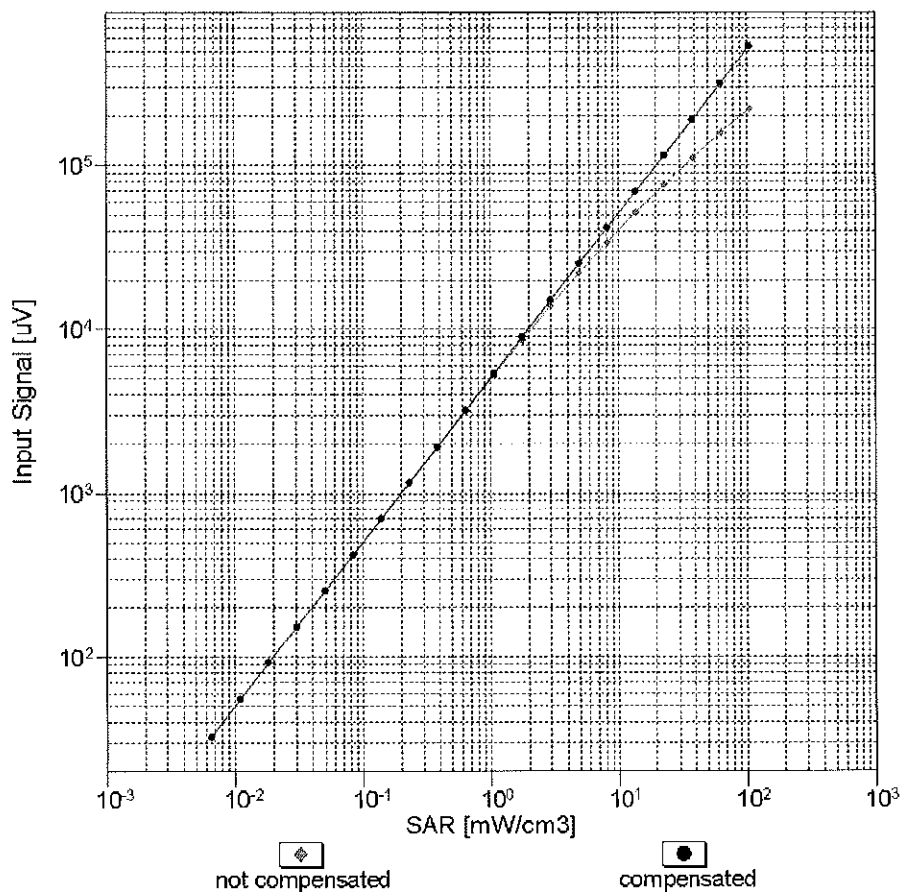


f=1800 MHz,R22



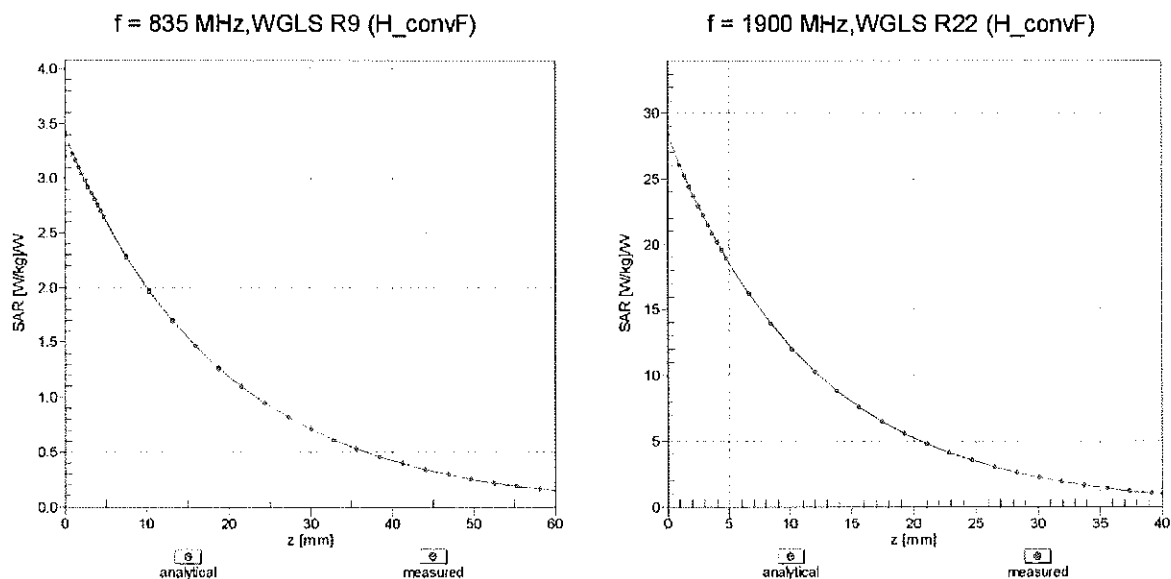
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



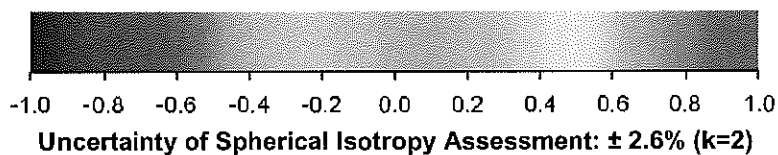
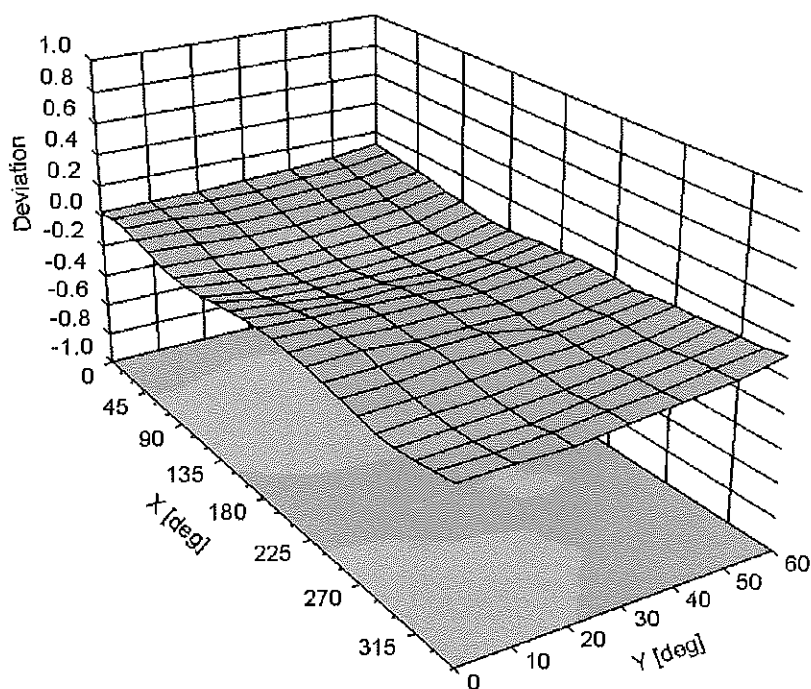
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-21.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **EX3-3589 Jan13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3589**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **January 17, 2013**

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	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: January 17, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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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., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- 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 E^2 -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.

Probe EX3DV4

SN:3589

Manufactured: March 30, 2006
Calibrated: January 17, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.46	0.40	0.40	$\pm 10.1 \%$
DCP (mV) ^B	100.5	103.8	99.6	

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	165.8	$\pm 3.3 \%$
		Y	0.0	0.0	1.0		134.3	
		Z	0.0	0.0	1.0		140.5	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	8.70	8.70	8.70	0.39	0.96	± 12.0 %
835	41.5	0.90	8.40	8.40	8.40	0.52	0.74	± 12.0 %
1750	40.1	1.37	7.34	7.34	7.34	0.45	0.93	± 12.0 %
1900	40.0	1.40	7.09	7.09	7.09	0.80	0.65	± 12.0 %
2450	39.2	1.80	6.37	6.37	6.37	0.39	0.97	± 12.0 %
2600	39.0	1.96	6.19	6.19	6.19	0.30	1.12	± 12.0 %
5200	36.0	4.66	4.48	4.48	4.48	0.45	1.80	± 13.1 %
5300	35.9	4.76	4.27	4.27	4.27	0.45	1.80	± 13.1 %
5500	35.6	4.96	4.14	4.14	4.14	0.50	1.80	± 13.1 %
5600	35.5	5.07	3.81	3.81	3.81	0.55	1.80	± 13.1 %
5800	35.3	5.27	3.85	3.85	3.85	0.55	1.80	± 13.1 %

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Calibration Parameter Determined in Body Tissue Simulating Media

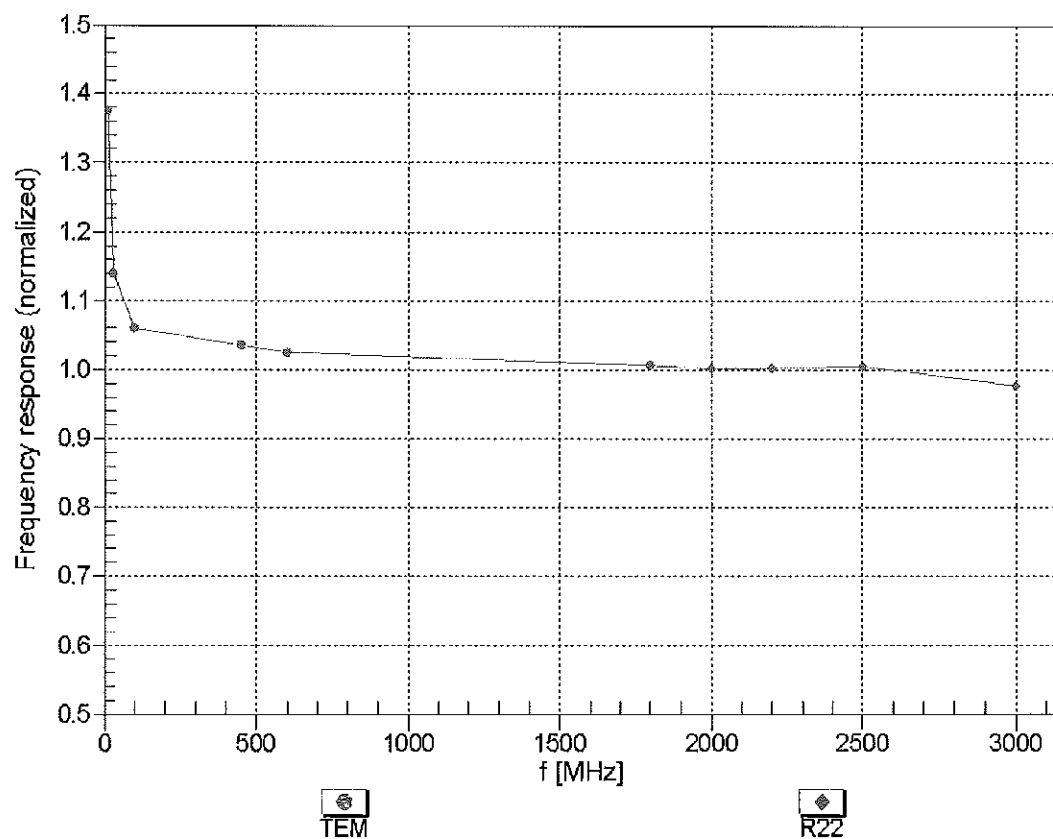
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	8.59	8.59	8.59	0.49	0.86	± 12.0 %
835	55.2	0.97	8.43	8.43	8.43	0.38	1.05	± 12.0 %
1750	53.4	1.49	7.87	7.87	7.87	0.44	0.89	± 12.0 %
1900	53.3	1.52	7.46	7.46	7.46	0.58	0.75	± 12.0 %
2450	52.7	1.95	7.07	7.07	7.07	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.68	6.68	6.68	0.80	0.50	± 12.0 %
5200	49.0	5.30	3.99	3.99	3.99	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.81	3.81	3.81	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.52	3.52	3.52	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.32	3.32	3.32	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.66	3.66	3.66	0.60	1.90	± 13.1 %

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

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

Frequency Response of E-Field

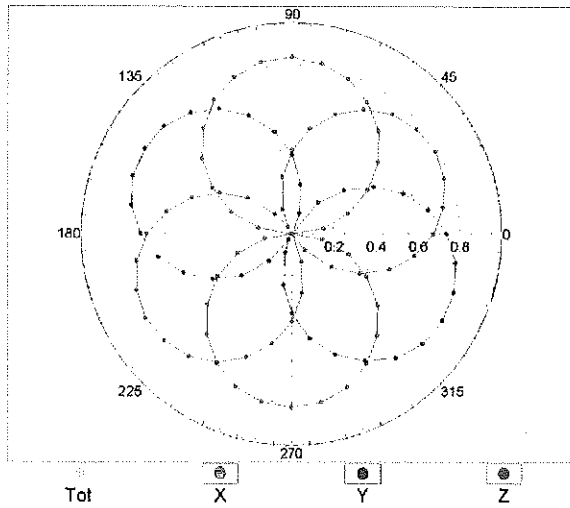
(TEM-Cell:ifi110 EXX, Waveguide: R22)



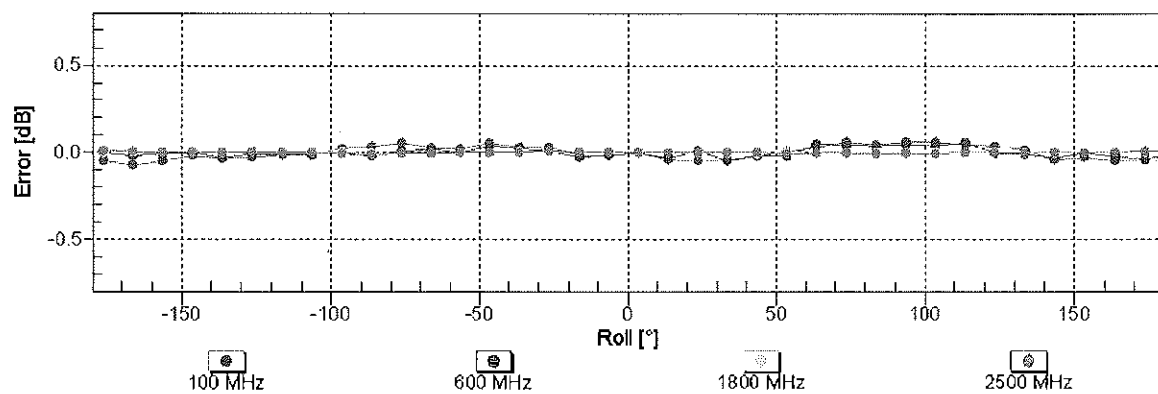
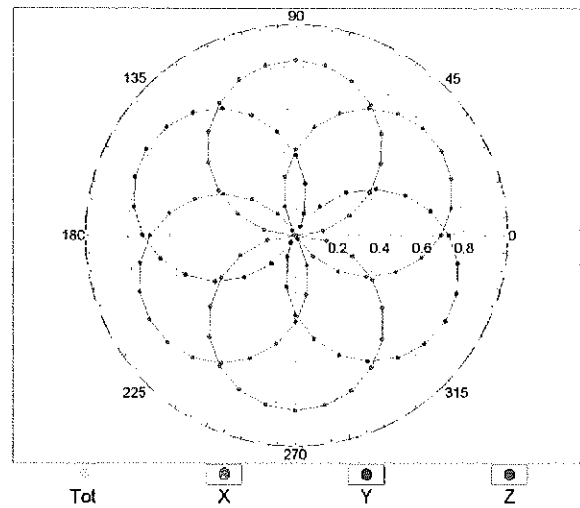
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

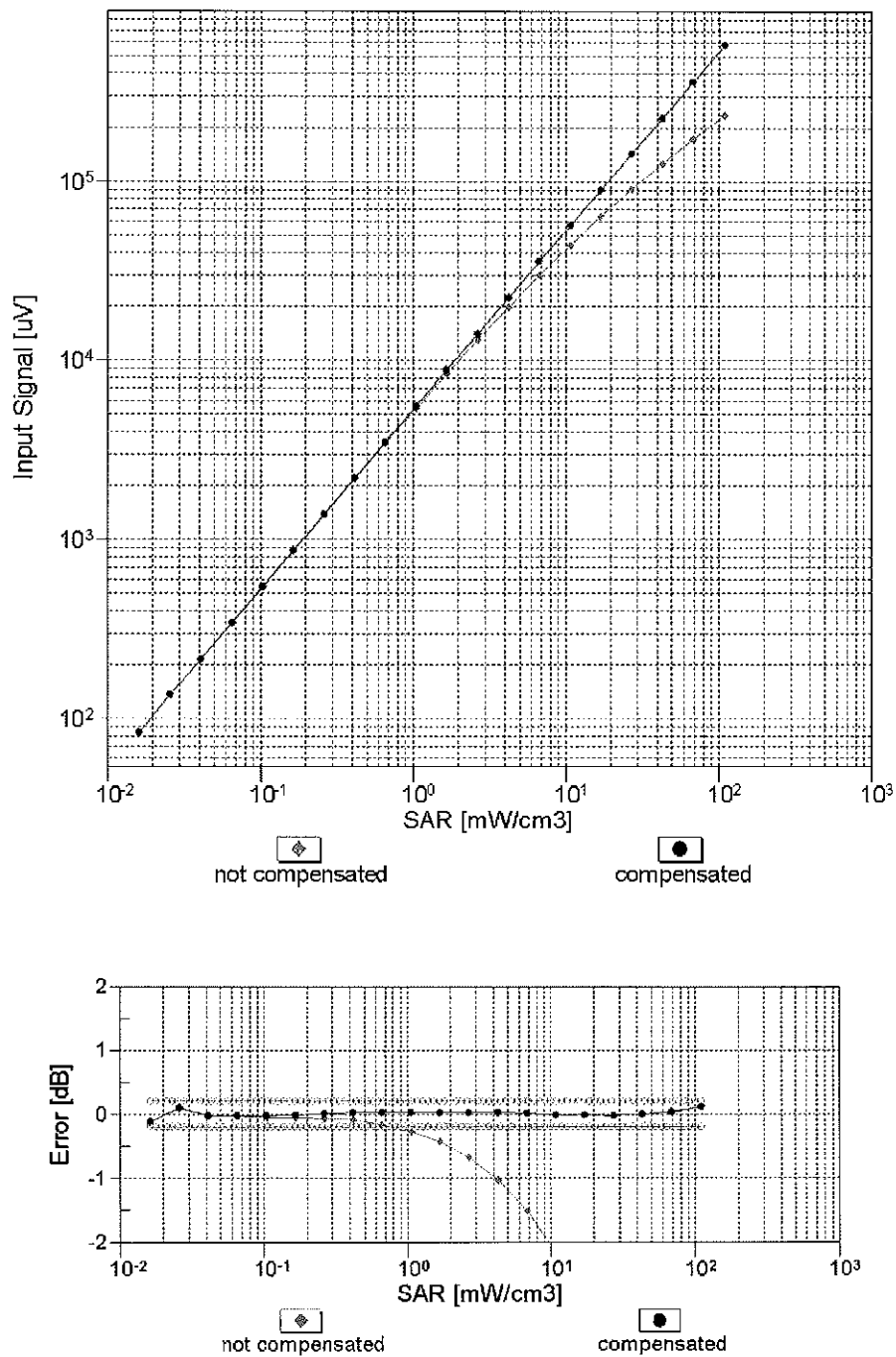


f=1800 MHz,R22



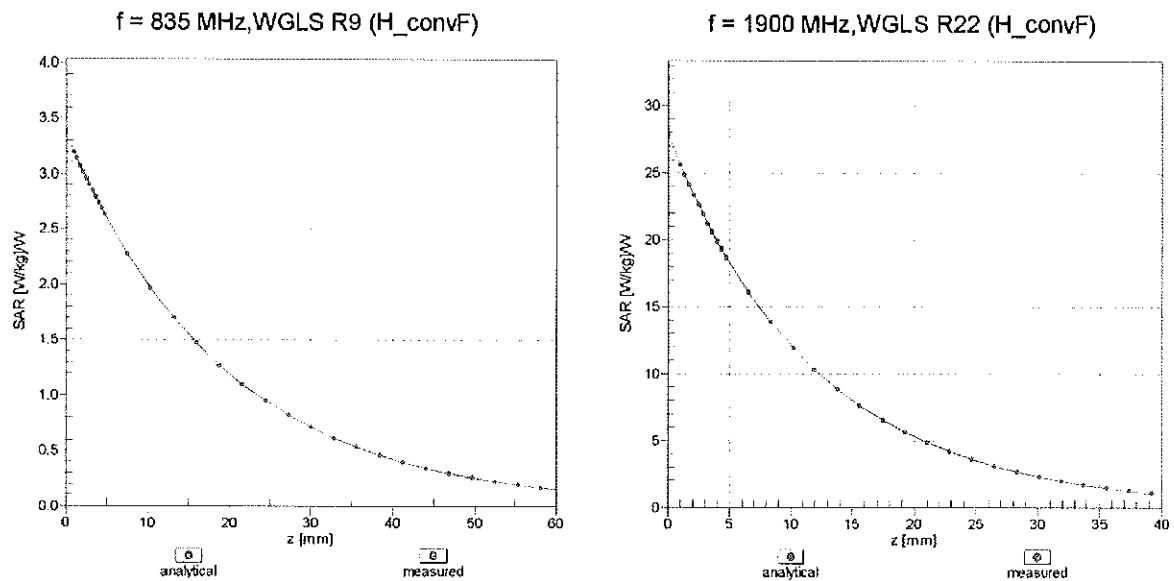
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



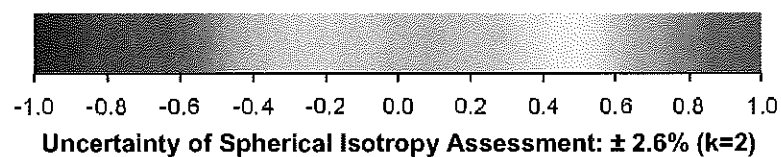
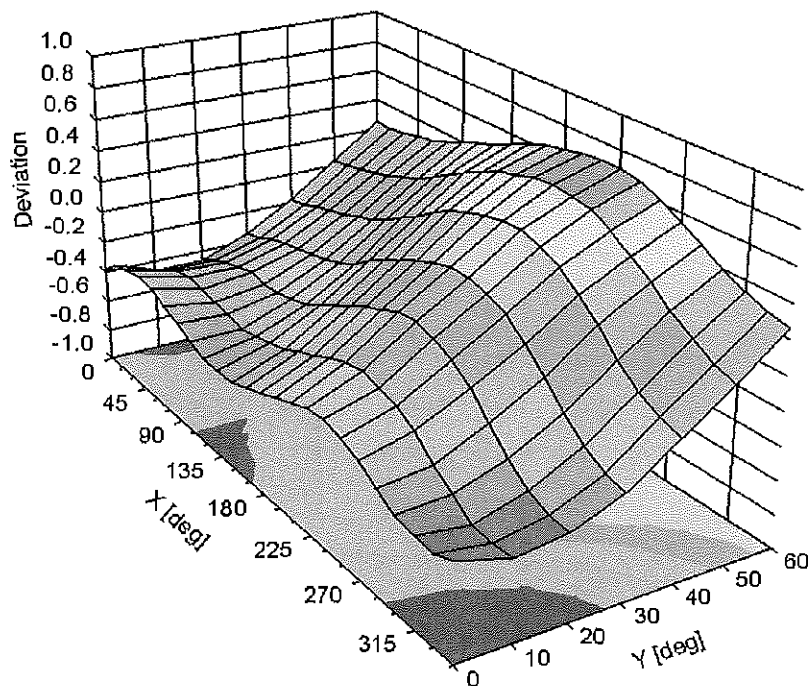
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-26.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

- 1) The network analyzer and probe system was configured and calibrated.
- 2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
- 3) The complex admittance with respect to the probe aperture was measured
- 4) The complex relative permittivity ϵ can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{[\ln(b/a)]^2} \int_a^b \int_a^b \int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\epsilon_r'\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

Table D-I
Composition of the Tissue Equivalent Matter

Frequency (MHz)	750	835	1750	1900	2450	5200-5800
Tissue	Body	Body	Body	Body	Body	Body
Ingredients (% by weight)						
Bactericide	See Page 2	0.1				
DGBE			31	29.44	26.7	
HEC		1				
NaCl		0.94	0.2	0.39	0.1	
Sucrose		44.9				
Polysorbate (Tween) 80						20
Water		53.06	68.8	70.17	73.2	80

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2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H ₂ O	Water, 35 – 58%
Sucrose	Sugar, white, refined, 40 – 60%
NaCl	Sodium Chloride, 0 – 6%
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyl-3(2H)-isothiazolone, 0.1 – 0.7%
Relevant for safety; Refer to the respective Safety Data Sheet*.	

Figure D-1

Composition of 750 MHz Body Tissue Equivalent Matter

Note: 750MHz liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	Body Tissue Simulating Liquid (MSL750)
Product No.	SL AAM 075 AA (Charge: 111130-3)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

Ambient Condition 22°C ; 30% humidity
TSL Temperature 22°C
Test Date 7-Dec-11

Additional Information

TSL Density 1.212 g/cm³
TSL Heat-capacity 3.006 kJ/(kg*K)

Results

f [MHz]	Measured			Target		Diff.to Target (%)	
	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
600	57.9	26.01	0.83	56.1	0.95	3.1	-12.3
625	57.6	24.66	0.86	56.0	0.95	2.9	-10.1
650	57.4	24.31	0.88	55.9	0.96	2.6	-8.0
675	57.1	24.02	0.90	55.8	0.96	2.3	-5.8
700	56.8	23.74	0.92	55.7	0.96	2.0	-3.7
725	56.6	23.50	0.95	55.6	0.96	1.7	-1.5
750	56.4	23.26	0.97	55.5	0.96	1.5	0.8
775	56.1	23.00	0.99	55.4	0.97	1.2	3.0
800	55.8	22.86	1.02	55.3	0.97	0.9	5.2
825	55.6	22.72	1.04	55.2	0.98	0.6	6.6
850	55.5	22.64	1.05	55.2	0.98	0.5	7.3
875	55.4	22.57	1.07	55.2	0.99	0.4	8.0
900	54.9	22.31	1.12	55.0	1.05	-0.2	6.4
925	54.7	22.20	1.14	55.0	1.06	-0.5	7.5
950	54.5	22.09	1.17	54.9	1.08	-0.9	8.5
975	54.3	21.99	1.19	54.9	1.09	-1.2	9.7
1000	54.1	21.89	1.22	54.8	1.10	-1.4	10.9

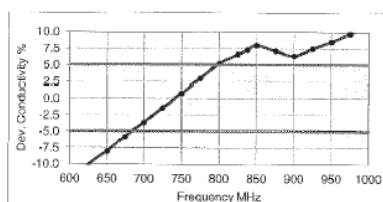
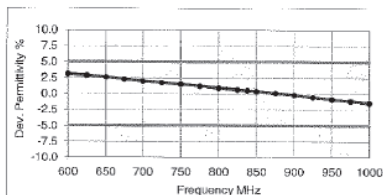


Figure D-2

750MHz Body Tissue Equivalent Matter

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APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01 v01. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ε _r)	SENSI- TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
G	750	3/28/2013	3209	ES3DV3	750	Body	0.974	55.21	PASS	PASS	PASS	N/A	N/A	N/A
B	835	1/24/2013	3287	ES3DV3	835	Body	0.959	53.44	PASS	PASS	PASS	GMSK	PASS	N/A
G	835	3/26/2013	3209	ES3DV3	835	Body	1.006	54.42	PASS	PASS	PASS	GMSK	PASS	N/A
E	1750	3/13/2013	3920	EX3DV4	1750	Head	1.386	38.47	PASS	PASS	PASS	N/A	N/A	N/A
D	1900	10/17/2012	3288	ES3DV3	1900	Body	1.562	52.56	PASS	PASS	PASS	GMSK	PASS	N/A
E	1900	3/5/2013	3920	EX3DV4	1900	Body	1.574	52.42	PASS	PASS	PASS	GMSK	PASS	N/A
B	1900	1/29/2013	3287	ES3DV3	1900	Body	1.570	51.00	PASS	PASS	PASS	GMSK	PASS	N/A
C	2450	11/8/2012	3022	ES3DV2	2450	Body	2.038	51.10	PASS	PASS	PASS	OFDM	N/A	PASS
F	2450	4/4/2013	3258	ES3DV3	2450	Body	2.010	52.45	PASS	PASS	PASS	OFDM	N/A	N/A
A	5200	1/23/2013	3589	EX3DV4	5200	Body	5.292	47.85	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	1/23/2013	3589	EX3DV4	5300	Body	5.477	47.47	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	1/23/2013	3589	EX3DV4	5500	Body	5.729	47.03	PASS	PASS	PASS	OFDM	N/A	PASS
A	5600	1/23/2013	3589	EX3DV4	5600	Body	6.233	46.20	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	1/23/2013	3589	EX3DV4	5800	Body	6.233	46.20	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: All measurements were performed using probes calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

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APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

FCC ID: A3LSGHI467	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Test Dates: 04/05/13 – 05/07/13	DUT Type: Portable Tablet	APPENDIX G: Page G1 of G4

A3LSGHI467 Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D04v01, this device was tested by the manufacturer to determine the proximity sensor triggering distances for the back and top edge of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D04v01) with the device at maximum output power without power reduction. These additional SAR Tests are included additionally to the SAR tests for the device touching the SAR phantom, with reduced power.

The operational description contains information explaining how this device remains compliant in the event of a sensor malfunction.

Back Side

Moving device toward the phantom:

KDB616217 6.2.6											
Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GPRS850 1Tx	32.87	32.80 3	2.84 3	2.83 3	2.78 2	7.92 2	7.97 2	7.89 2	7.86 27	.92 27	.97
GPRS850 2Tx	31.48	31.50 3	1.45 3	1.50 3	1.44 2	6.33 2	6.31 2	6.38 2	6.28 26	.37 26	.38
GPRS850 3Tx	29.93	29.96 2	9.93 2	9.85 2	9.92 2	4.50 2	4.44 2	4.48 2	4.46 24	.46 24	.45
GPRS850 4Tx	28.08	28.08 2	7.98 2	7.98 2	8.07 2	2.82 2	2.86 2	2.76 2	2.86 22	.83 22	.81
GPRS1900 1Tx	30.47	30.42 3	0.50 3	0.40 3	0.45 2	1.17 2	1.24 2	1.13 2	1.18 21	.21 21	.22
GPRS1900 2Tx	28.66	28.68 2	8.64 2	8.61 2	8.56 1	9.43 1	9.37 1	9.50 1	9.44 19	.48 19	.40
GPRS1900 3Tx	27.60	27.64 2	7.58 2	7.58 2	7.58 1	7.83 1	7.79 1	7.77 1	7.87 17	.79 17	.78
GPRS1900 4Tx	26.14	26.17 2	6.16 2	6.14 2	6.19 1	6.43 1	6.37 1	6.49 1	6.44 16	.42 16	.47
WCDMA850	22.30	22.34 2	2.36 2	2.27 2	2.37 1	8.17 1	8.20 1	8.19 1	8.16 18	.12 18	.13
WCDMA1900	22.10	22.11 2	2.22 2	2.19 2	2.13 1	3.21 1	3.25 1	3.27 1	3.26 13	.16 13	.27
LTE B2	22.96	22.91 2	2.84 2	2.90 2	2.82 1	2.50 1	2.50 1	2.48 1	2.43 12	.46 12	.46
LTE B4	23.46	23.49 2	3.50 2	3.45 2	3.45 1	5.50 1	5.44 1	5.50 1	5.50 15	.43 15	.47
LTE B5	22.59	22.64 2	2.55 2	2.65 2	2.58 1	7.40 1	7.34 1	7.42 1	7.37 17	.34 17	.40
LTE B17	23.10	23.08 2	3.12 2	3.07 2	3.07 2	0.45 2	0.39 2	0.39 2	0.47 20	.50 20	.48
EDGE850 1Tx	27.78	27.81 2	7.78 2	7.83 2	7.72 2	7.20 2	7.17 2	7.20 2	7.17 27	.27 27	.24
EDGE850 2Tx	25.36	25.44 2	5.37 2	5.45 2	5.36 2	5.00 2	4.95 2	5.00 2	4.96 24	.88 24	.93
EDGE850 3Tx	23.60	23.72 2	3.65 2	3.71 2	3.73 2	3.77 2	3.80 2	3.81 2	3.73 23	.70 23	.71
EDGE850 4Tx	22.79	22.71 2	2.68 2	2.68 2	2.74 2	2.47 2	2.46 2	2.48 2	2.41 22	.43 22	.46
EDGE1900 1Tx	26.60	26.52 2	6.56 2	6.54 2	6.55 2	0.50 2	0.48 2	0.44 2	0.47 20	.43 20	.46
EDGE1900 2Tx	25.07	25.08 2	4.98 2	5.03 2	5.07 1	8.95 1	8.90 1	8.99 1	8.91 18	.90 18	.95
EDGE1900 3Tx	23.62	23.62 2	3.56 2	3.61 2	3.61 1	7.30 1	7.24 1	7.34 1	7.26 17	.26 17	.27
EDGE1900 4Tx	22.50	22.54 2	2.54 2	2.63 2	2.57 1	5.62 1	5.62 1	5.60 1	5.64 15	.61 15	.61

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Moving device away from the phantom:

KDB616217 6.2.8																
Measured Power [dBm]																
Distance[mm]	27	24	21	20	19	18	17	16	15	14	13	12	11	8	5	0
GPRS850 1Tx	32.87	32.88	32.87	32.85	32.74	32.85	32.78	27.94	27.98	27.85	27.87	27.88	27.96	27.98	27.88	27.87
GPRS850 2Tx	31.48	31.47	31.45	31.47	31.43	31.44	31.49	26.34	26.37	26.39	26.38	26.39	26.28	26.31	26.29	26.37
GPRS850 3Tx	29.91	29.94	29.92	29.91	29.90	29.93	29.87	24.45	24.47	24.44	24.42	24.46	24.47	24.48	24.45	24.44
GPRS850 4Tx	28.02	28.02	28.05	28.97	28.04	28.08	28.01	22.85	22.89	22.83	22.81	22.8	22.85	22.87	22.89	22.84
GPRS1900 1Tx	30.48	30.48	30.48	30.41	30.42	30.49	30.45	21.15	21.17	21.20	21.2	21.2	21.19	21.23	21.17	21.19
GPRS1900 2Tx	28.63	28.66	28.56	28.55	28.58	28.58	28.60	19.38	19.38	19.39	19.38	19.4	19.45	19.37	19.43	19.47
GPRS1900 3Tx	27.66	27.56	27.66	27.57	27.65	27.55	27.61	17.82	17.83	17.89	17.86	17.87	17.88	17.80	17.90	17.86
GPRS1900 4Tx	26.14	26.17	26.16	26.14	26.16	26.14	26.19	16.36	16.36	16.48	16.45	16.46	16.47	16.42	16.39	16.46
WCDMA850	22.36	22.38	22.30	22.33	22.33	22.36	22.32	18.13	18.16	18.19	18.18	18.18	18.19	18.12	18.20	18.14
WCDMA1900	22.16	22.13	22.10	22.16	22.18	22.16	22.21	13.23	13.23	13.26	13.26	13.25	13.25	13.20	13.18	13.22
LTE B2	22.88	22.78	22.86	22.91	22.84	22.96	22.87	12.48	12.47	12.43	12.42	12.42	12.46	12.47	12.49	12.44
LTE B4	23.46	23.40	23.40	23.41	23.43	23.52	23.42	15.46	15.46	15.48	15.45	15.44	15.48	15.49	15.46	15.46
LTE B5	22.66	22.62	22.56	22.57	22.53	22.62	22.58	17.35	17.35	17.35	17.36	17.35	17.39	17.36	17.35	17.41
LTE B17	23.10	23.06	23.02	23.03	23.08	23.05	23.13	20.49	20.50	20.44	20.43	20.44	20.50	20.47	20.47	20.40
EDGE850 1Tx	27.74	27.81	27.75	27.75	27.74	27.81	27.74	22	27.22	27.24	27.24	27.24	27.20	27.15	27.23	27.26
EDGE850 2Tx	25.38	25.39	25.36	25.35	25.34	25.34	25.42	24.96	24.97	24.95	24.94	24.94	24.95	24.96	24.94	24.94
EDGE850 3Tx	23.73	23.74	23.69	23.73	23.66	23.64	23.72	23.82	23.78	23.77	23.76	23.75	23.82	23.76	23.82	23.82
EDGE850 4Tx	22.68	22.77	22.79	22.73	22.78	22.79	22.74	22.45	22.43	22.45	22.45	22.45	22.47	22.41	22.44	22.47
EDGE1900 1Tx	26.63	26.65	26.64	26.59	26.56	26.63	26.60	20.45	20.45	20.49	20.48	20.47	20.49	20.47	20.47	20.46
EDGE1900 2Tx	25.05	25.07	24.99	25.00	25.97	25.05	25.97	18.90	18.90	18.97	18.96	18.95	18.97	18.95	18.99	18.95
EDGE1900 3Tx	23.65	23.69	23.65	23.57	23.63	23.68	23.65	17.36	17.36	17.33	17.32	17.32	17.35	17.29	17.31	17.26
EDGE1900 4Tx	22.62	22.59	22.56	22.58	22.54	22.63	22.55	15.66	15.66	15.68	15.67	15.65	15.57	15.58	15.58	15.65

Based on the most conservative measured triggering distance of 16 mm, additional SAR measurements were required at 15 mm from the back side.

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Top Edge

Moving device toward the phantom:

KDB616217 6.2.6											
Measured Power [dBm]											
Distance[mm]	21	20	19	18	17	16	15	14	13	12	11
GPRS850 1Tx	32.81 32	72 3	2.78 32	.71 32	83 2	7.91 27	.89 27	95 2	7.92 27	.92 27	86
GPRS850 2Tx	31.46 31	48 3	1.44 31	.46 31	42 2	6.31 26	.25 26	24 2	6.32 26	.33 26	24
GPRS850 3Tx	29.94 29	91 2	9.96 29	.91 29	86 2	4.45 24	.46 24	49 2	4.47 24	.43 24	48
GPRS850 4Tx	27.98 27	95 2	8.04 27	.92 28	04 2	2.80 22	.80 22	83 2	2.85 22	.82 22	76
GPRS1900 1Tx	30.41 30	37 3	0.35 30	.39 30	40 2	1.13 21	.18 21	16 2	1.07 21	.08 21	06
GPRS1900 2Tx	28.59 28	63 2	8.68 28	.68 28	60 1	9.36 19	.39 19	34 1	9.31 19	.36 19	33
GPRS1900 3Tx	27.54 27	57 2	7.60 27	.59 27	55 1	7.89 17	.95 17	84 1	7.89 17	.88 17	85
GPRS1900 4Tx	26.21 26	14 2	6.12 26	.21 26	13 1	6.46 16	.43 16	47 1	6.44 16	.45 16	40
WCDMA850	22.30 22	34 2	2.37 22	.31 22	27 1	8.13 18	.17 18	19 1	8.18 18	.13 18	09
WCDMA1900	22.08 22	05 2	2.03 22	.12 22	08 1	3.15 13	.13 13	15 1	3.17 13	.17 13	10
LTE B2	22.92 22	88 2	2.84 22	.78 22	87 1	2.48 12	.50 12	45 1	2.48 12	.48 12	45
LTE B4	23.50 23	57 2	3.45 23	.56 23	44 1	5.47 15	.46 15	46 1	5.49 15	.48 15	44
LTE B5	22.65 22	62 2	2.58 22	.59 22	60 1	7.39 17	.41 17	34 1	7.33 17	.44 17	36
LTE B17	23.10 23	18 2	3.11 23	.18 23	13 2	0.39 20	.33 20	33 2	0.38 20	.42 20	33
EDGE850 1Tx	27.77 27	81 2	7.71 27	.73 27	73 2	7.15 27	.19 27	10 2	7.10 27	.09 27	18
EDGE850 2Tx	25.40 25	36 2	5.41 25	.34 25	39 2	4.98 24	.99 24	98 2	4.95 24	.96 24	92
EDGE850 3Tx	23.73 23	78 2	3.78 23	.66 23	65 2	3.77 23	.83 23	76 2	3.75 23	.70 23	79
EDGE850 4Tx	22.76 22	73 2	2.74 22	.76 22	77 2	2.44 22	.46 22	46 2	2.49 22	.49 22	40
EDGE1900 1Tx	26.51 26	61 2	6.58 26	.50 26	49 2	0.46 20	.43 20	49 2	0.48 20	.42 20	43
EDGE1900 2Tx	24.97 25	06 2	4.97 24	.97 24	97 1	8.92 18	.98 18	99 1	8.93 18	.96 19	00
EDGE1900 3Tx	23.68 23	61 2	3.62 23	.61 23	64 1	7.29 17	.23 17	25 1	7.33 17	.29 17	27
EDGE1900 4Tx	22.59 22	50 2	2.50 22	.63 22	57 1	5.59 15	.64 15	62 1	5.59 15	.58 15	59

Moving device away from the phantom:

KDB616217 6.2.8																
Measured Power [dBm]																
Distance[mm]	27	24	21	20	19	18	17	16	15	14	13	12	11	8	5	0
GPRS850 1Tx	32.77 32	71 32	72 32	72 32	80 32	76 32	82 27	85 27	90 27	88 27	87	27.86	27.86 27	90 27	92 27	93
GPRS850 2Tx	31.44 31	49 31	45 31	47 31	45 31	50 31	43 26	35 26	28 26	36 26	36	26.35	26.35 26	28 26	25 26	28
GPRS850 3Tx	29.98 29	96 29	96 29	94 29	88 29	98 29	96 24	43 24	49 24	46 24	45	24.48	24.50 24	48 24	42 24	46
GPRS850 4Tx	27.96 27	97 28	00 28	03 28	01 28	00 27	93 22	84 22	81 22	78 22	78	22.76	22.74 22	79 22	77 22	75
GPRS1900 1Tx	30.41 30	45 30	41 30	41 30	45 30	44 30	41 21	07 21	19 21	13 21	14	21.13	21.13 21	06 21	15 21	18
GPRS1900 2Tx	28.59 28	62 28	68 28	65 28	61 28	66 28	67 19	33 19	35 19	36 19	35	19.34	19.35 19	32 19	30 19	30
GPRS1900 3Tx	27.59 27	61 27	54 27	60 27	59 27	58 27	63 17	87 17	88 17	93 17	91	17.9	17.91 17	86 17	87 17	90
GPRS1900 4Tx	26.22 26	24 26	18 26	16 26	11 26	18 26	16 16	47 16	49 16	43 16	42	16.42	16.46 16	47 16	41 16	45
WCDMA850	22.30 22	26 22	34 22	32 22	27 22	38 22	37 18	09 18	10 18	12 18	12	18.13	18.13 18	10 18	12 18	17
WCDMA1900	22.09 22	14 22	02 22	11 22	09 22	11 22	10 13	08 13	16 13	18 13	17	13.18	13.19 13	20 13	15 13	12
LTE B2	22.88 22	92 22	86 22	93 22	84 22	96 22	85 12	50 12	46 12	50 12	49	12.48	12.49 12	47 12	48 12	49
LTE B4	23.56 23	53 23	44 23	49 23	54 23	52 23	46 15	47 15	48 15	43 15	42	15.45	15.50 15	46 15	49 15	46
LTE B5	22.62 22	60 22	65 22	65 22	60 22	62 22	61 17	39 17	38 17	38 17	37	17.38	17.41 17	36 17	41 17	37
LTE B17	23.16 23	10 23	16 23	08 23	19 23	12 23	08 20	43 20	44 20	34 20	32	20.35	20.45 20	34 20	32 20	36
EDGE850 1Tx	27.70 27	80 27	77 27	77 27	75 27	70 27	72 27	14 27	12 27	16 27	16	27.18	27.20 27	11 27	22 27	13
EDGE850 2Tx	25.37 25	33 25	36 25	32 25	43 25	37 25	39 24	99 24	95 24	98 24	96	24.96	24.96 24	96 24	92 24	96
EDGE850 3Tx	23.66 23	65 23	71 23	75 23	77 23	76 23	70 23	84 23	80 23	73 23	72	23.76	23.83 23	77 23	83 23	74
EDGE850 4Tx	22.69 22	71 22	72 22	73 22	66 22	77 22	71 22	38 22	42 22	48 22	48	22.47	22.48 22	45 22	39 22	38
EDGE1900 1Tx	26.61 26	52 26	62 26	57 26	55 26	55 26	56 20	47 20	45 20	42 20	41	20.4	20.41 20	44 20	39 20	41
EDGE1900 2Tx	25.03 25	06 25	05 25	05 24	99 25	08 24	99 18	95 18	97 18	93 18	92	18.82	18.95 18	94 18	93 18	92
EDGE1900 3Tx	23.57 23	58 23	60 23	66 23	70 23	59 23	62 17	36 17	24 17	34 17	33	17.3	17.23 17	36 17	28 17	28
EDGE1900 4Tx	22.59 22	57 22	50 22	50 22	60 22	50 22	62 15	66 15	61 15	57 15	56	15.58	15.64 15	57 15	62 15	60

Based on the most conservative measured triggering distance of 16 mm, additional SAR measurements were required at 15 mm from the top edge.

FCC ID: A3LSGHI467	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
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