



SAR EVALUATION REPORT

Applicant Name:

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

Date of Testing:

04/01/13 - 04/03/13

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

OY1303260534-R5.A3L

FCC ID:

A3LEKGN120

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Camera

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

EK-GN120, EK-GN100

Equipment Class	Band & Mode	Tx Frequency	Measured Conducted Power [dBm]	Hand SAR (W/kg)	Body SAR (W/kg)	Body-worn Accessory SAR (W/kg)
				10 gram	1 gram	1 gram
PCB	UMTS 850	826.40 - 846.60 MHz	22.43	0.50	0.14	0.34
PCB	UMTS 1900	1852.4 - 1907.6 MHz	21.85	1.39	0.47	0.35
PCB	LTE Band 5 (Cell)	824.7 - 848.3 MHz	22.35	0.43	0.23	0.22
DTS	2.4 GHz WLAN	2412 - 2462 MHz	16.42	0.49	0.14	0.18
DTS	Bluetooth LE	2402 - 2480 MHz	8.01	N/A	N/A	N/A
DTS	5.8 GHz WLAN	5745 - 5825 MHz	14.30	0.36	0.44	0.19
NII	5.2 GHz WLAN	5180 - 5240 MHz	14.22	0.17	0.11	< 0.1
NII	5.3 GHz WLAN	5260 - 5320 MHz	13.99	0.27	0.15	< 0.1
NII	5.5 GHz WLAN	5500 - 5700 MHz	14.26	0.32	0.45	0.12
DSS	Bluetooth	2402 - 2480 MHz	10.31	< 0.1	< 0.1	< 0.1
Simultaneous SAR per KDB 690783 D01v01r02:					0.87	0.64

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.

Note: This revised test report (S/N: OY1303260534-R5.A3L) supersedes and replaces the previously issued test report on the same subject DUT for the same type of testing indicated. Please discard or destroy the previously issued tests report(s) and dispose of accordingly.

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



FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 1 of 46

T A B L E O F C O N T E N T S

1	DEVICE UNDER TEST	3
2	LTE INFORMATION	9
3	INTRODUCTION	10
4	DOSIMETRIC ASSESSMENT	11
5	RF EXPOSURE LIMITS	12
6	SAR TESTING PROCEDURES	13
7	FCC MEASUREMENT PROCEDURES.....	14
8	RF CONDUCTED POWERS.....	18
9	SYSTEM VERIFICATION.....	26
10	SAR DATA SUMMARY	28
11	FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS.....	34
12	SAR MEASUREMENT VARIABILITY	40
13	EQUIPMENT LIST	41
14	MEASUREMENT UNCERTAINTIES	42
15	CONCLUSION.....	44
16	REFERENCES	45
APPENDIX A: SAR TEST PLOTS		
APPENDIX B: SAR DIPOLE VERIFICATION PLOTS		
APPENDIX C: PROBE AND DIPOLE CALIBRATION CERTIFICATES		
APPENDIX D: SAR TISSUE SPECIFICATIONS		
APPENDIX E: SAR SYSTEM VALIDATION		
APPENDIX F: SAR TEST SETUP PHOTOGRAPHS		

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 2 of 46	

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
UMTS 850	Data	826.40 - 846.60 MHz
UMTS 1900	Data	1852.4 - 1907.6 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 MHz
2.4 GHz WLAN	Data	2412 - 2462 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 intended when the camera is touching the user while using the neck-strap body-worn accessory. The proximity sensor triggers power reduction for UMTS1900 only. The proximity sensor is only applicable for body SAR back side exposure conditions. A complete description of the proximity sensor can be found in the operational description document.

SAR was evaluated per FCC KDB Publication 941225 D07 for UMPC devices.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 3 of 46	

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.

Device operating at Maximum Power:

Mode / Band		Modulated Average (dBm)			
		3GPP RMC	3GPP HSDPA	3GPP HSUPA	3GPP DC-HSDPA
UMTS Band 5 (850 MHz)	Maximum	22.5	22.0	22.0	22.0
	Nominal	22.0	21.5	21.5	21.5
UMTS Band 2 (1900 MHz)	Maximum	22.0	21.5	21.5	21.5
	Nominal	21.5	21.0	21.0	21.0

Mode / Band		Modulated Average (dBm)
LTE Band 5 (Cell)	Maximum	22.5
	Nominal	22.0

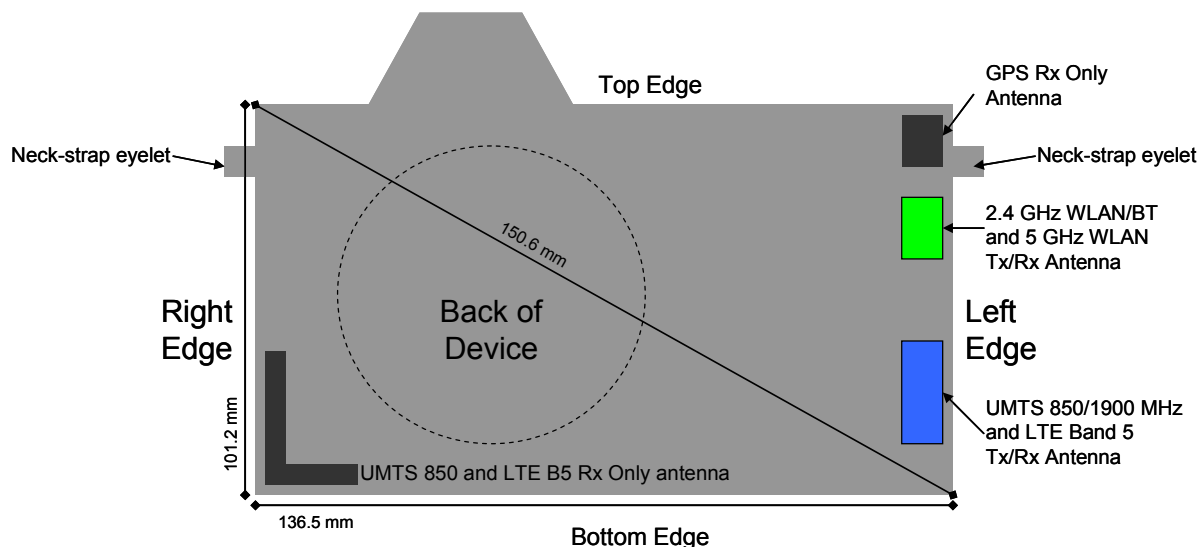
Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	17.0
	Nominal	16.5
IEEE 802.11g (2.4 GHz)	Maximum	14.0
	Nominal	13.5
IEEE 802.11n (2.4 GHz)	Maximum	13.0
	Nominal	12.5
IEEE 802.11a (5 GHz)	Maximum	14.5
	Nominal	14.0
IEEE 802.11n (5 GHz)	Maximum	12.5
	Nominal	12.0
Bluetooth	Maximum	10.5
	Nominal	10.0
Bluetooth LE	Maximum	8.5
	Nominal	8.0

Device operating at Reduced Power:

Mode / Band		Modulated Average (dBm)			
		3GPP RMC	3GPP HSDPA	3GPP HSUPA	3GPP DC-HSDPA
UMTS Band 2 (1900 MHz)	Maximum	16.5	15.5	15.5	15.5
	Nominal	16.0	15.0	15.0	15.0

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 4 of 46

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

Table 1-1
Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
UMTS 850	Yes	Yes	No	Yes	No	Yes
UMTS 1900	Yes	Yes	No	Yes	No	Yes
LTE Band 5 (Cell)	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	No	No	Yes
5 GHz WLAN	Yes	Yes	Yes	No	No	Yes
Bluetooth	Yes	Yes	Yes	No	No	Yes

Note: Particular DUT edges were not required to be evaluated for SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D07 guidance, page 1. The antenna document shows the distances between the transmit antennas and the edges of the device.

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 5 of 46

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 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configurations	Hand	Body	Body-worn Accessory (Neck-strap)	Note
		FCC KDB 941225 D07 Edges/Sides	FCC KDB 941225 D07 Edges/Sides		
1	UMTS 850/1900 MHz Data + Wifi 2.4 Ghz	Yes	Yes	Yes	3G Hotspot
2	LTE B5 Data + Wifi 2.4 GHz	Yes	Yes	Yes	4G Hotspot
3	UMTS 850/1900 MHz Data + Wifi 5 Ghz	Yes	Yes	Yes	Wifi Direct
4	LTE B5 Data + Wifi 5 GHz	Yes	Yes	Yes	Wifi Direct
5	UMTS 850/1900 MHz Data + 2.4 Ghz Bluetooth	Yes	Yes	Yes	
6	LTE B5 Data + 2.4 GHz Bluetooth	Yes	Yes	Yes	
7	UMTS 850/1900 MHz Data + LTE B5 Data + Wifi 2.4 Ghz	N/A	N/A	N/A	Not supported by S/W
8	UMTS 850/1900 MHz Data + LTE B5 Data + Wifi 5 Ghz	N/A	N/A	N/A	Not supported by S/W

FCC ID: A3LEKGN120		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera			Page 6 of 46

1.6 SAR Test Exclusions Applied

(A) WIFI/BT

2.4 GHz WLAN and 5 GHz WLAN and Bluetooth share the same antenna path and cannot transmit simultaneously.

Per FCC KDB 447498 D01 v05, the 1-g SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Per FCC KDB 447498 D01 v05, the 10-g extremity SAR exclusion threshold for distances <50mm is defined by the following equation:

$$\frac{\text{Max Power of Channel (mW)}}{\text{Test Separation Dist (mm)}} * \sqrt{\text{Frequency (GHz)}} \leq 7.5$$

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 for 1-g SAR evaluations; $[(7/10) * \sqrt{2.441}] = 1.1 < 3.0$. Bluetooth LE SAR was also not required for 10-g extremity SAR evaluations; $[(7/5) * \sqrt{2.441}] = 2.2 < 7.5$.

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.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 7 of 46

1.7 Guidance Applied

- FCC KDB Publication 941225 D01-D07 (3G/4G & UMPC devices)
- 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)

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.

	Maximum Power Serial Number	Reduced Power Serial Number
UMTS 850	25	-
UMTS 1900	25	34
LTE Band 5 (Cell)	25	-
2.4 GHz WLAN	42	-
5 GHz WLAN	42	-
Bluetooth	25	-

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 8 of 46

2

LTE INFORMATION

LTE Information			
FCC ID	A3LEKGN120		
Form Factor	Portable Camera		
Frequency Range of each LTE transmission band	LTE Band 5 (Cell) (824.7 - 848.3 MHz)		
Channel Bandwidths	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
UE Category	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE Transmitter and Antenna Implementation	This device uses 1 Tx/Rx antenna for UMTS/LTE and 1 Rx only Antenna for UMTS/LTE		
Description of LTE Tx and Ant. Implementation	UMTS/LTE operate on the same transmission path		
Hotspot with LTE+WIFI	YES		
Hotspot with LTE+WIFI active with Voice sessions?	NO		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		
Conducted power Table provided for 1RB (low, mid and high offset), 50% RB (low, mid, and high offset), and 100% RB	YES		

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 9 of 46	

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/m^3)
- E = Total RMS electric field strength (V/m)

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

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 10 of 46

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.

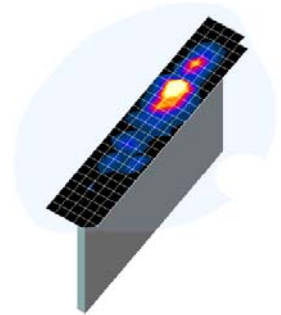


Figure 4-1
Sample SAR Area Scan

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		
			$\Delta z_{\text{zoom}}(n)$	$\Delta z_{\text{zoom}}(1)^*$	$\Delta z_{\text{zoom}}(n>1)^*$	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 22

FCC ID: A3LEKGN120		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera			Page 11 of 46

5 RF EXPOSURE LIMITS

5.1 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.

5.2 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 5-1
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.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 12 of 46

6 SAR TESTING PROCEDURES

6.1 SAR Testing per KDB Publication 941225 D07

Hand-held devices that have transmitting antennas located less than 25 mm from the edge/surface of the device require routine SAR evaluation. Such devices are considered portable, and are designed primarily for interactive hand-held use next to or near the body of a user. Devices are to be setup according to KDB publication 941225 D07 requirements and are configured with maximum output power during SAR assessment for a worst-case SAR evaluation.

Per KDB Publication 941225 D07, SAR testing applies for the device edges with antennas located within 25 mm of each device edge closest to the user. A test separation distance of 10 mm may be considered for 1-g SAR, with the addition of 10-g SAR measurement at 0 mm test separation distance for all 1-g SAR configurations to address hand exposure.

1-g SAR was additionally evaluated at 0mm test separation distance for back side configuration to account for chest-strap accessories.

6.2 Proximity Sensor Considerations

Reduced power UMTS1900 1-g SAR was evaluated at 0 mm test separation distance for back side configuration to account for proximity sensor considerations. Maximum Power UMTS1900 1-g SAR was additionally evaluated at 9 mm test separation distance for back side configuration to show SAR compliance per KDB Publication 941225 D07. More information about the proximity sensor can be found in the Operational Description document.

10-g extremity SAR was evaluated at maximum power for all bands/modes and all configurations (including back side).

6.3 Wireless Router Configurations

When the user enables the personal wireless router functions for the device, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions. Therefore, SAR must be evaluated for each frequency transmission and mode separately and summed with the WIFI transmitter according to KDB 648474 publication procedures. The "Portable Hotspot" feature on the device was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 13 of 46

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".

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 14 of 46

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	$\beta_{1s}^{(1)}$	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 $\Delta_{CQI} = 8 \Leftrightarrow A_{1s} = \beta_{1s}/\beta_c = 30/15 \Leftrightarrow \beta_{1s} = 30/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{1s}/\beta_c = 24/15$. 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.

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 15 of 46

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.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 16 of 46

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.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 17 of 46

8 RF CONDUCTED POWERS

8.1 UMTS Conducted Powers

Table 8-1
Maximum UMTS Conducted Powers

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	22.37	22.43	22.48	21.77	21.85	21.94	-
6	HSDPA	Subtest 1	21.44	21.58	21.54	21.00	21.07	20.84	0
6		Subtest 2	21.58	21.64	21.64	21.03	20.93	20.80	0
6		Subtest 3	20.97	21.16	21.08	20.46	20.56	20.42	0.5
6		Subtest 4	21.00	21.09	21.15	20.30	20.47	20.33	0.5
6	HSUPA	Subtest 1	21.20	21.66	21.55	20.67	21.15	21.04	0
6		Subtest 2	20.57	20.69	20.60	19.80	20.12	19.86	2
6		Subtest 3	20.28	20.47	20.73	20.04	20.07	20.00	1
6		Subtest 4	20.84	20.75	20.79	20.52	20.72	20.44	2
6		Subtest 5	21.01	21.27	21.26	20.53	20.54	21.00	0
8	DC-HSDPA	Subtest 1	21.53	21.65	21.38	20.87	21.01	20.73	0
8		Subtest 2	21.53	21.10	21.46	20.66	21.01	20.71	0
8		Subtest 3	21.47	21.07	21.49	20.85	20.95	20.63	0.5
8		Subtest 4	21.52	21.08	21.50	20.87	21.09	20.71	0.5

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.

It is expected by the manufacturer that MPR for some HSUPA subtests may be also as low as 0 dB according to the chipset implementation in this model.

DC-HSDPA Considerations:

- 3GPP Specification 34.121-1 Release 8 Ver 8.10.0 was used for DC-HSDPA guidance
- H-Set 12 (QPSK) was confirmed to be used during DC-HSDPA measurements
- Measured maximum output powers for DC-HSDPA were not greater than ¼ dB higher than the WCDMA 12.2 kbps RMC maximum output and as a result, SAR is not required for DC-HSDPA
- The DUT supports UE category 24 for HSDPA



Figure 8-1
Power Measurement Setup

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 18 of 46

Table 8-2
Reduced UMTS Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	PCS Band [dBm]			3GPP MPR [dB]
			9262	9400	9538	
99	WCDMA	12.2 kbps RMC	16.37	16.40	16.37	-
6	HSDPA	Subtest 1	15.50	15.45	15.41	0
6		Subtest 2	15.41	15.50	15.48	0
6		Subtest 3	14.32	14.23	14.83	0.5
6		Subtest 4	14.40	14.33	14.81	0.5
6	HSUPA	Subtest 1	14.95	15.50	15.03	0
6		Subtest 2	13.95	13.92	14.16	2
6		Subtest 3	13.65	13.64	13.96	1
6		Subtest 4	14.85	14.57	14.70	2
6		Subtest 5	15.20	15.50	14.93	0
8	DC-HSDPA	Subtest 1	15.07	15.17	15.19	0
8		Subtest 2	15.16	15.19	15.34	0
8		Subtest 3	15.14	15.25	15.28	0.5
8		Subtest 4	15.23	15.19	15.38	0.5

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.

It is expected by the manufacturer that MPR for some HSUPA subtests may be also as low as 0 dB according to the chipset implementation in this model.

DC-HSDPA Considerations:

- 3GPP Specification 34.121-1 Release 8 Ver 8.10.0 was used for DC-HSDPA guidance
- H-Set 12 (QPSK) was confirmed to be used during DC-HSDPA measurements
- Measured maximum output powers for DC-HSDPA were not greater than ¼ dB higher than the WCDMA 12.2 kbps RMC maximum output and as a result, SAR is not required for DC-HSDPA
- The DUT supports UE category 24 for HSDPA



Figure 8-2
Power Measurement Setup

Table 8-3
UMTS 1900 Power Reduction Summary due to Proximity Sensor

Mode/Band	Proximity Sensor State	Modulated Average (dBm)			
		3GPP RMC	3GPP HSDPA	3GPP HSUPA	3GPP DC-HSDPA
UMTS Band 2 (1900 MHz)	Inactive	21.5	21.0	21.0	21.0
	Active	16.0	15.0	15.0	15.0

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 19 of 46	

8.2 LTE Conducted Powers

8.2.1 LTE Band 5 (Cell)

Table 8-4
LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]	Applied MPR [dB]
Mid	836.5	20525	10	QPSK	1	0	22.35	0	0	-0.35
	836.5	20525	10	QPSK	1	25	22.13	0	0	-0.13
	836.5	20525	10	QPSK	1	49	22.14	0	0	-0.14
	836.5	20525	10	QPSK	25	0	21.18	1	0-1	0.82
	836.5	20525	10	QPSK	25	12	21.06	1	0-1	0.94
	836.5	20525	10	QPSK	25	25	21.16	1	0-1	0.84
	836.5	20525	10	QPSK	50	0	21.10	1	0-1	0.90
	836.5	20525	10	16QAM	1	0	20.97	1	0-1	1.03
	836.5	20525	10	16QAM	1	25	21.03	1	0-1	0.97
	836.5	20525	10	16QAM	1	49	21.11	1	0-1	0.89
	836.5	20525	10	16QAM	25	0	20.20	2	0-2	1.80
	836.5	20525	10	16QAM	25	12	20.04	2	0-2	1.96
	836.5	20525	10	16QAM	25	25	20.13	2	0-2	1.87
	836.5	20525	10	16QAM	50	0	20.00	2	0-2	2.00

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]	Applied MPR [dB]
Low	826.5	20425	5	QPSK	1	0	22.03	0	0	-0.03
	826.5	20425	5	QPSK	1	12	22.10	0	0	-0.10
	826.5	20425	5	QPSK	1	24	22.08	0	0	-0.08
	826.5	20425	5	QPSK	12	0	21.09	1	0-1	0.91
	826.5	20425	5	QPSK	12	6	21.10	1	0-1	0.90
	826.5	20425	5	QPSK	12	13	21.05	1	0-1	0.95
	826.5	20425	5	QPSK	25	0	20.98	1	0-1	1.02
	826.5	20425	5	16-QAM	1	0	21.13	1	0-1	0.87
	826.5	20425	5	16-QAM	1	12	21.10	1	0-1	0.90
	826.5	20425	5	16-QAM	1	24	20.97	1	0-1	1.03
	826.5	20425	5	16-QAM	12	0	20.16	2	0-2	1.84
	826.5	20425	5	16-QAM	12	6	20.12	2	0-2	1.88
	826.5	20425	5	16-QAM	12	13	20.11	2	0-2	1.89
	826.5	20425	5	16-QAM	25	0	19.99	2	0-2	2.01
Mid	836.5	20525	5	QPSK	1	0	22.34	0	0	-0.34
	836.5	20525	5	QPSK	1	12	22.13	0	0	-0.13
	836.5	20525	5	QPSK	1	24	22.17	0	0	-0.17
	836.5	20525	5	QPSK	12	0	21.25	1	0-1	0.75
	836.5	20525	5	QPSK	12	6	21.22	1	0-1	0.78
	836.5	20525	5	QPSK	12	13	21.04	1	0-1	0.96
	836.5	20525	5	QPSK	25	0	21.03	1	0-1	0.97
	836.5	20525	5	16-QAM	1	0	21.30	1	0-1	0.70
	836.5	20525	5	16-QAM	1	12	21.16	1	0-1	0.84
	836.5	20525	5	16-QAM	1	24	21.19	1	0-1	0.81
	836.5	20525	5	16-QAM	12	0	20.16	2	0-2	1.84
	836.5	20525	5	16-QAM	12	6	20.09	2	0-2	1.91
	836.5	20525	5	16-QAM	12	13	20.00	2	0-2	2.00
	836.5	20525	5	16-QAM	25	0	19.96	2	0-2	2.04
High	846.5	20625	5	QPSK	1	0	22.31	0	0	-0.31
	846.5	20625	5	QPSK	1	12	22.10	0	0	-0.10
	846.5	20625	5	QPSK	1	24	22.08	0	0	-0.08
	846.5	20625	5	QPSK	12	0	21.23	1	0-1	0.77
	846.5	20625	5	QPSK	12	6	21.17	1	0-1	0.83
	846.5	20625	5	QPSK	12	13	21.00	1	0-1	1.00
	846.5	20625	5	QPSK	25	0	20.94	1	0-1	1.06
	846.5	20625	5	16-QAM	1	0	21.00	1	0-1	1.00
	846.5	20625	5	16-QAM	1	12	20.96	1	0-1	1.04
	846.5	20625	5	16-QAM	1	24	21.14	1	0-1	0.86
	846.5	20625	5	16-QAM	12	0	20.02	2	0-2	1.98
	846.5	20625	5	16-QAM	12	6	20.09	2	0-2	1.91
	846.5	20625	5	16-QAM	12	13	20.10	2	0-2	1.90
	846.5	20625	5	16-QAM	25	0	20.16	2	0-2	1.84

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 20 of 46

Table 8-6
LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]	Applied MPR [dB]
Low	825.5	20415	3	QPSK	1	0	21.97	0	0	0.03
	825.5	20415	3	QPSK	1	7	22.07	0	0	-0.07
	825.5	20415	3	QPSK	1	14	22.10	0	0	-0.10
	825.5	20415	3	QPSK	8	0	21.09	1	0-1	0.91
	825.5	20415	3	QPSK	8	4	21.04	1	0-1	0.96
	825.5	20415	3	QPSK	8	7	21.11	1	0-1	0.89
	825.5	20415	3	QPSK	15	0	21.10	1	0-1	0.90
	825.5	20415	3	16-QAM	1	0	21.07	1	0-1	0.93
	825.5	20415	3	16-QAM	1	7	20.90	1	0-1	1.10
	825.5	20415	3	16-QAM	1	14	21.03	1	0-1	0.97
	825.5	20415	3	16-QAM	8	0	20.16	2	0-2	1.84
	825.5	20415	3	16-QAM	8	4	19.97	2	0-2	2.03
	825.5	20415	3	16-QAM	8	7	19.98	2	0-2	2.02
	825.5	20415	3	16-QAM	15	0	20.00	2	0-2	2.00
	836.5	20525	3	QPSK	1	0	22.18	0	0	-0.18
Mid	836.5	20525	3	QPSK	1	7	22.15	0	0	-0.15
	836.5	20525	3	QPSK	1	14	22.05	0	0	-0.05
	836.5	20525	3	QPSK	8	0	21.20	1	0-1	0.80
	836.5	20525	3	QPSK	8	4	21.06	1	0-1	0.94
	836.5	20525	3	QPSK	8	7	20.99	1	0-1	1.01
	836.5	20525	3	QPSK	15	0	21.05	1	0-1	0.95
	836.5	20525	3	16-QAM	1	0	20.76	1	0-1	1.24
	836.5	20525	3	16-QAM	1	7	20.79	1	0-1	1.21
	836.5	20525	3	16-QAM	1	14	20.60	1	0-1	1.40
	836.5	20525	3	16-QAM	8	0	20.17	2	0-2	1.83
	836.5	20525	3	16-QAM	8	4	20.06	2	0-2	1.94
	836.5	20525	3	16-QAM	8	7	20.13	2	0-2	1.87
	836.5	20525	3	16-QAM	15	0	20.05	2	0-2	1.95
	847.5	20635	3	QPSK	1	0	22.03	0	0	-0.03
	847.5	20635	3	QPSK	1	7	22.07	0	0	-0.07
High	847.5	20635	3	QPSK	1	14	22.10	0	0	-0.10
	847.5	20635	3	QPSK	8	0	21.06	1	0-1	0.94
	847.5	20635	3	QPSK	8	4	20.98	1	0-1	1.02
	847.5	20635	3	QPSK	8	7	21.06	1	0-1	0.94
	847.5	20635	3	QPSK	15	0	21.07	1	0-1	0.93
	847.5	20635	3	16-QAM	1	0	20.94	1	0-1	1.06
	847.5	20635	3	16-QAM	1	7	21.16	1	0-1	0.84
	847.5	20635	3	16-QAM	1	14	21.14	1	0-1	0.86
	847.5	20635	3	16-QAM	8	0	20.16	2	0-2	1.84
	847.5	20635	3	16-QAM	8	4	20.10	2	0-2	1.90
	847.5	20635	3	16-QAM	8	7	20.07	2	0-2	1.93
	847.5	20635	3	16-QAM	15	0	20.00	2	0-2	2.00

Table 8-7
LTE Band 5 (Cell) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]	Applied MPR [dB]
Low	824.7	20407	1.4	QPSK	1	0	22.09	0	0	-0.09
	824.7	20407	1.4	QPSK	1	2	22.10	0	0	-0.10
	824.7	20407	1.4	QPSK	1	5	22.05	0	0	-0.05
	824.7	20407	1.4	QPSK	3	0	21.97	0	0	0.03
	824.7	20407	1.4	QPSK	3	2	21.90	0	0	0.10
	824.7	20407	1.4	QPSK	3	3	22.14	0	0	-0.14
	824.7	20407	1.4	QPSK	6	0	21.07	1	0-1	0.93
	824.7	20407	1.4	16-QAM	1	0	20.97	1	0-1	1.03
	824.7	20407	1.4	16-QAM	1	2	20.98	1	0-1	1.02
	824.7	20407	1.4	16-QAM	1	5	21.09	1	0-1	0.91
	824.7	20407	1.4	16-QAM	3	0	21.03	1	0-1	0.97
	824.7	20407	1.4	16-QAM	3	2	21.04	1	0-1	0.96
	824.7	20407	1.4	16-QAM	3	3	21.10	1	0-1	0.90
	824.7	20407	1.4	16-QAM	6	0	20.02	2	0-2	1.98
Mid	836.5	20525	1.4	QPSK	1	0	22.23	0	0	-0.23
	836.5	20525	1.4	QPSK	1	2	22.17	0	0	-0.17
	836.5	20525	1.4	QPSK	1	5	22.15	0	0	-0.15
	836.5	20525	1.4	QPSK	3	0	22.15	0	0	-0.15
	836.5	20525	1.4	QPSK	3	2	22.21	0	0	-0.21
	836.5	20525	1.4	QPSK	3	3	22.15	0	0	-0.15
	836.5	20525	1.4	QPSK	6	0	21.17	1	0-1	0.83
	836.5	20525	1.4	16-QAM	1	0	21.09	1	0-1	0.91
	836.5	20525	1.4	16-QAM	1	2	21.07	1	0-1	0.93
	836.5	20525	1.4	16-QAM	1	5	21.10	1	0-1	0.90
	836.5	20525	1.4	16-QAM	3	0	21.00	1	0-1	1.00
	836.5	20525	1.4	16-QAM	3	2	20.97	1	0-1	1.03
	836.5	20525	1.4	16-QAM	3	3	20.90	1	0-1	1.10
	836.5	20525	1.4	16-QAM	6	0	20.06	2	0-2	1.94
High	848.3	20643	1.4	QPSK	1	0	22.03	0	0	-0.03
	848.3	20643	1.4	QPSK	1	2	22.06	0	0	-0.06
	848.3	20643	1.4	QPSK	1	5	22.09	0	0	-0.09
	848.3	20643	1.4	QPSK	3	0	22.10	0	0	-0.10
	848.3	20643	1.4	QPSK	3	2	22.09	0	0	-0.09
	848.3	20643	1.4	QPSK	3	3	21.97	0	0	0.03
	848.3	20643	1.4	QPSK	6	0	21.06	1	0-1	0.94
	848.3	20643	1.4	16-QAM	1	0	21.05	1	0-1	0.95
	848.3	20643	1.4	16-QAM	1	2	21.10	1	0-1	0.90
	848.3	20643	1.4	16-QAM	1	5	20.97	1	0-1	1.03
	848.3	20643	1.4	16-QAM	3	0	21.06	1	0-1	0.94
	848.3	20643	1.4	16-QAM	3	2	21.05	1	0-1	0.95
	848.3	20643	1.4	16-QAM	3	3	21.03	1	0-1	0.97
	848.3	20643	1.4	16-QAM	6	0	20.17	2	0-2	1.83

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 21 of 46	

8.3 WLAN/Bluetooth Conducted Powers

Table 8-8
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*	16.12	16.08	16.04	16.11
802.11b	2437	6*	16.42	16.53	16.54	16.58
802.11b	2462	11*	16.42	16.39	16.42	16.43

Table 8-9
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	13.22	13.27	13.24	13.18	13.11	13.28	13.24	13.21
802.11g	2437	6	13.66	13.66	13.66	13.54	13.62	13.53	13.61	13.64
802.11g	2462	11	13.51	13.55	13.55	13.50	13.57	13.43	13.52	13.50

Table 8-10
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	12.22	12.24	12.23	12.22	12.21	12.21	12.19	12.24
802.11n	2437	6	12.61	12.59	12.55	12.53	12.60	12.56	12.63	12.67
802.11n	2462	11	12.46	12.44	12.43	12.45	12.46	12.44	12.49	12.48

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 22 of 46

Table 8-11
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*	14.22	14.22	14.09	14.16	14.24	14.18	14.26	14.22
802.11a	5200	40	14.10	14.06	14.12	14.06	14.22	14.09	14.07	14.22
802.11a	5220	44	14.05	14.08	14.09	14.07	14.01	14.11	14.07	14.06
802.11a	5240	48*	13.98	14.01	14.02	14.04	14.02	14.02	14.03	14.07
802.11a	5260	52*	13.99	13.92	13.96	13.91	13.91	14.00	13.93	13.97
802.11a	5280	56	13.91	13.88	13.89	13.89	13.91	13.87	13.93	13.92
802.11a	5300	60	13.85	13.88	13.88	13.90	13.91	13.91	13.94	13.91
802.11a	5320	64*	13.84	13.89	13.87	13.88	13.87	13.83	13.91	13.90
802.11a	5500	100	14.05	13.97	14.06	14.08	14.07	14.10	14.18	14.11
802.11a	5520	104*	14.03	14.06	14.04	14.07	14.11	14.07	14.12	14.12
802.11a	5540	108	14.03	14.13	14.04	14.06	14.04	14.12	14.14	14.11
802.11a	5560	112	14.06	14.09	14.11	14.09	14.13	14.10	14.12	14.17
802.11a	5580	116*	14.09	14.09	14.09	14.03	14.14	13.99	14.15	14.16
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	14.14	14.12	14.15	14.13	14.23	14.24	14.20	14.21
802.11a	5680	136*	14.18	14.14	14.21	14.24	14.16	14.19	14.32	14.23
802.11a	5700	140	14.26	14.19	14.18	14.27	14.29	14.30	14.27	14.31
802.11a	5745	149*	14.23	14.29	14.25	14.24	14.27	14.28	14.40	14.37
802.11a	5765	153	14.28	14.22	14.27	14.32	14.22	14.36	14.34	14.40
802.11a	5785	157*	14.26	14.30	14.26	14.35	14.27	14.41	14.34	14.42
802.11a	5805	161*	14.27	14.25	14.37	14.36	14.28	14.30	14.39	14.47
802.11a	5825	165	14.30	14.33	14.38	14.26	14.44	14.44	14.49	14.45

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 than the default channels, these “required channels” are considered for SAR testing instead of the default channels.

Table 8-12
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	12.28	12.30	12.20	12.33	12.29	12.36	12.43	12.43
802.11n	5200	40	12.22	12.33	12.29	12.35	12.23	12.30	12.31	12.42
802.11n	5220	44	12.34	12.22	12.25	12.23	12.27	12.29	12.31	12.32
802.11n	5240	48	12.27	12.22	12.25	12.24	12.23	12.26	12.27	12.32
802.11n	5260	52	12.16	12.20	12.13	12.18	12.21	12.24	12.28	12.18
802.11n	5280	56	12.10	12.02	12.14	12.12	12.17	12.21	12.20	12.21
802.11n	5300	60	12.07	12.11	12.09	12.17	12.10	12.17	12.15	12.10
802.11n	5320	64	12.05	12.01	12.07	12.00	12.06	12.01	12.08	12.03
802.11n	5500	100	12.19	12.20	12.15	12.15	12.21	12.24	12.24	12.25
802.11n	5520	104	12.05	12.09	12.14	12.14	12.28	12.19	12.22	12.21
802.11n	5540	108	12.14	12.15	12.16	12.22	12.23	12.16	12.20	12.20
802.11n	5560	112	12.11	12.13	12.14	12.15	12.26	12.28	12.20	12.27
802.11n	5580	116	12.14	12.22	12.13	12.20	12.23	12.13	12.21	12.27
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	12.23	12.17	12.17	12.19	12.28	12.29	12.23	12.31
802.11n	5680	136	12.16	12.23	12.12	12.26	12.30	12.24	12.34	12.35
802.11n	5700	140	12.25	12.09	12.25	12.30	12.32	12.36	12.24	12.35
802.11n	5745	149	12.28	12.30	12.33	12.33	12.34	12.35	12.36	12.36
802.11n	5765	153	12.29	12.26	12.33	12.34	12.35	12.36	12.38	12.39
802.11n	5785	157	12.36	12.28	12.36	12.34	12.38	12.35	12.40	12.38
802.11n	5805	161	12.32	12.33	12.36	12.38	12.38	12.39	12.42	12.40
802.11n	5825	165	12.35	12.35	12.39	12.39	12.38	12.39	12.38	12.41

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.

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 23 of 46	

Table 8-13
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	11.71	11.64	11.67	11.65	11.70	11.64	11.71	11.70
802.11n	5230	46	11.72	11.55	11.59	11.60	11.70	11.69	11.66	11.70
802.11n	5270	54	11.46	11.59	11.51	11.47	11.61	11.60	11.57	11.59
802.11n	5310	62	11.48	11.42	11.43	11.42	11.48	11.47	11.57	11.52
802.11n	5510	102	11.66	11.63	11.58	11.63	11.60	11.75	11.74	11.71
802.11n	5550	110	11.60	11.55	11.65	11.67	11.77	11.77	11.71	11.67
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	11.75	11.73	11.75	11.67	11.83	11.83	11.89	11.78
802.11n	5755	151	11.66	11.76	11.77	11.70	11.85	11.79	11.82	11.84
802.11n	5795	159	11.77	11.85	11.82	11.80	11.84	11.80	11.89	11.88

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.

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 data rate and channel for the bolded powers above were tested for SAR.



Figure 8-3
Power Measurement Setup

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 24 of 46	

Table 8-14
Bluetooth Average RF Power

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Peak Conducted Power		Avg Conducted Power	
			[dBm]	[mW]	[dBm]	[mW]
2402	1.0	0	9.171	8.262	9.055	8.045
2441	1.0	39	10.421	11.018	10.310	10.740
2480	1.0	78	8.055	6.390	7.896	6.160
2402	2.0	0	7.599	5.753	5.450	3.507
2441	2.0	39	8.685	7.388	6.578	4.548
2480	2.0	78	6.155	4.126	3.879	2.443
2402	3.0	0	8.006	6.318	5.550	3.589
2441	3.0	39	9.098	8.125	6.571	4.540
2480	3.0	78	6.593	4.564	3.926	2.469

Note: The channel and data rate for the bolded power above was tested for SAR.

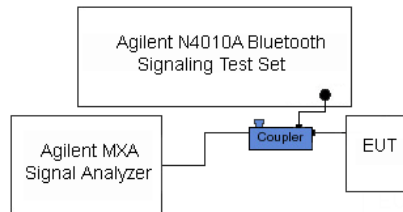


Figure 8-4
Power Measurement Setup

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 25 of 46	

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
4/1/2013	835B	22.1	820	0.985	53.355	0.969	55.258	1.65%	-3.44%
			835	1.001	53.203	0.970	55.200	3.20%	-3.62%
			850	1.017	53.025	0.988	55.154	2.94%	-3.86%
4/1/2013	1900B	20.7	1850	1.483	52.290	1.520	53.300	-2.43%	-1.89%
			1880	1.511	52.258	1.520	53.300	-0.59%	-1.95%
			1910	1.549	52.094	1.520	53.300	1.91%	-2.26%
4/3/2013	2450B	23.6	2401	1.881	52.794	1.903	52.765	-1.16%	0.05%
			2450	1.947	52.639	1.950	52.700	-0.15%	-0.12%
			2499	2.013	52.433	2.019	52.638	-0.30%	-0.39%
04/01/2013	5200B-5800B	24.1	5180	5.211	48.285	5.276	49.041	-1.23%	-1.54%
			5200	5.252	48.233	5.299	49.014	-0.89%	-1.59%
			5260	5.330	48.088	5.369	48.906	-0.73%	-1.67%
			5300	5.380	48.024	5.416	48.851	-0.66%	-1.69%
			5500	5.669	47.593	5.650	48.580	0.34%	-2.03%
			5580	5.791	47.363	5.743	48.471	0.84%	-2.29%
			5600	5.817	47.365	5.766	48.444	0.88%	-2.23%
			5700	5.963	47.089	5.880	48.275	1.41%	-2.46%
			5765	6.080	47.016	5.959	48.220	2.03%	-2.50%
			5785	6.116	46.902	5.982	48.242	2.24%	-2.78%
			5800	6.124	46.860	6.000	48.200	2.07%	-2.78%
			5825	6.173	46.820	6.029	48.132	2.39%	-2.73%

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.

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 26 of 46

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
1g 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 (%)
835	BODY	04/01/2013	23.8	22.9	0.100	4d026	3287	1.010	9.580	10.100	5.43%
1900	BODY	04/01/2013	23.7	21.9	0.100	5d148	3209	3.770	40.800	37.700	-7.60%
2450	BODY	04/03/2013	24.1	23.3	0.100	719	3287	4.990	51.600	49.900	-3.29%
5200	BODY	04/01/2013	24.3	23.2	0.100	1057	3589	7.410	75.500	74.100	-1.85%
5300	BODY	04/01/2013	24.3	23.2	0.100	1057	3589	7.220	75.300	72.200	-4.12%
5500	BODY	04/01/2013	24.3	23.2	0.100	1057	3589	8.070	80.800	80.700	-0.12%
5600	BODY	04/01/2013	24.4	23.3	0.100	1057	3589	8.020	80.300	80.200	-0.12%
5800	BODY	04/01/2013	24.4	23.3	0.100	1057	3589	7.490	75.100	74.900	-0.27%

Table 9-3
10g 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 _{10g} (W/kg)	1 W Target SAR _{10g} (W/kg)	1 W Normalized SAR _{10g} (W/kg)	Deviation (%)
835	BODY	04/01/2013	23.8	22.9	0.100	4d026	3287	0.664	6.330	6.640	4.90%
1900	BODY	04/01/2013	23.7	21.9	0.100	5d148	3209	1.960	21.700	19.600	-9.68%
2450	BODY	04/03/2013	24.1	23.3	0.100	719	3287	2.310	24.400	23.100	-5.33%
5200	BODY	04/01/2013	24.3	23.2	0.100	1057	3589	2.050	21.100	20.500	-2.84%
5300	BODY	04/01/2013	24.3	23.2	0.100	1057	3589	1.950	21.100	19.500	-7.58%
5500	BODY	04/01/2013	24.3	23.2	0.100	1057	3589	2.190	22.400	21.900	-2.23%
5600	BODY	04/01/2013	24.4	23.3	0.100	1057	3589	2.180	22.300	21.800	-2.24%
5800	BODY	04/01/2013	24.4	23.3	0.100	1057	3589	2.020	20.700	20.200	-2.42%

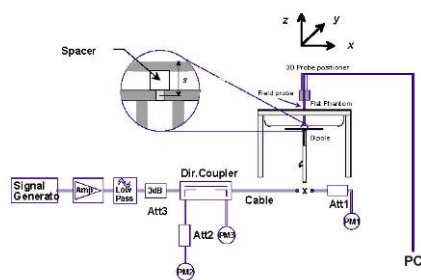


Figure 9-1
System Verification Setup Diagram



Figure 9-2
System Verification Setup Photo

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 27 of 46

10 SAR DATA SUMMARY

10.1 Standalone Hand SAR Data

Table 10-1
UMTS Hand SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (10g)	Scaling Factor	Scaled SAR (10g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	22.5	22.43	0.06	0 mm	25	1:1	back	0.198	1.016	0.201	
836.60	4183	UMTS 850	RMC	22.5	22.43	-0.02	0 mm	25	1:1	front	0.032	1.016	0.033	
836.60	4183	UMTS 850	RMC	22.5	22.43	0.05	0 mm	25	1:1	bottom	0.377	1.016	0.383	
836.60	4183	UMTS 850	RMC	22.5	22.43	0.04	0 mm	25	1:1	left	0.494	1.016	0.502	A1
1880.00	9400	UMTS 1900	RMC	22.0	21.85	0.01	0 mm	25	1:1	back	0.595	1.035	0.616	
1880.00	9400	UMTS 1900	RMC	22.0	21.85	-0.07	0 mm	25	1:1	front	0.118	1.035	0.122	
1880.00	9400	UMTS 1900	RMC	22.0	21.85	-0.04	0 mm	25	1:1	bottom	0.518	1.035	0.536	
1880.00	9400	UMTS 1900	RMC	22.0	21.85	0.02	0 mm	25	1:1	left	1.340	1.035	1.387	A5
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Hand 4.0 W/kg (mW/g) averaged over 10 grams							

Table 10-2
LTE Hand SAR Data

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (10g)	Scaling Factor	Scaled SAR (10g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	22.35	-0.10	0	25	QPSK	1	0	0 mm	back	1:1	0.129	1.035	0.134	
836.50	20525	Mid	LTE Band 5 (Cell)	10	21.5	21.18	-0.09	1	25	QPSK	25	0	0 mm	back	1:1	0.096	1.076	0.104	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	22.35	0.03	0	25	QPSK	1	0	0 mm	front	1:1	0.063	1.035	0.065	
836.50	20525	Mid	LTE Band 5 (Cell)	10	21.5	21.18	0.10	1	25	QPSK	25	0	0 mm	front	1:1	0.046	1.076	0.049	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	22.35	0.00	0	25	QPSK	1	0	0 mm	bottom	1:1	0.346	1.035	0.358	
836.50	20525	Mid	LTE Band 5 (Cell)	10	21.5	21.18	-0.07	1	25	QPSK	25	0	0 mm	bottom	1:1	0.281	1.076	0.302	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	22.35	-0.02	0	25	QPSK	1	0	0 mm	left	1:1	0.418	1.035	0.433	A3
836.50	20525	Mid	LTE Band 5 (Cell)	10	21.5	21.18	0.10	1	25	QPSK	25	0	0 mm	left	1:1	0.320	1.076	0.344	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Hand 4.0 W/kg (mW/g) averaged over 10 grams											

Table 10-3
DTS Hand SAR Data

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 (10g)	Scaling Factor	Scaled SAR (10g) (W/kg)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2437	6	IEEE 802.11b	DSSS	17.0	16.42	-0.17	0 mm	42	1	back	1:1	0.074	1.143	0.084	
2437	6	IEEE 802.11b	DSSS	17.0	16.42	-0.03	0 mm	42	1	front	1:1	0.012	1.143	0.014	
2437	6	IEEE 802.11b	DSSS	17.0	16.42	0.14	0 mm	42	1	top	1:1	0.061	1.143	0.070	
2437	6	IEEE 802.11b	DSSS	17.0	16.42	0.13	0 mm	42	1	left	1:1	0.424	1.143	0.485	A7
5825	165	IEEE 802.11a	OFDM	14.5	14.30	-0.06	0 mm	42	6	back	1:1	0.057	1.047	0.059	
5825	165	IEEE 802.11a	OFDM	14.5	14.30	0.14	0 mm	42	6	front	1:1	0.006	1.047	0.006	
5825	165	IEEE 802.11a	OFDM	14.5	14.30	0.03	0 mm	42	6	top	1:1	0.039	1.047	0.041	
5825	165	IEEE 802.11a	OFDM	14.5	14.30	0.17	0 mm	42	6	left	1:1	0.339	1.047	0.355	A13
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Hand 2.0 W/kg (mW/g) averaged over 10 grams								

FCC ID: A3LEKGN120			SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 28 of 46	

Table 10-4
NII Hand SAR Data

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 (10g)	Scaling Factor	Scaled SAR (10g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	14.5	14.22	-0.15	0 mm	42	6	back	1:1	0.021	1.067	0.022	
5180	36	IEEE 802.11a	OFDM	14.5	14.22	-0.09	0 mm	42	6	front	1:1	0.000	1.067	0.000	
5180	36	IEEE 802.11a	OFDM	14.5	14.22	0.13	0 mm	42	6	top	1:1	0.013	1.067	0.014	
5180	36	IEEE 802.11a	OFDM	14.5	14.22	-0.18	0 mm	42	6	left	1:1	0.163	1.067	0.174	
5260	52	IEEE 802.11a	OFDM	14.5	13.99	-0.09	0 mm	42	6	back	1:1	0.026	1.125	0.029	
5260	52	IEEE 802.11a	OFDM	14.5	13.99	0.00	0 mm	42	6	front	1:1	0.000	1.125	0.000	
5260	52	IEEE 802.11a	OFDM	14.5	13.99	0.07	0 mm	42	6	top	1:1	0.014	1.125	0.016	
5260	52	IEEE 802.11a	OFDM	14.5	13.99	0.07	0 mm	42	6	left	1:1	0.236	1.125	0.266	
5700	140	IEEE 802.11a	OFDM	14.5	14.26	-0.07	0 mm	42	6	back	1:1	0.037	1.057	0.040	
5700	140	IEEE 802.11a	OFDM	14.5	14.26	-0.05	0 mm	42	6	front	1:1	0.001	1.057	0.001	
5700	140	IEEE 802.11a	OFDM	14.5	14.26	0.04	0 mm	42	6	top	1:1	0.039	1.057	0.041	
5700	140	IEEE 802.11a	OFDM	14.5	14.26	0.11	0 mm	42	6	left	1:1	0.307	1.057	0.324	A11
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Hand 4.0 W/kg (mW/g) averaged over 10 grams								

Table 10-5
Bluetooth Hand SAR Data

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 (10g)	Scaling Factor	Scaled SAR (10g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2441	39	Bluetooth	FHSS	10.5	10.31	0.03	0 mm	25	1	back	1:1	0.004	1.045	0.004	
2441	39	Bluetooth	FHSS	10.5	10.31	-0.05	0 mm	25	1	front	1:1	0.000	1.045	0.000	
2441	39	Bluetooth	FHSS	10.5	10.31	-0.03	0 mm	25	1	top	1:1	0.014	1.045	0.015	
2441	39	Bluetooth	FHSS	10.5	10.31	0.20	0 mm	25	1	left	1:1	0.034	1.045	0.036	A9
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Hand 4.0 W/kg (mW/g) averaged over 10 grams								

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 29 of 46

10.2 Standalone Body SAR Data

Table 10-6
UMTS Body SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	22.5	22.43	-0.20	10 mm	25	1:1	front	0.026	1.016	0.026	
836.60	4183	UMTS 850	RMC	22.5	22.43	0.03	10 mm	25	1:1	bottom	0.133	1.016	0.135	
836.60	4183	UMTS 850	RMC	22.5	22.43	0.06	10 mm	25	1:1	left	0.120	1.016	0.122	
1880.00	9400	UMTS 1900	RMC	22.0	21.85	0.04	10 mm	25	1:1	front	0.080	1.035	0.083	
1880.00	9400	UMTS 1900	RMC	22.0	21.85	0.13	10 mm	25	1:1	bottom	0.452	1.035	0.468	A6
1880.00	9400	UMTS 1900	RMC	22.0	21.85	0.05	10 mm	25	1:1	left	0.404	1.035	0.418	
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 10-7
LTE Band 5 (Cell) Body SAR Data

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	22.35	-0.04	0	25	QPSK	1	0	10 mm	front	1:1	0.054	1.035	0.056	
836.50	20525	Mid	LTE Band 5 (Cell)	10	21.5	21.18	0.00	1	25	QPSK	25	0	10 mm	front	1:1	0.040	1.076	0.043	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	22.35	-0.06	0	25	QPSK	1	0	10 mm	bottom	1:1	0.226	1.035	0.234	A4
836.50	20525	Mid	LTE Band 5 (Cell)	10	21.5	21.18	-0.03	1	25	QPSK	25	0	10 mm	bottom	1:1	0.156	1.076	0.168	
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	22.35	0.08	0	25	QPSK	1	0	10 mm	left	1:1	0.118	1.035	0.122	
836.50	20525	Mid	LTE Band 5 (Cell)	10	21.5	21.18	0.00	1	25	QPSK	25	0	10 mm	left	1:1	0.077	1.076	0.083	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT																			
Spatial Peak							Body												
Uncontrolled Exposure/General Population							1.6 W/kg (mW/g)												
							averaged over 1 gram												

Table 10-8
DTS Body SAR Data

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)	
2437	6	IEEE 802.11b	DSSS	17.0	16.42	-0.15	10 mm	42	1	front	1:1	0.014	1.143	0.016	
2437	6	IEEE 802.11b	DSSS	17.0	16.42	0.15	10 mm	42	1	top	1:1	0.036	1.143	0.041	
2437	6	IEEE 802.11b	DSSS	17.0	16.42	-0.11	10 mm	42	1	left	1:1	0.120	1.143	0.137	
5825	165	IEEE 802.11a	OFDM	14.5	14.30	0.10	10 mm	42	6	front	1:1	0.000	1.047	0.000	
5825	165	IEEE 802.11a	OFDM	14.5	14.30	0.09	10 mm	42	6	top	1:1	0.037	1.047	0.039	
5765	153	IEEE 802.11a	OFDM	14.5	14.28	-0.02	10 mm	42	6	left	1:1	0.422	1.052	0.444	A14
5785	157	IEEE 802.11a	OFDM	14.5	14.26	-0.10	10 mm	42	6	left	1:1	0.410	1.057	0.433	
5825	165	IEEE 802.11a	OFDM	14.5	14.30	0.12	10 mm	42	6	left	1:1	0.377	1.047	0.395	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

FCC ID: A3LEKGN120			SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera			Page 30 of 46

Table 10-9
NII Body SAR Data

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)	
5180	36	IEEE 802.11a	OFDM	14.5	14.22	0.09	10 mm	42	6	front	1:1	0.000	1.067	0.000	
5180	36	IEEE 802.11a	OFDM	14.5	14.22	0.00	10 mm	42	6	top	1:1	0.022	1.067	0.023	
5180	36	IEEE 802.11a	OFDM	14.5	14.22	-0.07	10 mm	42	6	left	1:1	0.105	1.067	0.112	
5260	52	IEEE 802.11a	OFDM	14.5	13.99	0.00	10 mm	42	6	front	1:1	0.000	1.125	0.000	
5260	52	IEEE 802.11a	OFDM	14.5	13.99	0.16	10 mm	42	6	top	1:1	0.026	1.125	0.029	
5260	52	IEEE 802.11a	OFDM	14.5	13.99	-0.17	10 mm	42	6	left	1:1	0.133	1.125	0.150	
5700	140	IEEE 802.11a	OFDM	14.5	14.26	0.09	10 mm	42	6	front	1:1	0.000	1.057	0.000	
5700	140	IEEE 802.11a	OFDM	14.5	14.26	0.09	10 mm	42	6	top	1:1	0.033	1.057	0.035	
5500	100	IEEE 802.11a	OFDM	14.5	14.05	-0.06	10 mm	42	6	left	1:1	0.328	1.109	0.364	
5580	116	IEEE 802.11a	OFDM	14.5	14.09	-0.04	10 mm	42	6	left	1:1	0.397	1.099	0.436	
5700	140	IEEE 802.11a	OFDM	14.5	14.26	-0.04	10 mm	42	6	left	1:1	0.427	1.057	0.451	A12
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 10-10
Bluetooth Body SAR Data

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	FHSS	10.5	10.31	-0.01	10 mm	25	1	front	1:1	0.000	1.045	0.000	
2441	39	Bluetooth	FHSS	10.5	10.31	-0.11	10 mm	25	1	top	1:1	0.004	1.045	0.004	
2441	39	Bluetooth	FHSS	10.5	10.31	0.02	10 mm	25	1	left	1:1	0.006	1.045	0.006	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

10.3 Standalone Body-worn Accessory (Neck-strap) SAR Data

Table 10-11
UMTS Body-worn Accessory (Neck-strap) SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	22.5	22.43	0.06	0 mm	25	1:1	back	0.331	1.016	0.336	A2
1880.00	9400	UMTS 1900	RMC	16.5	16.40	-0.03	0 mm	34	1:1	back	0.343	1.023	0.351	
1880.00	9400	UMTS 1900	RMC	22.0	21.85	0.16	9 mm	25	1:1	back	0.208	1.035	0.215	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram							

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 31 of 46

Table 10-12
LTE Band 5 (Cell) Body-worn Accessory (Neck-strap) SAR Data

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	22.5	22.35	-0.10	0	25	QPSK	1	0	0 mm	back	1:1	0.210	1.035	0.217	
836.50	20525	Mid	LTE Band 5 (Cell)	10	21.5	21.18	-0.09	1	25	QPSK	25	0	0 mm	back	1:1	0.158	1.076	0.170	
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 10-13
DTS Body-worn Accessory (Neck-strap) SAR Data

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)	
2437	6	IEEE 802.11b	DSSS	17.0	16.42	-0.17	0 mm	42	1	back	1:1	0.158	1.143	0.181	A8
5825	165	IEEE 802.11a	OFDM	14.5	14.30	-0.06	0 mm	42	6	back	1:1	0.178	1.047	0.186	
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 10-14
NII Body-worn Accessory (Neck-strap) SAR Data

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)	
5180	36	IEEE 802.11a	OFDM	14.5	14.22	-0.15	0 mm	42	6	back	1:1	0.060	1.067	0.064	
5260	52	IEEE 802.11a	OFDM	14.5	13.99	-0.09	0 mm	42	6	back	1:1	0.074	1.125	0.083	
5700	140	IEEE 802.11a	OFDM	14.5	14.26	-0.07	0 mm	42	6	back	1:1	0.117	1.057	0.124	
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 10-15
Bluetooth Body-worn Accessory (Neck-strap) SAR Data

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	FHSS	10.5	10.31	0.03	0 mm	25	1	back	1:1	0.010	1.045	0.010	A10
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 32 of 46

10.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 447498 D01v05 and FCC KDB Publication 941225 D07.
2. Per FCC KDB Publication 941225 D07, a test separation distance of 10 mm was considered for 1-g SAR, with the addition of 10-g SAR measurement at 0 mm test separation distance for all 1-g SAR configurations to address hand exposure.
3. 1-g SAR was additionally evaluated at 0mm test separation distance for back side configuration to account for chest-strap accessories.
4. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
5. Liquid tissue depth was at least 15.0 cm for all frequencies.
6. 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.
7. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
8. Per FCC KDB 865664 D01 v01, variability SAR tests were not performed since the measured 1 gram SAR results for all frequency bands were less than 0.8 W/kg and the measured 10 gram SAR results for all frequency bands were less than 2.0 W/kg.
9. This device uses a proximity sensor for SAR compliance intended when the camera is touching the user while using the neck-strap body-worn accessory. The proximity sensor triggers power reduction for UMTS1900 only. The proximity sensor is only applicable for body SAR back side exposure conditions.
10. Back side tests were performed without body-worn accessory neck-strap attached to camera as there was no neck-strap provided by the manufacturer.

UMTS Notes:

1. UMTS mode in Body and Hand 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.

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 permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.

WLAN 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 was performed on the other required default channels.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 33 of 46

11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05 are applicable to portable devices 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 when the test separation distance is less than 50mm:

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

Table 11-1
Estimated 1-g SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth LE	2441	8.50	10	0.146
Bluetooth LE	2441	8.50	5	0.292

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 10g SAR for simultaneous transmission assessment involving that transmitter when the test separation distance is less than 50mm:

$$\text{Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{18.75} * \frac{(\text{Max Power of channel, mW})}{\text{Min. Separation Distance, mm}}$$

Table 11-2
Estimated 10-g SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth LE	2441	8.50	5	0.117

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 34 of 46

11.3 Body SAR (1g) Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D07, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR (“-”).

Table 11-3
Simultaneous Transmission Scenario with 2.4 GHz
(Body-worn Accessory [Neck-strap] SAR 1g at 0.0 cm)

Configuration	Mode	3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	UMTS 850	0.336	0.181	0.517
Back Side	UMTS 1900	0.351	0.181	0.532
Back Side	LTE Band 5 (Cell)	0.217	0.181	0.398

Table 11-4
Simultaneous Transmission Scenario with 5 GHz
(Body-worn Accessory [Neck-strap] SAR 1g at 0.0 cm)

Configuration	Mode	3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	UMTS 850	0.336	0.186	0.522
Back Side	UMTS 1900	0.351	0.186	0.537
Back Side	LTE Band 5 (Cell)	0.217	0.186	0.403

Table 11-5
Simultaneous Transmission Scenario with Bluetooth
(Body-worn Accessory [Neck-strap] SAR 1g at 0.0 cm)

Configuration	Mode	3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	UMTS 850	0.336	0.010	0.346
Back Side	UMTS 1900	0.351	0.010	0.361
Back Side	LTE Band 5 (Cell)	0.217	0.010	0.227

Table 11-6
Simultaneous Transmission Scenario with Bluetooth LE
(Body-worn Accessory [Neck-strap] SAR 1g at 0.0 cm)

Configuration	Mode	3G/4G SAR (W/kg)	Bluetooth LE SAR (W/kg)	Σ SAR (W/kg)
Back Side	UMTS 850	0.336	0.292	0.628
Back Side	UMTS 1900	0.351	0.292	0.643
Back Side	LTE Band 5 (Cell)	0.217	0.292	0.509

Note: Bluetooth LE SAR was not required to be measured per FCC KDB 447498. Estimated Bluetooth LE SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 35 of 46

Table 11-7
Simultaneous Transmission Scenario with 2.4 GHz (Body SAR 1g at 1.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ 1g SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ 1g SAR (W/kg)
Body SAR	Front	0.026	0.016	0.042	Body SAR	Front	0.083	0.016	0.099
	Top	-	0.041	0.041		Top	-	0.041	0.041
	Bottom	0.135	-	0.135		Bottom	0.468	-	0.468
	Right	-	-	0.000		Right	-	-	0.000
	Left	0.122	0.137	0.259		Left	0.418	0.137	0.555

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ 1g SAR (W/kg)
Body SAR	Front	0.056	0.016	0.072
	Top	-	0.041	0.041
	Bottom	0.234	-	0.234
	Right	-	-	0.000
	Left	0.122	0.137	0.259

Table 11-8
Simultaneous Transmission Scenario with 5 GHz (Body SAR 1g at 1.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ 1g SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ 1g SAR (W/kg)
Body SAR	Front	0.026	0.000	0.026	Body SAR	Front	0.083	0.000	0.083
	Top	-	0.039	0.039		Top	-	0.039	0.039
	Bottom	0.135	-	0.135		Bottom	0.468	-	0.468
	Right	-	-	0.000		Right	-	-	0.000
	Left	0.122	0.451	0.573		Left	0.418	0.451	0.869

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ 1g SAR (W/kg)
Body SAR	Front	0.056	0.000	0.056
	Top	-	0.039	0.039
	Bottom	0.234	-	0.234
	Right	-	-	0.000
	Left	0.122	0.451	0.573

Table 11-9
Simultaneous Transmission Scenario with Bluetooth (Body SAR 1g at 1.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ 1g SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ 1g SAR (W/kg)
Body SAR	Front	0.026	0.000	0.026	Body SAR	Front	0.083	0.000	0.083
	Top	-	0.004	0.004		Top	-	0.004	0.004
	Bottom	0.135	-	0.135		Bottom	0.468	-	0.468
	Right	-	-	0.000		Right	-	-	0.000
	Left	0.122	0.006	0.128		Left	0.418	0.006	0.424

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ 1g SAR (W/kg)
Body SAR	Front	0.056	0.000	0.056
	Top	-	0.004	0.004
	Bottom	0.234	-	0.234
	Right	-	-	0.000
	Left	0.122	0.006	0.128

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 36 of 46	

Table 11-10
Simultaneous Transmission Scenario with Bluetooth LE (Body SAR 1g at 1.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth LE SAR (W/kg)	Σ 1g SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth LE SAR (W/kg)	Σ 1g SAR (W/kg)
Body SAR	Front	0.026	0.146	0.172	Body SAR	Front	0.083	0.146	0.229
	Top	-	0.146	0.146		Top	-	0.146	0.146
	Bottom	0.135	-	0.135		Bottom	0.468	-	0.468
	Right	-	-	0.000		Right	-	-	0.000
	Left	0.122	0.146	0.268		Left	0.418	0.146	0.564

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth LE SAR (W/kg)	Σ 1g SAR (W/kg)
Body SAR	Front	0.056	0.146	0.202
	Top	-	0.146	0.146
	Bottom	0.234	-	0.234
	Right	-	-	0.000
	Left	0.122	0.146	0.268

Note: Bluetooth LE SAR was not required to be measured per FCC KDB 447498. Estimated Bluetooth LE SAR results were used in the above table to determine simultaneous transmission SAR test exclusion

11.4 Hand SAR (10g) Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D07, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR (“-”).

Table 11-11
Simultaneous Transmission Scenario with 2.4 GHz (Hand SAR 10g at 0.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.201	0.084	0.285	4.000
	Front	0.033	0.014	0.047	
	Top	-	0.070	0.070	
	Bottom	0.383	-	0.383	
	Right	-	-	0.000	
	Left	0.502	0.485	0.987	
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.616	0.084	0.700	4.000
	Front	0.122	0.014	0.136	
	Top	-	0.070	0.070	
	Bottom	0.536	-	0.536	
	Right	-	-	0.000	
	Left	1.387	0.485	1.872	
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.134	0.084	0.218	4.000
	Front	0.065	0.014	0.079	
	Top	-	0.070	0.070	
	Bottom	0.358	-	0.358	
	Right	-	-	0.000	
	Left	0.433	0.485	0.918	

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 37 of 46	

Table 11-12
Simultaneous Transmission Scenario with 5 GHz (Hand SAR 10g at 0.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.201	0.059	0.260	4.000
	Front	0.033	0.006	0.039	
	Top	-	0.041	0.041	
	Bottom	0.383	-	0.383	
	Right	-	-	0.000	
	Left	0.502	0.355	0.857	
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.616	0.059	0.675	4.000
	Front	0.122	0.006	0.128	
	Top	-	0.041	0.041	
	Bottom	0.536	-	0.536	
	Right	-	-	0.000	
	Left	1.387	0.355	1.742	
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.134	0.059	0.193	4.000
	Front	0.065	0.006	0.071	
	Top	-	0.041	0.041	
	Bottom	0.358	-	0.358	
	Right	-	-	0.000	
	Left	0.433	0.355	0.788	

Table 11-13
Simultaneous Transmission Scenario with Bluetooth (Hand SAR 10g at 0.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.201	0.004	0.205	4.000
	Front	0.033	0.000	0.033	
	Top	-	0.015	0.015	
	Bottom	0.383	-	0.383	
	Right	-	-	0.000	
	Left	0.502	0.036	0.538	
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.616	0.004	0.620	4.000
	Front	0.122	0.000	0.122	
	Top	-	0.015	0.015	
	Bottom	0.536	-	0.536	
	Right	-	-	0.000	
	Left	1.387	0.036	1.423	
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.134	0.004	0.138	4.000
	Front	0.065	0.000	0.065	
	Top	-	0.015	0.015	
	Bottom	0.358	-	0.358	
	Right	-	-	0.000	
	Left	0.433	0.036	0.469	

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 38 of 46	

Table 11-14
Simultaneous Transmission Scenario with Bluetooth LE (Hand SAR 10g at 0.0 cm)

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	Bluetooth LE SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.201	0.117	0.318	4.000
	Front	0.033	0.117	0.150	
	Top	-	0.117	0.117	
	Bottom	0.383	-	0.383	
	Right	-	-	0.000	
	Left	0.502	0.117	0.619	
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	Bluetooth LE SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.616	0.117	0.733	4.000
	Front	0.122	0.117	0.239	
	Top	-	0.117	0.117	
	Bottom	0.536	-	0.536	
	Right	-	-	0.000	
	Left	1.387	0.117	1.504	
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth LE SAR (W/kg)	Σ 10g SAR (W/kg)	Σ 10g SAR limit per ANSI/IEEE C95.1-1992 (W/kg)
Hand SAR	Back	0.134	0.117	0.251	4.000
	Front	0.065	0.117	0.182	
	Top	-	0.117	0.117	
	Bottom	0.358	-	0.358	
	Right	-	-	0.000	
	Left	0.433	0.117	0.550	

Note: Bluetooth LE SAR was not required to be measured per FCC KDB 447498. Estimated Bluetooth LE SAR results were used in the above table to determine simultaneous transmission SAR test exclusion

11.5 Simultaneous Transmission Conclusion

The above numerical summed SAR 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.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 39 of 46	

12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability was assessed when measured 1 gram SAR is > 0.80 W/kg or when measured 10 gram is > 2.00 W/kg. Since all measured 1 gram SAR values were < 0.8 W/kg and all measured 10 gram SAR values were < 2.00 W/kg for this device, SAR measurement variability was not assessed.

12.2 Measurement Uncertainty

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

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 40 of 46

13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	10/10/2012	Annual	10/10/2013	3613A00315
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/4/2012	Annual	4/4/2013	JP38020182
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/5/2012	Annual	4/5/2013	MY45470194
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
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	CBT	N/A	CBT	21910
Anritsu	ML2438A	Power Meter	12/4/2012	Annual	12/4/2013	1070030
Anritsu	MA2481A	Power Sensor	2/14/2013	Annual	2/14/2014	5821
Anritsu	MA2481A	Power Sensor	4/5/2012	Annual	4/5/2013	5605
Anritsu	MA2481A	Power Sensor	2/14/2013	Annual	2/14/2014	2400
Anritsu	MA2411B	Pulse Sensor	9/19/2012	Annual	9/19/2013	1027293
Anritsu	ML2495A	Power Meter	10/11/2012	Annual	10/11/2013	1039008
Anritsu	MT8820C	Radio Communication Tester	11/6/2012	Annual	11/6/2013	6200901190
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Control Company	61220-416	Long-Stem Thermometer	7/1/2011	Biennial	7/1/2013	111642834
Control Company	36934-158	Wall-Mounted Thermometer	1/4/2012	Biennial	1/4/2014	122014488
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
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
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-S3W2	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	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	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-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
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	D2450V2	2450 MHz SAR Dipole	8/23/2012	Annual	8/23/2013	719
SPEAG	D1900V2	1900 MHz SAR Dipole	2/6/2013	Annual	2/6/2014	5d148
SPEAG	D5GHzV2	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	1/17/2013	Annual	1/17/2014	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/13/2012	Annual	11/13/2013	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/8/2013	Annual	3/8/2014	1334
SPEAG	DAK-3.5	Dielectric Assessment Kit	12/11/2012	Annual	12/11/2013	1091
SPEAG	ES3DV3	SAR Probe	3/15/2013	Annual	3/15/2014	3209
SPEAG	ES3DV3	SAR Probe	11/15/2012	Annual	11/15/2013	3287
SPEAG	EX3DV4	SAR Probe	1/17/2013	Annual	1/17/2014	3589
Tektronix	RSA-6114A	Real Time Spectrum Analyzer	4/5/2012	Annual	4/5/2013	B010177
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	23226-658	Long Stem Thermometer	5/16/2012	Biennial	5/16/2014	122295544

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.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 41 of 46

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

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

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 42 of 46

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

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 43 of 46

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]

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera		Page 44 of 46

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FCC ID: A3LEKGN120	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: OY1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 45 of 46

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FCC ID: A3LEKGN120	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: 0Y1303260534-R5.A3L	Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	Page 46 of 46

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 25

Communication System: UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 1.003 \text{ S/m}$; $\epsilon_r = 53.184$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-01-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.9°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 14.6.8 (7028)

Mode: UMTS 850, Hand SAR, Left Edge, Mid.ch

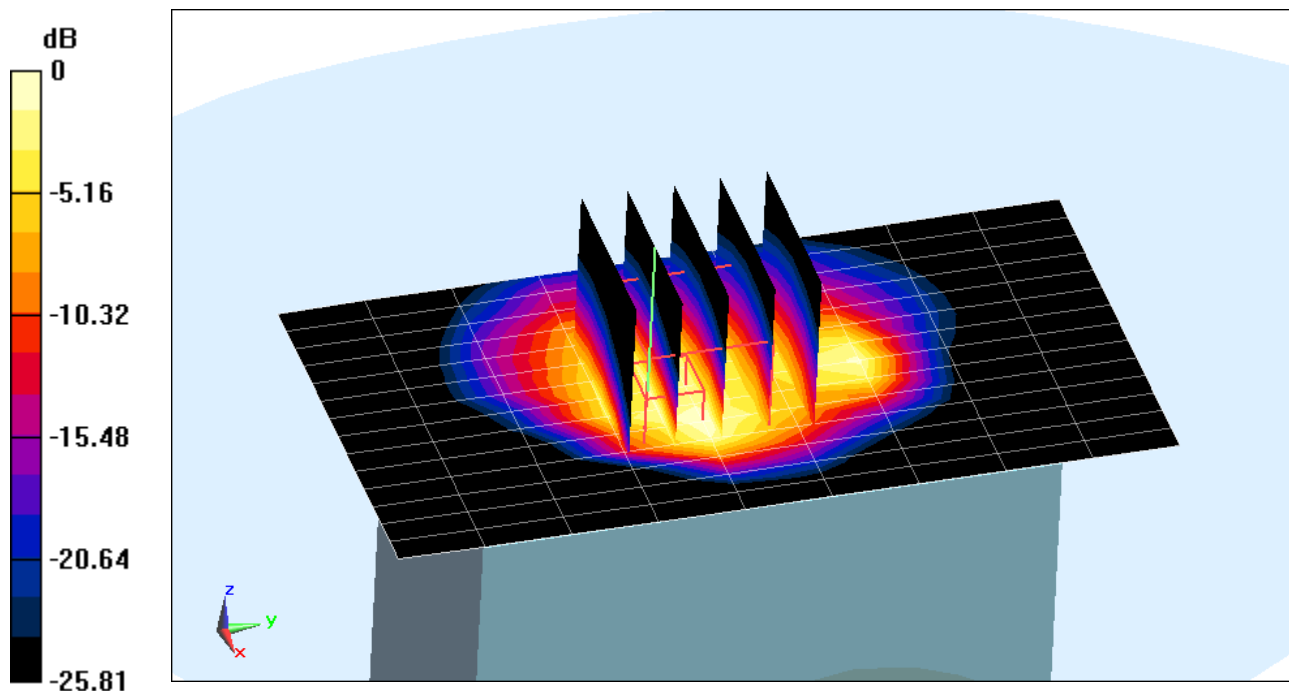
Area Scan (9x13x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 30.730 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 1.77 W/kg

SAR(1 g) = 0.849 W/kg; SAR(10 g) = 0.494 W/kg



0 dB = 0.905 W/kg = -0.43 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 25

Communication System: UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 1.003 \text{ S/m}$; $\epsilon_r = 53.184$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-01-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.9°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 14.6.8 (7028)

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

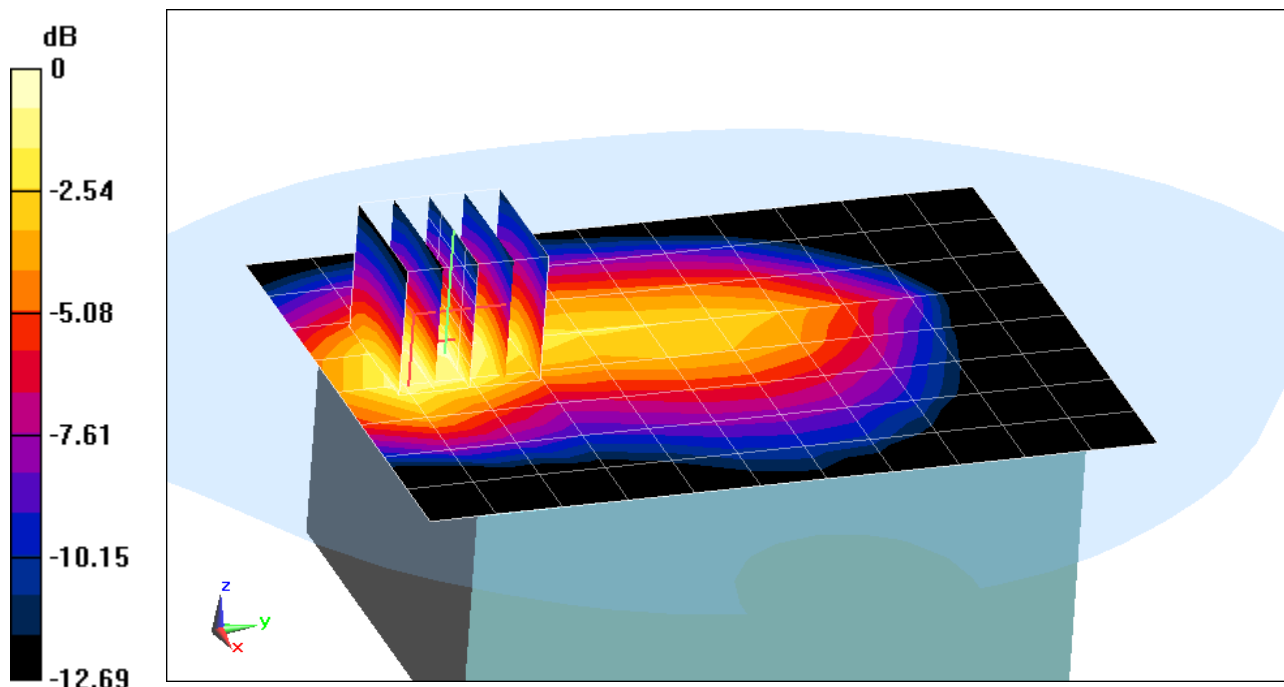
Area Scan (9x12x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 19.249 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.550 W/kg

SAR(1 g) = 0.331 W/kg; SAR(10 g) = 0.198 W/kg



0 dB = 0.360 W/kg = -4.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 25

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

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 1.003 \text{ S/m}$; $\epsilon_r = 53.185$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-01-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.9°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 14.6.8 (7028)

Mode: LTE Band 5 (Cell), Hand SAR, Left Edge, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, RB Offset 0

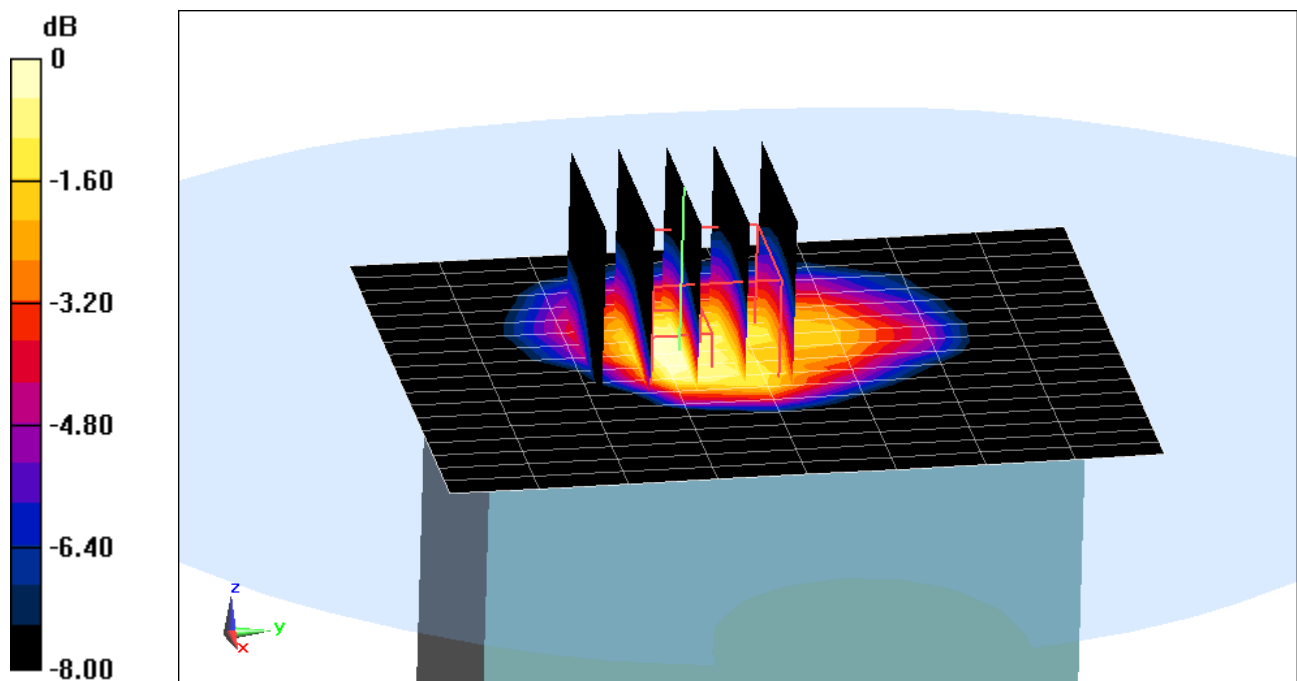
Area Scan (19x9x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 28.897 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.47 W/kg

SAR(1 g) = 0.726 W/kg; SAR(10 g) = 0.418 W/kg



0 dB = 0.790 W/kg = -1.02 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 25

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

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 1.003 \text{ S/m}$; $\epsilon_r = 53.185$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.9°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 14.6.8 (7028)

Mode: LTE Band 5 (Cell), Body SAR, Bottom Edge, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, RB Offset 0

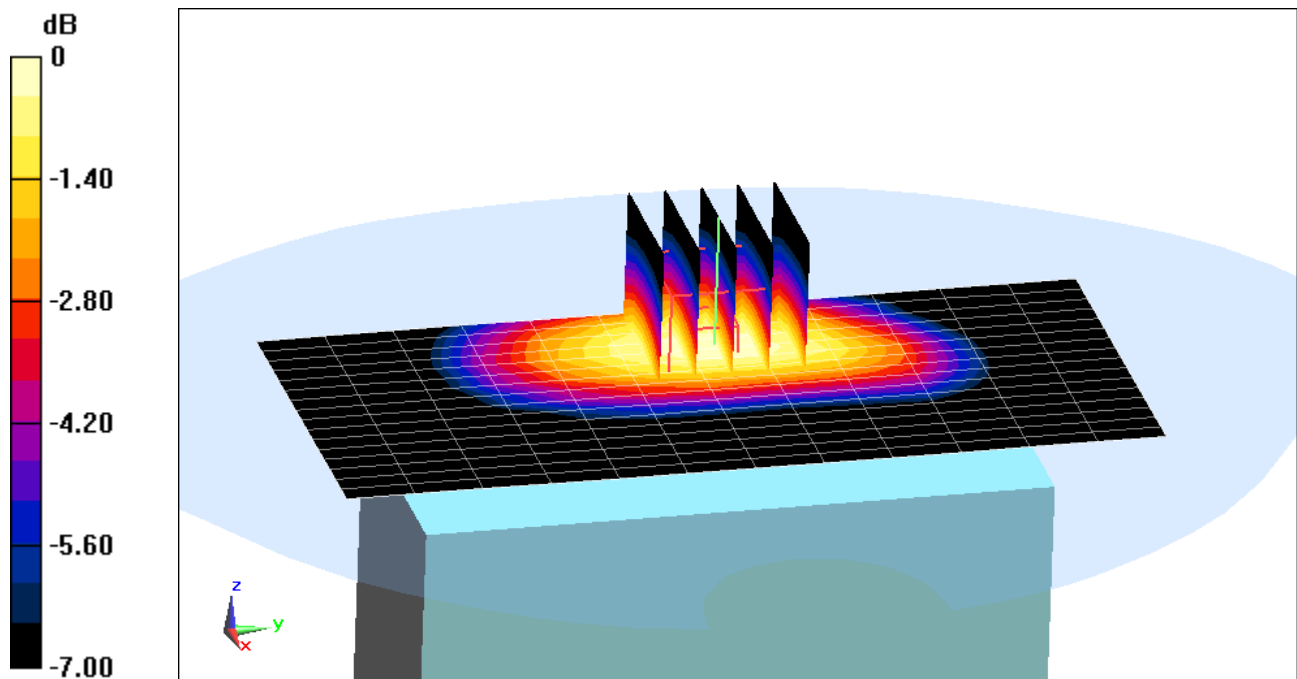
Area Scan (17x13x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 15.657 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.312 W/kg

SAR(1 g) = 0.226 W/kg; SAR(10 g) = 0.157 W/kg



0 dB = 0.241 W/kg = -6.18 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 25

Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.511 \text{ S/m}$; $\epsilon_r = 52.258$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-01-2013; Ambient Temp: 23.7°C; Tissue Temp: 21.9°C

Probe: ES3DV3 - SN3209; ConvF(4.77, 4.77, 4.77); 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 14.6.8 (7028)

Mode: UMTS 1900, Hand SAR, Left Edge, Mid.ch

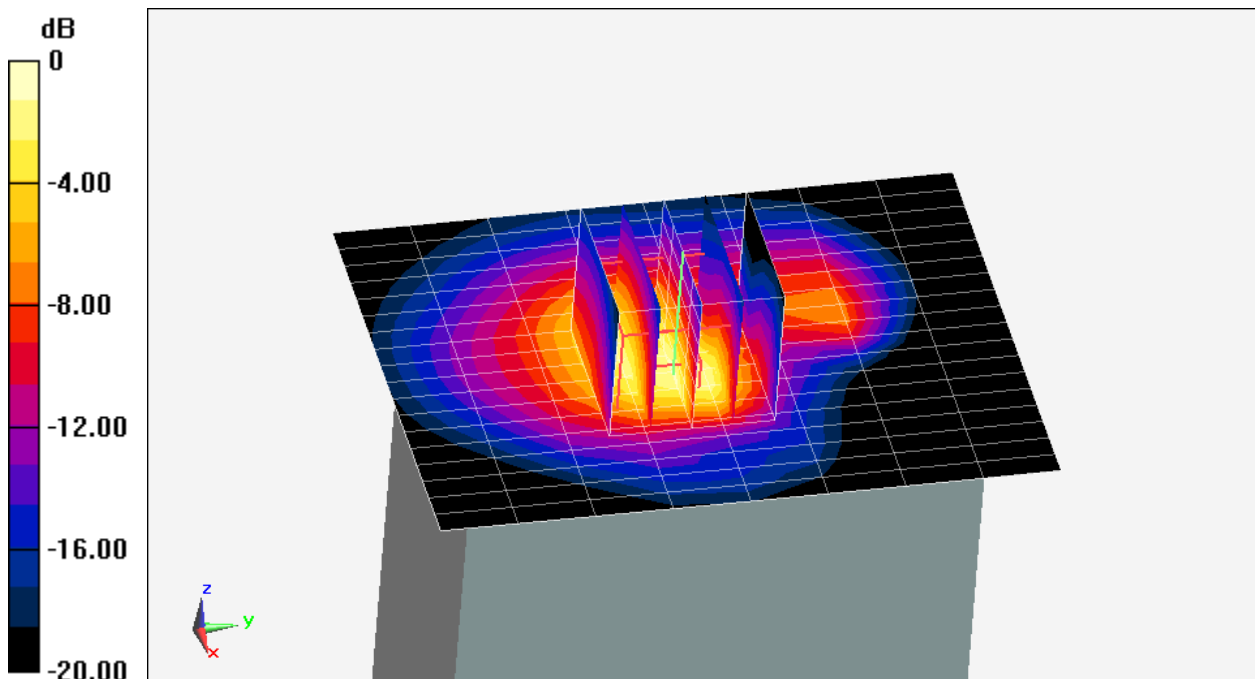
Area Scan (19x9x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 42.140 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 5.78 W/kg

SAR(1 g) = 2.87 W/kg; SAR(10 g) = 1.34 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 25

Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.511 \text{ S/m}$; $\epsilon_r = 52.258$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 23.7°C; Tissue Temp: 21.9°C

Probe: ES3DV3 - SN3209; ConvF(4.77, 4.77, 4.77); 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 14.6.8 (7028)

Mode: UMTS 1900, Body SAR, Bottom Edge, Mid.ch

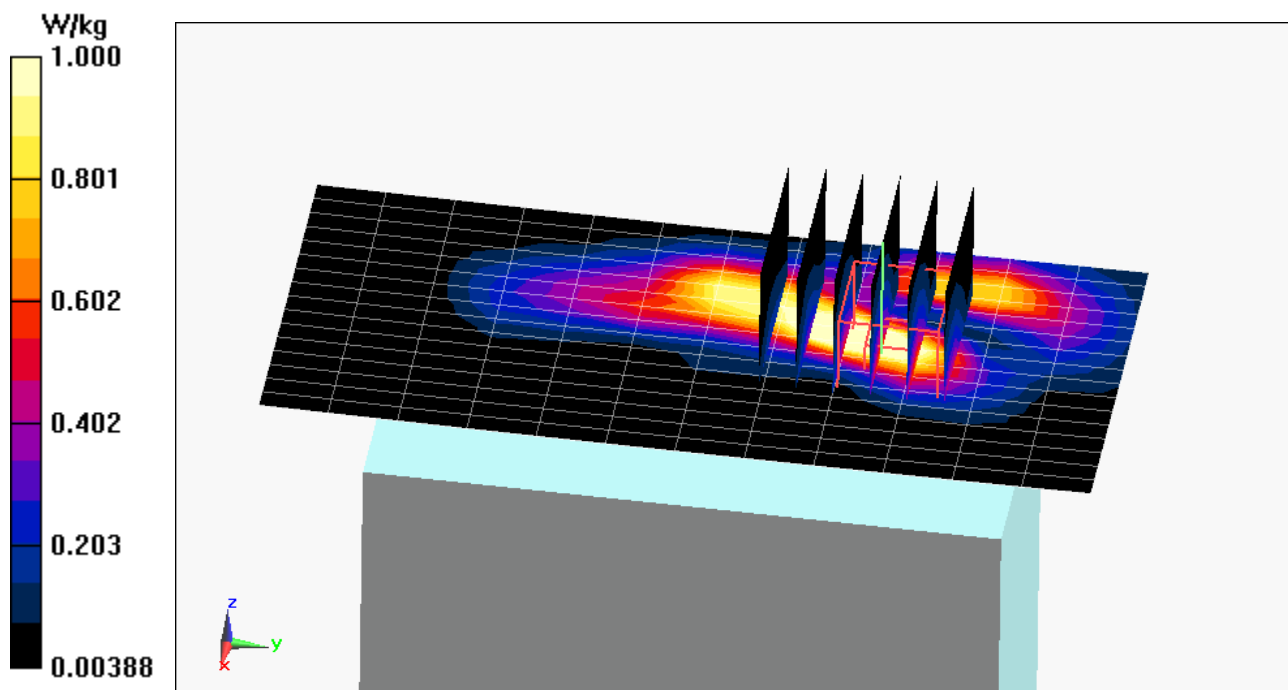
Area Scan (17x13x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 14.350 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 0.737 W/kg

SAR(1 g) = 0.452 W/kg; SAR(10 g) = 0.254 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 42

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

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.929 \text{ S/m}$; $\epsilon_r = 52.68$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-03-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.3°C

Probe: ES3DV3 - SN3287; ConvF(4.29, 4.29, 4.29); Calibrated: 11/15/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.8 (7028)

Mode: IEEE 802.11b, Hand SAR, Ch 06, 1 Mbps, Left Edge

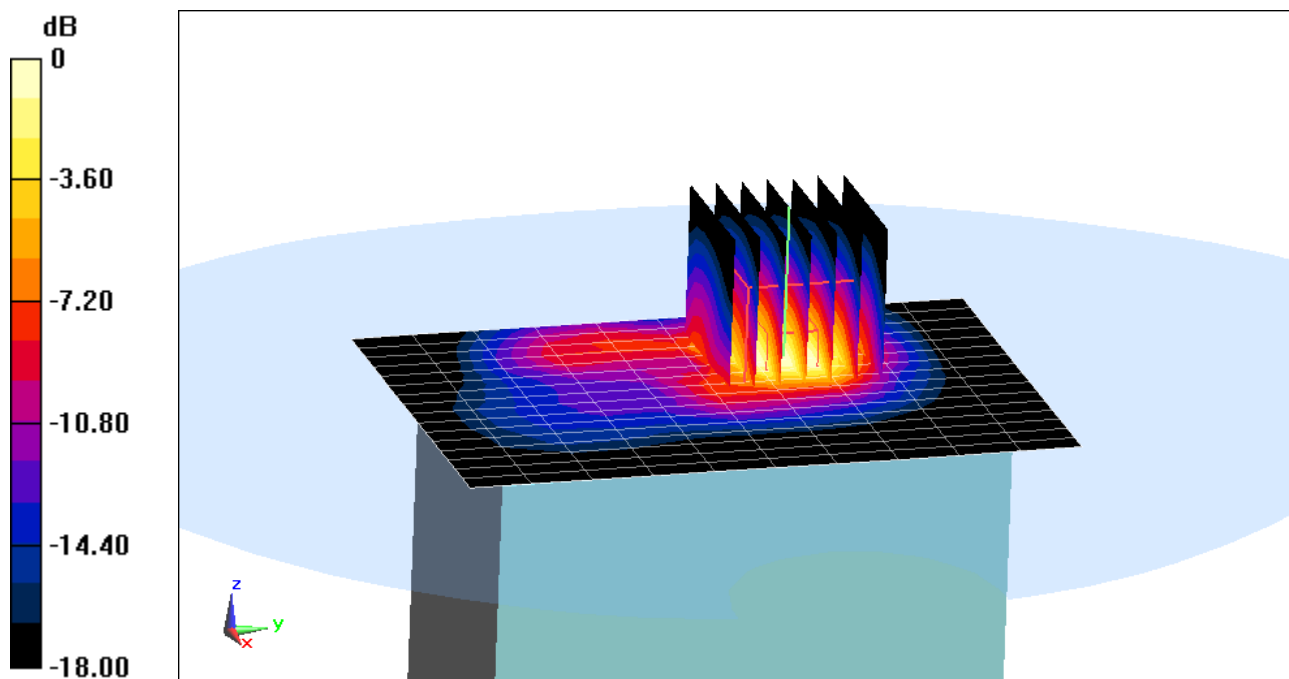
Area Scan (17x11x1): Measurement grid: $dx=5\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 22.462 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 2.31 W/kg

SAR(1 g) = 1.01 W/kg; SAR(10 g) = 0.424 W/kg



0 dB = 1.29 W/kg = 1.11 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 42

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

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.929 \text{ S/m}$; $\epsilon_r = 52.68$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-03-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.3°C

Probe: ES3DV3 - SN3287; ConvF(4.29, 4.29, 4.29); Calibrated: 11/15/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.8 (7028)

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

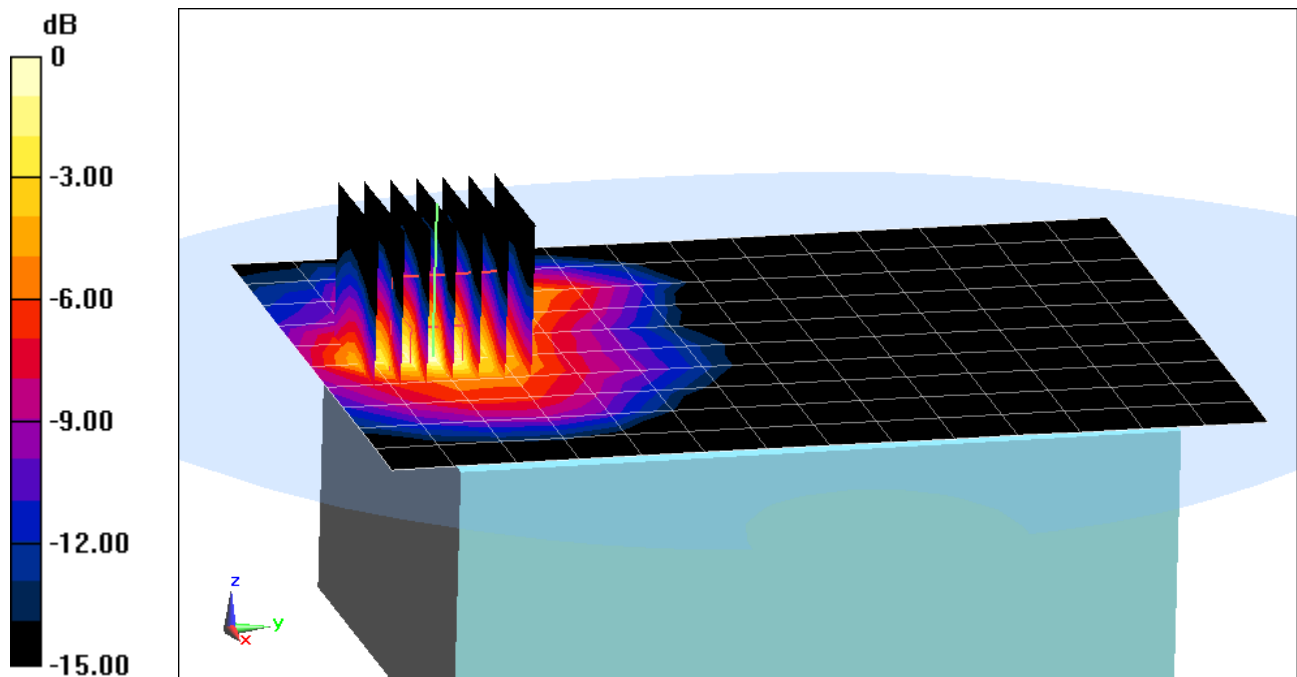
Area Scan (11x15x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 9.144 V/m; Power Drift = -0.17 dB

Peak SAR (extrapolated) = 0.345 W/kg

SAR(1 g) = 0.158 W/kg; SAR(10 g) = 0.074 W/kg



0 dB = 0.207 W/kg = -6.84 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 25

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

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2441 \text{ MHz}$; $\sigma = 1.935 \text{ S/m}$; $\epsilon_r = 52.667$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-03-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.3°C

Probe: ES3DV3 - SN3287; ConvF(4.29, 4.29, 4.29); Calibrated: 11/15/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.8 (7028)

Mode: Bluetooth, Hand SAR, Ch 39, 1 Mbps, Left Edge

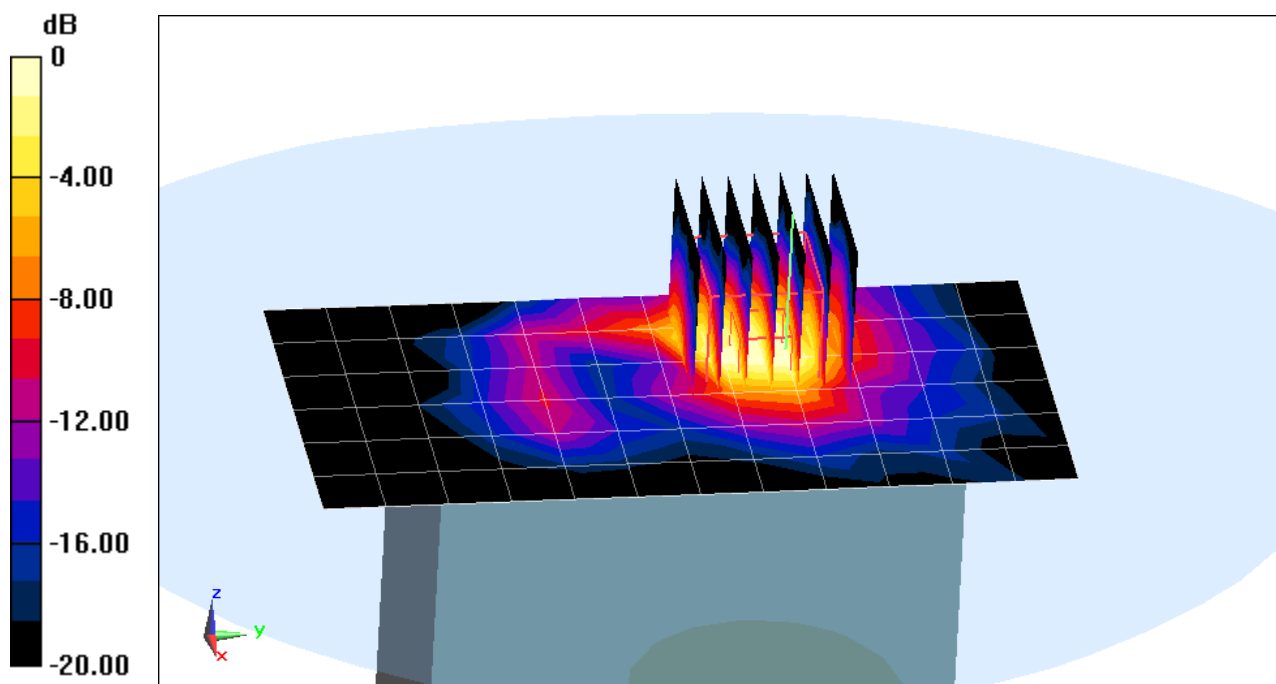
Area Scan (7x13x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 6.605 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 0.192 W/kg

SAR(1 g) = 0.078 W/kg; SAR(10 g) = 0.034 W/kg



0 dB = 0.106 W/kg = -9.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 25

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

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2441 \text{ MHz}$; $\sigma = 1.935 \text{ S/m}$; $\epsilon_r = 52.667$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-03-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.3°C

Probe: ES3DV3 - SN3287; ConvF(4.29, 4.29, 4.29); Calibrated: 11/15/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.8 (7028)

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

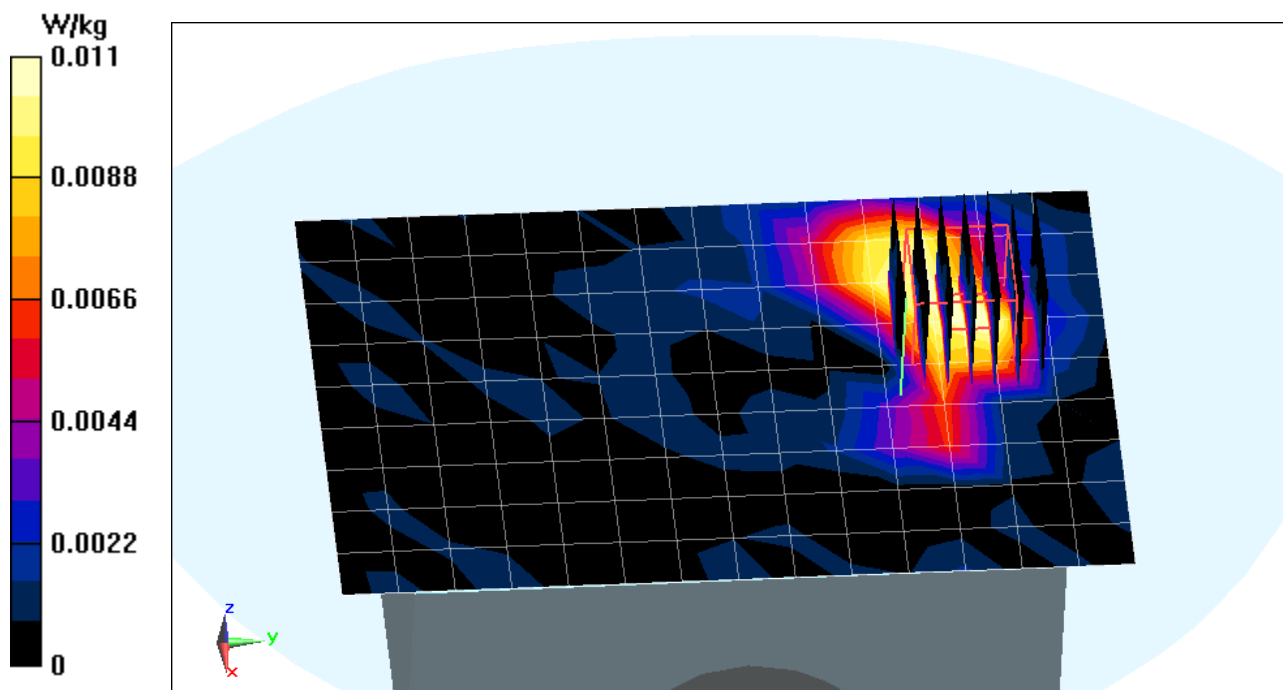
Area Scan (10x15x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 2.173 V/m; Power Drift = 0.029 dB

Peak SAR (extrapolated) = 0.0210 W/kg

SAR(1 g) = 0.00994 W/kg; SAR(10 g) = 0.00376 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 42

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5700 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5700 \text{ MHz}$; $\sigma = 5.963 \text{ S/m}$; $\epsilon_r = 47.089$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.3°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 14.6.8 (7028)

Mode: IEEE 802.11a, 5.5 GHz, Hand SAR, Ch 140, 6 Mbps, Left Edge

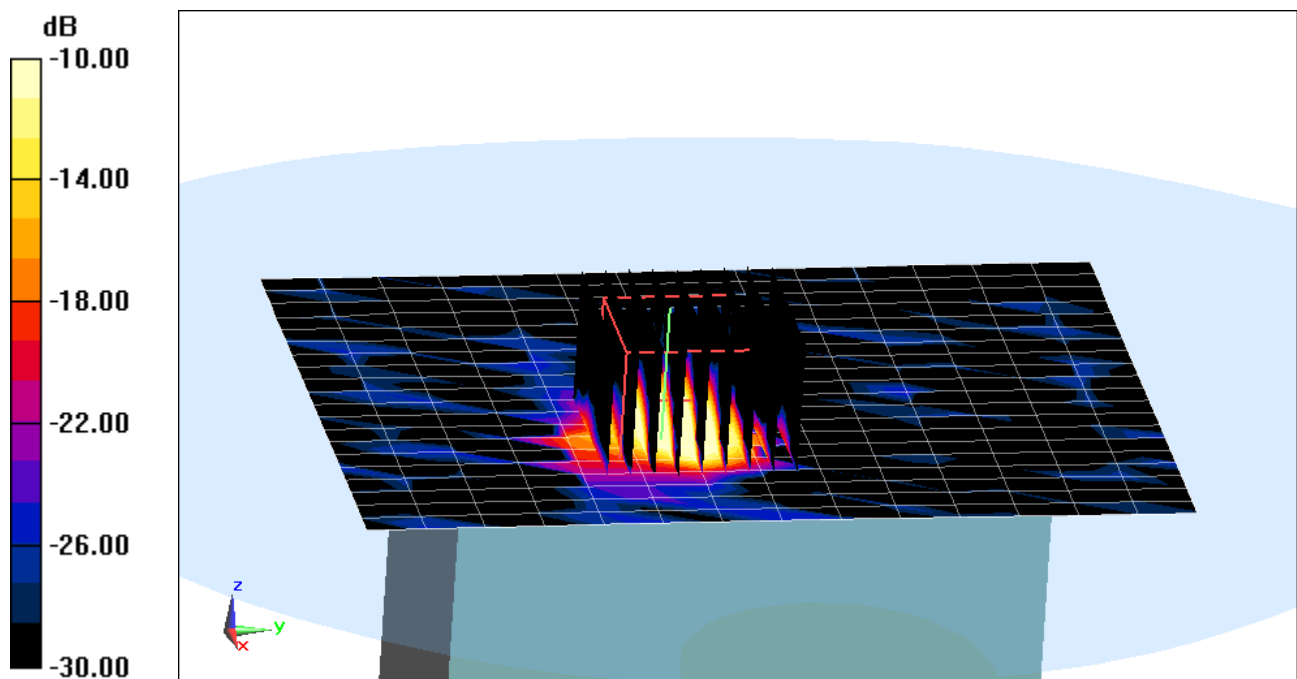
Area Scan (21x15x1): Measurement grid: dx=5mm, dy=10mm

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 16.703 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 10.7 W/kg

SAR(1 g) = 1.56 W/kg; SAR(10 g) = 0.307 W/kg



0 dB = 4.80 W/kg = 6.81 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 42

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5700 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5700 \text{ MHz}$; $\sigma = 5.963 \text{ S/m}$; $\epsilon_r = 47.089$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.3°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 14.6.8 (7028)

Mode: IEEE 802.11a, 5.5 GHz, Body SAR, Ch 140, 6 Mbps, Left Edge

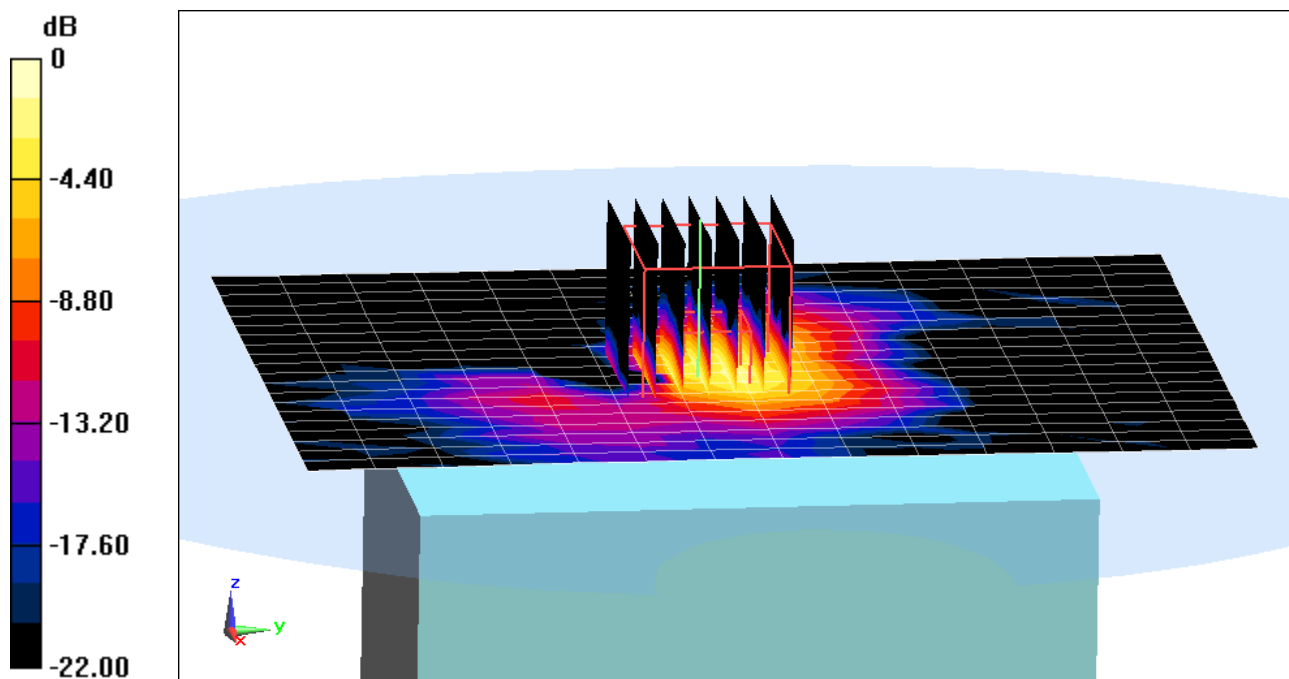
Area Scan (21x15x1): Measurement grid: dx=5mm, dy=10mm

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

Reference Value = 8.789 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 2.00 W/kg

SAR(1 g) = 0.427 W/kg; SAR(10 g) = 0.139 W/kg



0 dB = 1.07 W/kg = 0.29 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 42

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5825 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5825 \text{ MHz}$; $\sigma = 6.173 \text{ S/m}$; $\epsilon_r = 46.82$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.3°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 14.6.8 (7028)

Mode: IEEE 802.11a, 5.8 GHz, Hand SAR, Ch 165, 6 Mbps, Left Edge

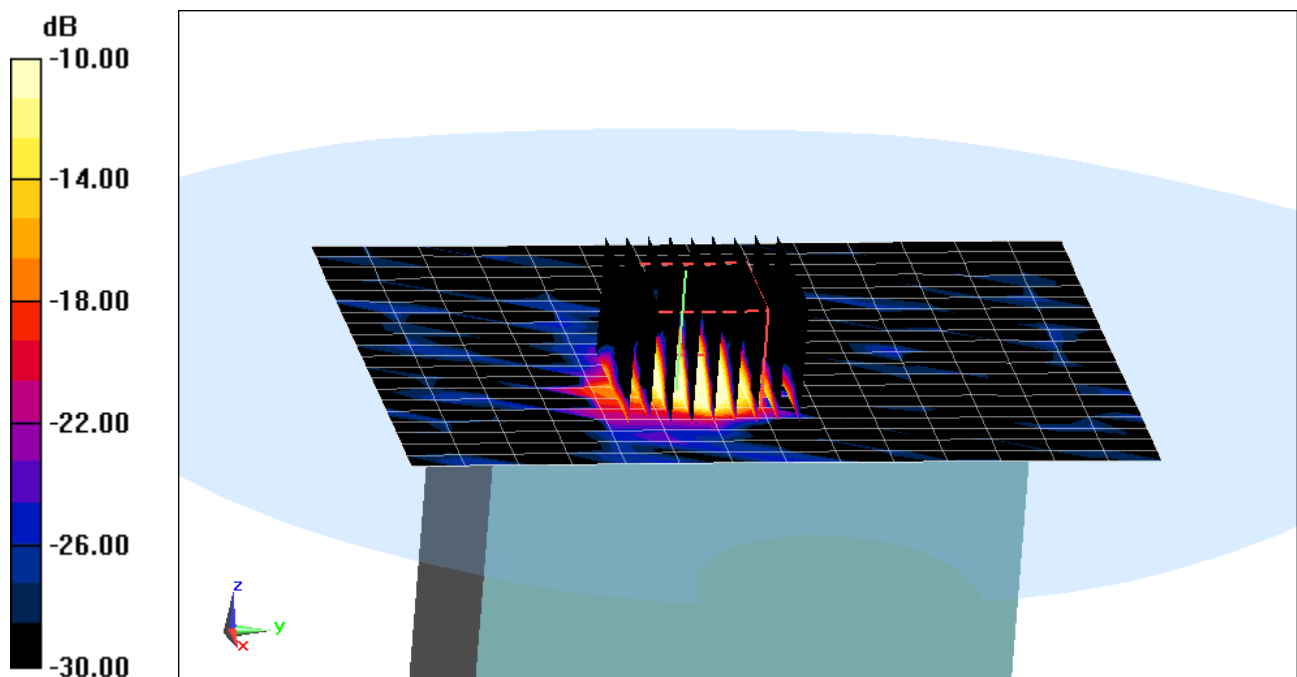
Area Scan (21x15x1): Measurement grid: dx=5mm, dy=10mm

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 16.790 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 12.1 W/kg

SAR(1 g) = 1.71 W/kg; SAR(10 g) = 0.339 W/kg



0 dB = 5.15 W/kg = 7.12 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LEKGN120; Type: Portable Camera; Serial: 42

Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5765 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5765 \text{ MHz}$; $\sigma = 6.08 \text{ S/m}$; $\epsilon_r = 47.016$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.3°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 14.6.8 (7028)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 153, 6 Mbps, Left Edge

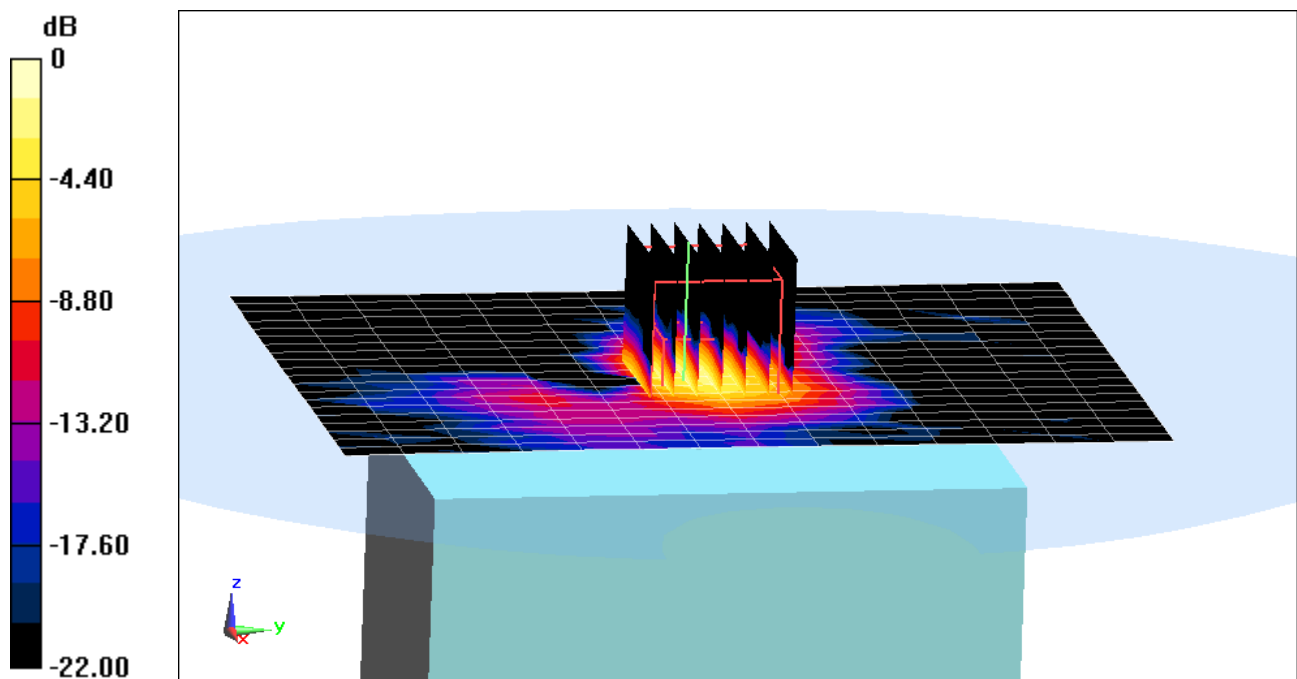
Area Scan (21x15x1): Measurement grid: dx=5mm, dy=10mm

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

Reference Value = 8.245 V/m; Power Drift = -0.023 dB

Peak SAR (extrapolated) = 2.03 W/kg

SAR(1 g) = 0.422 W/kg; SAR(10 g) = 0.141 W/kg



0 dB = 1.06 W/kg = 0.25 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

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:

$f = 835 \text{ MHz}$; $\sigma = 1.001 \text{ S/m}$; $\epsilon_r = 53.203$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-01-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.9°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 14.6.8 (7028)

835 MHz System Verification

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

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

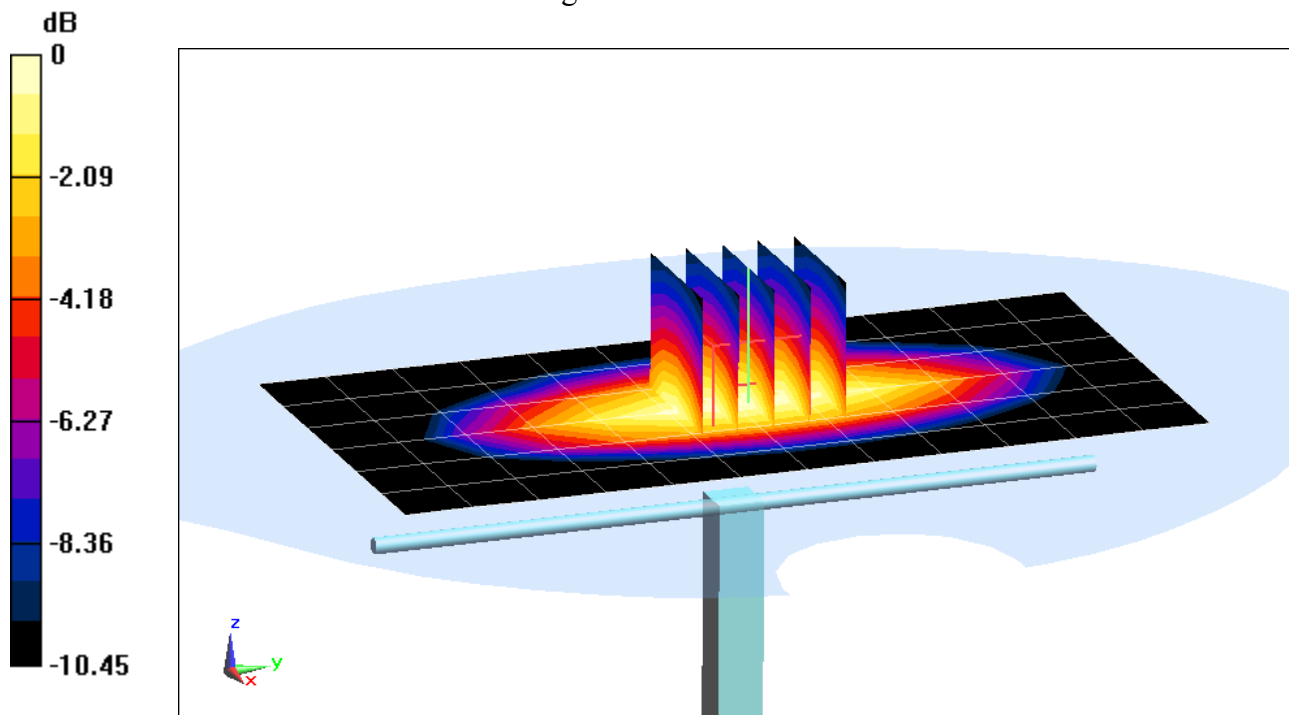
Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.45 W/kg

SAR(1 g) = 1.01 W/kg; SAR(10 g) = 0.664 W/kg

1g Deviation = 5.43 %

10g Deviation = 4.90 %



0 dB = 1.09 W/kg = 0.37 dBW/kg

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):

$f = 1900 \text{ MHz}$; $\sigma = 1.536 \text{ S/m}$; $\epsilon_r = 52.149$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 23.7°C; Tissue Temp: 21.9°C

Probe: ES3DV3 - SN3209; ConvF(4.77, 4.77, 4.77); 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 14.6.8 (7028)

1900 MHz System Verification

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

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

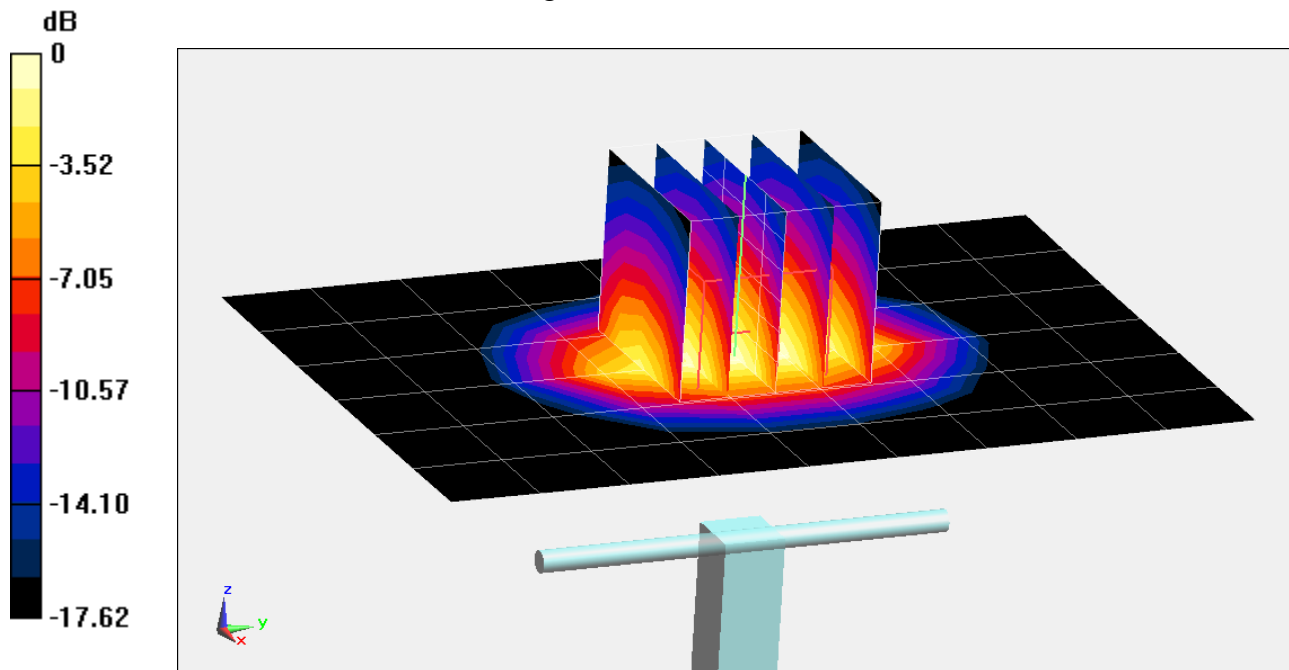
Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.96 W/kg

SAR(1 g) = 3.77 W/kg; SAR(10 g) = 1.96 W/kg

1g Deviation = -7.60 %

10g Deviation = -9.68 %



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:

$f = 2450 \text{ MHz}$; $\sigma = 1.947 \text{ S/m}$; $\epsilon_r = 52.639$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-03-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.3°C

Probe: ES3DV3 - SN3287; ConvF(4.29, 4.29, 4.29); Calibrated: 11/15/2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

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

Phantom: SAM Sub Dasy B; Type: SAM 5.0; Serial: TP-1626

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.8 (7028)

2450 MHz System Verification

Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm

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

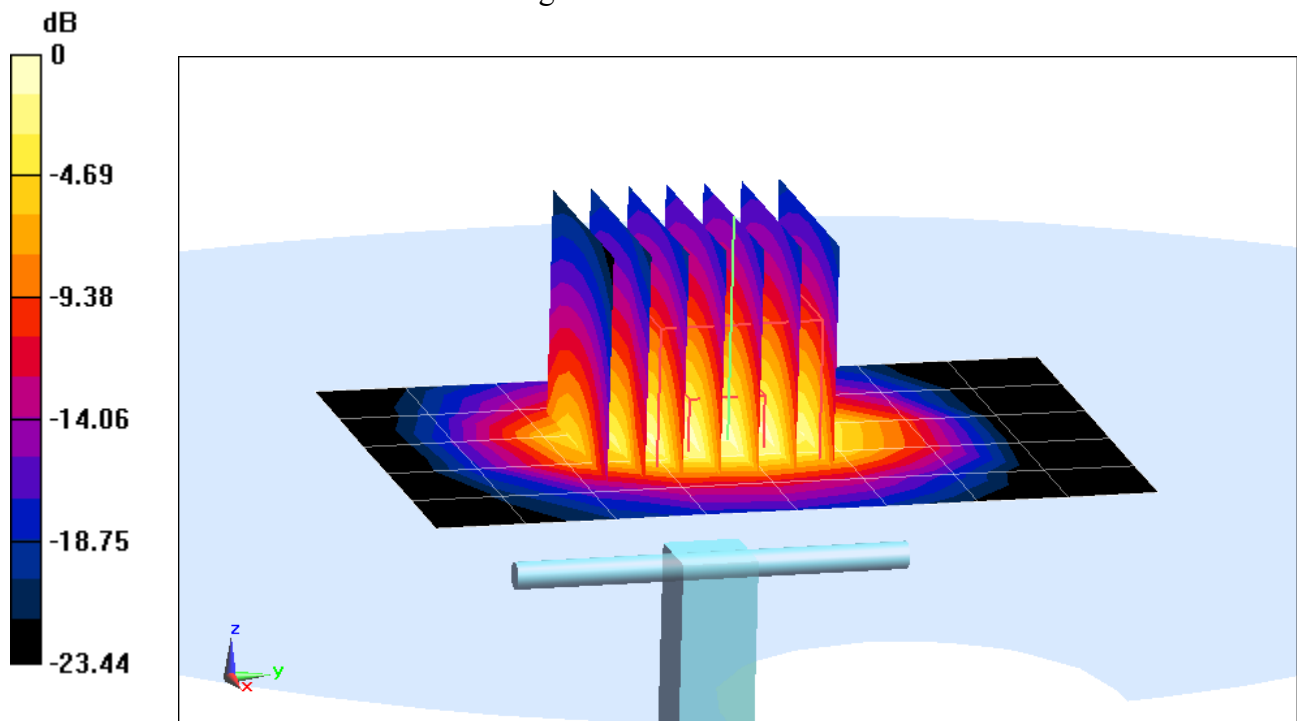
Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 10.7 W/kg

SAR(1 g) = 4.99 W/kg; SAR(10 g) = 2.31 W/kg

1g Deviation = -3.29 %

10g Deviation = -5.33 %



0 dB = 6.54 W/kg = 8.16 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:

$f = 5200 \text{ MHz}$; $\sigma = 5.252 \text{ mho/m}$; $\epsilon_r = 48.233$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.3°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 14.6.8 (7028)

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

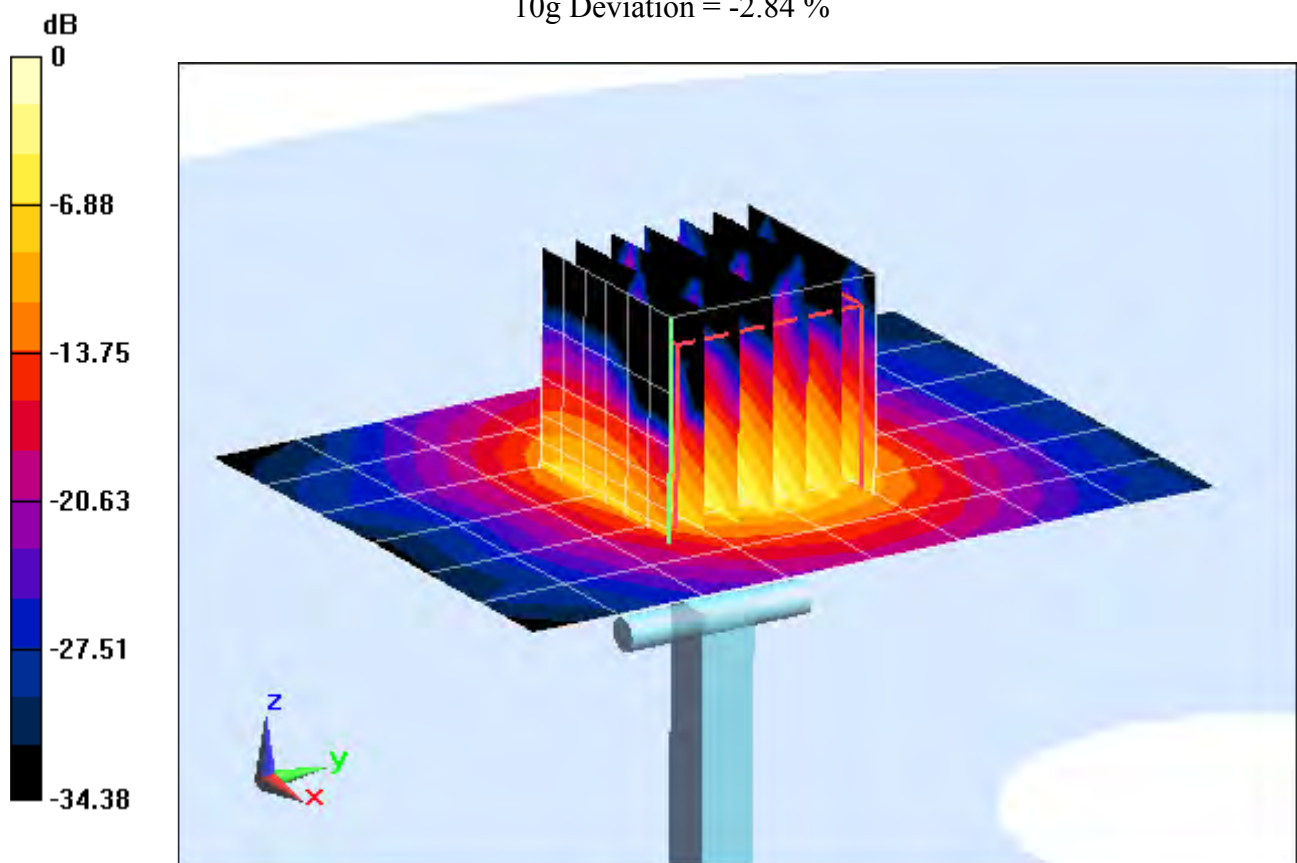
Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 34.8 mW/g

SAR(1 g) = 7.41 mW/g; SAR(10 g) = 2.05 mW/g

1g Deviation = -1.85 %

10g Deviation = -2.84 %



0 dB = 15.8 mW/g = 23.99 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:

$f = 5300 \text{ MHz}$; $\sigma = 5.38 \text{ mho/m}$; $\epsilon_r = 48.024$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.2°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); 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 14.6.8 (7028)

5300MHz 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

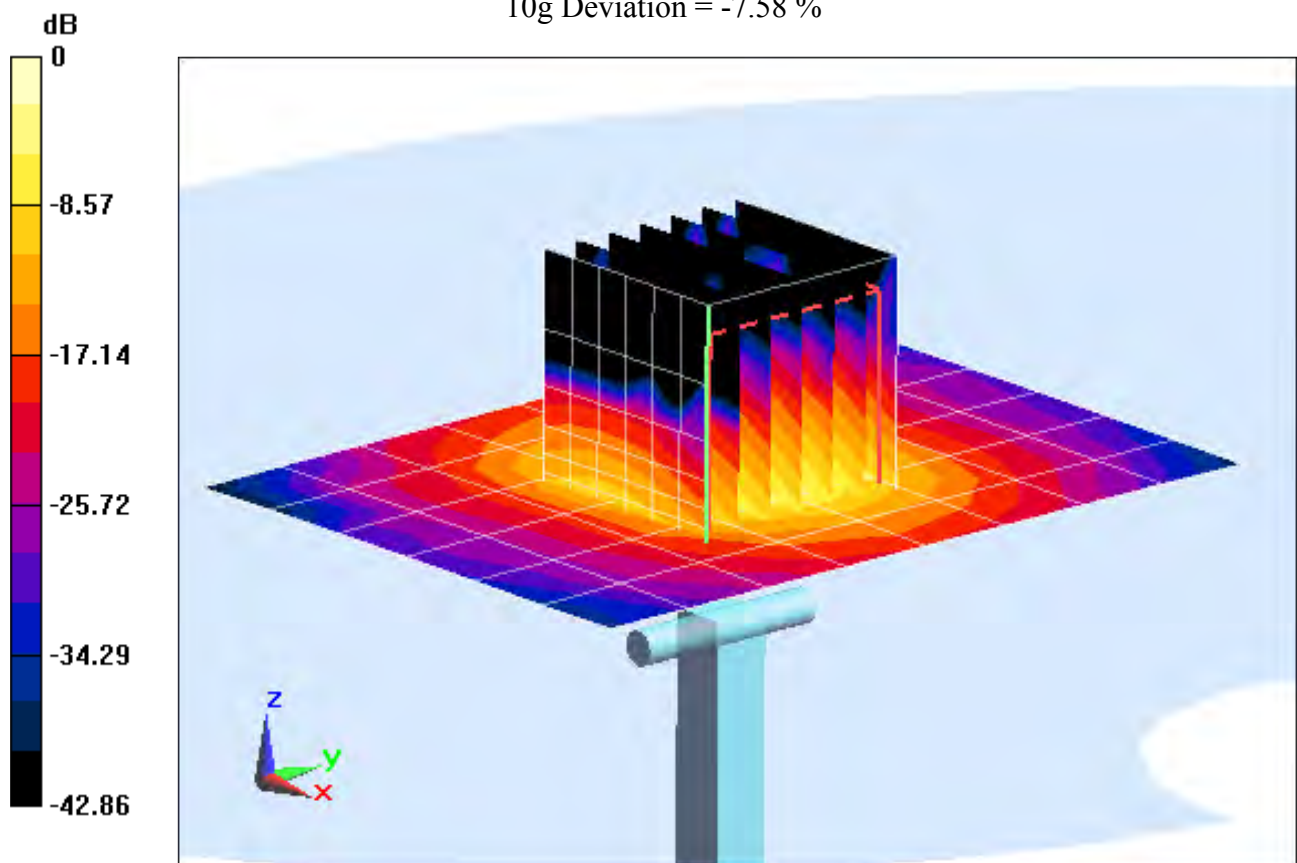
Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 35.1 mW/g

SAR(1 g) = 7.22 mW/g; SAR(10 g) = 1.95 mW/g

1g Deviation = -4.12 %

10g Deviation = -7.58 %



0 dB = 15.5 mW/g = 23.83 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:

$f = 5500 \text{ MHz}$; $\sigma = 5.669 \text{ mho/m}$; $\epsilon_r = 47.593$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.2°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 14.6.8 (7028)

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

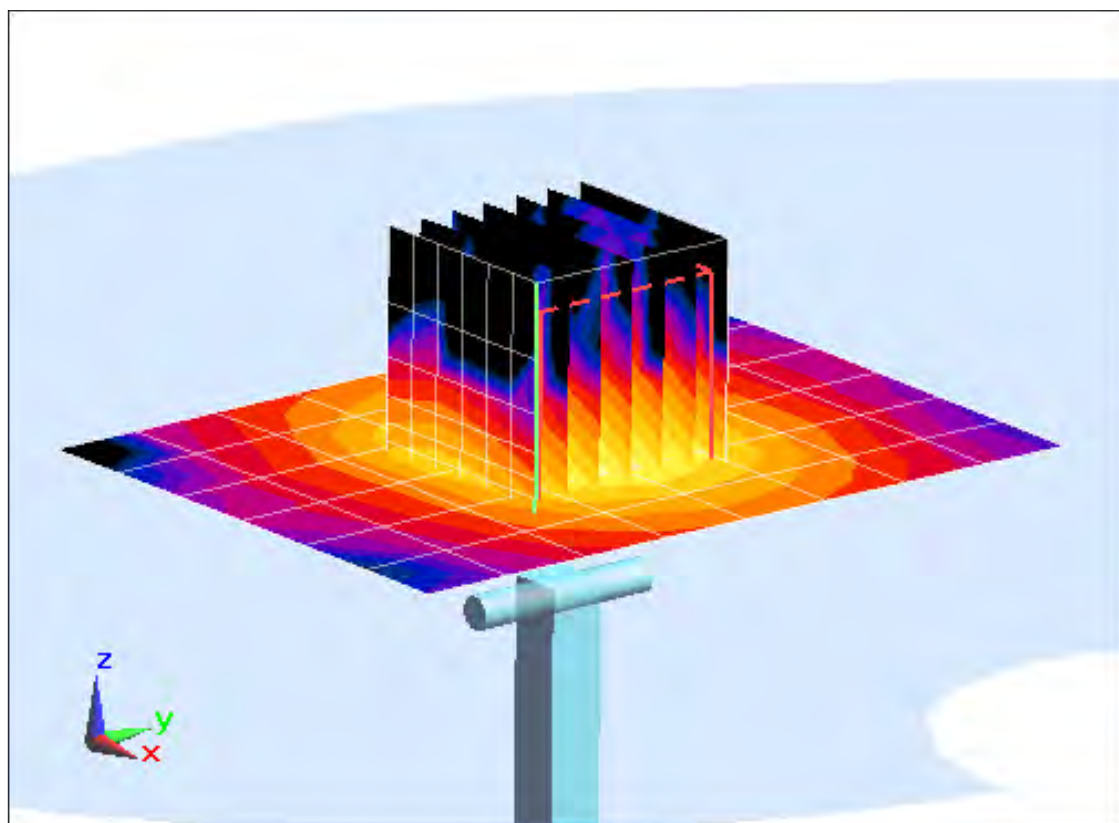
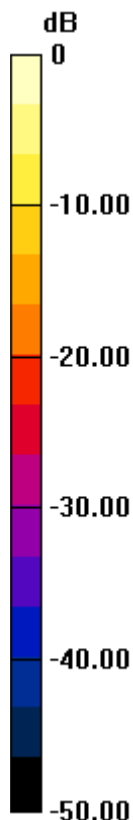
Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 40.1 mW/g

SAR(1 g) = 8.07 mW/g; SAR(10 g) = 2.19 mW/g

1g Deviation = -0.12 %

10g Deviation = -2.23 %



0 dB = 17.7 mW/g = 24.94 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:

$f = 5600 \text{ MHz}$; $\sigma = 5.817 \text{ mho/m}$; $\epsilon_r = 47.365$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.3°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 14.6.8 (7028)

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

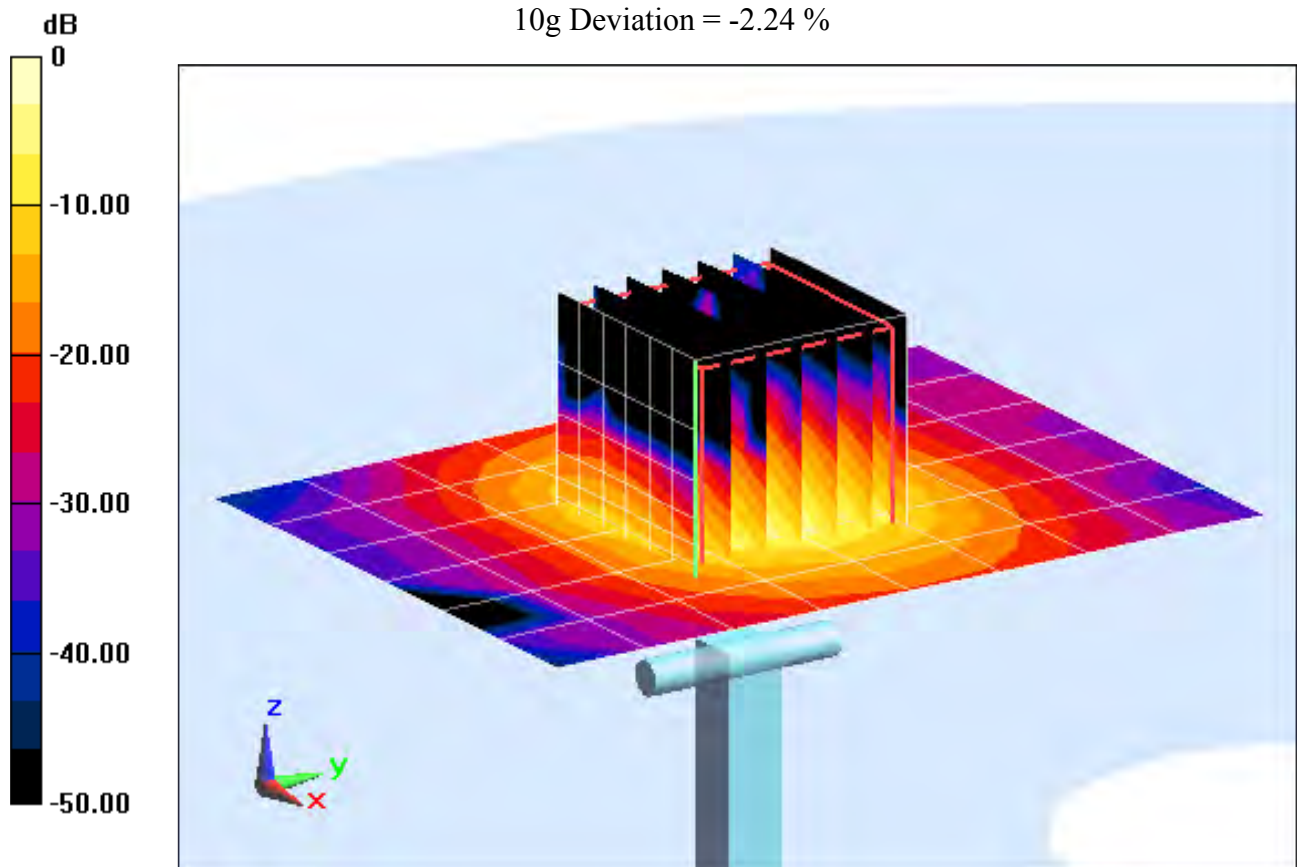
Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 38.6 mW/g

SAR(1 g) = 8.02 mW/g; SAR(10 g) = 2.18 mW/g

1g Deviation = -0.12 %

10g Deviation = -2.24 %



0 dB = 17.4 mW/g = 24.81 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:

$f = 5800 \text{ MHz}$; $\sigma = 6.124 \text{ mho/m}$; $\epsilon_r = 46.86$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.3°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 14.6.8 (7028)

5800MHz 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

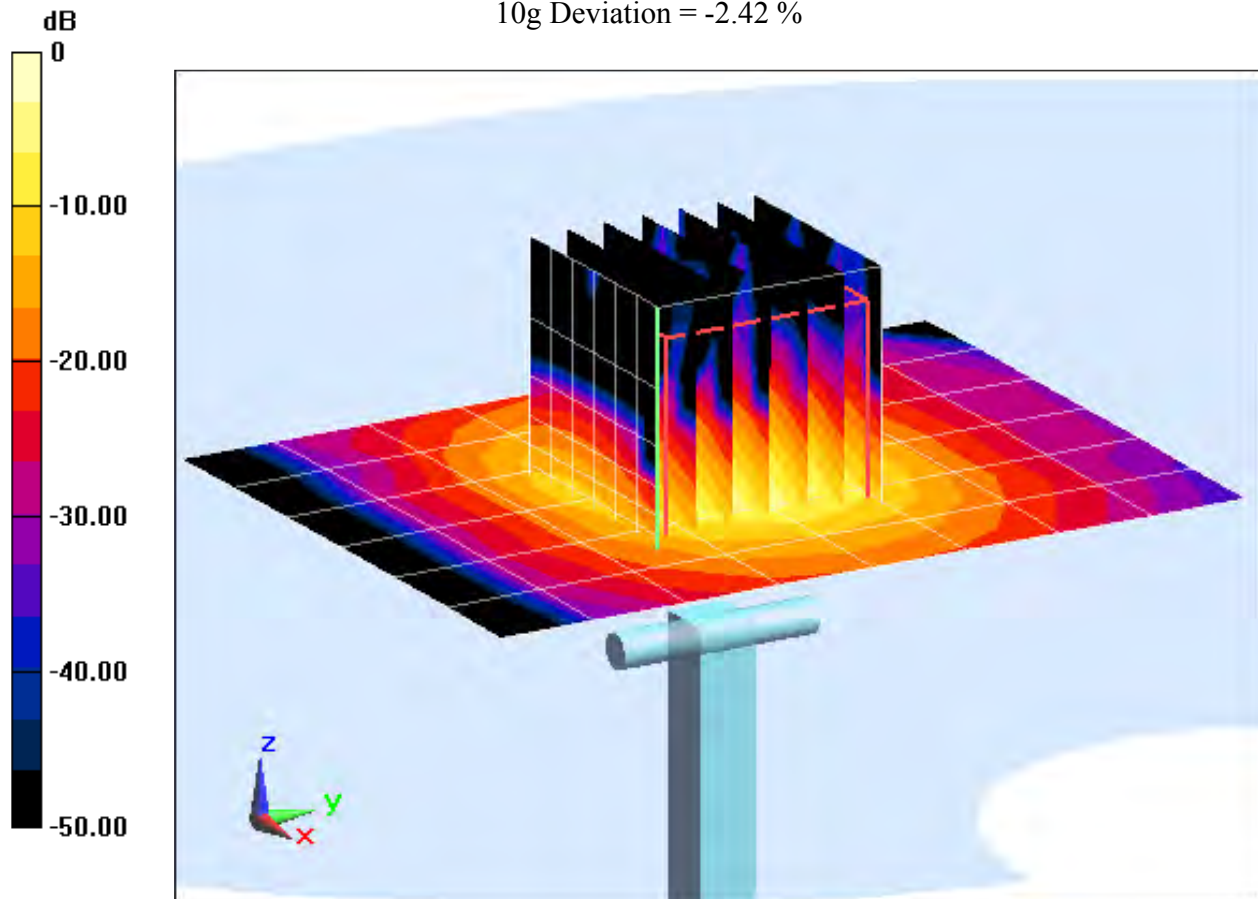
Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 39.2 mW/g

SAR(1 g) = 7.49 mW/g; SAR(10 g) = 2.02 mW/g

1g Deviation = -0.27 %

10g Deviation = -2.42 %



0 dB = 15.6 mW/g = 23.89 dB mW/g

APPENDIX C: PROBE CALIBRATION



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

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
----------------------------------	----------

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:

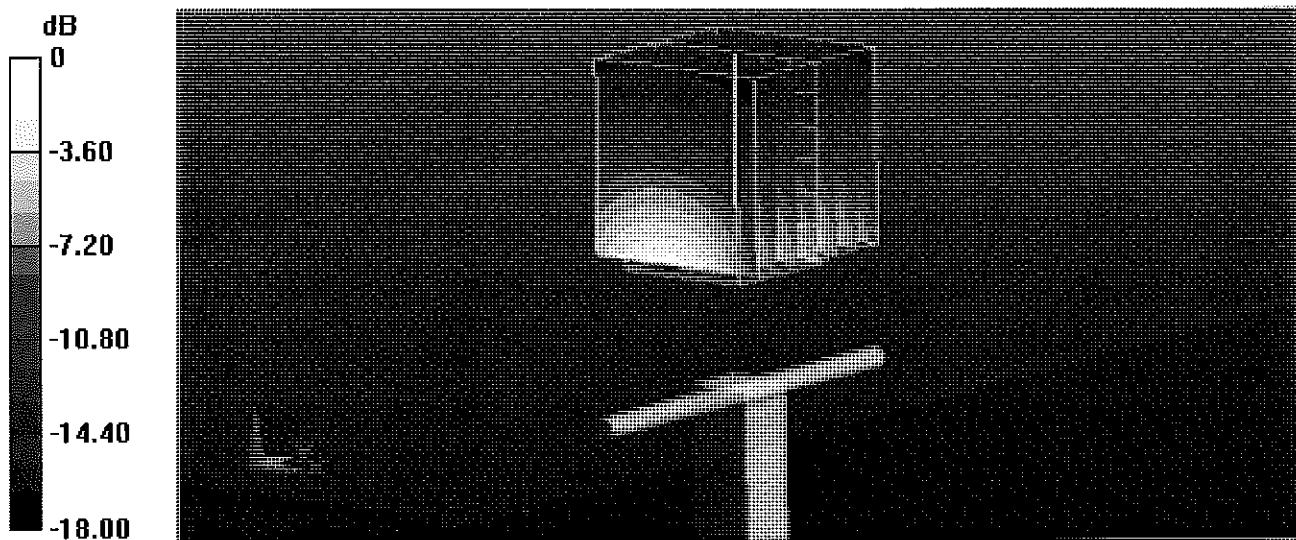
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

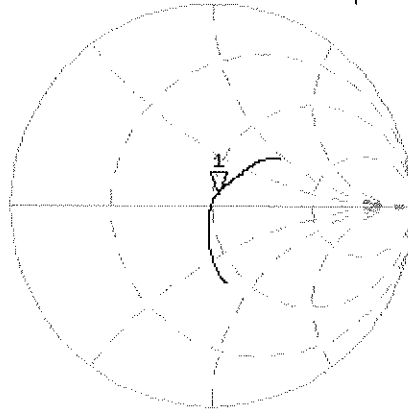


0 dB = 12.1 W/kg = 10.83 dBW/kg

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

*
 Del
 CA



Avg
 16

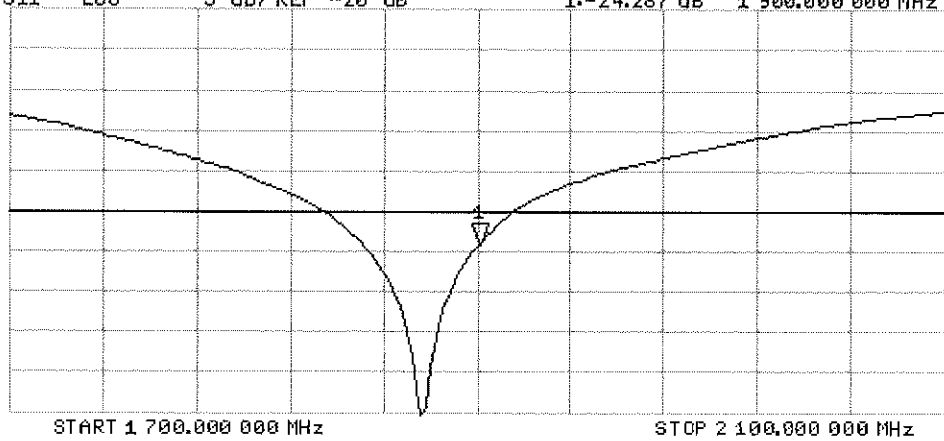
H1d

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:

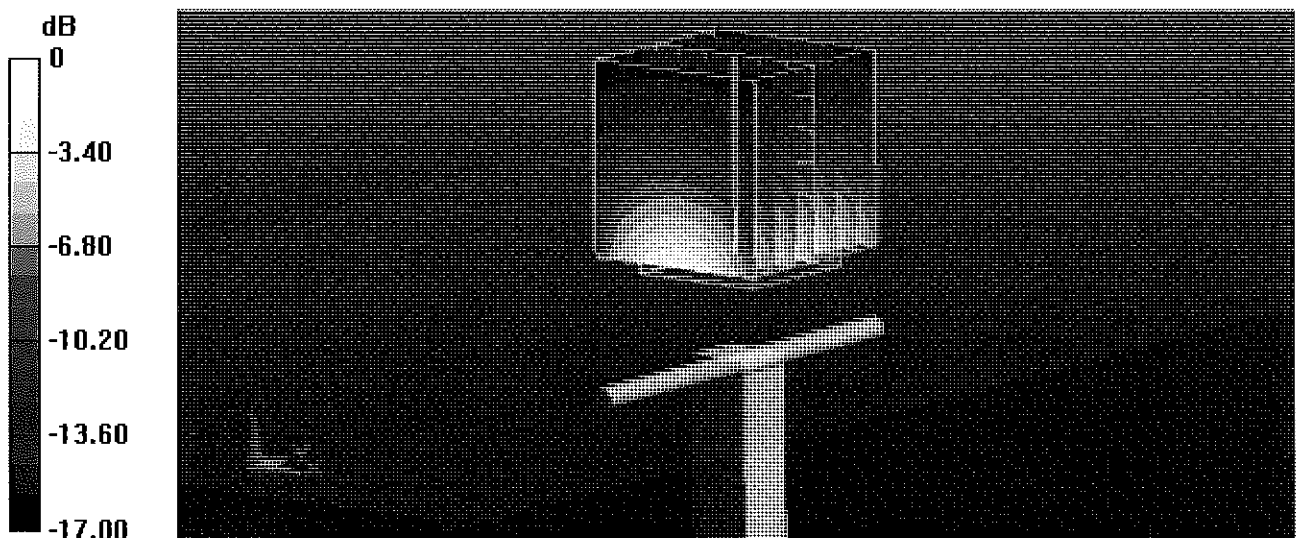
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

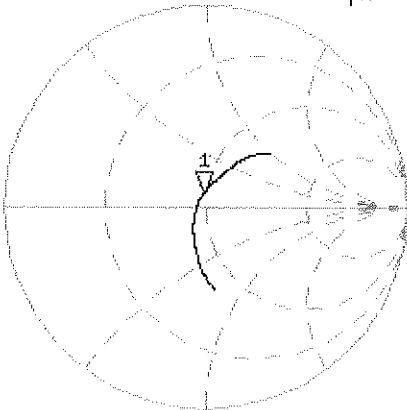


0 dB = 13.1 W/kg = 11.17 dBW/kg

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

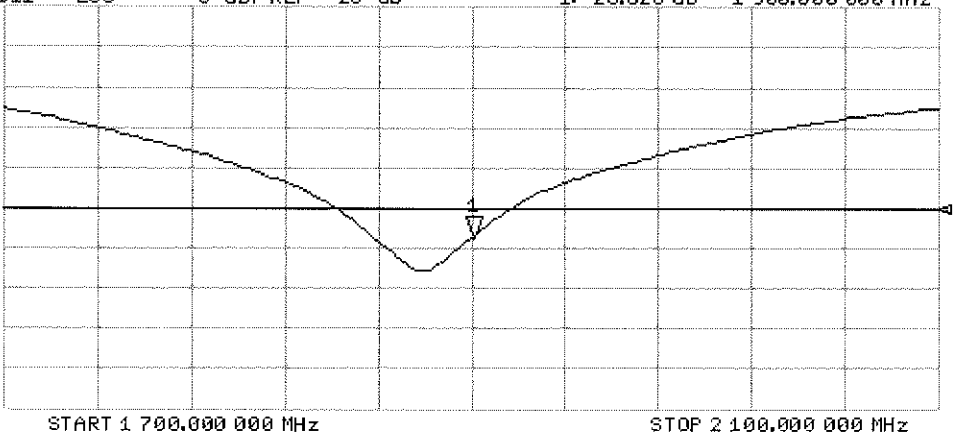
*
De1
CA



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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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
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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	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:

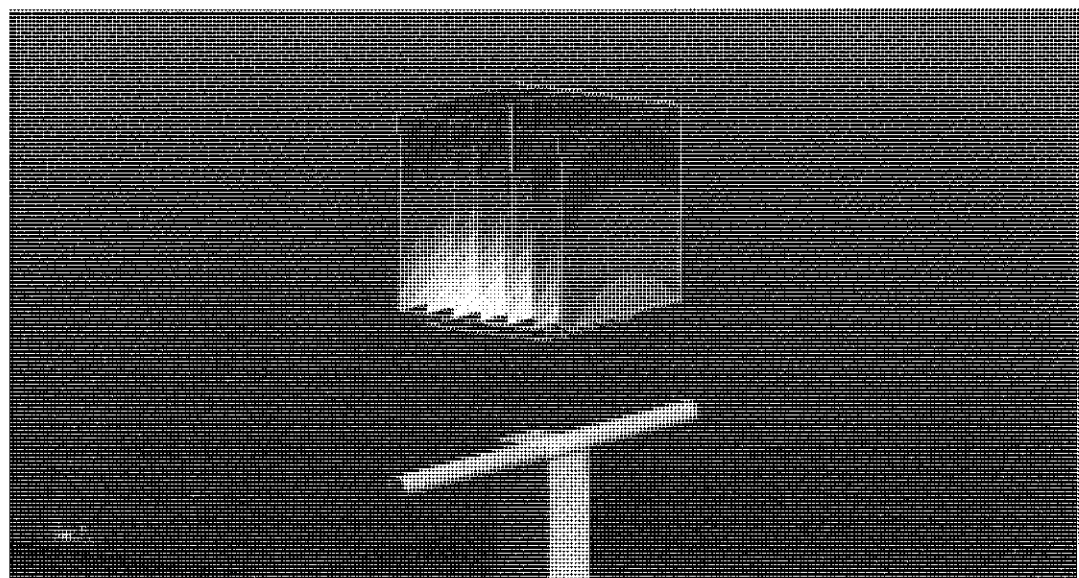
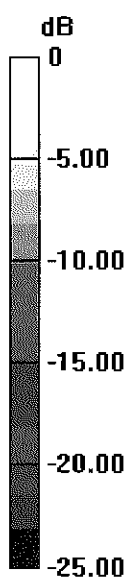
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

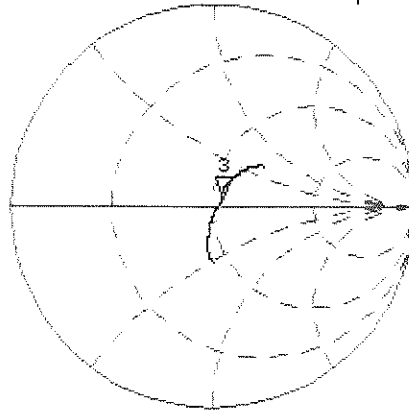


0 dB = 16.5 W/kg = 24.35 dB W/kg

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

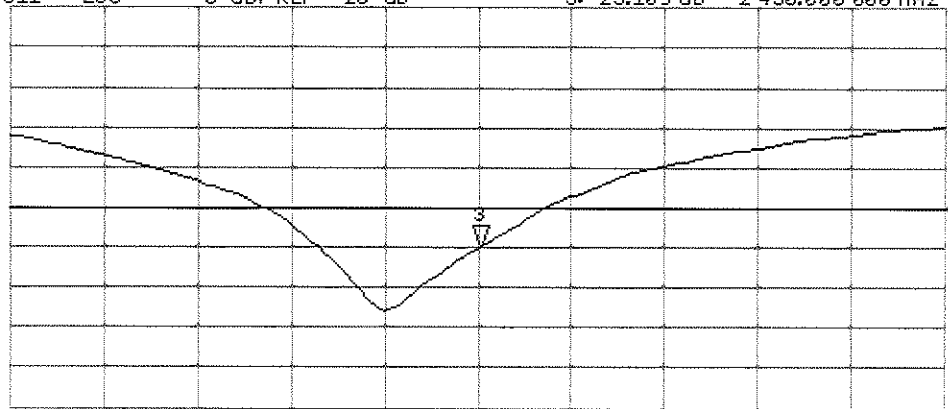
H1d

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:

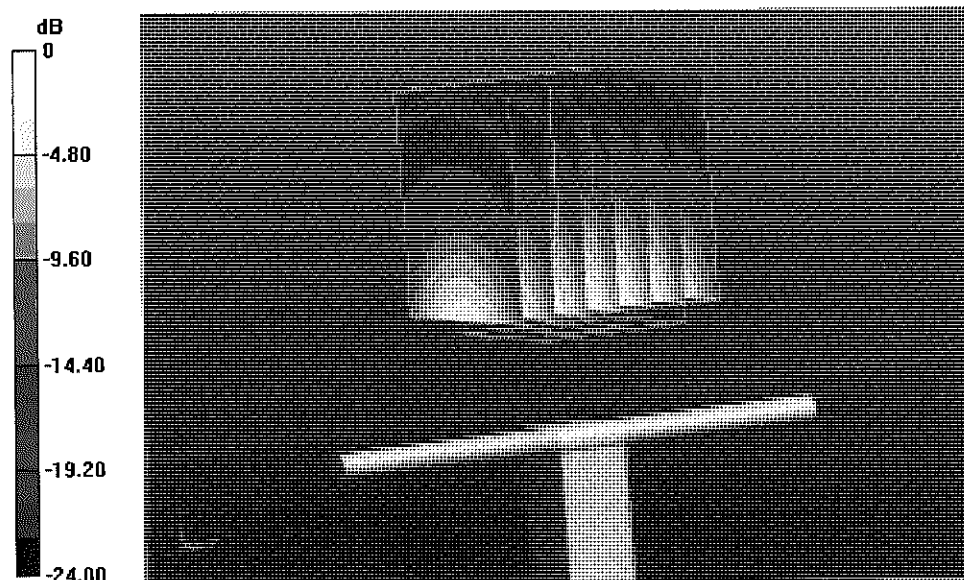
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

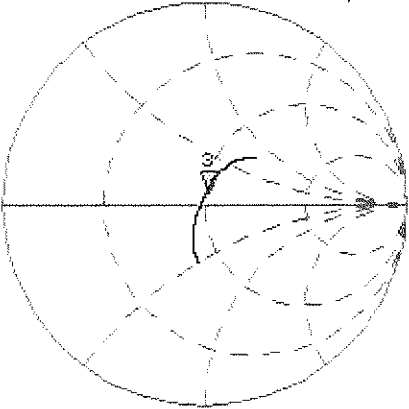


0 dB = 17.1 W/kg = 24.66 dB W/kg

Impedance Measurement Plot for Body TSL

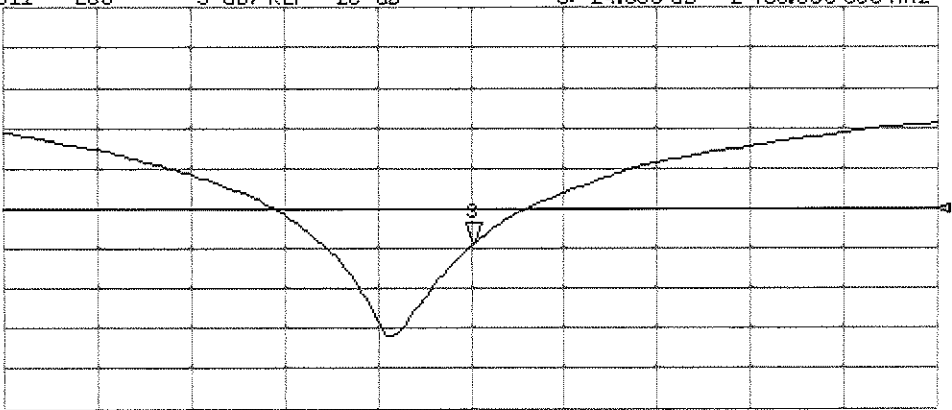
22 Aug 2012 15:38:22
[CH1] S11 1 U FS 3: 50.709 Ω 5.8906 Ω 382.66 pF 2 450.000 000 MHz

*
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



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** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** 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 cm³ (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 cm³ (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 cm³ (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 cm³ (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 cm³ (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 cm³ (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
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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	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

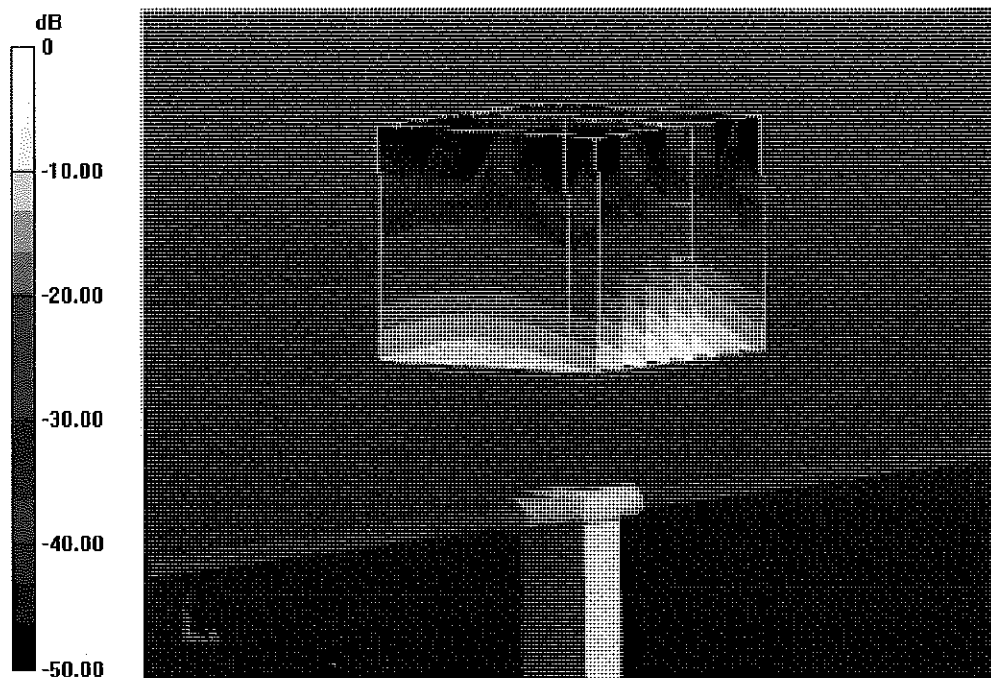
Peak SAR (extrapolated) = 33.2 W/kg

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

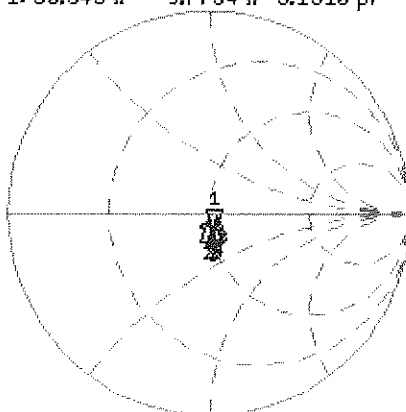
Impedance Measurement Plot for Head TSL

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

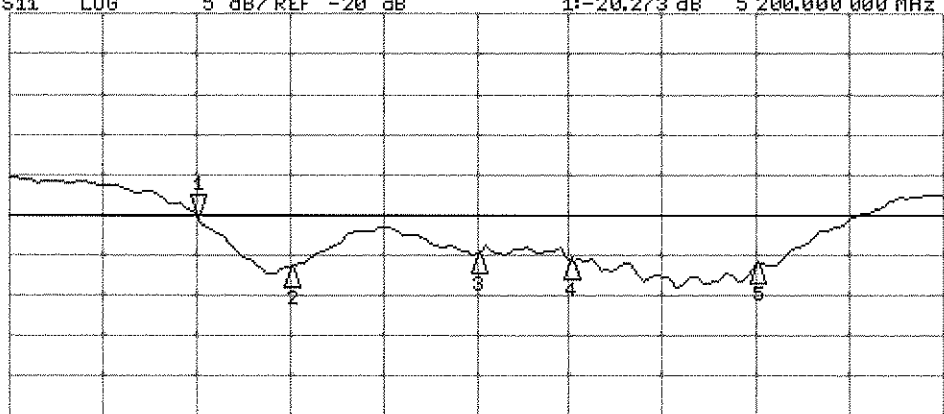
2: 48.508 Ω
 -4.4805 Ω
 5.30000 GHz
 3: 50.617 Ω
 -5.7559 Ω
 5.50000 GHz
 4: 53.891 Ω
 -3.8418 Ω
 5.60000 GHz
 5: 52.500 Ω
 -4.4160 Ω
 5.80000 GHz

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: -25.396 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

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz

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

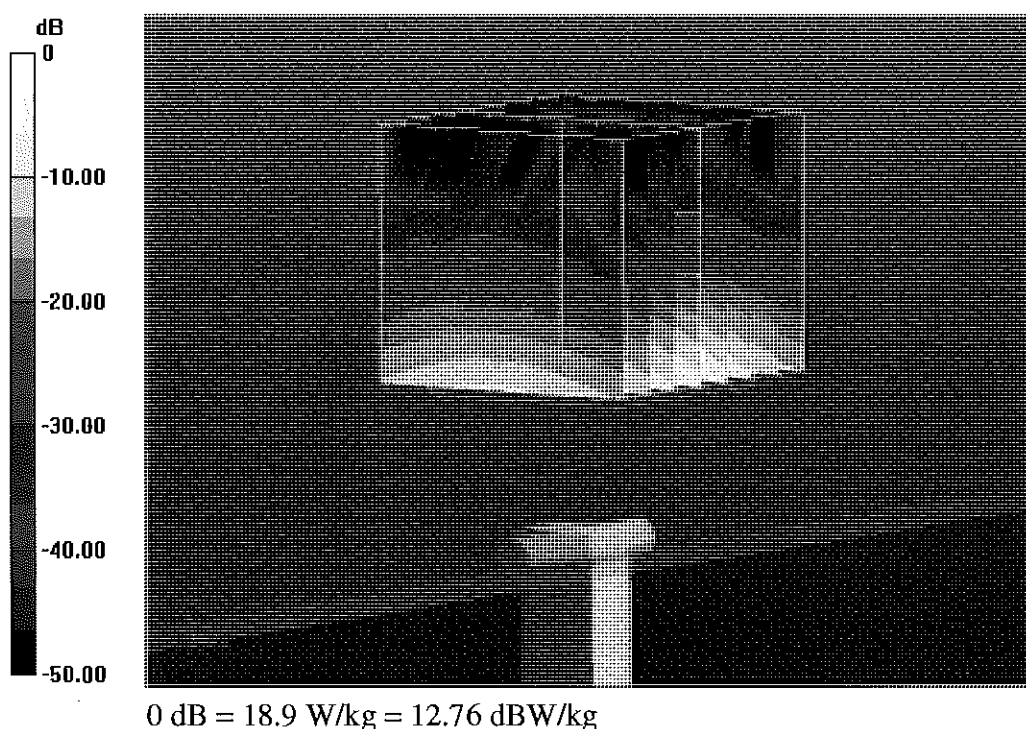
Peak SAR (extrapolated) = 35.3 W/kg

SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.26 W/kg

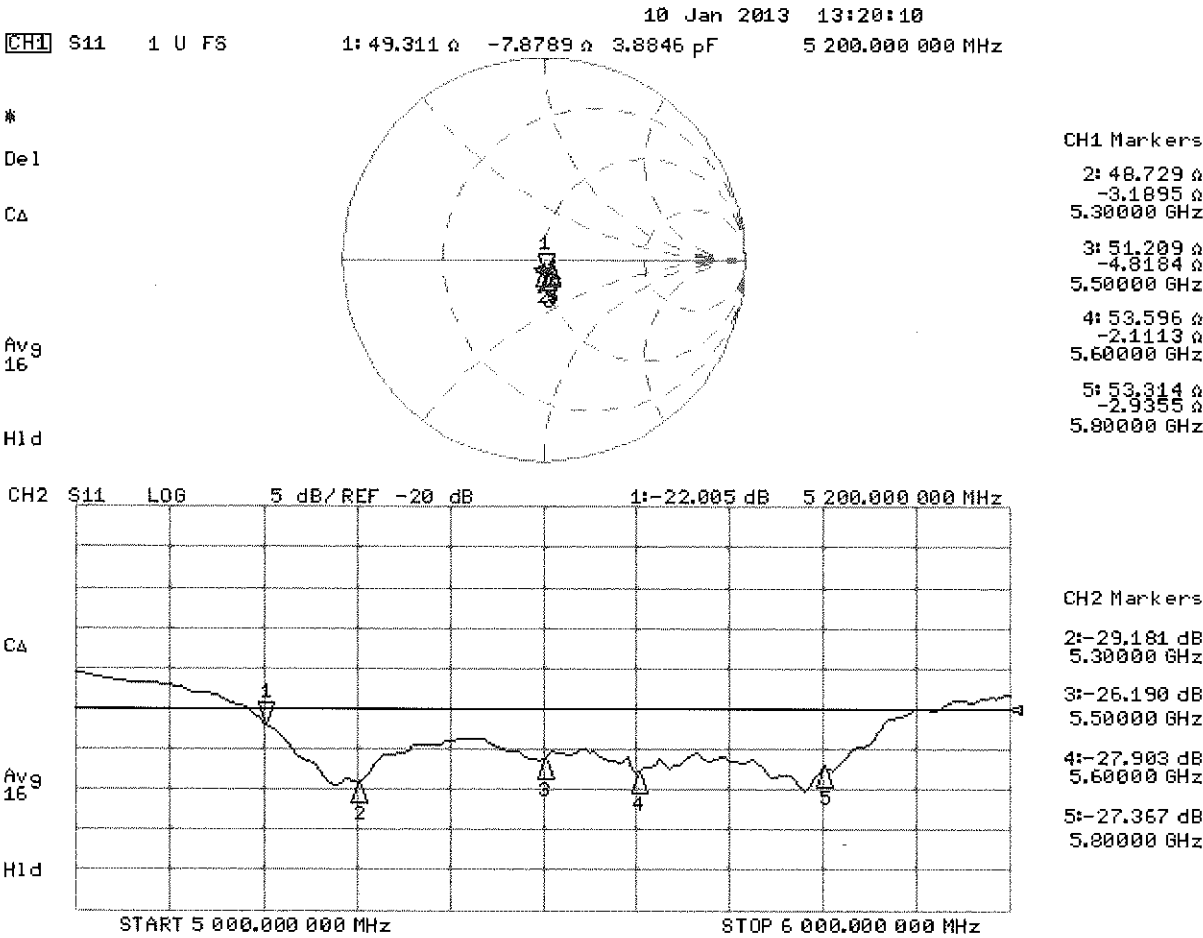
Maximum value of SAR (measured) = 19.7 W/kg

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**

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**

*1/10K
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** **Function**
Laboratory Technician

Signature

Israe El-Naouq
[Signature]

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

Issued: August 23, 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
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:

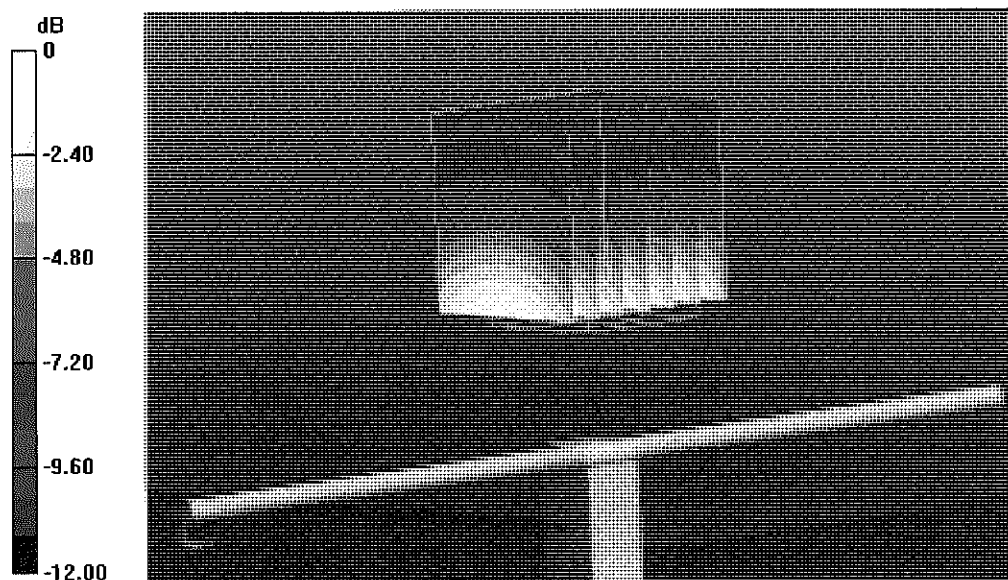
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

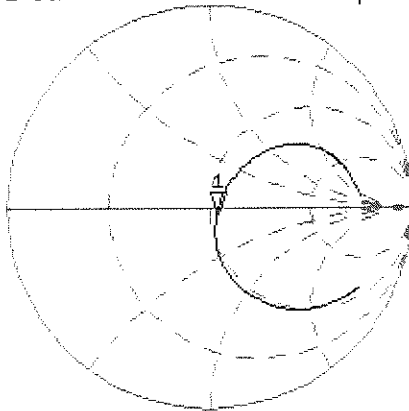


0 dB = 2.72 W/kg = 8.69 dB W/kg

Impedance Measurement Plot for Head TSL

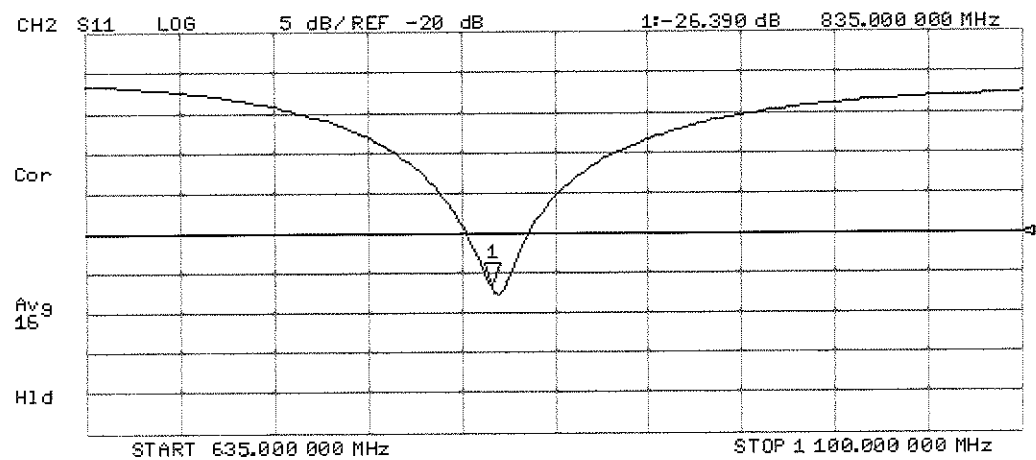
23 Aug 2012 12:19:04
 CH1 S11 1 U FS 1: 53.662 $\angle$ -3.3516 $\angle$ 56.870 pF 835.000 000 MHz

*
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 Cor



Avg
 15

H1 d



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:

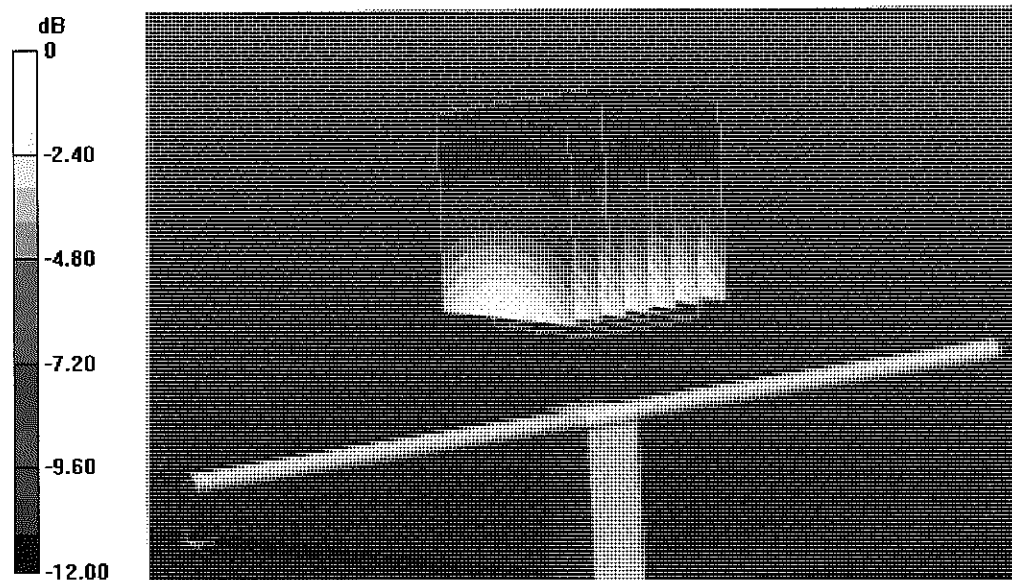
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

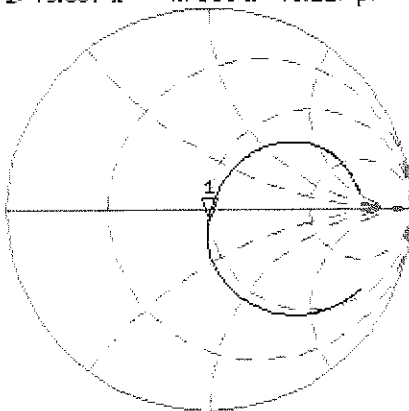


0 dB = 2.87 W/kg = 9.16 dB W/kg

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

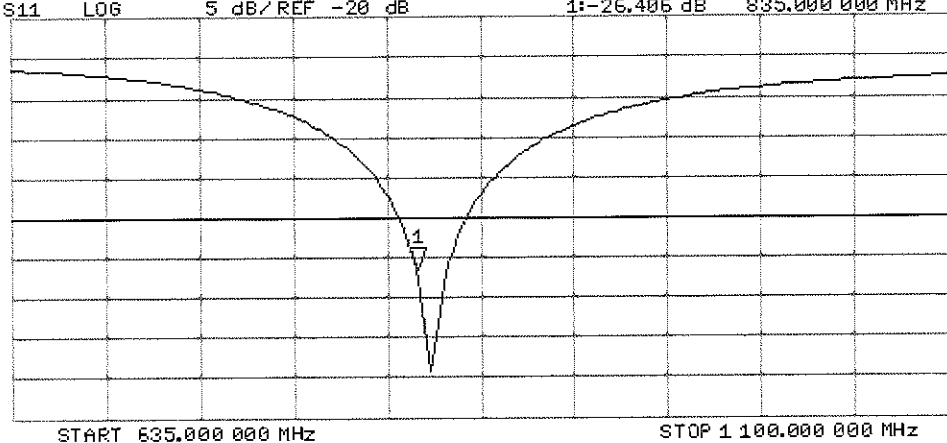
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-26.405 dB 835.000 000 MHz

Cor

Avg
 16

H1d





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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
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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

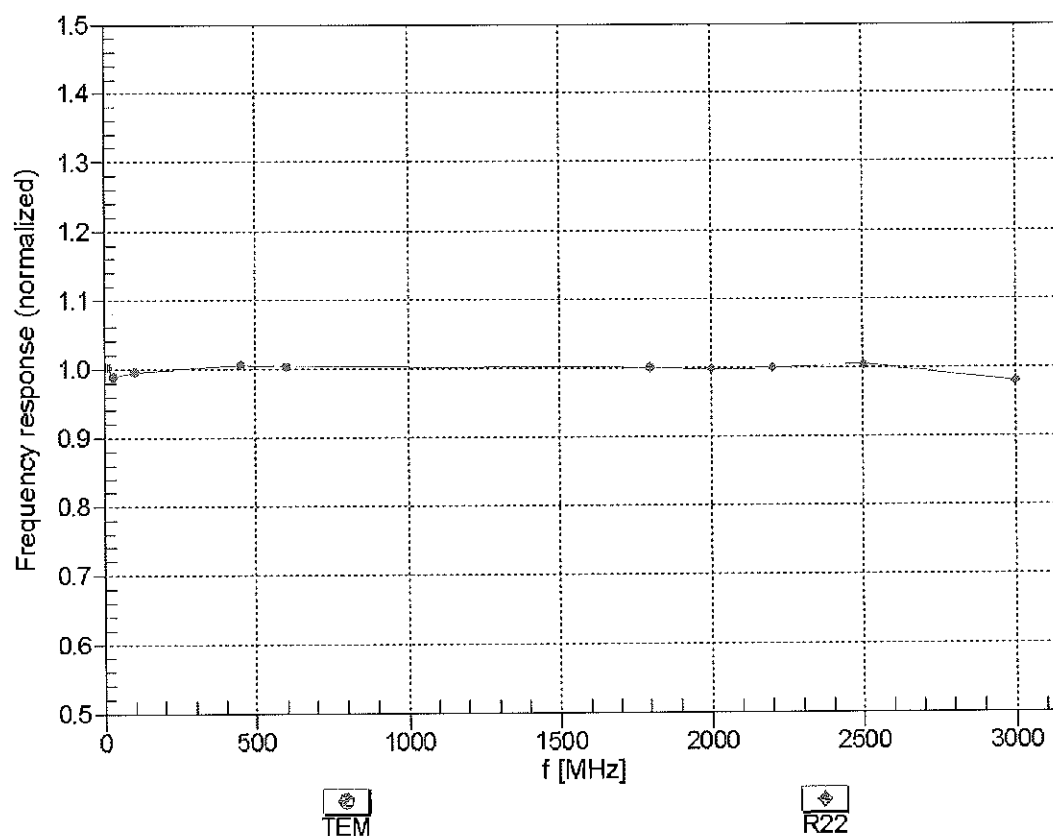
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.38	6.38	6.38	0.80	1.16	± 12.0 %
835	55.2	0.97	6.28	6.28	6.28	0.52	1.45	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.58	1.45	± 12.0 %
1900	53.3	1.52	4.77	4.77	4.77	0.70	1.36	± 12.0 %
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

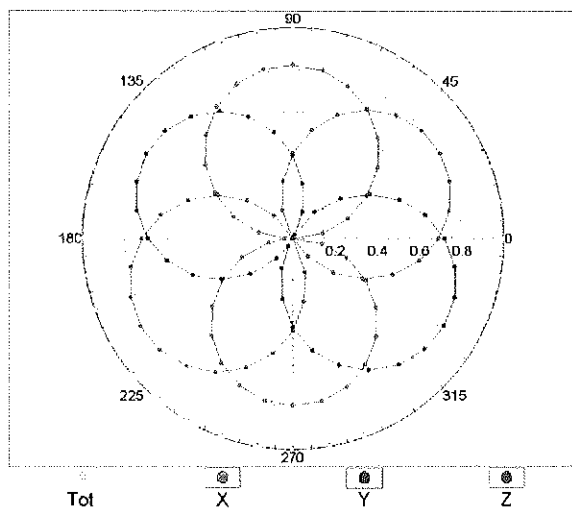
(TEM-Cell:ifi110 EXX, Waveguide: R22)



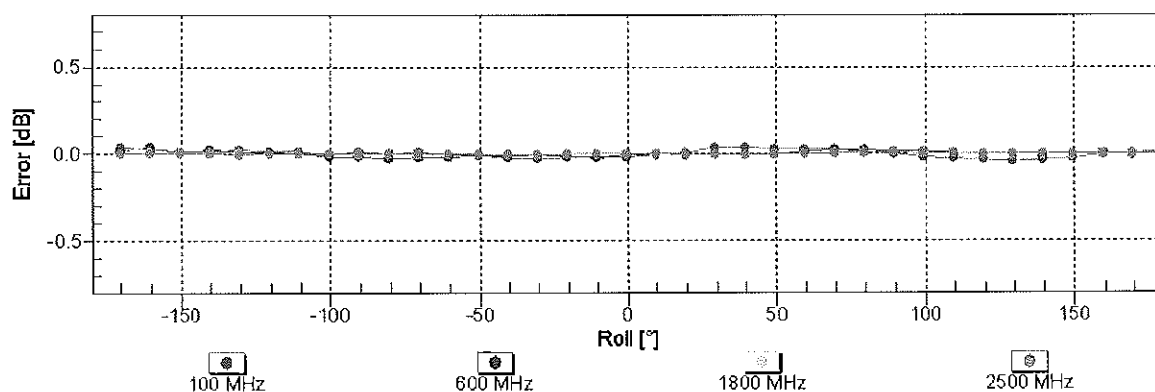
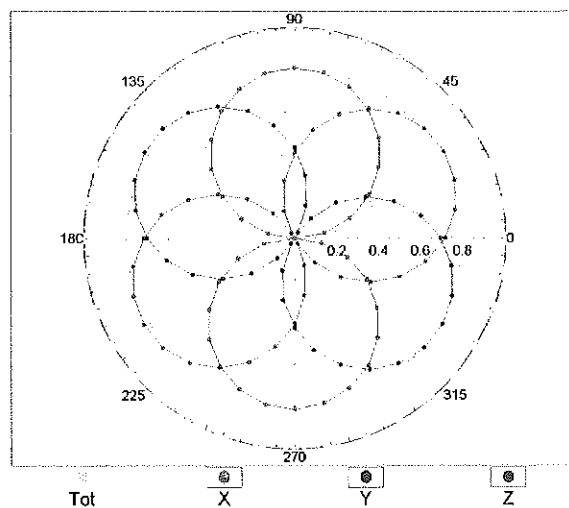
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

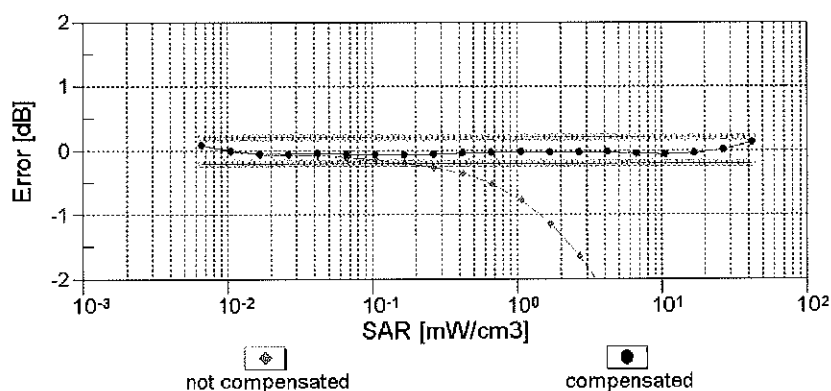
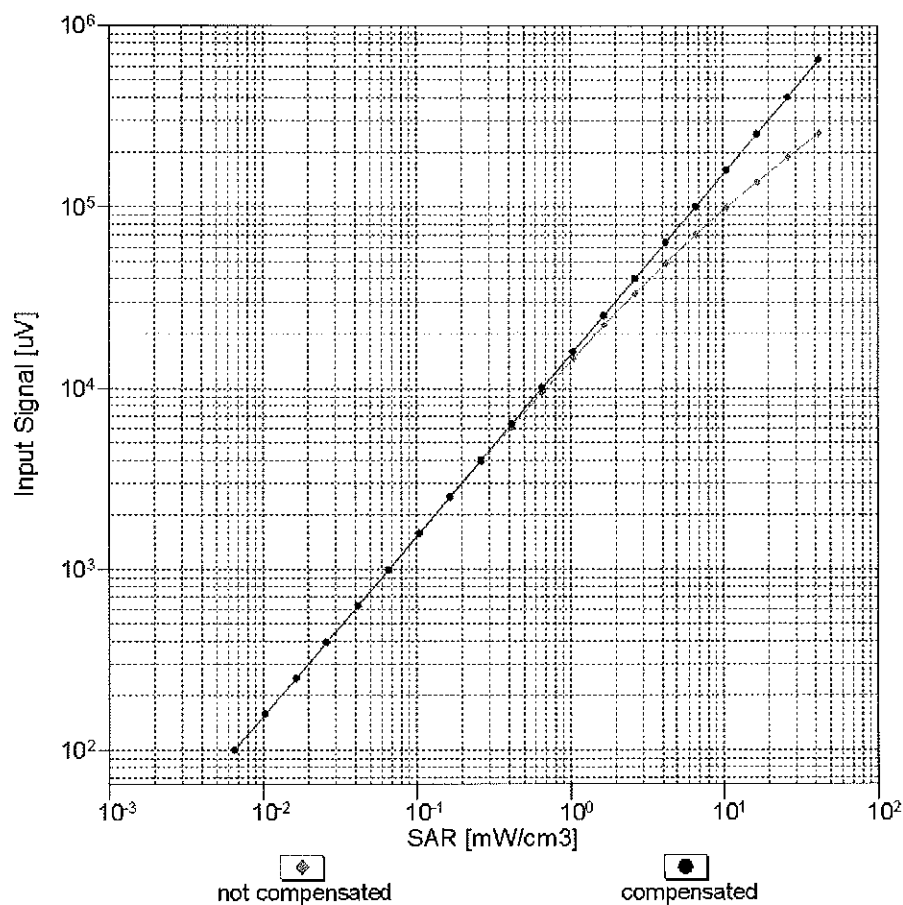


f=1800 MHz,R22



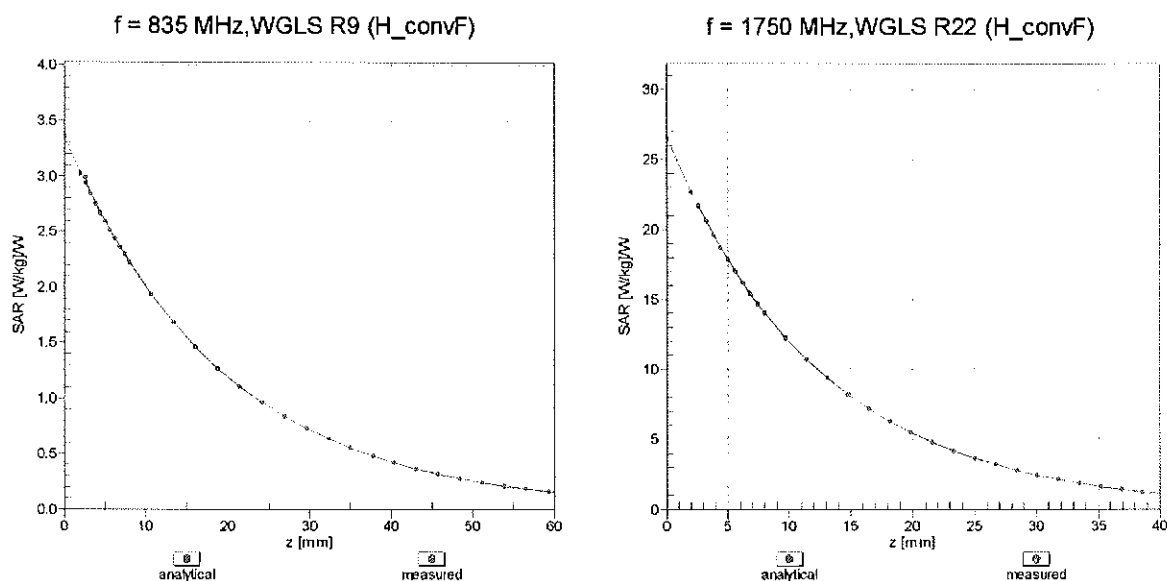
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)



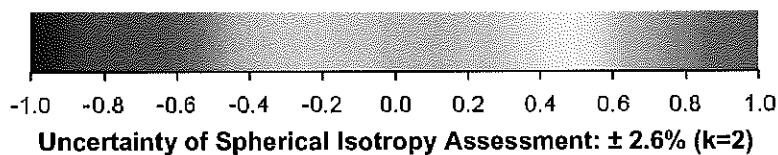
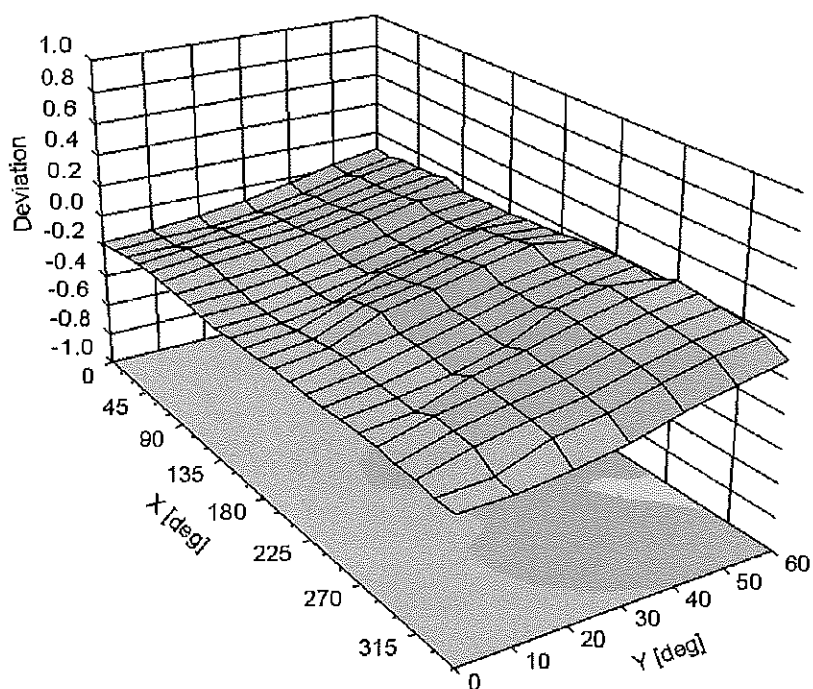
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

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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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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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: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

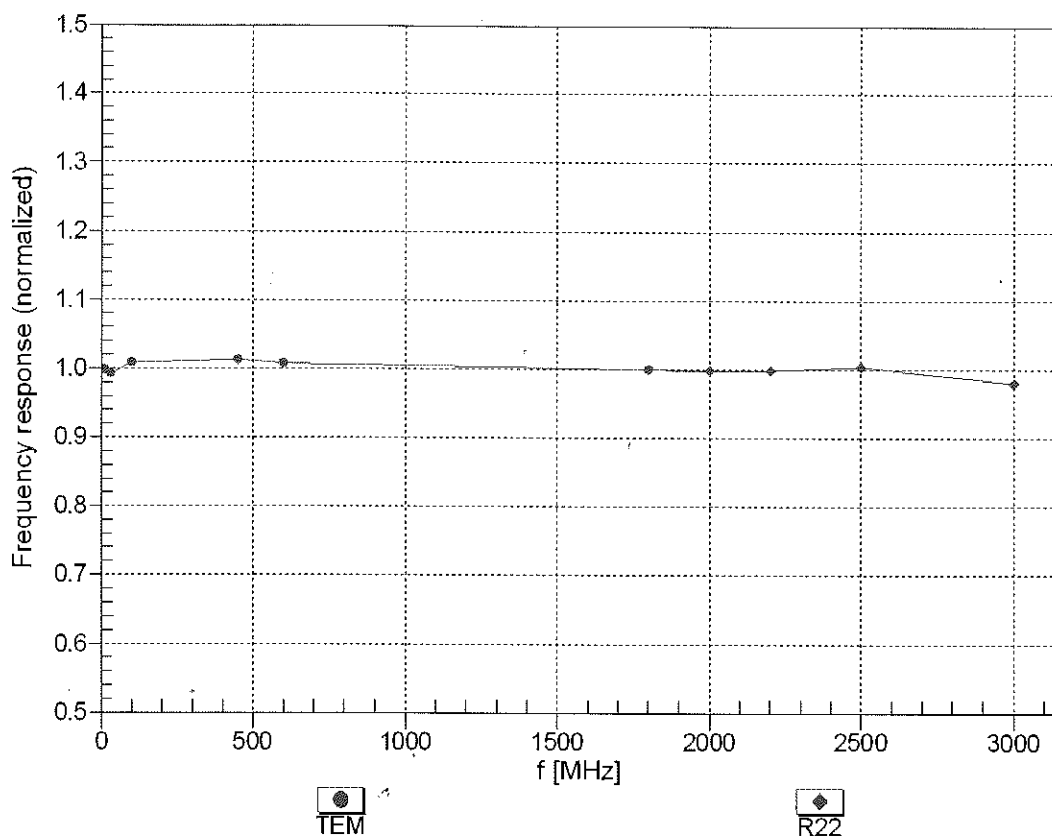
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.14	6.14	6.14	0.28	2.06	± 12.0 %
835	55.2	0.97	6.06	6.06	6.06	0.42	1.63	± 12.0 %
1750	53.4	1.49	4.86	4.86	4.86	0.43	1.64	± 12.0 %
1900	53.3	1.52	4.69	4.69	4.69	0.56	1.54	± 12.0 %
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

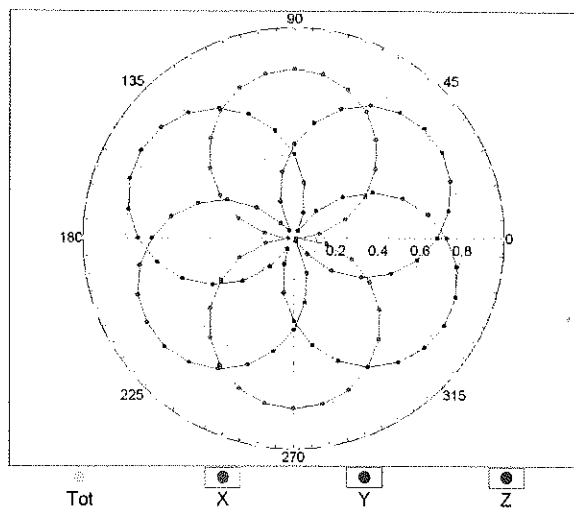
(TEM-Cell:ifi110 EXX, Waveguide: R22)



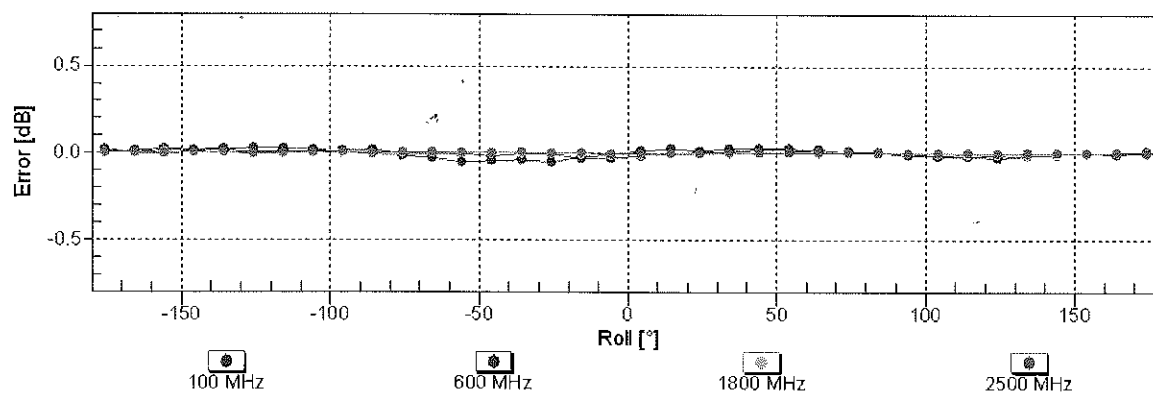
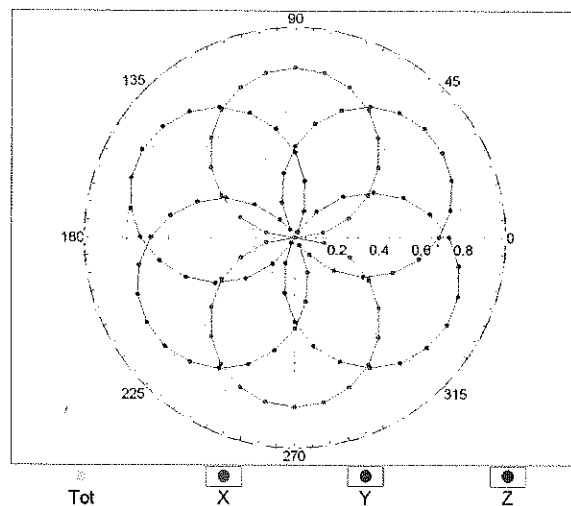
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

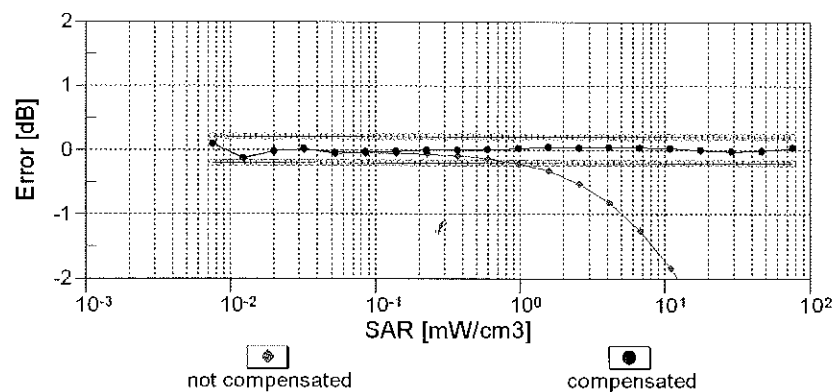
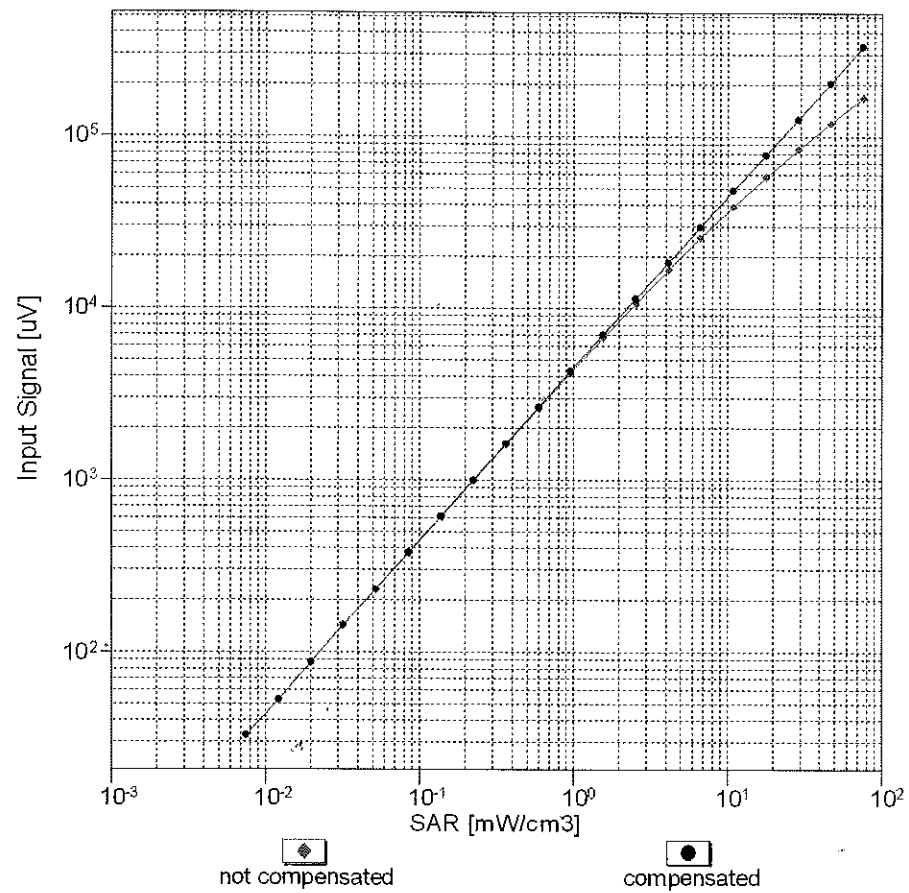


f=1800 MHz, R22



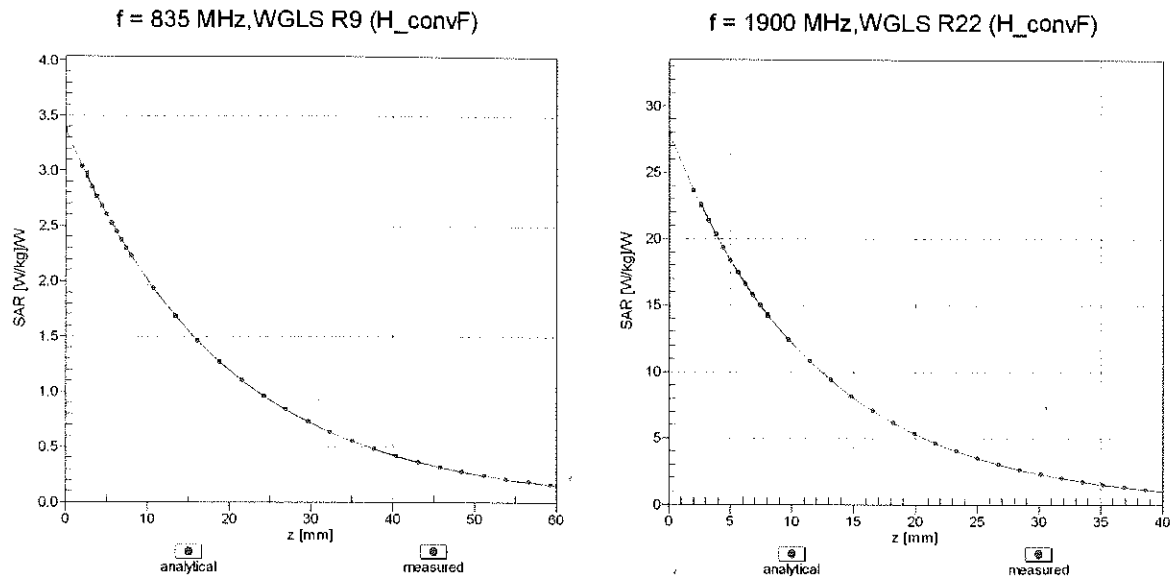
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)



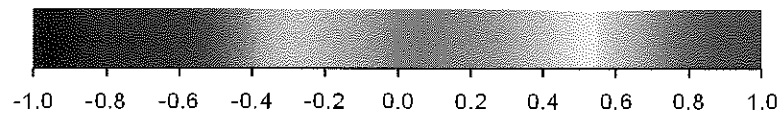
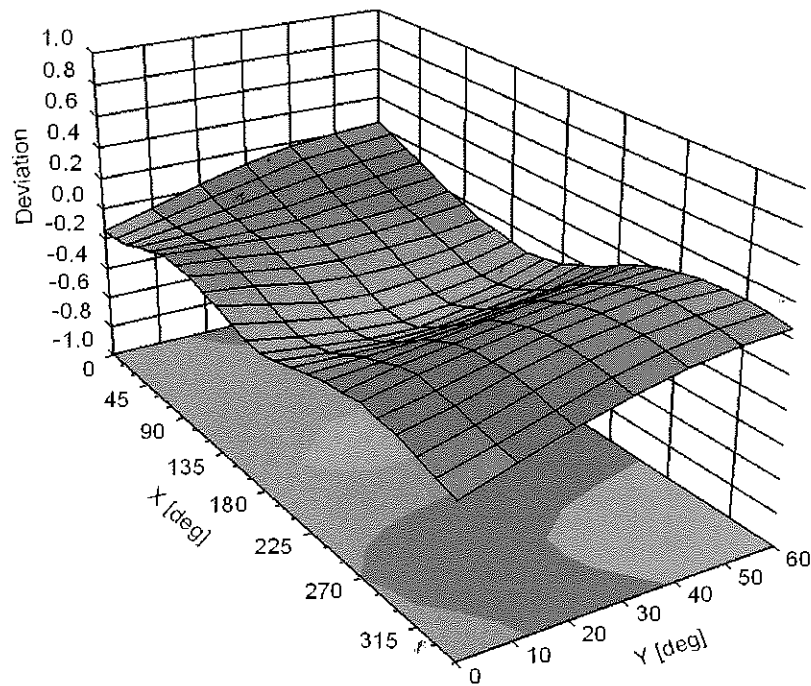
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

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



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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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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 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

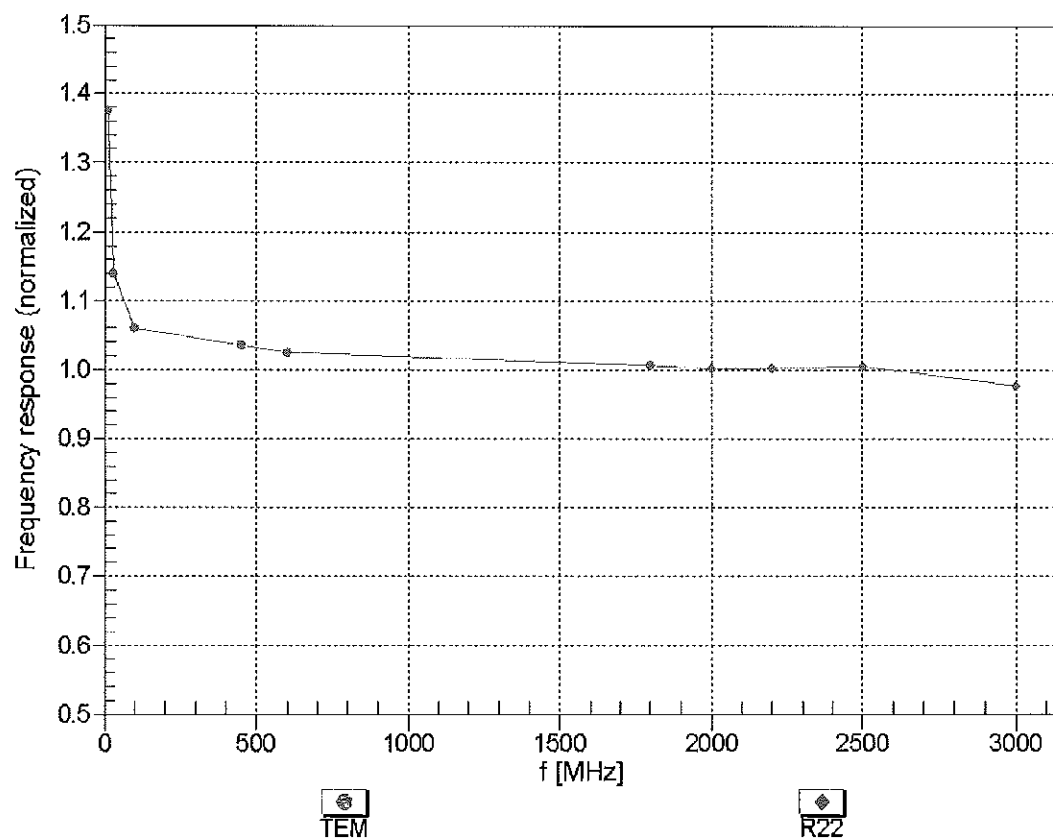
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	8.59	8.59	8.59	0.49	0.86	± 12.0 %
835	55.2	0.97	8.43	8.43	8.43	0.38	1.05	± 12.0 %
1750	53.4	1.49	7.87	7.87	7.87	0.44	0.89	± 12.0 %
1900	53.3	1.52	7.46	7.46	7.46	0.58	0.75	± 12.0 %
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

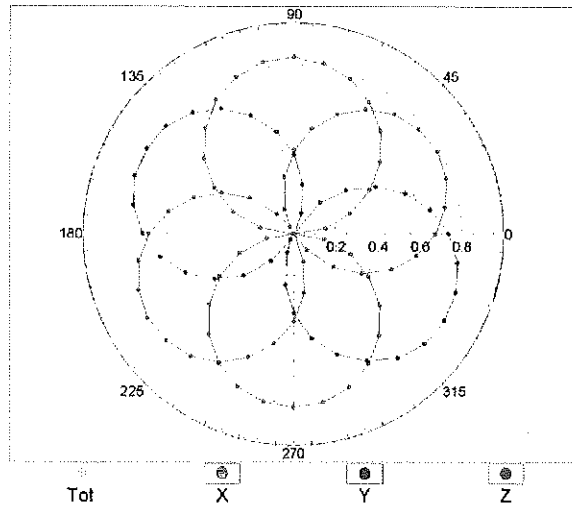
(TEM-Cell:ifi110 EXX, Waveguide: R22)



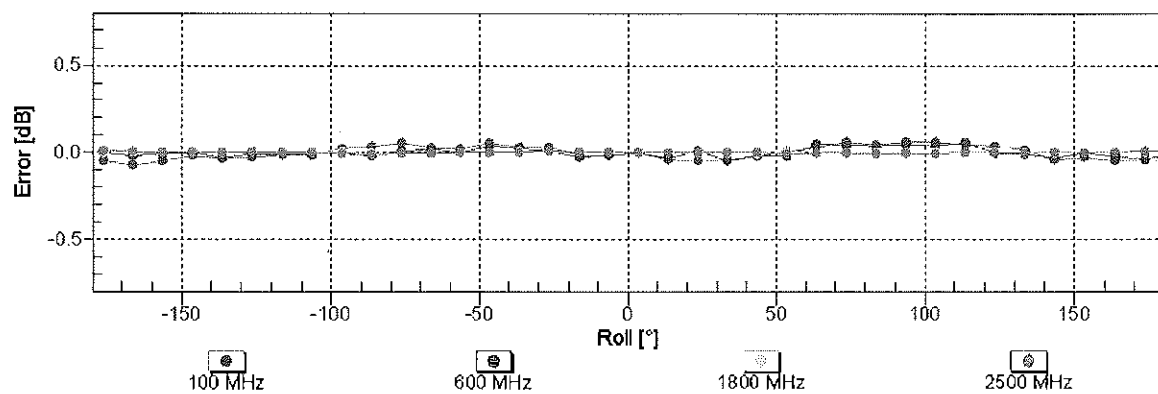
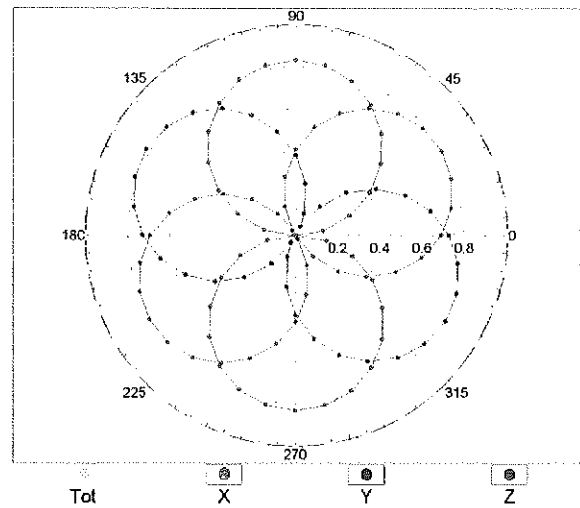
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM



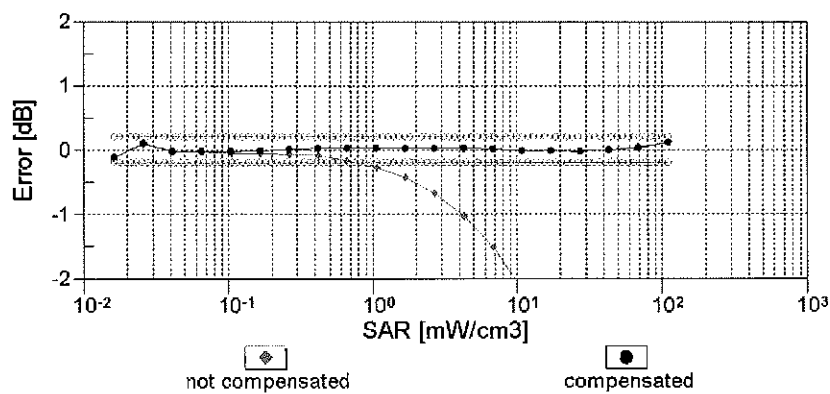
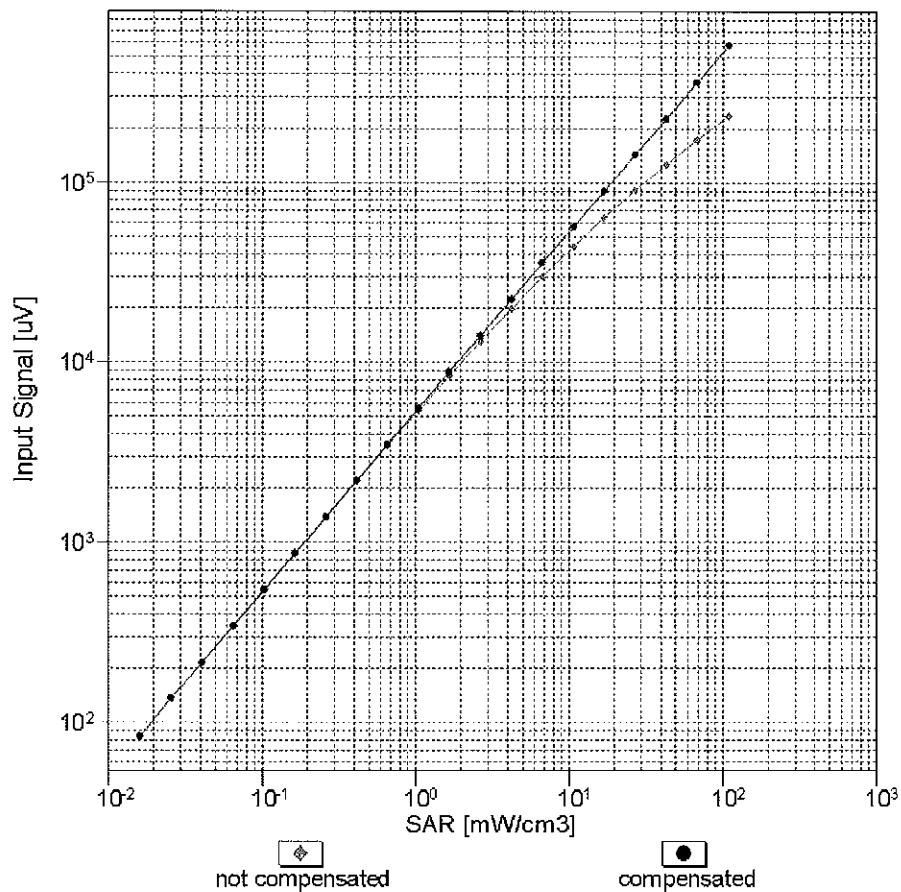
f=1800 MHz,R22



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

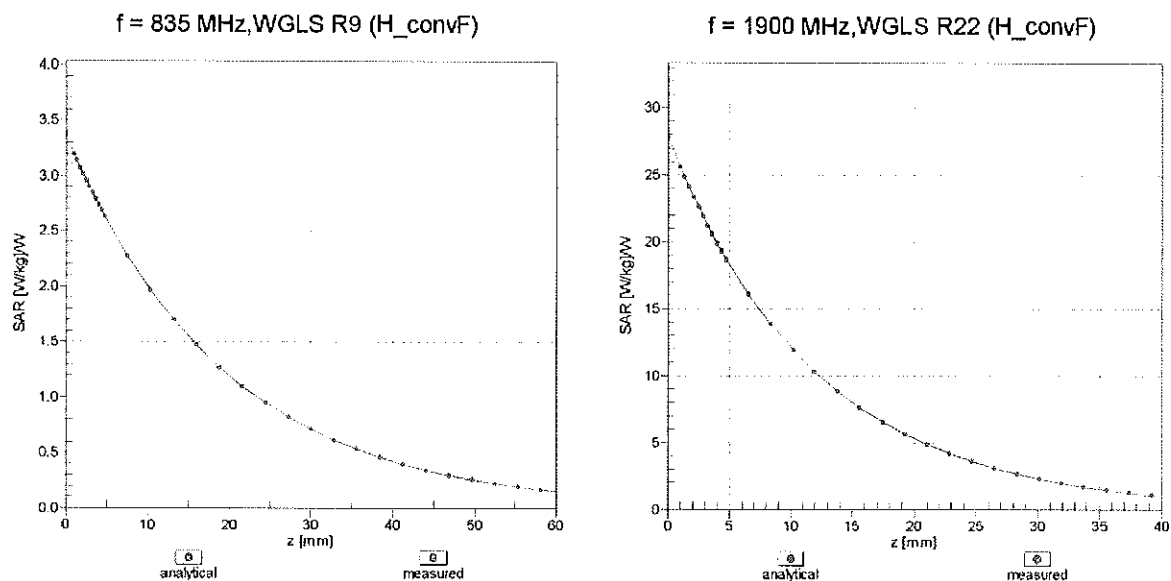
Dynamic Range f(SAR_{head})

(TEM cell , f = 900 MHz)



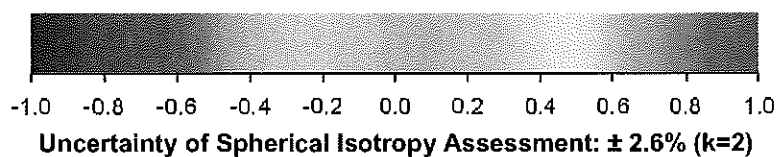
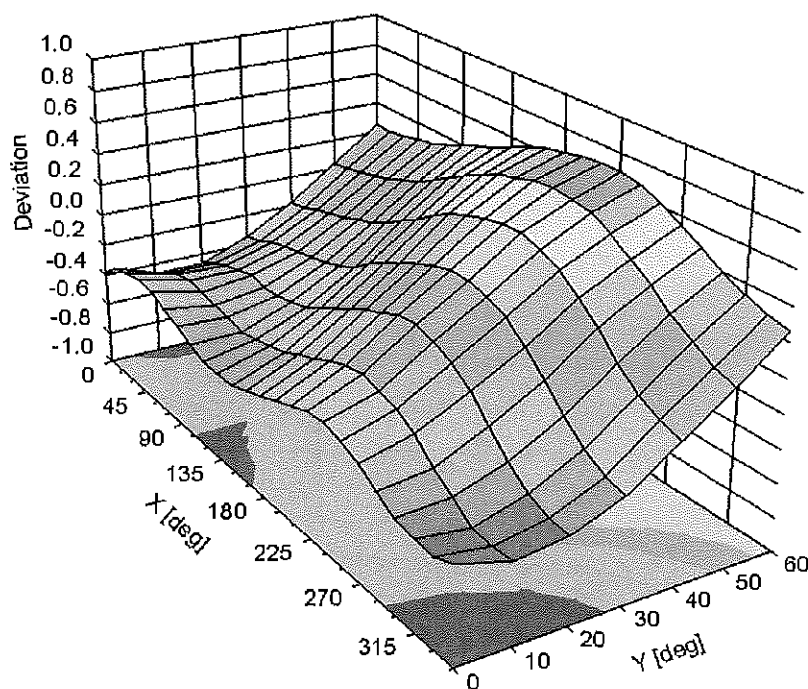
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

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)	835	1900	2450	5200-5800
Tissue	Body	Body	Body	Body
Ingredients (% by weight)				
Bactericide	0.1			
DGBE		29.44	26.7	
HEC	1			
NaCl	0.94	0.39	0.1	
Sucrose	44.9			
Polysorbate (Tween) 80				20
Water	53.06	70.17	73.2	80

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera			APPENDIX D: Page 1 of 1

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)	SENSI-TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
B	835	1/24/2013	3287	ES3DV3	835	Body	0.959	53.44	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	3/26/2013	3209	ES3DV3	1900	Body	1.556	52.37	PASS	PASS	PASS	GMSK	PASS	N/A
B	2450	1/30/2013	3287	ES3DV3	2450	Body	1.985	51.49	PASS	PASS	PASS	OFDM	N/A	PASS
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

Table E-II
SAR System Validation Summary – Extremity SAR Considerations

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ε)	SENSI-TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
B	835	3/28/2013	3287	ES3DV3	835	Body	0.968	52.69	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	4/1/2013	3209	ES3DV3	1900	Body	1.536	52.15	PASS	PASS	PASS	GMSK	PASS	N/A
B	2450	2/11/2013	3287	ES3DV3	2450	Body	2.011	52.07	PASS	PASS	PASS	OFDM	N/A	PASS
A	5200	3/11/2013	3589	EX3DV4	5200	Body	5.268	48.58	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	3/11/2013	3589	EX3DV4	5300	Body	5.405	48.31	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	3/11/2013	3589	EX3DV4	5500	Body	5.703	47.90	PASS	PASS	PASS	OFDM	N/A	PASS
A	5600	3/11/2013	3589	EX3DV4	5600	Body	5.875	47.66	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	3/11/2013	3589	EX3DV4	5800	Body	6.160	47.11	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.

FCC ID: A3LEKGN120		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/01/13 - 04/03/13	DUT Type: Portable Camera	APPENDIX E: Page 1 of 1		

APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/01/13 – 04/03/13	DUT Type: Portable Camera			APPENDIX G: Page G1 of G2

A3LEKGN120 Sensor Triggering Data Summary

Per FCC KDB Publication 941225 D07, this device was tested by the manufacturer to determine the proximity sensor triggering distances for the back side of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side.

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 941225 D07) 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:

Output Power by Distance												
Distance (mm)	16	15	14	13	12	11	10	9	8	7	6	5
WCDMA1900 (dBm)	22.02	21.93	21.93	21.95	21.99	21.90	16.00	16.04	16.07	16.04	16.09	15.99

Moving device away from the phantom:

Output Power by Distance													
Distance (mm)	20	17	16	15	14	13	12	11	10	9	6	3	0
WCDMA1900 (dBm)	21.91	21.97	22.01	22.00	22.06	22.09	21.93	22.09	16.09	15.91	15.93	15.98	15.93

Based on the most conservative measured triggering distance of 10 mm, additional SAR measurements were required at 9 mm from the back side.

FCC ID: A3LEKGN120	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 04/01/13 – 04/03/13	DUT Type: Portable Camera			APPENDIX G: Page G2 of G2