



SAR EVALUATION REPORT

Applicant Name:

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Gyeonggi-do 443-742, Korea

Date of Testing:

03/25/14 - 04/01/14

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

OY1403260617-R1.A3L

FCC ID:

A3LSMT537R4

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Tablet

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SM-T537R4

Equipment Class	Band & Mode	Tx Frequency	SAR
			1 gm Body (W/kg)
PCB	Cell. CDMA/EVDO	824.70 - 848.31 MHz	0.91
PCB	PCS CDMA/EVDO	1851.25 - 1908.75 MHz	0.94
PCB	LTE Band 12/17	701.5 - 713.5 MHz	0.92
PCB	LTE Band 5 (Cell)	826.5 - 846.5 MHz	0.82
PCB	LTE Band 4 (AWS)	1712.5 - 1752.5 MHz	0.76
PCB	LTE Band 2 (PCS)	1852.5 - 1907.5 MHz	1.04
DTS	2.4 GHz WLAN	2412 - 2462 MHz	1.02
DTS	5.8 GHz WLAN	5745 - 5825 MHz	0.77
NII	5.2 GHz WLAN	5180 - 5240 MHz	0.95
NII	5.3 GHz WLAN	5260 - 5320 MHz	0.96
NII	5.5 GHz WLAN	5500 - 5700 MHz	1.07
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A
Simultaneous SAR per KDB 690783 D01v01r02:			1.41

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.

Note: This revised Test Report (S/N: OY1403260617-R1.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 1 of 76

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

1	DEVICE UNDER TEST	3
2	LTE INFORMATION	8
3	INTRODUCTION	9
4	DOSIMETRIC ASSESSMENT	10
5	SAR TESTING PROCEDURES	11
6	RF EXPOSURE LIMITS	12
7	FCC MEASUREMENT PROCEDURES.....	13
8	RF CONDUCTED POWERS.....	16
9	SYSTEM VERIFICATION.....	36
10	SAR DATA SUMMARY	38
11	FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS.....	43
12	SAR MEASUREMENT VARIABILITY	70
13	EQUIPMENT LIST	71
14	MEASUREMENT UNCERTAINTIES	72
15	CONCLUSION.....	74
16	REFERENCES	75
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		
APPENDIX G: SAR SENSOR TRIGGERING DATA DOCUMENT		

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 2 of 76	

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
Cell. CDMA/EVDO	Data	824.70 - 848.31 MHz
PCS CDMA/EVDO	Data	1851.25 - 1908.75 MHz
LTE Band 12/17	Data	701.5 - 713.5 MHz
LTE Band 5 (Cell)	Data	826.5 - 846.5 MHz
LTE Band 4 (AWS)	Data	1712.5 - 1752.5 MHz
LTE Band 2 (PCS)	Data	1852.5 - 1907.5 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
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
ANT+	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses a proximity sensor for SAR compliance. The proximity sensor is activated when used in close proximity to the user's body. The proximity sensor triggers power reduction for all data modes and is only applicable for tablet operations. There is no power reduction mechanism for WIFI/BT modes for SAR purposes. There are no body-worn accessories for this device.

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

1.3 Nominal and Maximum Output Power Specifications

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

Maximum Power:

Mode / Band		Modulated Average (dBm)
Cell. CDMA/EVDO	Maximum	25.0
	Nominal	24.5
PCS CDMA/EVDO	Maximum	24.5
	Nominal	24.0

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 3 of 76	

Mode / Band		Modulated Average (dBm)
LTE Band 12/17	Maximum	24.5
	Nominal	24.0
LTE Band 5 (Cell)	Maximum	25.0
	Nominal	24.5
LTE Band 4 (AWS)	Maximum	24.0
	Nominal	23.5
LTE Band 2 (PCS)	Maximum	23.5
	Nominal	23.0

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	12.5
	Nominal	12.0
IEEE 802.11g (2.4 GHz)	Maximum	8.5
	Nominal	8.0
IEEE 802.11n (2.4 GHz)	Maximum	7.5
	Nominal	7.0
IEEE 802.11a (5 GHz)	Maximum	8.0
	Nominal	7.5
IEEE 802.11n (5 GHz)	Maximum	8.0
	Nominal	7.5
Bluetooth	Maximum	9.5
	Nominal	9.0
Bluetooth LE	Maximum	1.5
	Nominal	1.0

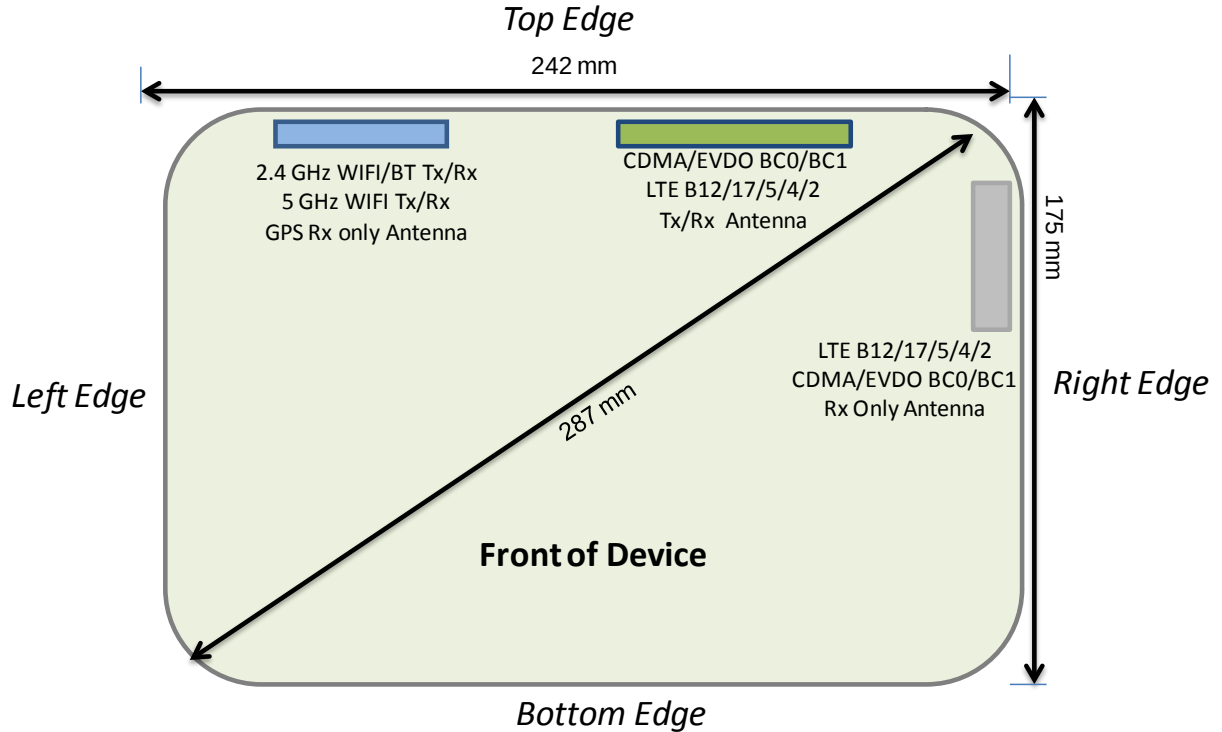
Reduced Power – Body at 0 mm:

Mode / Band		Modulated Average (dBm)
Cell. CDMA/EVDO	Maximum	20.5
	Nominal	20.0
PCS CDMA/EVDO	Maximum	13.0
	Nominal	12.5

Mode / Band		Modulated Average (dBm)
LTE Band 12/17	Maximum	20.5
	Nominal	20.0
LTE Band 5 (Cell)	Maximum	20.5
	Nominal	20.0
LTE Band 4 (AWS)	Maximum	12.5
	Nominal	12.0
LTE Band 2 (PCS)	Maximum	12.5
	Nominal	12.0

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 4 of 76	

1.4 DUT Antenna Locations



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

Figure 1-1
DUT Antenna Locations

Table 1-1
Sides for SAR Testing

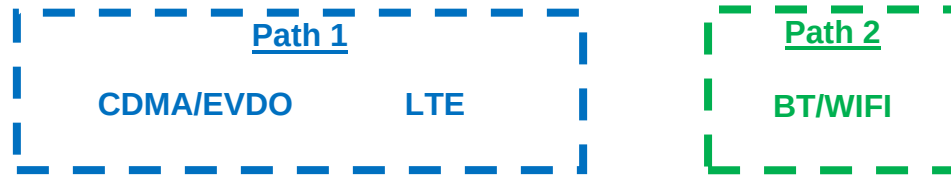
Mode	Back	Front	Top	Bottom	Right	Left
Cell. EVDO	Yes	No	Yes	No	Yes	No
PCS EVDO	Yes	No	Yes	No	Yes	No
LTE Band 12	Yes	No	Yes	No	Yes	No
LTE Band 5 (Cell)	Yes	No	Yes	No	Yes	No
LTE Band 4 (AWS)	Yes	No	Yes	No	Yes	No
LTE Band 2 (PCS)	Yes	No	Yes	No	Yes	No
2.4 GHz WLAN	Yes	No	Yes	No	No	Yes
5 GHz WLAN	Yes	No	Yes	No	No	Yes

Note: Per FCC KDB 616217 D04, particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01.

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 5 of 76

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.



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

Table 1-2
Simultaneous Transmission Scenarios

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

1. Bluetooth, 2.4 GHz, and 5 GHz share the same antenna path and cannot transmit simultaneously.
2. CDMA/EVDO and LTE share the same antenna path and cannot transmit simultaneously.

1.6 SAR Test Exclusions Applied

(A) WIFI/BT

Per FCC KDB 447498 D01v05, the SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth SAR was not required; $[(9/5) * \sqrt{2.441}] = 2.8 < 3.0$. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

Based on the maximum conducted power of 5 GHz WLAN (rounded to the nearest mW) and the antenna to user separation distance, 5 GHz WLAN SAR was not required; $[(6/5) * \sqrt{5.825}] = 2.9 < 3.0$. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation. 5 GHz WLAN SAR was evaluated per manufacturer request.

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.

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 6 of 76

(B) Licensed Transmitter(s)

This device supports both LTE B12 and LTE B17. Since the supported frequency span for LTE B17 falls completely within the supported frequency span for LTE B12, both LTE bands have the same target power, and both LTE bands share the same transmission path, SAR was only assessed for LTE B12.

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02.

1.7 Guidance Applied

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

1.8 Device Serial Numbers

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

	Maximum Power Body Serial Number	Reduced Power Serial Number
Cell. CDMA/EVDO	22	99
PCS CDMA/EVDO	22	99
LTE Band 12/17	70	72
LTE Band 5 (Cell)	70	72
LTE Band 4 (AWS)	69	60
LTE Band 2 (PCS)	69	60
2.4 GHz WLAN	70	-
5 GHz WLAN	68	-

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 7 of 76

2

LTE INFORMATION

LTE Information			
FCC ID	A3LSMT537R4		
Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 12 (701.5 - 713.5 MHz)		
	LTE Band 17 (706.5 - 713.5 MHz)		
	LTE Band 5 (Cell) (826.5 - 846.5 MHz)		
	LTE Band 4 (AWS) (1712.5 - 1752.5 MHz)		
	LTE Band 2 (PCS) (1852.5 - 1907.5 MHz)		
Channel Bandwidths	LTE Band 12: 5 MHz, 10 MHz		
	LTE Band 17: 5 MHz, 10 MHz		
	LTE Band 5 (Cell): 5 MHz, 10 MHz		
	LTE Band 4 (AWS): 5 MHz, 10 MHz		
	LTE Band 2 (PCS): 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 12: 5 MHz	701.5 (23035)	707.5 (23095)	713.5 (23155)
LTE Band 12: 10 MHz	704 (23060)	707.5 (23095)	711 (23130)
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
UE Category	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 8 of 76	

3 INTRODUCTION

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

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

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

- σ = conductivity of the tissue-simulating material (S/m)
- ρ = mass density of the tissue-simulating material (kg/m³)
- E = Total RMS electric field strength (V/m)

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

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 9 of 76

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
 - a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
 - b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

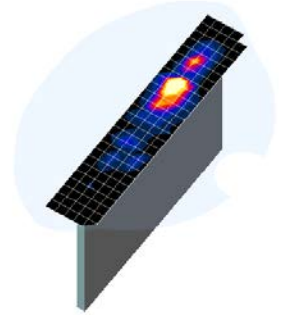


Figure 4-1
Sample SAR Area
Scan

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

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

*Also compliant to IEEE 1528-2013 Table 6

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 10 of 76

5 SAR TESTING PROCEDURES

5.1 SAR Testing for Tablet per FCC KDB Publication 616217 D04v01

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

5.2 Additional Test Positions due to Proximity Sensor Considerations

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

When the sensor detects a user is touching the device on or near to the antenna the device reduces the maximum allowed output power. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, an additional exposure condition is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level.

FCC KDB 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. Since the sensor activation distance for the back side of the device is 23 mm, a conservative distance of 22 mm was tested for SAR on the back side at maximum power. Since the sensor activation distance for the top edge of the device is 23 mm, a conservative distance of 22 mm was tested for SAR on the top edge at maximum power. Sensor triggering distance summary data is included in Appendix G. The sensor does not trigger power reduction from the front of the device.

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

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 11 of 76

6 RF EXPOSURE LIMITS

6.1 Uncontrolled Environment

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

6.2 Controlled Environment

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

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

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

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 12 of 76

7 FCC MEASUREMENT PROCEDURES

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 CDMA2000

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

7.3.1 Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended by "SAR Measurement Procedures for 3G Devices" v02, October 2007. Maximum output power is verified on the High, Middle and Low channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E. SO55 tests were measured with power control bits in the "All Up" condition.

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 7-1 parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH₀ and demodulation of RC 3,4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH₀ data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 7-2 was applied.

Table 7-1
Parameters for Max. Power for RC1

Parameter	Units	Value
I_{or}	dBm/1.23 MHz	-104
$\frac{Pilot E_c}{I_{or}}$	dB	-7
$\frac{Traffic E_c}{I_{or}}$	dB	-7.4

Table 7-2
Parameters for Max. Power for RC3

Parameter	Units	Value
I_{or}	dBm/1.23 MHz	-86
$\frac{Pilot E_c}{I_{or}}$	dB	-7
$\frac{Traffic E_c}{I_{or}}$	dB	-7.4

5. FCHs were configured at full rate for maximum SAR with "All Up" power control bits.

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 13 of 76

7.3.2 Body SAR Measurements for EVDO Data Devices

Hotspot Body SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0 per KDB Publication 941225 D01 procedures for “1x Ev-Do data Devices”. SAR for Subtype 2 Physical layer configurations is not required for Rev. A when the maximum average output of each RF channels is less than that measured in Subtype 0/1 Physical layer configurations. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for the RF channels in Rev. 0. The AT is tested with a Reverse Data Channel rate of 153.6 kbps in Subtype 0/1 Physical Layer configurations; and a Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots in Subtype 2 Physical Layer configurations.

SAR is not required for 1x RTT for Ev-Do devices that also support 1x RTT voice and/or data operations, when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0. Otherwise, CDMA “Body-SAR Measurement” procedures for “CDMA 2000 1x Handsets” were applied.

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. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

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.

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 14 of 76

- iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
- b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
- c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
- d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to $\frac{1}{2}$ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/kg.

7.5 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g/n/ac 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 [24]

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 higher than 0.25 dB or more 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 and 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: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 15 of 76

8 RF CONDUCTED POWERS

8.1 CDMA Conducted Powers

Maximum Power:

Band	Channel	Rule Part	Frequency	TDSO S032 [dBm]	TDSO S032 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC		MHz	FCH+SCH	FCH	(RTAP)	(RETAP)
Cellular	1013	22H	824.7	24.24	24.25	24.01	23.97
	384	22H	836.52	24.35	24.36	24.12	24.01
	777	22H	848.31	24.30	24.33	24.11	24.09
PCS	25	24E	1851.25	23.98	24.01	23.98	23.95
	600	24E	1880	23.99	24.02	24.03	23.99
	1175	24E	1908.75	24.06	24.08	24.05	24.02

Reduced Power – Body at 0mm:

Band	Channel	Rule Part	Frequency	TDSO S032 [dBm]	TDSO S032 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC		MHz	FCH+SCH	FCH	(RTAP)	(RETAP)
Cellular	1013	22H	824.7	20.50	20.49	20.50	20.47
	384	22H	836.52	20.48	20.48	20.49	20.46
	777	22H	848.31	20.47	20.46	20.47	20.45
PCS	25	24E	1851.25	12.99	12.94	12.94	12.90
	600	24E	1880	12.97	12.88	12.89	12.84
	1175	24E	1908.75	12.95	12.97	12.91	12.87

Note:

Per KDB Publication 941225 D01v02 Body SAR was measured using Subtype 0/1 Physical Layer configurations for Rev. 0. If the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, then Rev. A SAR is not required. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for that RF channel in Rev. 0. SAR is not required for 1x RTT for Ev-Do hotspot devices when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0

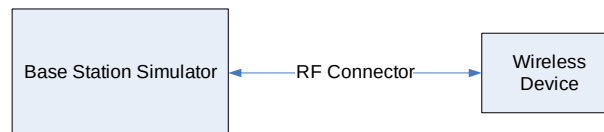


Figure 8-1
Power Measurement Setup

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 16 of 76

8.2 LTE Conducted Powers

8.2.1 LTE Band 12 Maximum Power

Table 8-1
LTE Band 12 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	707.5	23095	10	QPSK	1	0	23.89	0	0
	707.5	23095	10	QPSK	1	25	24.12	0	0
	707.5	23095	10	QPSK	1	49	24.04	0	0
	707.5	23095	10	QPSK	25	0	23.08	0-1	1
	707.5	23095	10	QPSK	25	12	22.97	0-1	1
	707.5	23095	10	QPSK	25	25	22.98	0-1	1
	707.5	23095	10	QPSK	50	0	22.99	0-1	1
	707.5	23095	10	16QAM	1	0	22.91	0-1	1
	707.5	23095	10	16QAM	1	25	22.96	0-1	1
	707.5	23095	10	16QAM	1	49	22.94	0-1	1
	707.5	23095	10	16QAM	25	0	22.00	0-2	2
	707.5	23095	10	16QAM	25	12	21.98	0-2	2
	707.5	23095	10	16QAM	25	25	21.99	0-2	2
	707.5	23095	10	16QAM	50	0	22.00	0-2	2

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 17 of 76

Table 8-2
LTE Band 12 Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	701.5	23035	5	QPSK	1	0	24.07	0	0
	701.5	23035	5	QPSK	1	12	24.12	0	0
	701.5	23035	5	QPSK	1	24	24.17	0	0
	701.5	23035	5	QPSK	12	0	22.99	0-1	1
	701.5	23035	5	QPSK	12	6	22.93	0-1	1
	701.5	23035	5	QPSK	12	13	23.06	0-1	1
	701.5	23035	5	QPSK	25	0	22.95	0-1	1
	701.5	23035	5	16-QAM	1	0	23.01	0-1	1
	701.5	23035	5	16-QAM	1	12	22.98	0-1	1
	701.5	23035	5	16-QAM	1	24	23.11	0-1	1
	701.5	23035	5	16-QAM	12	0	21.97	0-2	2
	701.5	23035	5	16-QAM	12	6	21.99	0-2	2
	701.5	23035	5	16-QAM	12	13	22.06	0-2	2
	701.5	23035	5	16-QAM	25	0	22.04	0-2	2
Mid	707.5	23095	5	QPSK	1	0	24.10	0	0
	707.5	23095	5	QPSK	1	12	24.07	0	0
	707.5	23095	5	QPSK	1	24	24.14	0	0
	707.5	23095	5	QPSK	12	0	23.03	0-1	1
	707.5	23095	5	QPSK	12	6	22.96	0-1	1
	707.5	23095	5	QPSK	12	13	22.97	0-1	1
	707.5	23095	5	QPSK	25	0	22.99	0-1	1
	707.5	23095	5	16-QAM	1	0	23.06	0-1	1
	707.5	23095	5	16-QAM	1	12	22.97	0-1	1
	707.5	23095	5	16-QAM	1	24	23.01	0-1	1
	707.5	23095	5	16-QAM	12	0	22.01	0-2	2
	707.5	23095	5	16-QAM	12	6	22.02	0-2	2
	707.5	23095	5	16-QAM	12	13	21.98	0-2	2
	707.5	23095	5	16-QAM	25	0	22.07	0-2	2
High	713.5	23155	5	QPSK	1	0	24.04	0	0
	713.5	23155	5	QPSK	1	12	24.06	0	0
	713.5	23155	5	QPSK	1	24	24.14	0	0
	713.5	23155	5	QPSK	12	0	22.87	0-1	1
	713.5	23155	5	QPSK	12	6	22.91	0-1	1
	713.5	23155	5	QPSK	12	13	23.08	0-1	1
	713.5	23155	5	QPSK	25	0	22.89	0-1	1
	713.5	23155	5	16-QAM	1	0	22.95	0-1	1
	713.5	23155	5	16-QAM	1	12	22.92	0-1	1
	713.5	23155	5	16-QAM	1	24	23.12	0-1	1
	713.5	23155	5	16-QAM	12	0	21.96	0-2	2
	713.5	23155	5	16-QAM	12	6	21.65	0-2	2
	713.5	23155	5	16-QAM	12	13	22.05	0-2	2
	713.5	23155	5	16-QAM	25	0	22.01	0-2	2

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 18 of 76	

8.2.2 LTE Band 12 Reduced Power - Body at 0mm

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	707.5	23095	10	QPSK	1	0	20.37	0	0
	707.5	23095	10	QPSK	1	25	20.43	0	0
	707.5	23095	10	QPSK	1	49	20.34	0	0
	707.5	23095	10	QPSK	25	0	19.22	0-1	1
	707.5	23095	10	QPSK	25	12	19.14	0-1	1
	707.5	23095	10	QPSK	25	25	19.17	0-1	1
	707.5	23095	10	QPSK	50	0	19.09	0-1	1
	707.5	23095	10	16QAM	1	0	19.18	0-1	1
	707.5	23095	10	16QAM	1	25	19.09	0-1	1
	707.5	23095	10	16QAM	1	49	19.28	0-1	1
	707.5	23095	10	16QAM	25	0	18.02	0-2	2
	707.5	23095	10	16QAM	25	12	17.99	0-2	2
	707.5	23095	10	16QAM	25	25	18.07	0-2	2
	707.5	23095	10	16QAM	50	0	18.08	0-2	2

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

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 19 of 76

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	701.5	23035	5	QPSK	1	0	20.21	0	0
	701.5	23035	5	QPSK	1	12	20.17	0	0
	701.5	23035	5	QPSK	1	24	20.25	0	0
	701.5	23035	5	QPSK	12	0	19.03	0-1	1
	701.5	23035	5	QPSK	12	6	19.01	0-1	1
	701.5	23035	5	QPSK	12	13	19.06	0-1	1
	701.5	23035	5	QPSK	25	0	19.11	0-1	1
	701.5	23035	5	16-QAM	1	0	19.24	0-1	1
	701.5	23035	5	16-QAM	1	12	18.87	0-1	1
	701.5	23035	5	16-QAM	1	24	19.11	0-1	1
	701.5	23035	5	16-QAM	12	0	17.91	0-2	2
	701.5	23035	5	16-QAM	12	6	17.89	0-2	2
	701.5	23035	5	16-QAM	12	13	18.00	0-2	2
Mid	707.5	23095	5	QPSK	1	0	20.27	0	0
	707.5	23095	5	QPSK	1	12	20.35	0	0
	707.5	23095	5	QPSK	1	24	20.24	0	0
	707.5	23095	5	QPSK	12	0	19.06	0-1	1
	707.5	23095	5	QPSK	12	6	19.09	0-1	1
	707.5	23095	5	QPSK	12	13	19.13	0-1	1
	707.5	23095	5	QPSK	25	0	19.07	0-1	1
	707.5	23095	5	16-QAM	1	0	19.14	0-1	1
	707.5	23095	5	16-QAM	1	12	18.99	0-1	1
	707.5	23095	5	16-QAM	1	24	19.01	0-1	1
	707.5	23095	5	16-QAM	12	0	18.01	0-2	2
	707.5	23095	5	16-QAM	12	6	17.96	0-2	2
	707.5	23095	5	16-QAM	12	13	17.89	0-2	2
	707.5	23095	5	16-QAM	25	0	18.00	0-2	2
High	713.5	23155	5	QPSK	1	0	20.20	0	0
	713.5	23155	5	QPSK	1	12	20.11	0	0
	713.5	23155	5	QPSK	1	24	20.16	0	0
	713.5	23155	5	QPSK	12	0	19.02	0-1	1
	713.5	23155	5	QPSK	12	6	18.95	0-1	1
	713.5	23155	5	QPSK	12	13	18.94	0-1	1
	713.5	23155	5	QPSK	25	0	19.00	0-1	1
	713.5	23155	5	16-QAM	1	0	19.08	0-1	1
	713.5	23155	5	16-QAM	1	12	18.89	0-1	1
	713.5	23155	5	16-QAM	1	24	19.11	0-1	1
	713.5	23155	5	16-QAM	12	0	17.53	0-2	2
	713.5	23155	5	16-QAM	12	6	17.75	0-2	2
	713.5	23155	5	16-QAM	12	13	17.77	0-2	2
	713.5	23155	5	16-QAM	25	0	17.92	0-2	2

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 20 of 76	

8.2.3 LTE Band 5 (Cell) Maximum Power

Table 8-5
LTE Band 5 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	836.5	20525	10	QPSK	1	0	24.70	0	0
	836.5	20525	10	QPSK	1	25	24.89	0	0
	836.5	20525	10	QPSK	1	49	24.91	0	0
	836.5	20525	10	QPSK	25	0	23.66	0-1	1
	836.5	20525	10	QPSK	25	12	23.65	0-1	1
	836.5	20525	10	QPSK	25	25	23.89	0-1	1
	836.5	20525	10	QPSK	50	0	23.81	0-1	1
	836.5	20525	10	16QAM	1	0	23.42	0-1	1
	836.5	20525	10	16QAM	1	25	23.77	0-1	1
	836.5	20525	10	16QAM	1	49	23.77	0-1	1
	836.5	20525	10	16QAM	25	0	22.58	0-2	2
	836.5	20525	10	16QAM	25	12	22.70	0-2	2
	836.5	20525	10	16QAM	25	25	22.72	0-2	2
	836.5	20525	10	16QAM	50	0	22.72	0-2	2

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 21 of 76

Table 8-6
LTE Band 5 Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	826.5	20425	5	QPSK	1	0	24.36	0	0
	826.5	20425	5	QPSK	1	12	24.47	0	0
	826.5	20425	5	QPSK	1	24	24.53	0	0
	826.5	20425	5	QPSK	12	0	23.06	0-1	1
	826.5	20425	5	QPSK	12	6	23.22	0-1	1
	826.5	20425	5	QPSK	12	13	23.21	0-1	1
	826.5	20425	5	QPSK	25	0	23.16	0-1	1
	826.5	20425	5	16-QAM	1	0	23.19	0-1	1
	826.5	20425	5	16-QAM	1	12	23.24	0-1	1
	826.5	20425	5	16-QAM	1	24	23.26	0-1	1
	826.5	20425	5	16-QAM	12	0	22.14	0-2	2
	826.5	20425	5	16-QAM	12	6	22.24	0-2	2
Mid	836.5	20525	5	QPSK	12	13	22.19	0-2	2
	826.5	20425	5	16-QAM	25	0	22.28	0-2	2
	836.5	20525	5	QPSK	1	0	24.42	0	0
	836.5	20525	5	QPSK	1	12	24.50	0	0
	836.5	20525	5	QPSK	1	24	24.49	0	0
	836.5	20525	5	QPSK	12	0	23.31	0-1	1
	836.5	20525	5	QPSK	12	6	23.32	0-1	1
	836.5	20525	5	QPSK	12	13	23.28	0-1	1
	836.5	20525	5	QPSK	25	0	23.27	0-1	1
	836.5	20525	5	16-QAM	1	0	23.31	0-1	1
	836.5	20525	5	16-QAM	1	12	23.34	0-1	1
	836.5	20525	5	16-QAM	1	24	23.29	0-1	1
High	846.5	20625	5	16-QAM	12	0	22.32	0-2	2
	846.5	20625	5	16-QAM	12	6	22.31	0-2	2
	836.5	20525	5	16-QAM	12	13	22.27	0-2	2
	836.5	20525	5	16-QAM	25	0	22.31	0-2	2
	846.5	20625	5	QPSK	1	0	24.41	0	0
	846.5	20625	5	QPSK	1	12	24.46	0	0
	846.5	20625	5	QPSK	1	24	24.43	0	0
	846.5	20625	5	QPSK	12	0	23.29	0-1	1
	846.5	20625	5	QPSK	12	6	23.20	0-1	1
	846.5	20625	5	QPSK	12	13	23.23	0-1	1
	846.5	20625	5	QPSK	25	0	23.19	0-1	1
	846.5	20625	5	16-QAM	1	0	23.34	0-1	1
	846.5	20625	5	16-QAM	1	12	23.33	0-1	1
	846.5	20625	5	16-QAM	1	24	23.27	0-1	1
	846.5	20625	5	16-QAM	12	0	22.29	0-2	2
	846.5	20625	5	16-QAM	12	6	22.22	0-2	2
	846.5	20625	5	16-QAM	12	13	22.27	0-2	2
	846.5	20625	5	16-QAM	25	0	22.25	0-2	2

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 22 of 76	

8.2.4 LTE Band 5 (Cell) Reduced Power - Body at 0mm

Table 8-7
LTE Band 5 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	836.5	20525	10	QPSK	1	0	20.37	0	0
	836.5	20525	10	QPSK	1	25	20.34	0	0
	836.5	20525	10	QPSK	1	49	20.50	0	0
	836.5	20525	10	QPSK	25	0	19.18	0-1	1
	836.5	20525	10	QPSK	25	12	19.24	0-1	1
	836.5	20525	10	QPSK	25	25	19.27	0-1	1
	836.5	20525	10	QPSK	50	0	19.25	0-1	1
	836.5	20525	10	16QAM	1	0	19.25	0-1	1
	836.5	20525	10	16QAM	1	25	19.41	0-1	1
	836.5	20525	10	16QAM	1	49	19.34	0-1	1
	836.5	20525	10	16QAM	25	0	18.22	0-2	2
	836.5	20525	10	16QAM	25	12	18.16	0-2	2
	836.5	20525	10	16QAM	25	25	18.26	0-2	2
	836.5	20525	10	16QAM	50	0	18.24	0-2	2

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 23 of 76

Table 8-8
LTE Band 5 Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	826.5	20425	5	QPSK	1	0	20.26	0	0
	826.5	20425	5	QPSK	1	12	20.21	0	0
	826.5	20425	5	QPSK	1	24	20.24	0	0
	826.5	20425	5	QPSK	12	0	19.03	0-1	1
	826.5	20425	5	QPSK	12	6	19.00	0-1	1
	826.5	20425	5	QPSK	12	13	19.00	0-1	1
	826.5	20425	5	QPSK	25	0	19.08	0-1	1
	826.5	20425	5	16-QAM	1	0	18.68	0-1	1
	826.5	20425	5	16-QAM	1	12	18.59	0-1	1
	826.5	20425	5	16-QAM	1	24	19.06	0-1	1
	826.5	20425	5	16-QAM	12	0	18.01	0-2	2
	826.5	20425	5	16-QAM	12	6	17.96	0-2	2
Mid	836.5	20525	5	QPSK	12	13	17.91	0-2	2
	826.5	20425	5	16-QAM	25	0	17.89	0-2	2
	836.5	20525	5	QPSK	1	0	20.30	0	0
	836.5	20525	5	QPSK	1	12	20.31	0	0
	836.5	20525	5	QPSK	1	24	20.40	0	0
	836.5	20525	5	QPSK	12	0	19.21	0-1	1
	836.5	20525	5	QPSK	12	6	19.22	0-1	1
	836.5	20525	5	QPSK	12	13	19.25	0-1	1
	836.5	20525	5	QPSK	25	0	19.19	0-1	1
	836.5	20525	5	16-QAM	1	0	19.11	0-1	1
	836.5	20525	5	16-QAM	1	12	19.05	0-1	1
	836.5	20525	5	16-QAM	1	24	19.35	0-1	1
High	846.5	20625	5	16-QAM	12	0	18.13	0-2	2
	846.5	20625	5	16-QAM	12	6	18.10	0-2	2
	836.5	20525	5	16-QAM	12	13	18.15	0-2	2
	836.5	20525	5	16-QAM	25	0	18.20	0-2	2
	846.5	20625	5	QPSK	1	0	20.50	0	0
	846.5	20625	5	QPSK	1	12	20.43	0	0
	846.5	20625	5	QPSK	1	24	20.32	0	0
	846.5	20625	5	QPSK	12	0	19.24	0-1	1
	846.5	20625	5	QPSK	12	6	19.30	0-1	1
	846.5	20625	5	QPSK	12	13	19.15	0-1	1
	846.5	20625	5	QPSK	25	0	19.16	0-1	1
	846.5	20625	5	16-QAM	1	0	19.27	0-1	1
	846.5	20625	5	16-QAM	1	12	19.25	0-1	1
	846.5	20625	5	16-QAM	1	24	19.11	0-1	1
	846.5	20625	5	16-QAM	12	0	18.20	0-2	2
	846.5	20625	5	16-QAM	12	6	18.22	0-2	2
	846.5	20625	5	16-QAM	12	13	18.03	0-2	2
	846.5	20625	5	16-QAM	25	0	18.13	0-2	2

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 24 of 76	

8.2.5 LTE Band 4 Maximum Power

Table 8-9
LTE Band 4 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1715	20000	10	QPSK	1	0	23.83	0	0
	1715	20000	10	QPSK	1	25	23.63	0	0
	1715	20000	10	QPSK	1	49	23.76	0	0
	1715	20000	10	QPSK	25	0	22.71	0-1	1
	1715	20000	10	QPSK	25	12	22.64	0-1	1
	1715	20000	10	QPSK	25	25	22.75	0-1	1
	1715	20000	10	QPSK	50	0	22.74	0-1	1
	1715	20000	10	16QAM	1	0	22.59	0-1	1
	1715	20000	10	16QAM	1	25	22.70	0-1	1
	1715	20000	10	16QAM	1	49	22.83	0-1	1
	1715	20000	10	16QAM	25	0	21.76	0-2	2
	1715	20000	10	16QAM	25	12	21.75	0-2	2
Mid	1715	20000	10	16QAM	25	25	21.72	0-2	2
	1715	20000	10	16QAM	50	0	21.80	0-2	2
	1732.5	20175	10	QPSK	1	0	23.83	0	0
	1732.5	20175	10	QPSK	1	25	23.80	0	0
	1732.5	20175	10	QPSK	1	49	23.92	0	0
	1732.5	20175	10	QPSK	25	0	22.94	0-1	1
	1732.5	20175	10	QPSK	25	12	22.86	0-1	1
	1732.5	20175	10	QPSK	25	25	22.99	0-1	1
	1732.5	20175	10	QPSK	50	0	22.99	0-1	1
	1732.5	20175	10	16QAM	1	0	22.71	0-1	1
	1732.5	20175	10	16QAM	1	25	22.85	0-1	1
	1732.5	20175	10	16QAM	1	49	22.87	0-1	1
High	1732.5	20175	10	16QAM	25	0	21.94	0-2	2
	1732.5	20175	10	16QAM	25	12	22.00	0-2	2
	1732.5	20175	10	16QAM	25	25	21.98	0-2	2
	1732.5	20175	10	16QAM	50	0	21.99	0-2	2
	1750	20350	10	QPSK	1	0	24.00	0	0
	1750	20350	10	QPSK	1	25	23.99	0	0
	1750	20350	10	QPSK	1	49	23.97	0	0
	1750	20350	10	QPSK	25	0	23.00	0-1	1
	1750	20350	10	QPSK	25	12	22.93	0-1	1
	1750	20350	10	QPSK	25	25	22.98	0-1	1
	1750	20350	10	QPSK	50	0	22.99	0-1	1
	1750	20350	10	16QAM	1	0	22.88	0-1	1
	1750	20350	10	16QAM	1	25	22.58	0-1	1
	1750	20350	10	16QAM	1	49	22.83	0-1	1
	1750	20350	10	16QAM	25	0	21.91	0-2	2
	1750	20350	10	16QAM	25	12	21.99	0-2	2
	1750	20350	10	16QAM	25	25	21.97	0-2	2
	1750	20350	10	16QAM	50	0	21.94	0-2	2

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 25 of 76

Table 8-10
LTE Band 4 Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1712.5	19975	5	QPSK	1	0	23.89	0	0
	1712.5	19975	5	QPSK	1	12	23.81	0	0
	1712.5	19975	5	QPSK	1	24	23.23	0	0
	1712.5	19975	5	QPSK	12	0	22.72	0-1	1
	1712.5	19975	5	QPSK	12	6	22.72	0-1	1
	1712.5	19975	5	QPSK	12	13	22.70	0-1	1
	1712.5	19975	5	QPSK	25	0	22.25	0-1	1
	1712.5	19975	5	16-QAM	1	0	22.45	0-1	1
	1712.5	19975	5	16-QAM	1	12	22.43	0-1	1
	1712.5	19975	5	16-QAM	1	24	22.50	0-1	1
	1712.5	19975	5	16-QAM	12	0	21.34	0-2	2
	1712.5	19975	5	16-QAM	12	6	21.48	0-2	2
Mid	1712.5	19975	5	16-QAM	12	13	21.65	0-2	2
	1712.5	19975	5	16-QAM	25	0	21.78	0-2	2
	1732.5	20175	5	QPSK	1	0	24.00	0	0
	1732.5	20175	5	QPSK	1	12	23.97	0	0
	1732.5	20175	5	QPSK	1	24	23.99	0	0
	1732.5	20175	5	QPSK	12	0	22.87	0-1	1
	1732.5	20175	5	QPSK	12	6	22.94	0-1	1
	1732.5	20175	5	QPSK	12	13	22.93	0-1	1
	1732.5	20175	5	QPSK	25	0	22.86	0-1	1
	1732.5	20175	5	16-QAM	1	0	22.87	0-1	1
	1732.5	20175	5	16-QAM	1	12	22.83	0-1	1
	1732.5	20175	5	16-QAM	1	24	23.00	0-1	1
High	1732.5	20175	5	16-QAM	12	0	21.90	0-2	2
	1732.5	20175	5	16-QAM	12	6	21.84	0-2	2
	1732.5	20175	5	16-QAM	12	13	21.92	0-2	2
	1732.5	20175	5	16-QAM	25	0	21.93	0-2	2
	1752.5	20375	5	QPSK	1	0	23.97	0	0
	1752.5	20375	5	QPSK	1	12	23.95	0	0
	1752.5	20375	5	QPSK	1	24	23.95	0	0
	1752.5	20375	5	QPSK	12	0	23.00	0-1	1
	1752.5	20375	5	QPSK	12	6	22.96	0-1	1
	1752.5	20375	5	QPSK	12	13	22.89	0-1	1
	1752.5	20375	5	QPSK	25	0	22.96	0-1	1
	1752.5	20375	5	16-QAM	1	0	22.86	0-1	1
	1752.5	20375	5	16-QAM	1	12	22.81	0-1	1
	1752.5	20375	5	16-QAM	1	24	22.89	0-1	1
	1752.5	20375	5	16-QAM	12	0	21.92	0-2	2
	1752.5	20375	5	16-QAM	12	6	21.92	0-2	2
	1752.5	20375	5	16-QAM	12	13	21.93	0-2	2
	1752.5	20375	5	16-QAM	25	0	22.00	0-2	2

8.2.6 LTE Band 4 (AWS) Reduced Power - Body at 0mm

Table 8-11
LTE Band 4 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1715	20000	10	QPSK	1	0	12.37	0	0
	1715	20000	10	QPSK	1	25	12.35	0	0
	1715	20000	10	QPSK	1	49	12.16	0	0
	1715	20000	10	QPSK	25	0	11.50	0-1	1
	1715	20000	10	QPSK	25	12	11.32	0-1	1
	1715	20000	10	QPSK	25	25	11.37	0-1	1
	1715	20000	10	QPSK	50	0	11.37	0-1	1
	1715	20000	10	16QAM	1	0	11.23	0-1	1
	1715	20000	10	16QAM	1	25	11.50	0-1	1
	1715	20000	10	16QAM	1	49	11.39	0-1	1
	1715	20000	10	16QAM	25	0	10.44	0-2	2
	1715	20000	10	16QAM	25	12	10.28	0-2	2
Mid	1715	20000	10	16QAM	25	25	10.33	0-2	2
	1715	20000	10	16QAM	50	0	10.46	0-2	2
	1732.5	20175	10	QPSK	1	0	12.03	0	0
	1732.5	20175	10	QPSK	1	25	12.00	0	0
	1732.5	20175	10	QPSK	1	49	12.00	0	0
	1732.5	20175	10	QPSK	25	0	11.30	0-1	1
	1732.5	20175	10	QPSK	25	12	11.49	0-1	1
	1732.5	20175	10	QPSK	25	25	11.48	0-1	1
	1732.5	20175	10	QPSK	50	0	11.45	0-1	1
	1732.5	20175	10	16QAM	1	0	11.43	0-1	1
	1732.5	20175	10	16QAM	1	25	11.44	0-1	1
	1732.5	20175	10	16QAM	1	49	11.48	0-1	1
High	1732.5	20175	10	16QAM	25	0	10.40	0-2	2
	1732.5	20175	10	16QAM	25	12	10.50	0-2	2
	1732.5	20175	10	16QAM	25	25	10.50	0-2	2
	1732.5	20175	10	16QAM	50	0	10.42	0-2	2
	1750	20350	10	QPSK	1	0	12.29	0	0
	1750	20350	10	QPSK	1	25	12.19	0	0
	1750	20350	10	QPSK	1	49	12.24	0	0
	1750	20350	10	QPSK	25	0	11.12	0-1	1
	1750	20350	10	QPSK	25	12	11.12	0-1	1
	1750	20350	10	QPSK	25	25	11.00	0-1	1
	1750	20350	10	QPSK	50	0	11.13	0-1	1
	1750	20350	10	16QAM	1	0	11.30	0-1	1
	1750	20350	10	16QAM	1	25	11.21	0-1	1
	1750	20350	10	16QAM	1	49	11.10	0-1	1
	1750	20350	10	16QAM	25	0	10.10	0-2	2
	1750	20350	10	16QAM	25	12	10.13	0-2	2
	1750	20350	10	16QAM	25	25	10.01	0-2	2
	1750	20350	10	16QAM	50	0	10.12	0-2	2

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 27 of 76

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1712.5	19975	5	QPSK	1	0	11.83	0	0
	1712.5	19975	5	QPSK	1	12	11.88	0	0
	1712.5	19975	5	QPSK	1	24	11.83	0	0
	1712.5	19975	5	QPSK	12	0	10.79	0-1	1
	1712.5	19975	5	QPSK	12	6	10.74	0-1	1
	1712.5	19975	5	QPSK	12	13	10.75	0-1	1
	1712.5	19975	5	QPSK	25	0	10.74	0-1	1
	1712.5	19975	5	16-QAM	1	0	11.00	0-1	1
	1712.5	19975	5	16-QAM	1	12	11.06	0-1	1
	1712.5	19975	5	16-QAM	1	24	11.00	0-1	1
	1712.5	19975	5	16-QAM	12	0	9.80	0-2	2
	1712.5	19975	5	16-QAM	12	6	9.73	0-2	2
Mid	1712.5	19975	5	16-QAM	12	13	9.76	0-2	2
	1712.5	19975	5	16-QAM	25	0	9.68	0-2	2
	1732.5	20175	5	QPSK	1	0	12.00	0	0
	1732.5	20175	5	QPSK	1	12	12.11	0	0
	1732.5	20175	5	QPSK	1	24	12.01	0	0
	1732.5	20175	5	QPSK	12	0	10.88	0-1	1
	1732.5	20175	5	QPSK	12	6	10.68	0-1	1
	1732.5	20175	5	QPSK	12	13	10.77	0-1	1
	1732.5	20175	5	QPSK	25	0	10.80	0-1	1
	1732.5	20175	5	16-QAM	1	0	10.97	0-1	1
	1732.5	20175	5	16-QAM	1	12	10.87	0-1	1
	1732.5	20175	5	16-QAM	1	24	11.26	0-1	1
High	1732.5	20175	5	16-QAM	12	0	9.81	0-2	2
	1732.5	20175	5	16-QAM	12	6	9.70	0-2	2
	1732.5	20175	5	16-QAM	12	13	9.78	0-2	2
	1732.5	20175	5	16-QAM	25	0	9.75	0-2	2
	1752.5	20375	5	QPSK	1	0	11.70	0	0
	1752.5	20375	5	QPSK	1	12	11.64	0	0
	1752.5	20375	5	QPSK	1	24	11.53	0	0
	1752.5	20375	5	QPSK	12	0	10.63	0-1	1
	1752.5	20375	5	QPSK	12	6	10.54	0-1	1
	1752.5	20375	5	QPSK	12	13	10.56	0-1	1
	1752.5	20375	5	QPSK	25	0	10.51	0-1	1
	1752.5	20375	5	16-QAM	1	0	10.85	0-1	1
	1752.5	20375	5	16-QAM	1	12	11.00	0-1	1
	1752.5	20375	5	16-QAM	1	24	10.87	0-1	1
	1752.5	20375	5	16-QAM	12	0	9.69	0-2	2
	1752.5	20375	5	16-QAM	12	6	9.56	0-2	2
	1752.5	20375	5	16-QAM	12	13	9.50	0-2	2
	1752.5	20375	5	16-QAM	25	0	9.51	0-2	2

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 28 of 76	

8.2.7 LTE Band 2 (PCS) Maximum Power

Table 8-13
LTE Band 2 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1855	18650	10	QPSK	1	0	23.48	0	0
	1855	18650	10	QPSK	1	25	23.27	0	0
	1855	18650	10	QPSK	1	49	23.47	0	0
	1855	18650	10	QPSK	25	0	22.48	0-1	1
	1855	18650	10	QPSK	25	12	22.26	0-1	1
	1855	18650	10	QPSK	25	25	22.40	0-1	1
	1855	18650	10	QPSK	50	0	22.46	0-1	1
	1855	18650	10	16QAM	1	0	22.37	0-1	1
	1855	18650	10	16QAM	1	25	22.39	0-1	1
	1855	18650	10	16QAM	1	49	22.38	0-1	1
	1855	18650	10	16QAM	25	0	21.50	0-2	2
	1855	18650	10	16QAM	25	12	21.49	0-2	2
	1855	18650	10	16QAM	25	25	21.48	0-2	2
Mid	1855	18650	10	16QAM	50	0	21.49	0-2	2
	1880.0	18900	10	QPSK	1	0	23.50	0	0
	1880.0	18900	10	QPSK	1	25	23.44	0	0
	1880.0	18900	10	QPSK	1	49	23.44	0	0
	1880.0	18900	10	QPSK	25	0	22.18	0-1	1
	1880.0	18900	10	QPSK	25	12	22.49	0-1	1
	1880.0	18900	10	QPSK	25	25	22.18	0-1	1
	1880.0	18900	10	QPSK	50	0	22.34	0-1	1
	1880.0	18900	10	16QAM	1	0	22.49	0-1	1
	1880.0	18900	10	16QAM	1	25	22.31	0-1	1
	1880.0	18900	10	16QAM	1	49	22.28	0-1	1
	1880.0	18900	10	16QAM	25	0	21.39	0-2	2
	1880.0	18900	10	16QAM	25	12	21.41	0-2	2
	1880.0	18900	10	16QAM	25	25	21.33	0-2	2
High	1880.0	18900	10	16QAM	50	0	21.29	0-2	2
	1905	19150	10	QPSK	1	0	23.40	0	0
	1905	19150	10	QPSK	1	25	23.23	0	0
	1905	19150	10	QPSK	1	49	23.23	0	0
	1905	19150	10	QPSK	25	0	22.13	0-1	1
	1905	19150	10	QPSK	25	12	22.15	0-1	1
	1905	19150	10	QPSK	25	25	22.20	0-1	1
	1905	19150	10	QPSK	50	0	22.27	0-1	1
	1905	19150	10	16QAM	1	0	22.16	0-1	1
	1905	19150	10	16QAM	1	25	22.00	0-1	1
	1905	19150	10	16QAM	1	49	22.05	0-1	1
	1905	19150	10	16QAM	25	0	21.14	0-2	2
	1905	19150	10	16QAM	25	12	21.17	0-2	2
	1905	19150	10	16QAM	25	25	21.28	0-2	2
	1905	19150	10	16QAM	50	0	21.12	0-2	2

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 29 of 76

Table 8-14
LTE Band 2 Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1852.5	18625	5	QPSK	1	0	23.50	0	0
	1852.5	18625	5	QPSK	1	12	23.49	0	0
	1852.5	18625	5	QPSK	1	24	23.48	0	0
	1852.5	18625	5	QPSK	12	0	22.25	0-1	1
	1852.5	18625	5	QPSK	12	6	22.48	0-1	1
	1852.5	18625	5	QPSK	12	13	22.50	0-1	1
	1852.5	18625	5	QPSK	25	0	22.47	0-1	1
	1852.5	18625	5	16-QAM	1	0	22.24	0-1	1
	1852.5	18625	5	16-QAM	1	12	21.63	0-1	1
	1852.5	18625	5	16-QAM	1	24	21.59	0-1	1
	1852.5	18625	5	16-QAM	12	0	21.44	0-2	2
	1852.5	18625	5	16-QAM	12	6	21.33	0-2	2
Mid	1852.5	18625	5	16-QAM	12	13	21.44	0-2	2
	1852.5	18625	5	16-QAM	25	0	21.45	0-2	2
	1880.0	18900	5	QPSK	1	0	23.50	0	0
	1880.0	18900	5	QPSK	1	12	23.31	0	0
	1880.0	18900	5	QPSK	1	24	23.49	0	0
	1880.0	18900	5	QPSK	12	0	22.10	0-1	1
	1880.0	18900	5	QPSK	12	6	22.20	0-1	1
	1880.0	18900	5	QPSK	12	13	22.28	0-1	1
	1880.0	18900	5	QPSK	25	0	22.21	0-1	1
	1880.0	18900	5	16-QAM	1	0	22.25	0-1	1
	1880.0	18900	5	16-QAM	1	12	22.35	0-1	1
	1880.0	18900	5	16-QAM	1	24	22.13	0-1	1
High	1880.0	18900	5	16-QAM	12	0	21.29	0-2	2
	1880.0	18900	5	16-QAM	12	6	21.31	0-2	2
	1880.0	18900	5	16-QAM	12	13	21.27	0-2	2
	1880.0	18900	5	16-QAM	25	0	21.35	0-2	2
	1907.5	19175	5	QPSK	1	0	23.24	0	0
	1907.5	19175	5	QPSK	1	12	23.25	0	0
	1907.5	19175	5	QPSK	1	24	23.39	0	0
	1907.5	19175	5	QPSK	12	0	22.15	0-1	1
	1907.5	19175	5	QPSK	12	6	22.10	0-1	1
	1907.5	19175	5	QPSK	12	13	22.19	0-1	1
	1907.5	19175	5	QPSK	25	0	22.05	0-1	1
	1907.5	19175	5	16-QAM	1	0	22.05	0-1	1
	1907.5	19175	5	16-QAM	1	12	22.22	0-1	1
	1907.5	19175	5	16-QAM	1	24	22.22	0-1	1
	1907.5	19175	5	16-QAM	12	0	21.12	0-2	2
	1907.5	19175	5	16-QAM	12	6	21.07	0-2	2
	1907.5	19175	5	16-QAM	12	13	21.09	0-2	2
	1907.5	19175	5	16-QAM	25	0	21.19	0-2	2

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 30 of 76	

8.2.8 LTE Band 2 (PCS) Reduced Power – Body at 0mm

Table 8-15
LTE Band 2 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1855	18650	10	QPSK	1	0	12.15	0	0
	1855	18650	10	QPSK	1	25	12.00	0	0
	1855	18650	10	QPSK	1	49	11.86	0	0
	1855	18650	10	QPSK	25	0	10.82	0-1	1
	1855	18650	10	QPSK	25	12	10.79	0-1	1
	1855	18650	10	QPSK	25	25	10.75	0-1	1
	1855	18650	10	QPSK	50	0	10.76	0-1	1
	1855	18650	10	16QAM	1	0	11.21	0-1	1
	1855	18650	10	16QAM	1	25	11.07	0-1	1
	1855	18650	10	16QAM	1	49	10.98	0-1	1
	1855	18650	10	16QAM	25	0	9.75	0-2	2
	1855	18650	10	16QAM	25	12	9.72	0-2	2
	1855	18650	10	16QAM	25	25	9.66	0-2	2
	1855	18650	10	16QAM	50	0	9.69	0-2	2
Mid	1880.0	18900	10	QPSK	1	0	12.38	0	0
	1880.0	18900	10	QPSK	1	25	12.35	0	0
	1880.0	18900	10	QPSK	1	49	12.34	0	0
	1880.0	18900	10	QPSK	25	0	11.47	0-1	1
	1880.0	18900	10	QPSK	25	12	11.48	0-1	1
	1880.0	18900	10	QPSK	25	25	11.46	0-1	1
	1880.0	18900	10	QPSK	50	0	11.43	0-1	1
	1880.0	18900	10	16QAM	1	0	11.48	0-1	1
	1880.0	18900	10	16QAM	1	25	11.45	0-1	1
	1880.0	18900	10	16QAM	1	49	11.49	0-1	1
	1880.0	18900	10	16QAM	25	0	10.26	0-2	2
	1880.0	18900	10	16QAM	25	12	10.33	0-2	2
	1880.0	18900	10	16QAM	25	25	10.23	0-2	2
	1880.0	18900	10	16QAM	50	0	10.24	0-2	2
High	1905	19150	10	QPSK	1	0	11.69	0	0
	1905	19150	10	QPSK	1	25	11.57	0	0
	1905	19150	10	QPSK	1	49	11.67	0	0
	1905	19150	10	QPSK	25	0	10.77	0-1	1
	1905	19150	10	QPSK	25	12	10.81	0-1	1
	1905	19150	10	QPSK	25	25	10.79	0-1	1
	1905	19150	10	QPSK	50	0	10.76	0-1	1
	1905	19150	10	16QAM	1	0	10.83	0-1	1
	1905	19150	10	16QAM	1	25	10.70	0-1	1
	1905	19150	10	16QAM	1	49	10.91	0-1	1
	1905	19150	10	16QAM	25	0	9.69	0-2	2
	1905	19150	10	16QAM	25	12	9.80	0-2	2
	1905	19150	10	16QAM	25	25	9.73	0-2	2
	1905	19150	10	16QAM	50	0	9.72	0-2	2

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 31 of 76

Table 8-16
LTE Band 2 Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1852.5	18625	5	QPSK	1	0	11.89	0	0
	1852.5	18625	5	QPSK	1	12	11.74	0	0
	1852.5	18625	5	QPSK	1	24	11.80	0	0
	1852.5	18625	5	QPSK	12	0	10.80	0-1	1
	1852.5	18625	5	QPSK	12	6	10.80	0-1	1
	1852.5	18625	5	QPSK	12	13	10.70	0-1	1
	1852.5	18625	5	QPSK	25	0	10.77	0-1	1
	1852.5	18625	5	16-QAM	1	0	11.03	0-1	1
	1852.5	18625	5	16-QAM	1	12	10.98	0-1	1
	1852.5	18625	5	16-QAM	1	24	11.04	0-1	1
	1852.5	18625	5	16-QAM	12	0	9.85	0-2	2
	1852.5	18625	5	16-QAM	12	6	9.81	0-2	2
	1852.5	18625	5	16-QAM	12	13	9.78	0-2	2
	1852.5	18625	5	16-QAM	25	0	9.72	0-2	2
Mid	1880.0	18900	5	QPSK	1	0	11.74	0	0
	1880.0	18900	5	QPSK	1	12	11.73	0	0
	1880.0	18900	5	QPSK	1	24	11.69	0	0
	1880.0	18900	5	QPSK	12	0	10.70	0-1	1
	1880.0	18900	5	QPSK	12	6	10.73	0-1	1
	1880.0	18900	5	QPSK	12	13	10.68	0-1	1
	1880.0	18900	5	QPSK	25	0	10.64	0-1	1
	1880.0	18900	5	16-QAM	1	0	10.51	0-1	1
	1880.0	18900	5	16-QAM	1	12	10.71	0-1	1
	1880.0	18900	5	16-QAM	1	24	11.05	0-1	1
	1880.0	18900	5	16-QAM	12	0	9.74	0-2	2
	1880.0	18900	5	16-QAM	12	6	9.78	0-2	2
	1880.0	18900	5	16-QAM	12	13	9.70	0-2	2
	1880.0	18900	5	16-QAM	25	0	9.61	0-2	2
High	1907.5	19175	5	QPSK	1	0	11.60	0	0
	1907.5	19175	5	QPSK	1	12	11.68	0	0
	1907.5	19175	5	QPSK	1	24	11.57	0	0
	1907.5	19175	5	QPSK	12	0	10.76	0-1	1
	1907.5	19175	5	QPSK	12	6	10.80	0-1	1
	1907.5	19175	5	QPSK	12	13	10.75	0-1	1
	1907.5	19175	5	QPSK	25	0	10.76	0-1	1
	1907.5	19175	5	16-QAM	1	0	10.74	0-1	1
	1907.5	19175	5	16-QAM	1	12	11.04	0-1	1
	1907.5	19175	5	16-QAM	1	24	10.55	0-1	1
	1907.5	19175	5	16-QAM	12	0	9.74	0-2	2
	1907.5	19175	5	16-QAM	12	6	9.83	0-2	2
	1907.5	19175	5	16-QAM	12	13	9.76	0-2	2
	1907.5	19175	5	16-QAM	25	0	9.77	0-2	2

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 32 of 76	

8.3 WLAN Conducted Powers

Table 8-17
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	802.11b Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1*	11.85	11.91	11.92	12.01
802.11b	2437	6*	11.47	11.62	11.57	11.60
802.11b	2462	11*	11.38	11.46	11.71	11.50

Table 8-18
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	802.11g Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	8.21	8.16	8.18	8.08	8.17	8.07	8.04	8.16
802.11g	2437	6	8.03	8.23	8.13	8.07	7.95	8.19	8.17	8.09
802.11g	2462	11	7.89	8.04	8.06	7.88	7.81	8.05	8.07	7.89

Table 8-19
IEEE 802.11n Average RF Power

Mode	Freq [MHz]	Channel	802.11n (2.4GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	19.5	26	39	52	58.5	65
802.11n	2412	1	7.24	7.36	7.39	7.33	7.34	7.37	7.24	7.49
802.11n	2437	6	7.15	6.95	7.07	6.92	7.08	6.92	7.04	6.97
802.11n	2462	11	7.14	7.12	6.84	6.95	6.91	7.04	6.89	6.90

Table 8-20
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	802.11a Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	7.76	7.68	7.84	7.96	7.90	7.83	7.76	7.69
802.11a	5200	40	7.74	7.73	7.84	7.98	7.68	7.75	7.74	7.76
802.11a	5220	44	7.80	7.80	7.82	7.80	7.88	7.93	7.81	7.74
802.11a	5240	48*	7.85	7.87	7.98	7.99	7.82	7.72	7.90	7.79
802.11a	5260	52*	7.58	7.60	7.69	7.67	7.65	7.54	7.71	7.42
802.11a	5280	56	7.69	7.76	7.81	7.87	7.81	7.68	7.77	7.69
802.11a	5300	60	7.75	7.67	7.86	7.86	7.80	7.72	7.80	7.59
802.11a	5320	64*	7.65	7.59	7.80	7.80	7.63	7.56	7.67	7.46
802.11a	5500	100	7.45	7.52	7.58	7.61	7.50	7.51	7.54	7.44
802.11a	5520	104*	7.41	7.40	7.56	7.51	7.38	7.35	7.35	7.31
802.11a	5540	108	7.67	7.67	7.79	7.87	7.68	7.70	7.75	7.56
802.11a	5560	112	7.58	7.66	7.77	7.60	7.62	7.50	7.56	7.52
802.11a	5580	116*	7.61	7.65	7.71	7.67	7.62	7.62	7.65	7.56
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	7.43	7.46	7.42	7.43	7.51	7.54	7.39	7.28
802.11a	5680	136*	7.48	7.40	7.59	7.59	7.60	7.58	7.54	7.42
802.11a	5700	140	7.32	7.35	7.37	7.54	7.39	7.32	7.42	7.18
802.11a	5745	149*	7.53	7.50	7.52	7.67	7.69	7.51	7.54	7.47
802.11a	5765	153	7.61	7.59	7.73	7.69	7.72	7.50	7.82	7.57
802.11a	5785	157*	7.33	7.41	7.43	7.45	7.41	7.24	7.35	7.35
802.11a	5805	161	7.27	7.24	7.33	7.38	7.30	7.37	7.34	7.24
802.11a	5825	165*	7.34	7.30	7.46	7.46	7.43	7.43	7.47	7.34

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.

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 33 of 76

Table 8-21
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	19.5	26	39	52	58.5	65
802.11n	5180	36	7.71	7.62	7.66	7.71	7.69	7.52	7.66	7.60
802.11n	5200	40	7.74	7.65	7.74	7.76	7.62	7.64	7.77	7.76
802.11n	5220	44	7.77	7.69	7.83	7.82	7.70	7.75	7.58	7.56
802.11n	5240	48	7.79	7.80	7.82	7.69	7.83	7.62	7.74	7.72
802.11n	5260	52	7.51	7.58	7.45	7.45	7.56	7.35	7.48	7.46
802.11n	5280	56	7.57	7.59	7.46	7.62	7.44	7.44	7.52	7.41
802.11n	5300	60	7.62	7.56	7.64	7.54	7.69	7.52	7.56	7.62
802.11n	5320	64	7.59	7.68	7.57	7.65	7.54	7.55	7.42	7.53
802.11n	5500	100	7.90	7.91	7.89	7.79	7.77	7.85	7.88	7.90
802.11n	5520	104	7.77	7.77	7.91	7.85	7.75	7.84	7.79	7.76
802.11n	5540	108	7.80	7.75	7.78	7.85	7.74	7.71	7.78	7.80
802.11n	5560	112	7.73	7.75	7.90	7.68	7.89	7.75	7.85	7.80
802.11n	5580	116	7.83	7.74	7.81	7.79	7.73	7.86	7.85	7.81
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	7.68	7.69	7.70	7.87	7.79	7.72	7.77	7.75
802.11n	5680	136	7.70	7.66	7.80	7.68	7.76	7.64	7.76	7.81
802.11n	5700	140	7.55	7.57	7.54	7.65	7.53	7.69	7.62	7.55
802.11n	5745	149	7.77	7.80	7.75	7.84	7.85	7.79	7.71	7.75
802.11n	5765	153	7.68	7.69	7.70	7.71	7.78	7.68	7.73	7.80
802.11n	5785	157	7.45	7.55	7.37	7.63	7.50	7.60	7.52	7.56
802.11n	5805	161	7.41	7.42	7.38	7.62	7.35	7.46	7.50	7.61
802.11n	5825	165	7.45	7.46	7.61	7.52	7.60	7.60	7.69	7.65

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.

Table 8-22
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	27	40.5	54	81	108	121.5	135
802.11n	5190	38	7.47	7.46	7.60	7.47	7.23	7.36	7.21	7.25
802.11n	5230	46	7.56	7.55	7.80	7.46	7.32	7.49	7.52	7.45
802.11n	5270	54	7.41	7.37	7.59	7.38	7.19	7.37	7.16	7.21
802.11n	5310	62	7.43	7.41	7.61	7.36	7.12	7.20	7.10	7.23
802.11n	5510	102	7.31	7.21	7.37	7.20	6.94	7.18	7.13	7.06
802.11n	5550	110	7.51	7.53	7.63	7.46	7.30	7.41	7.33	7.20
802.11n	5590	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5630	126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5670	134	7.32	7.40	7.55	7.34	7.05	7.30	7.09	7.25
802.11n	5755	151	7.33	7.32	7.39	7.40	7.48	7.22	7.30	7.33
802.11n	5795	159	7.12	7.02	7.27	7.18	7.18	7.00	7.20	7.03

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: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 34 of 76	

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012/April 2013 FCC/TCB Meeting Notes:

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

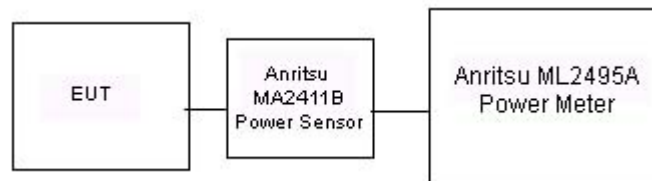


Figure 8-2
Power Measurement Setup

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 35 of 76

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
3/29/2014	740B	23.5	695	0.920	54.512	0.959	55.745	-4.07%	-2.21%
			710	0.935	54.347	0.960	55.687	-2.60%	-2.41%
			725	0.949	54.147	0.961	55.629	-1.25%	-2.66%
			740	0.963	53.938	0.963	55.570	0.00%	-2.94%
			755	0.977	53.736	0.964	55.512	1.35%	-3.20%
3/27/2014	835B	22.5	820	0.991	54.297	0.969	55.258	2.27%	-1.74%
			835	1.005	54.137	0.970	55.200	3.61%	-1.93%
			850	1.020	53.994	0.988	55.154	3.24%	-2.10%
3/25/2014	1750B	20.6	1710	1.507	52.592	1.463	53.537	3.01%	-1.77%
			1750	1.549	52.494	1.488	53.432	4.10%	-1.76%
			1790	1.589	52.342	1.514	53.326	4.95%	-1.85%
3/31/2014	1900B	23.3	1850	1.510	51.115	1.520	53.300	-0.66%	-4.10%
			1880	1.545	51.042	1.520	53.300	1.64%	-4.24%
			1910	1.581	50.925	1.520	53.300	4.01%	-4.46%
3/27/2014	2450B	22.9	2401	1.974	52.038	1.903	52.765	3.73%	-1.38%
			2450	2.042	51.875	1.950	52.700	4.72%	-1.57%
			2499	2.111	51.737	2.019	52.638	4.56%	-1.71%
03/25/2014	5200B-5800B	23.2	5745	6.203	46.617	5.936	48.275	4.50%	-3.43%
			5765	6.228	46.672	5.959	48.248	4.51%	-3.27%
			5800	6.279	46.726	6.000	48.200	4.65%	-3.06%
			5825	6.301	46.761	6.029	48.166	4.51%	-2.92%
04/01/2014	5200B-5800B	23.6	5180	5.242	48.673	5.276	49.041	-0.64%	-0.75%
			5200	5.271	48.586	5.299	49.014	-0.53%	-0.87%
			5240	5.346	48.508	5.346	48.960	0.00%	-0.92%
			5280	5.394	48.438	5.393	48.906	0.02%	-0.96%
			5300	5.431	48.317	5.416	48.879	0.28%	-1.15%
			5500	5.741	47.868	5.650	48.607	1.61%	-1.52%
			5540	5.794	47.785	5.696	48.553	1.72%	-1.58%
			5580	5.839	47.638	5.743	48.499	1.67%	-1.78%
			5600	5.879	47.624	5.766	48.471	1.96%	-1.75%
			5680	6.000	47.511	5.860	48.363	2.39%	-1.76%
			5745	6.117	47.327	5.936	48.275	3.05%	-1.96%
			5765	6.140	47.286	5.959	48.248	3.04%	-1.99%
			5800	6.180	47.185	6.000	48.200	3.00%	-2.11%
			5825	6.223	47.134	6.029	48.166	3.22%	-2.14%

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 36 of 76

9.2 Test System Verification

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

Table 9-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation _{1g} (%)
E	750	BODY	03/29/2014	24.1	23.4	0.100	1003	3914	0.869	8.770	8.690	-0.91%
K	835	BODY	03/27/2014	24.5	22.5	0.100	4d119	3333	1.000	9.540	10.000	4.82%
C	1750	BODY	03/25/2014	22.0	20.2	0.100	1008	3263	3.880	38.200	38.800	1.57%
D	1900	BODY	03/31/2014	23.2	21.6	0.100	5d149	3022	4.200	40.500	42.000	3.70%
H	2450	BODY	03/27/2014	23.8	23.0	0.040	719	3589	2.010	51.700	50.250	-2.80%
A	5800	BODY	03/25/2014	22.4	21.9	0.100	1007	3920	7.570	72.900	75.700	3.84%
A	5200	BODY	04/01/2014	23.8	22.3	0.100	1007	3920	7.580	72.600	75.800	4.41%
A	5300	BODY	04/01/2014	23.8	22.3	0.100	1007	3920	7.940	74.700	79.400	6.29%
A	5500	BODY	04/01/2014	23.8	22.3	0.100	1007	3920	7.740	75.900	77.400	1.98%
A	5600	BODY	04/01/2014	23.8	22.3	0.100	1007	3920	7.840	77.300	78.400	1.42%
A	5800	BODY	04/01/2014	23.8	22.3	0.100	1007	3920	7.460	72.900	74.600	2.33%

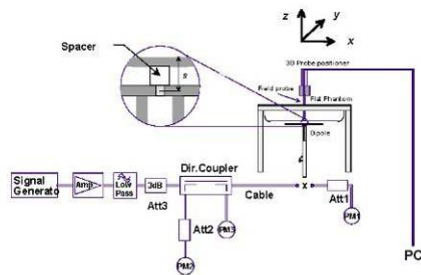


Figure 9-1
System Verification Setup Diagram



Figure 9-2
System Verification Setup Photo

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 37 of 76

10 SAR DATA SUMMARY

10.1 Standalone Body SAR Data

Table 10-1
CDMA 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)	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.0	24.12	0.07	22 mm	22	1:1	back	0.243	1.225	0.298	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.0	24.12	-0.05	22 mm	22	1:1	top	0.080	1.225	0.098	
824.70	1013	Cell. CDMA	EVDO Rev. 0	20.5	20.50	0.02	0 mm	99	1:1	back	0.905	1.000	0.905	A1
836.52	384	Cell. CDMA	EVDO Rev. 0	20.5	20.49	-0.05	0 mm	99	1:1	back	0.892	1.002	0.894	
848.31	777	Cell. CDMA	EVDO Rev. 0	20.5	20.47	-0.02	0 mm	99	1:1	back	0.882	1.007	0.888	
836.52	384	Cell. CDMA	EVDO Rev. 0	20.5	20.49	-0.01	0 mm	99	1:1	top	0.476	1.002	0.477	
836.52	384	Cell. CDMA	EVDO Rev. 0	25.0	24.12	0.04	0 mm	22	1:1	right	0.135	1.225	0.165	
824.70	1013	Cell. CDMA	EVDO Rev. 0	20.5	20.50	0.00	0 mm	99	1:1	back	0.905	1.000	0.905	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.5	24.03	-0.02	22 mm	22	1:1	back	0.574	1.114	0.639	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.5	24.03	0.01	22 mm	22	1:1	top	0.614	1.114	0.684	
1851.25	25	PCS CDMA	EVDO Rev. 0	13.0	12.94	0.00	0 mm	99	1:1	back	0.908	1.014	0.921	
1880.00	600	PCS CDMA	EVDO Rev. 0	13.0	12.89	0.00	0 mm	99	1:1	back	0.912	1.026	0.936	A2
1908.75	1175	PCS CDMA	EVDO Rev. 0	13.0	12.91	-0.03	0 mm	99	1:1	back	0.888	1.021	0.907	
1880.00	600	PCS CDMA	EVDO Rev. 0	13.0	12.89	-0.06	0 mm	99	1:1	top	0.416	1.026	0.427	
1880.00	600	PCS CDMA	EVDO Rev. 0	24.5	24.03	-0.09	0 mm	22	1:1	right	0.061	1.114	0.068	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram							

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

Table 10-2
LTE Band 12 Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
707.50	23095	Mid	LTE Band 12	10	24.5	24.12	0.00	0	70	QPSK	1	25	22 mm	back	1:1	0.121	1.091	0.132	
707.50	23095	Mid	LTE Band 12	10	23.5	23.08	-0.01	1	70	QPSK	25	0	22 mm	back	1:1	0.091	1.102	0.100	
707.50	23095	Mid	LTE Band 12	10	24.5	24.12	0.01	0	70	QPSK	1	25	22 mm	top	1:1	0.039	1.091	0.043	
707.50	23095	Mid	LTE Band 12	10	23.5	23.08	0.09	1	70	QPSK	25	0	22 mm	top	1:1	0.030	1.102	0.033	
707.50	23095	Mid	LTE Band 12	10	20.5	20.43	0.00	0	72	QPSK	1	25	0 mm	back	1:1	0.902	1.016	0.916	A3
707.50	23095	Mid	LTE Band 12	10	19.5	19.22	-0.03	1	72	QPSK	25	0	0 mm	back	1:1	0.707	1.067	0.754	
707.50	23095	Mid	LTE Band 12	10	19.5	19.09	0.00	1	72	QPSK	50	0	0 mm	back	1:1	0.706	1.099	0.776	
707.50	23095	Mid	LTE Band 12	10	20.5	20.43	0.06	0	72	QPSK	1	25	0 mm	top	1:1	0.277	1.016	0.281	
707.50	23095	Mid	LTE Band 12	10	19.5	19.22	-0.06	1	72	QPSK	25	0	0 mm	top	1:1	0.218	1.067	0.233	
707.50	23095	Mid	LTE Band 12	10	24.5	24.12	-0.02	0	70	QPSK	1	25	0 mm	right	1:1	0.175	1.091	0.191	
707.50	23095	Mid	LTE Band 12	10	23.5	23.08	-0.01	1	70	QPSK	25	0	0 mm	right	1:1	0.130	1.102	0.143	
707.50	23095	Mid	LTE Band 12	10	20.5	20.43	0.01	0	72	QPSK	1	25	0 mm	back	1:1	0.898	1.016	0.912	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak								Body 1.6 W/kg (mW/g) averaged over 1 gram											
Uncontrolled Exposure/General Population																			

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 38 of 76

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

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.0	24.91	0.05	0	70	QPSK	1	49	22 mm	back	1:1	0.168	1.021	0.172	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.89	0.01	1	70	QPSK	25	25	22 mm	back	1:1	0.130	1.026	0.133	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.0	24.91	0.12	0	70	QPSK	1	49	22 mm	top	1:1	0.079	1.021	0.081	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.89	0.14	1	70	QPSK	25	25	22 mm	top	1:1	0.063	1.026	0.065	
836.50	20525	Mid	LTE Band 5 (Cell)	10	20.5	20.50	0.06	0	72	QPSK	1	49	0 mm	back	1:1	0.822	1.000	0.822	A4
836.50	20525	Mid	LTE Band 5 (Cell)	10	19.5	19.27	0.04	1	72	QPSK	25	25	0 mm	back	1:1	0.656	1.054	0.691	
836.50	20525	Mid	LTE Band 5 (Cell)	10	19.5	19.25	0.11	1	72	QPSK	50	0	0 mm	back	1:1	0.658	1.059	0.697	
836.50	20525	Mid	LTE Band 5 (Cell)	10	20.5	20.50	0.01	0	72	QPSK	1	49	0 mm	top	1:1	0.410	1.000	0.410	
836.50	20525	Mid	LTE Band 5 (Cell)	10	19.5	19.27	-0.04	1	72	QPSK	25	25	0 mm	top	1:1	0.327	1.054	0.345	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.0	24.91	0.16	0	70	QPSK	1	49	0 mm	right	1:1	0.076	1.021	0.078	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.89	-0.04	1	70	QPSK	25	25	0 mm	right	1:1	0.065	1.026	0.067	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

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

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1750.00	20350	High	LTE Band 4 (AWS)	10	24.0	24.00	0.15	0	69	QPSK	1	0	22 mm	back	1:1	0.696	1.000	0.696	
1750.00	20350	High	LTE Band 4 (AWS)	10	23.0	23.00	-0.02	1	69	QPSK	25	0	22 mm	back	1:1	0.521	1.000	0.521	
1750.00	20350	High	LTE Band 4 (AWS)	10	24.0	24.00	-0.01	0	69	QPSK	1	0	22 mm	top	1:1	0.700	1.000	0.700	
1750.00	20350	High	LTE Band 4 (AWS)	10	23.0	23.00	0.02	1	69	QPSK	25	0	22 mm	top	1:1	0.533	1.000	0.533	
1715.00	20000	Low	LTE Band 4 (AWS)	10	12.5	12.37	-0.01	0	60	QPSK	1	0	0 mm	back	1:1	0.742	1.030	0.764	AS
1715.00	20000	Low	LTE Band 4 (AWS)	10	11.5	11.50	0.04	1	60	QPSK	25	0	0 mm	back	1:1	0.660	1.000	0.660	
1715.00	20000	Low	LTE Band 4 (AWS)	10	12.5	12.37	-0.03	0	60	QPSK	1	0	0 mm	top	1:1	0.375	1.030	0.386	
1715.00	20000	Low	LTE Band 4 (AWS)	10	11.5	11.50	0.01	1	60	QPSK	25	0	0 mm	top	1:1	0.313	1.000	0.313	
1750.00	20350	High	LTE Band 4 (AWS)	10	24.0	24.00	0.00	0	69	QPSK	1	0	0 mm	right	1:1	0.488	1.000	0.488	
1750.00	20350	High	LTE Band 4 (AWS)	10	23.0	23.00	0.01	1	69	QPSK	25	0	0 mm	right	1:1	0.364	1.000	0.364	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 39 of 76

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

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1855.00	18650	Low	LTE Band 2 (PCS)	10	23.5	23.48	0.00	0	69	QPSK	1	0	22 mm	back	1:1	0.821	1.005	0.825	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	23.5	23.50	-0.04	0	69	QPSK	1	0	22 mm	back	1:1	0.850	1.000	0.850	
1905.00	19150	High	LTE Band 2 (PCS)	10	23.5	23.40	-0.01	0	69	QPSK	1	0	22 mm	back	1:1	0.803	1.023	0.821	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	22.5	22.49	0.00	1	69	QPSK	25	12	22 mm	back	1:1	0.657	1.002	0.658	
1855.00	18650	Low	LTE Band 2 (PCS)	10	22.5	22.46	0.01	1	69	QPSK	50	0	22 mm	back	1:1	0.655	1.009	0.661	
1855.00	18650	Low	LTE Band 2 (PCS)	10	23.5	23.48	-0.01	0	69	QPSK	1	0	22 mm	top	1:1	1.000	1.005	1.005	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	23.5	23.50	-0.02	0	69	QPSK	1	0	22 mm	top	1:1	1.030	1.000	1.030	A6
1905.00	19150	High	LTE Band 2 (PCS)	10	23.5	23.40	0.01	0	69	QPSK	1	0	22 mm	top	1:1	0.947	1.023	0.969	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	22.5	22.49	0.01	1	69	QPSK	25	12	22 mm	top	1:1	0.786	1.002	0.788	
1855.00	18650	Low	LTE Band 2 (PCS)	10	22.5	22.46	-0.06	1	69	QPSK	50	0	22 mm	top	1:1	0.802	1.009	0.809	
1855.00	18650	Low	LTE Band 2 (PCS)	10	12.5	12.15	0.02	0	60	QPSK	1	0	0 mm	back	1:1	0.956	1.084	1.036	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	12.5	12.38	0.00	0	60	QPSK	1	0	0 mm	back	1:1	0.872	1.028	0.896	
1905.00	19150	High	LTE Band 2 (PCS)	10	12.5	11.69	-0.03	0	60	QPSK	1	0	0 mm	back	1:1	0.835	1.205	1.006	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	11.5	11.48	0.01	1	60	QPSK	25	12	0 mm	back	1:1	0.714	1.005	0.718	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	11.5	11.43	0.00	1	60	QPSK	50	0	0 mm	back	1:1	0.709	1.016	0.720	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	12.5	12.38	-0.03	0	60	QPSK	1	0	0 mm	top	1:1	0.350	1.028	0.360	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	11.5	11.48	-0.01	1	60	QPSK	25	12	0 mm	top	1:1	0.280	1.005	0.281	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	23.5	23.50	-0.04	0	69	QPSK	1	0	0 mm	right	1:1	0.372	1.000	0.372	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	22.5	22.49	-0.04	1	69	QPSK	25	12	0 mm	right	1:1	0.292	1.002	0.293	
1880.00	18900	Mid	LTE Band 2 (PCS)	10	23.5	23.50	0.05	0	69	QPSK	1	0	22 mm	top	1:1	0.956	1.000	0.956	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 40 of 76

Table 10-6
WLAN Body SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	12.5	11.85	0.01	0 mm	70	1	back	1:1	0.775	1.161	0.900	
2437	6	IEEE 802.11b	DSSS	12.5	11.47	0.11	0 mm	70	1	back	1:1	0.795	1.268	1.008	A7
2462	11	IEEE 802.11b	DSSS	12.5	11.38	0.04	0 mm	70	1	back	1:1	0.785	1.294	1.016	
2412	1	IEEE 802.11b	DSSS	12.5	11.85	-0.03	0 mm	70	1	top	1:1	0.544	1.161	0.632	
2412	1	IEEE 802.11b	DSSS	12.5	11.85	0.14	0 mm	70	1	left	1:1	0.019	1.161	0.022	
5745	149	IEEE 802.11a	OFDM	8.0	7.53	-0.03	0 mm	68	6	back	1:1	0.693	1.114	0.772	A8
5765	153	IEEE 802.11a	OFDM	8.0	7.61	-0.12	0 mm	68	6	back	1:1	0.660	1.094	0.722	
5825	165	IEEE 802.11a	OFDM	8.0	7.34	0.19	0 mm	68	6	back	1:1	0.656	1.164	0.764	
5765	153	IEEE 802.11a	OFDM	8.0	7.61	0.17	0 mm	68	6	top	1:1	0.115	1.094	0.126	
5765	153	IEEE 802.11a	OFDM	8.0	7.61	-0.17	0 mm	68	6	left	1:1	0.045	1.094	0.049	
5180	36	IEEE 802.11a	OFDM	8.0	7.76	0.10	0 mm	68	6	back	1:1	0.895	1.057	0.946	
5240	48	IEEE 802.11a	OFDM	8.0	7.85	0.08	0 mm	68	6	back	1:1	0.840	1.035	0.869	
5240	48	IEEE 802.11a	OFDM	8.0	7.85	0.21	0 mm	68	6	top	1:1	0.164	1.035	0.170	
5240	48	IEEE 802.11a	OFDM	8.0	7.85	0.17	0 mm	68	6	left	1:1	0.040	1.035	0.041	
5180	36	IEEE 802.11a	OFDM	8.0	7.76	0.17	0 mm	68	6	back	1:1	0.773	1.057	0.817	
5280	56	IEEE 802.11a	OFDM	8.0	7.69	0.13	0 mm	68	6	back	1:1	0.895	1.074	0.961	
5300	60	IEEE 802.11a	OFDM	8.0	7.75	-0.04	0 mm	68	6	back	1:1	0.835	1.059	0.884	
5300	60	IEEE 802.11a	OFDM	8.0	7.75	0.14	0 mm	68	6	top	1:1	0.117	1.059	0.124	
5300	60	IEEE 802.11a	OFDM	8.0	7.75	0.16	0 mm	68	6	left	1:1	0.038	1.059	0.040	
5280	56	IEEE 802.11a	OFDM	8.0	7.69	0.14	0 mm	68	6	back	1:1	0.813	1.074	0.873	
5540	108	IEEE 802.11a	OFDM	8.0	7.67	0.13	0 mm	68	6	back	1:1	0.992	1.079	1.070	A9
5580	116	IEEE 802.11a	OFDM	8.0	7.61	0.12	0 mm	68	6	back	1:1	0.892	1.094	0.976	
5680	136	IEEE 802.11a	OFDM	8.0	7.48	-0.01	0 mm	68	6	back	1:1	0.836	1.127	0.942	
5540	108	IEEE 802.11a	OFDM	8.0	7.67	0.16	0 mm	68	6	top	1:1	0.164	1.079	0.177	
5540	108	IEEE 802.11a	OFDM	8.0	7.67	-0.10	0 mm	68	6	left	1:1	0.062	1.079	0.067	
5540	108	IEEE 802.11a	OFDM	8.0	7.67	0.14	0 mm	68	6	back	1:1	0.852	1.079	0.919	
5580	116	IEEE 802.11a	OFDM	8.0	7.61	0.06	0 mm	68	6	back	1:1	0.943	1.094	1.032	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 41 of 76	

10.2 SAR Test Notes

General Notes:

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

CDMA Notes:

1. CDMA Body SAR was measured using Subtype 0/1 Physical Layer configurations for Rev. 0 according to KDB 941225 D01 procedures for data devices. Since the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, EVDO Rev. A SAR is not required. SAR is not required for 1x RTT for Ev-Do hotspot devices when the maximum average output of each channel is less than 1/4 dB higher than that measured in Subtype 0/1 Physical Layer configurations for Rev. 0.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r01. The general test procedures used for testing 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. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

WLAN Notes:

1. Justification for 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) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. WIFI transmission was verified using an uncalibrated spectrum analyzer.
4. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is >1.6 W/kg or the reported 1g averaged SAR is >0.8 W/kg, SAR testing on other default channels was required.
5. There is no proximity sensor power reduction mechanism applied for WIFI/BT modes.

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 42 of 76

11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05 are applicable to data 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 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 11-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2441	9.50	5	0.375
Bluetooth	2441	9.50	20	0.094
Bluetooth	2441	9.50	22	0.085

Note:

1. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
2. Per FCC KDB Publication 447498, when the test separation distance is < 5 mm, a distance of 5 mm is applied to determine estimated SAR.
3. For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 43 of 76

11.3 Body SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v01, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR (“-”).

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

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.905	1.016	see note 1	0.02
	Top	0.477	0.632	1.109	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.165	0.400	0.565	N/A
	Left	0.400	0.022	0.422	N/A
Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.936	1.016	see note 1	0.02
	Top	0.427	0.632	1.059	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.068	0.400	0.468	N/A
	Left	0.400	0.022	0.422	N/A
Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.916	1.016	see note 1	0.02
	Top	0.281	0.632	0.913	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.191	0.400	0.591	N/A
	Left	0.400	0.022	0.422	N/A
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.822	1.016	see note 1	0.02
	Top	0.410	0.632	1.042	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.078	0.400	0.478	N/A
	Left	0.400	0.022	0.422	N/A

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 44 of 76

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.764	1.016	see note 1	0.02
	Top	0.386	0.632	1.018	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.488	0.400	0.888	N/A
	Left	0.400	0.022	0.422	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.036	1.016	see note 1	0.02
	Top	0.360	0.632	0.992	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.372	0.400	0.772	N/A
	Left	0.400	0.022	0.422	N/A

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

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.905	1.070	see note 1	0.02
	Top	0.477	0.177	0.654	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.165	0.400	0.565	N/A
	Left	0.400	0.067	0.467	N/A
Simult Tx	Configuration	PCS EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.936	1.070	see note 1	0.02
	Top	0.427	0.177	0.604	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.068	0.400	0.468	N/A
	Left	0.400	0.067	0.467	N/A
Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.916	1.070	see note 1	0.02
	Top	0.281	0.177	0.458	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.191	0.400	0.591	N/A
	Left	0.400	0.067	0.467	N/A

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 45 of 76	

Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.822	1.070	see note 1	0.02
	Top	0.410	0.177	0.587	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.078	0.400	0.478	N/A
	Left	0.400	0.067	0.467	N/A
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.764	1.070	see note 1	0.02
	Top	0.386	0.177	0.563	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.488	0.400	0.888	N/A
	Left	0.400	0.067	0.467	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.036	1.070	see note 1	0.03
	Top	0.360	0.177	0.537	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.372	0.400	0.772	N/A
	Left	0.400	0.067	0.467	N/A

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

Simult Tx	Configuration	Cell. EVDO SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.905	0.375	1.280	N/A
	Top	0.477	0.375	0.852	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.165	0.400	0.565	N/A
	Left	0.400	0.094	0.494	N/A
Simult Tx	Configuration	PCS EVDO SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.936	0.375	1.311	N/A
	Top	0.427	0.375	0.802	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.068	0.400	0.468	N/A
	Left	0.400	0.094	0.494	N/A

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 46 of 76	

Simult Tx	Configuration	LTE Band 12 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.916	0.375	1.291	N/A
	Top	0.281	0.375	0.656	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.191	0.400	0.591	N/A
	Left	0.400	0.094	0.494	N/A
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.822	0.375	1.197	N/A
	Top	0.410	0.375	0.785	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.078	0.400	0.478	N/A
	Left	0.400	0.094	0.494	N/A
Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.764	0.375	1.139	N/A
	Top	0.386	0.375	0.761	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.488	0.400	0.888	N/A
	Left	0.400	0.094	0.494	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.036	0.375	1.411	N/A
	Top	0.360	0.375	0.735	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.372	0.400	0.772	N/A
	Left	0.400	0.094	0.494	N/A

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 47 of 76

Table 11-5
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Back at 22 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	Cell. EVDO	0.298	< 1.016	< 1.314	N/A
Back Side	PCS EVDO	0.639	< 1.016	see note 1	< 0.02
Back Side	LTE Band 12	0.132	< 1.016	< 1.148	N/A
Back Side	LTE Band 5 (Cell)	0.172	< 1.016	< 1.188	N/A
Back Side	LTE Band 4 (AWS)	0.696	< 1.016	see note 1	< 0.02
Back Side	LTE Band 2 (PCS)	0.850	< 1.016	see note 1	< 0.02

Table 11-6
Simultaneous Transmission Scenario with 5 GHz WLAN (Back at 22 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	Cell. EVDO	0.298	< 1.070	< 1.368	N/A
Back Side	PCS EVDO	0.639	< 1.070	see note 1	< 0.02
Back Side	LTE Band 12	0.132	< 1.070	< 1.202	N/A
Back Side	LTE Band 5 (Cell)	0.172	< 1.070	< 1.242	N/A
Back Side	LTE Band 4 (AWS)	0.696	< 1.070	see note 1	< 0.02
Back Side	LTE Band 2 (PCS)	0.850	< 1.070	see note 1	< 0.02

Table 11-7
Simultaneous Transmission Scenario with Bluetooth (Back at 22 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	Cell. EVDO	0.298	0.085	0.383	N/A
Back Side	PCS EVDO	0.639	0.085	0.724	N/A
Back Side	LTE Band 12	0.132	0.085	0.217	N/A
Back Side	LTE Band 5 (Cell)	0.172	0.085	0.257	N/A
Back Side	LTE Band 4 (AWS)	0.696	0.085	0.781	N/A
Back Side	LTE Band 2 (PCS)	0.850	0.085	0.935	N/A

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

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 48 of 76	

Table 11-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Top at 22 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	Cell. CDMA	0.098	< 0.632	< 0.730	N/A
Top Edge	PCS CDMA	0.684	< 0.632	< 1.316	N/A
Top Edge	LTE Band 12	0.043	< 0.632	< 0.675	N/A
Top Edge	LTE Band 5 (Cell)	0.081	< 0.632	< 0.713	N/A
Top Edge	LTE Band 4 (AWS)	0.700	< 0.632	< 1.332	N/A
Top Edge	LTE Band 2 (PCS)	1.030	< 0.632	see note 1	< 0.02

Table 11-9
Simultaneous Transmission Scenario with 5 GHz WLAN (Top at 22 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	Cell. CDMA	0.098	< 0.177	< 0.275	N/A
Top Edge	PCS CDMA	0.684	< 0.177	< 0.861	N/A
Top Edge	LTE Band 12	0.043	< 0.177	< 0.22	N/A
Top Edge	LTE Band 5 (Cell)	0.081	< 0.177	< 0.258	N/A
Top Edge	LTE Band 4 (AWS)	0.700	< 0.177	< 0.877	N/A
Top Edge	LTE Band 2 (PCS)	1.030	< 0.177	< 1.207	N/A

Table 11-10
Simultaneous Transmission Scenario with Bluetooth (Top at 22 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	Cell. CDMA	0.098	0.085	0.183	N/A
Top Edge	PCS CDMA	0.684	0.085	0.769	N/A
Top Edge	LTE Band 12	0.043	0.085	0.128	N/A
Top Edge	LTE Band 5 (Cell)	0.081	0.085	0.166	N/A
Top Edge	LTE Band 4 (AWS)	0.700	0.085	0.785	N/A
Top Edge	LTE Band 2 (PCS)	1.030	0.085	1.115	N/A

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

General Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not higher than 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.
2. For SAR summations for body back at 22 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. "<" denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
3. For SAR summations for body top edge at 22 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. "<" denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
4. For SAR summations for body left edge at 0 mm, estimated Bluetooth SAR values for 2.0 cm were used since Bluetooth SAR was not required to be measured per FCC KDB 447498 and the Bluetooth antenna to user separation distance is > 5 mm and < 50 mm.
5. For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion when the test separation distance was >50 mm.
6. The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet	Page 49 of 76	

11.4 SPLSR Evaluation and Analysis

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

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

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 50 of 76

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with Cell. EVDO antenna operating at reduced output power with 2.4 GHz WIFI.

Table 11-11
Peak SAR Locations for Body Back Side at 0 mm Cell. EVDO and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
Cell. EVDO	50.00	75.00
IEEE 802.11b	68.20	-75.60

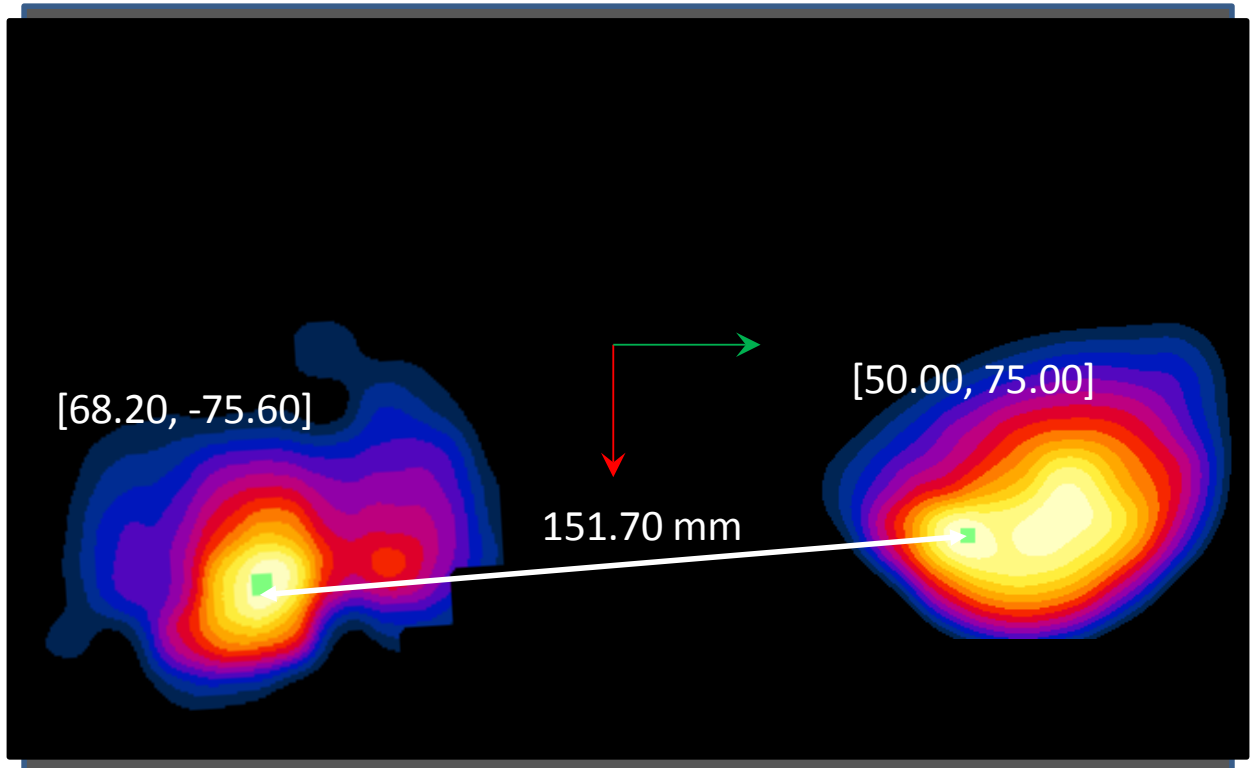


Figure 11-1
Peak SAR Locations for Body Back Side at 0 mm Cell. EVDO and 2.4 GHz WLAN Antenna

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

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
Cell. EVDO	IEEE 802.11b	0.905	1.016	1.921	151.70	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with PCS EVDO antenna operating at reduced output power with 2.4 GHz WIFI.

Table 11-13
Peak SAR Locations for Body Back Side at 0 mm PCS EVDO and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
PCS EVDO	53.50	66.50
IEEE 802.11b	68.20	-75.60

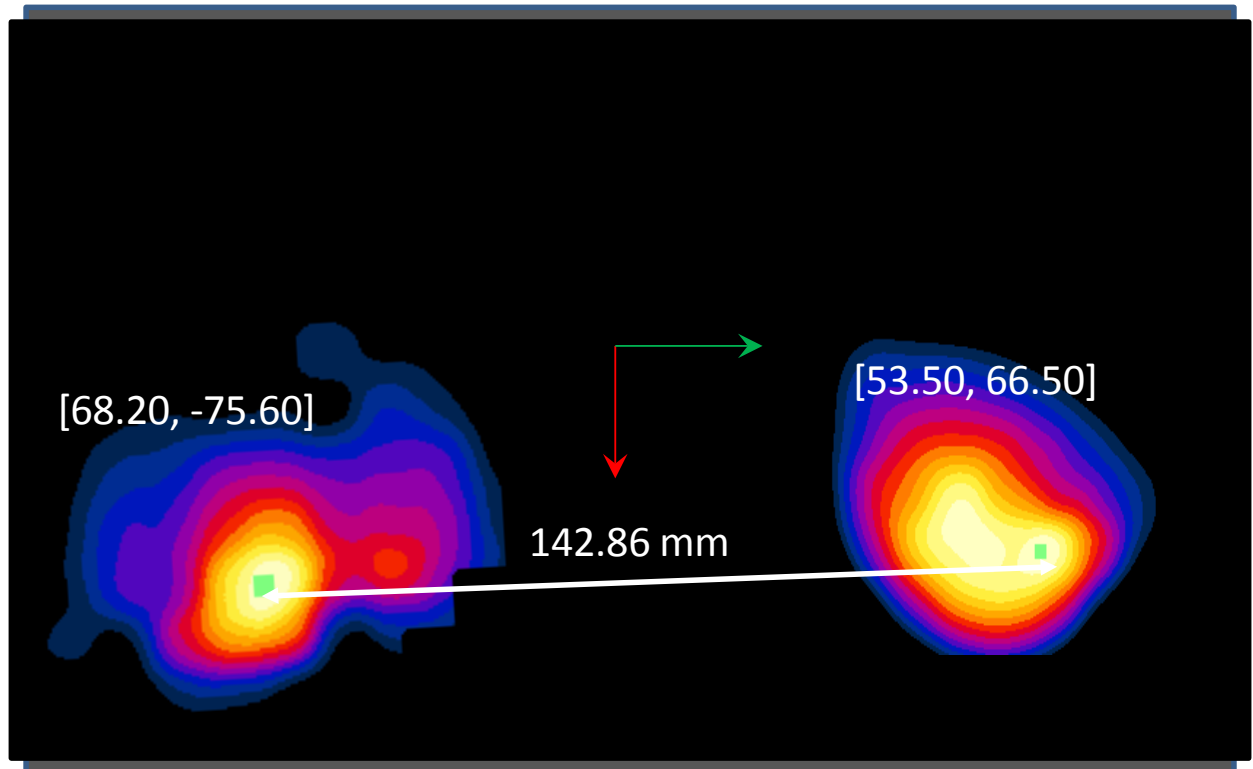


Figure 11-2
Peak SAR Locations for Body Back Side at 0 mm PCS EVDO and 2.4 GHz WLAN Antenna

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

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
PCS EVDO	IEEE 802.11b	0.936	1.016	1.952	142.86	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B12 antenna operating at reduced output power with 2.4 GHz WIFI.

Table 11-15
Peak SAR Locations for Body Back Side at 0 mm LTE B12 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B12	38.00	63.50
IEEE 802.11b	68.20	-75.60

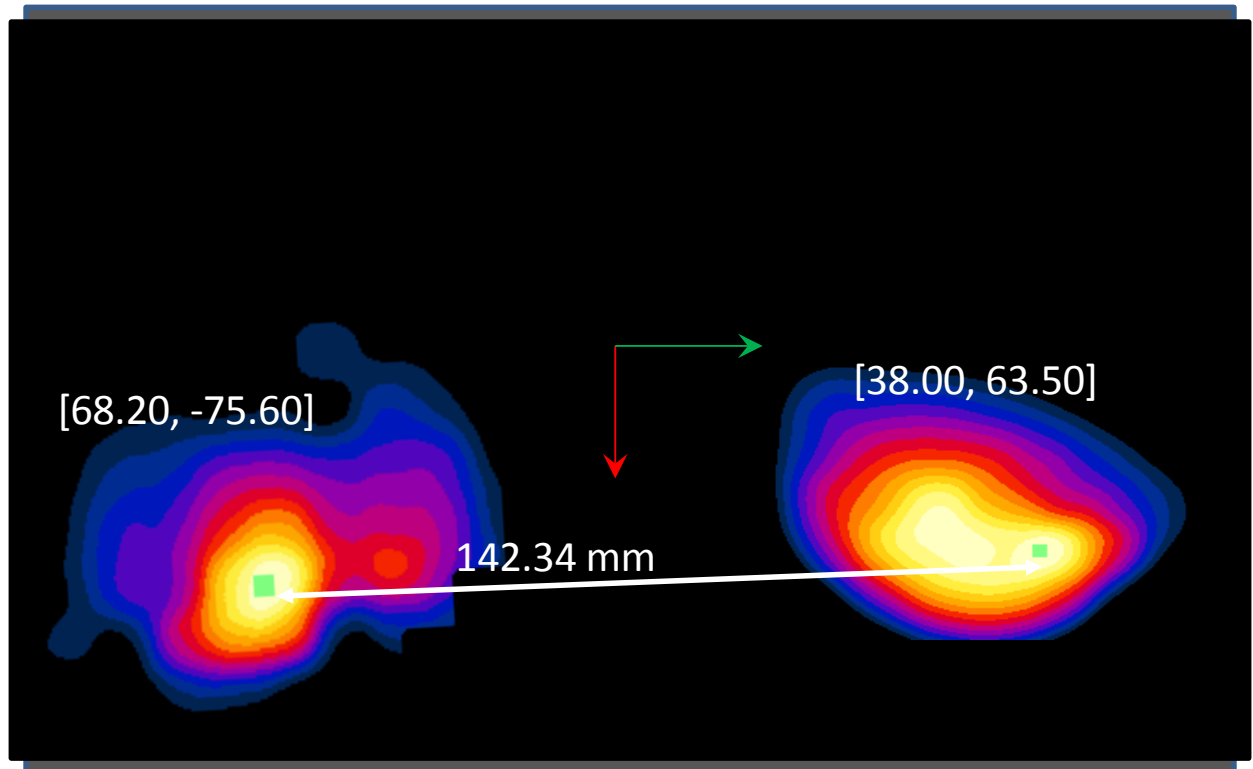


Figure 11-3
Peak SAR Locations for Body Back Side at 0 mm LTE B12 and 2.4 GHz WLAN Antenna

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

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B12	IEEE 802.11b	0.916	1.016	1.932	142.34	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B5 antenna operating at reduced output power with 2.4 GHz WIFI.

Table 11-17
Peak SAR Locations for Body Back Side at 0 mm LTE B5 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B5	44.50	75.00
IEEE 802.11b	68.20	-75.60

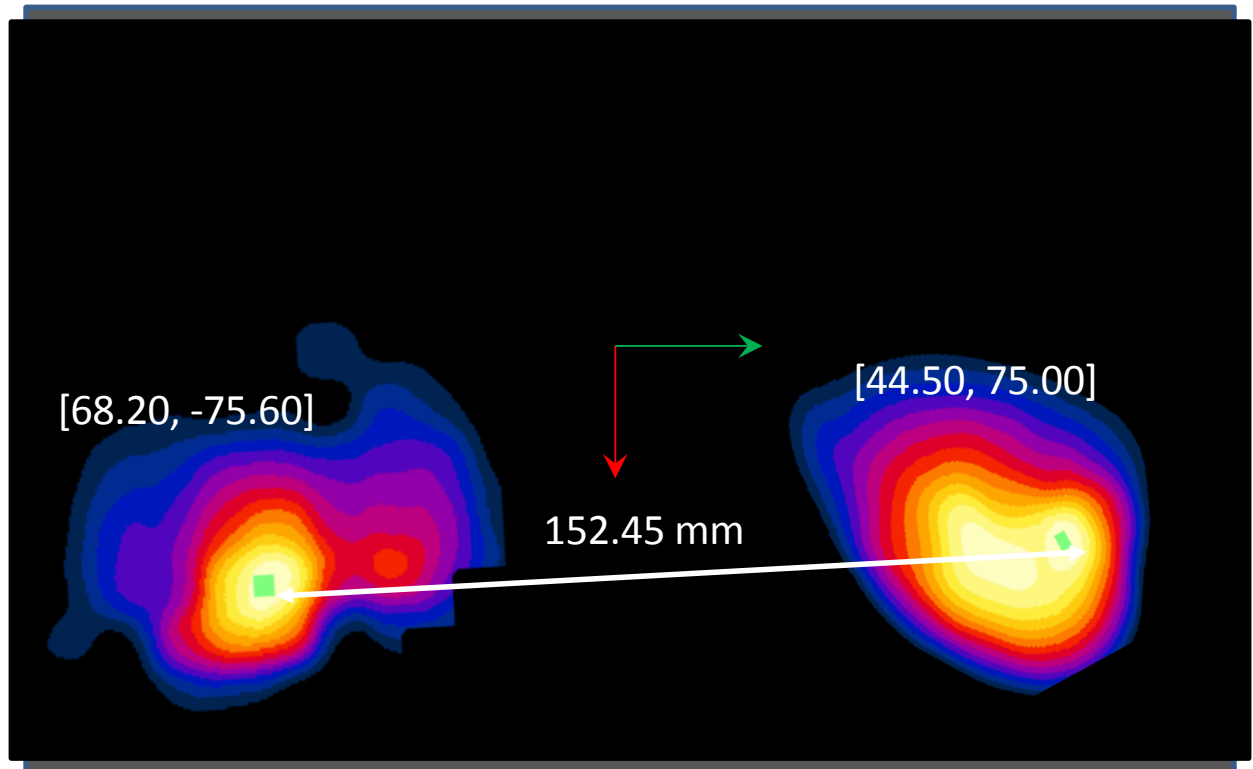


Figure 11-4
Peak SAR Locations for Body Back Side at 0 mm LTE B5 and 2.4 GHz WLAN Antenna

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

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B5	IEEE 802.11b	0.822	1.016	1.838	152.45	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B4 antenna operating at reduced output power with 2.4 GHz WIFI.

Table 11-19
Peak SAR Locations for Body Back Side at 0 mm LTE B4 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B4	53.49	66.50
IEEE 802.11b	68.20	-75.60

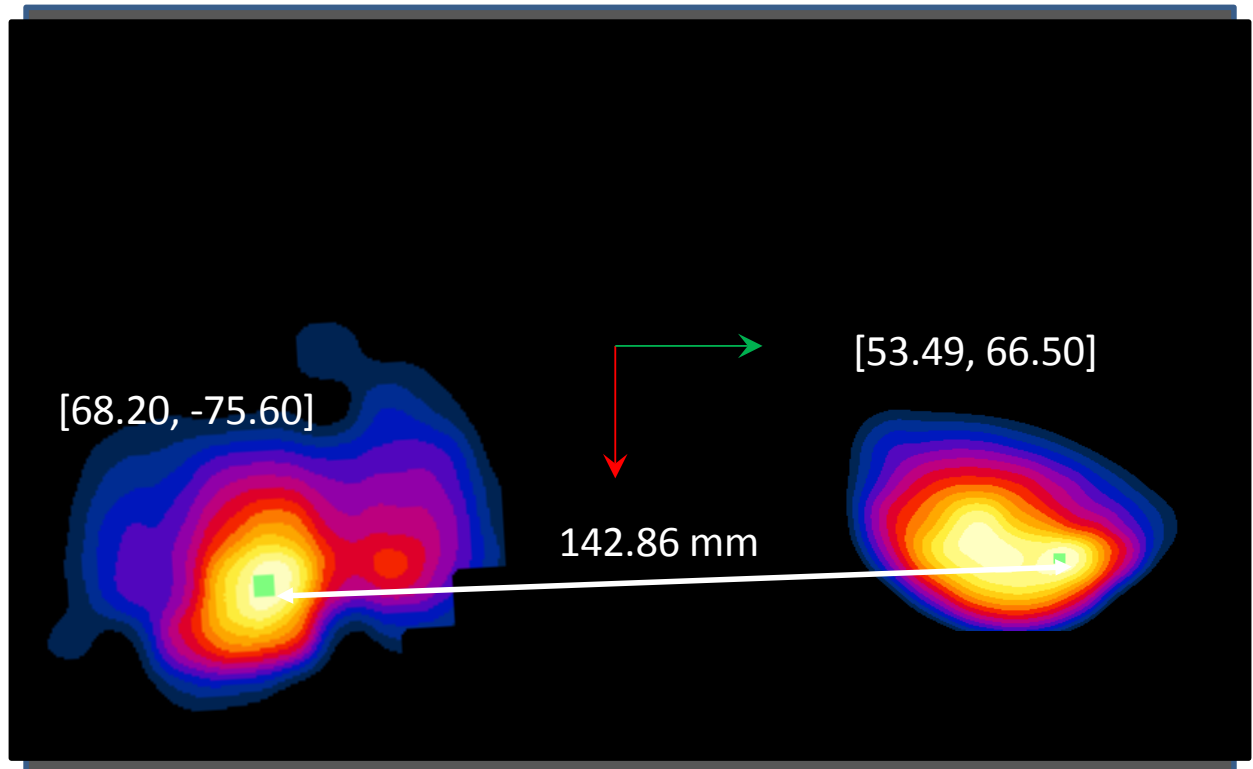


Figure 11-5
Peak SAR Locations for Body Back Side at 0 mm LTE B4 and 2.4 GHz WLAN Antenna

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

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B4	IEEE 802.11b	0.764	1.016	1.780	142.86	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B2 antenna operating at reduced output power with 2.4 GHz WIFI.

Table 11-21
Peak SAR Locations for Body Back Side at 0 mm LTE B2 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	49.50	60.00
IEEE 802.11b	68.20	-75.60

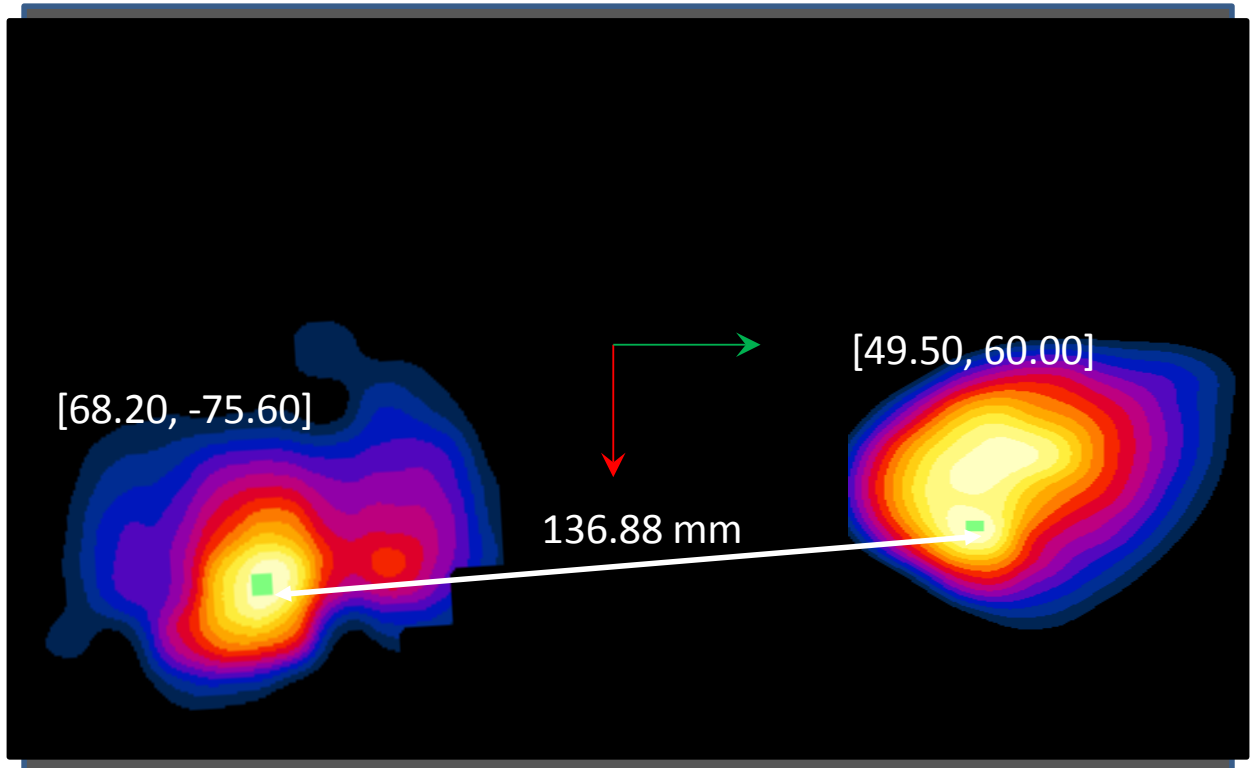


Figure 11-6
Peak SAR Locations for Body Back Side at 0 mm LTE B2 and 2.4 GHz WLAN Antenna

Table 11-22
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B2	IEEE 802.11b	1.036	1.016	2.052	136.88	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with Cell. EVDO antenna operating at reduced output power with 5 GHz WIFI.

Table 11-23
Peak SAR Locations for Body Back Side at 0 mm Cell. EVDO and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
Cell. EVDO	50.00	75.00
IEEE 802.11a	39.00	-58.00

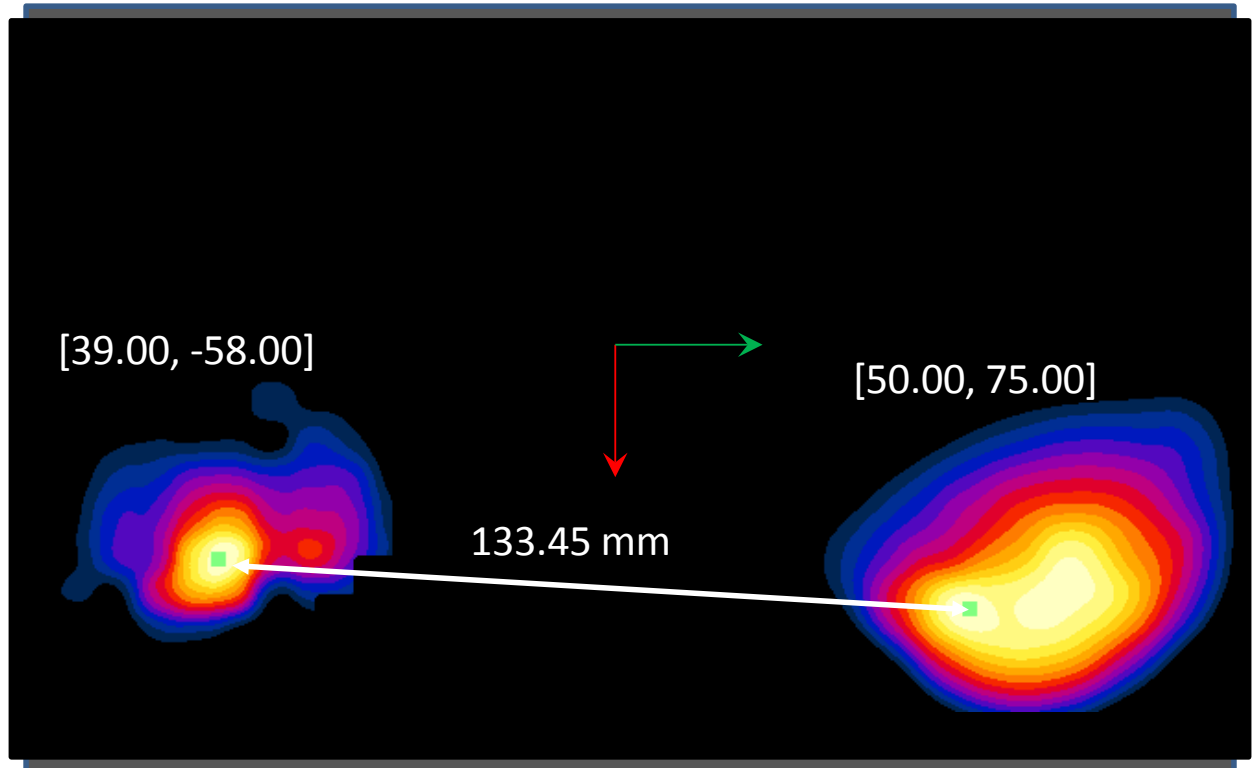


Figure 11-7
Peak SAR Locations for Body Back Side at 0 mm Cell. EVDO and 5 GHz WLAN Antenna

Table 11-24
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
Cell. EVDO	IEEE 802.11a	0.905	1.07	1.975	133.45	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with PCS EVDO antenna operating at reduced output power with 5 GHz WIFI.

Table 11-25
Peak SAR Locations for Body Back Side at 0 mm PCS EVDO and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
PCS EVDO	53.50	66.50
IEEE 802.11a	39.00	-58.00

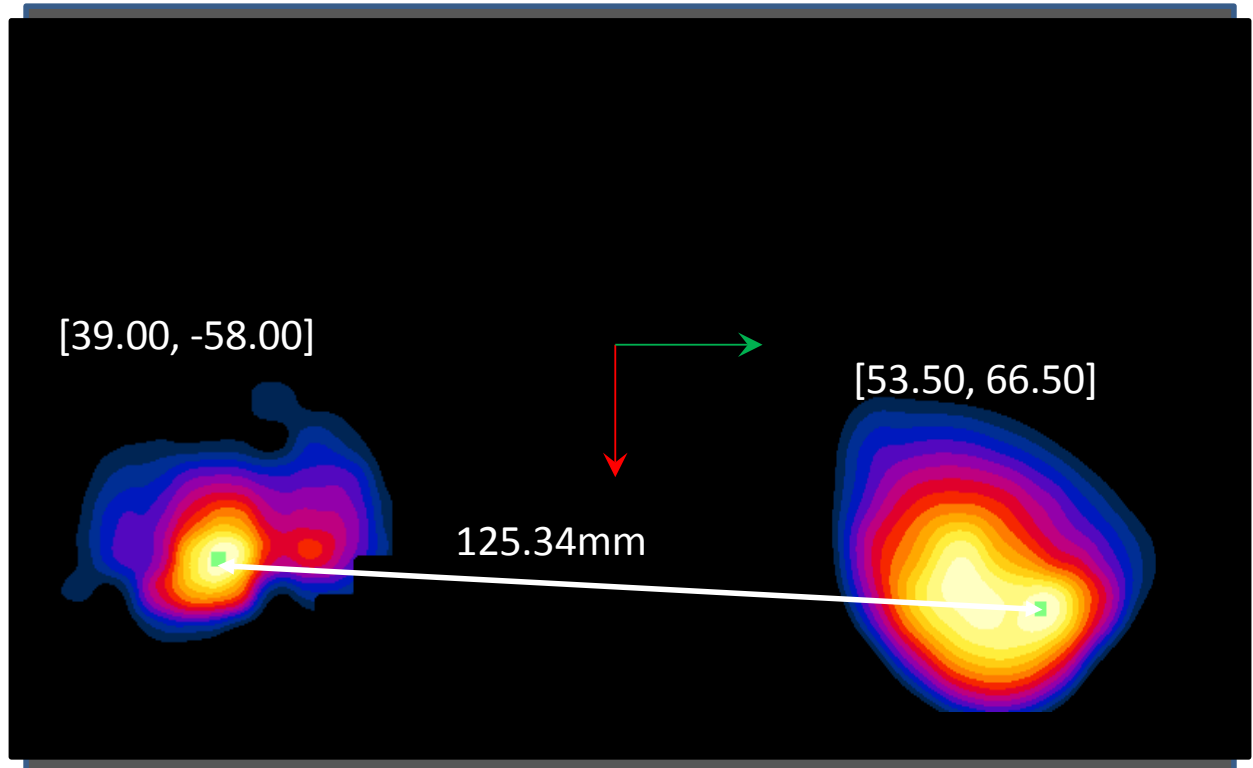


Figure 11-8
Peak SAR Locations for Body Back Side at 0 mm PCS EVDO and 5 GHz WLAN Antenna

Table 11-26
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
PCS EVDO	IEEE 802.11a	0.936	1.07	2.006	125.34	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B12 antenna operating at reduced output power with 5 GHz WIFI.

Table 11-27
Peak SAR Locations for Body Back Side at 0 mm LTE B12 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B12	38.00	63.50
IEEE 802.11a	39.00	-58.00

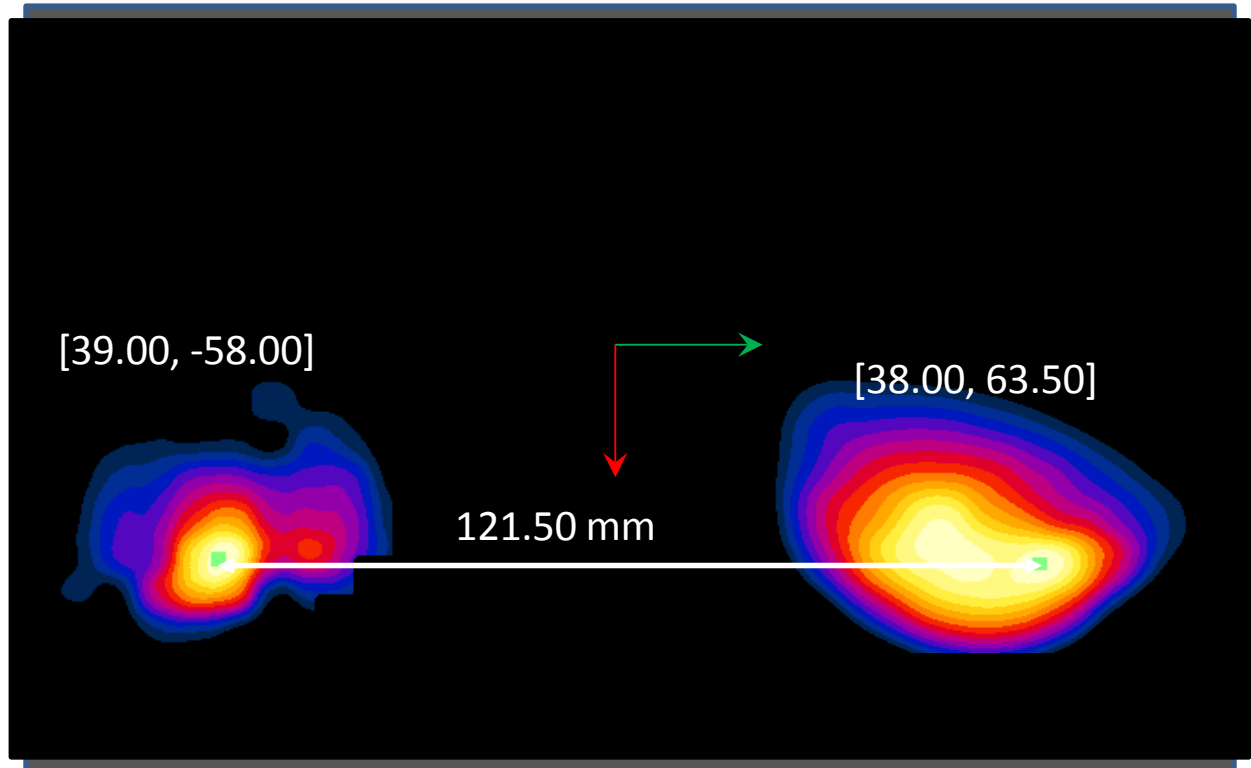


Figure 11-9
Peak SAR Locations for Body Back Side at 0 mm LTE B12 and 5 GHz WLAN Antenna

Table 11-28
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B12	IEEE 802.11a	0.916	1.07	1.986	121.5	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B5 antenna operating at reduced output power with 5 GHz WIFI.

Table 11-29
Peak SAR Locations for Body Back Side at 0 mm LTE B5 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B5	44.50	75.00
IEEE 802.11a	39.00	-58.00

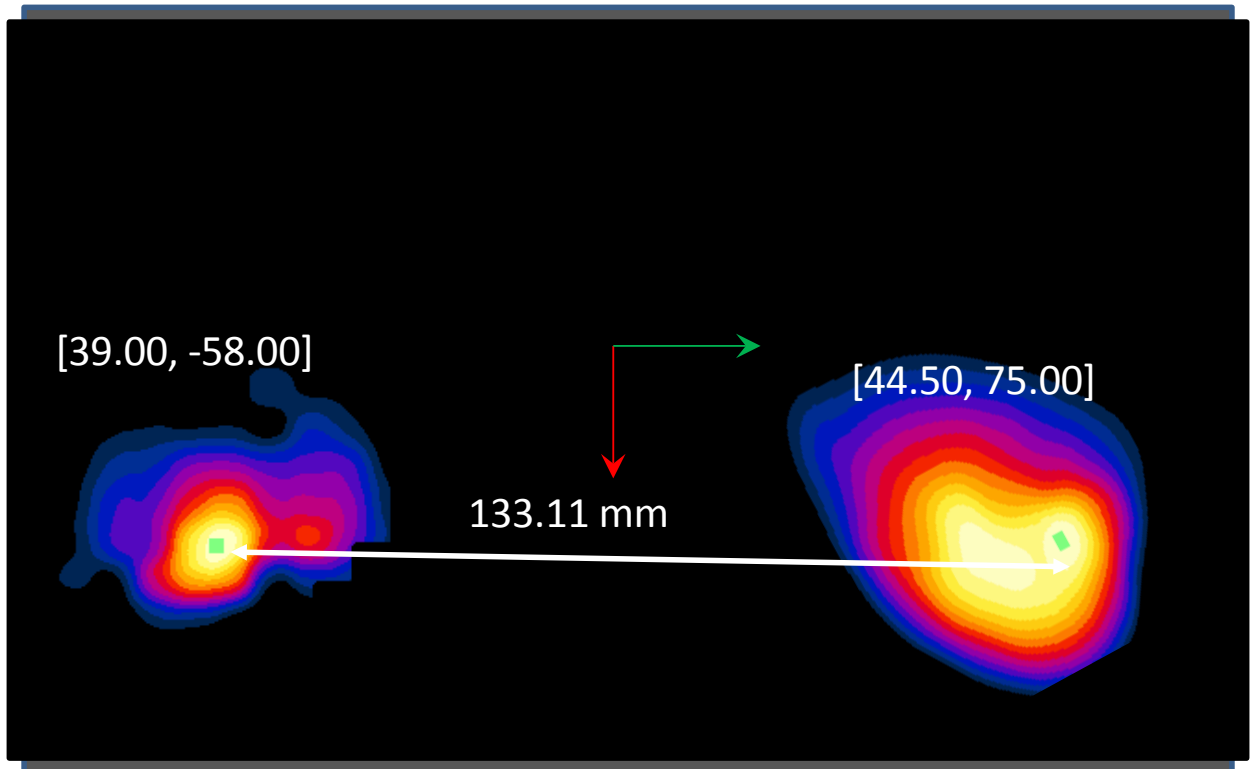


Figure 11-10
Peak SAR Locations for Body Back Side at 0 mm LTE B5 and 5 GHz WLAN Antenna

Table 11-30
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B5	IEEE 802.11a	0.822	1.07	1.892	133.11	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B4 antenna operating at reduced output power with 2.4 GHz WIFI.

Table 11-31
Peak SAR Locations for Body Back Side at 0 mm LTE B4 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B4	53.49	66.50
IEEE 802.11a	39.00	-58.00

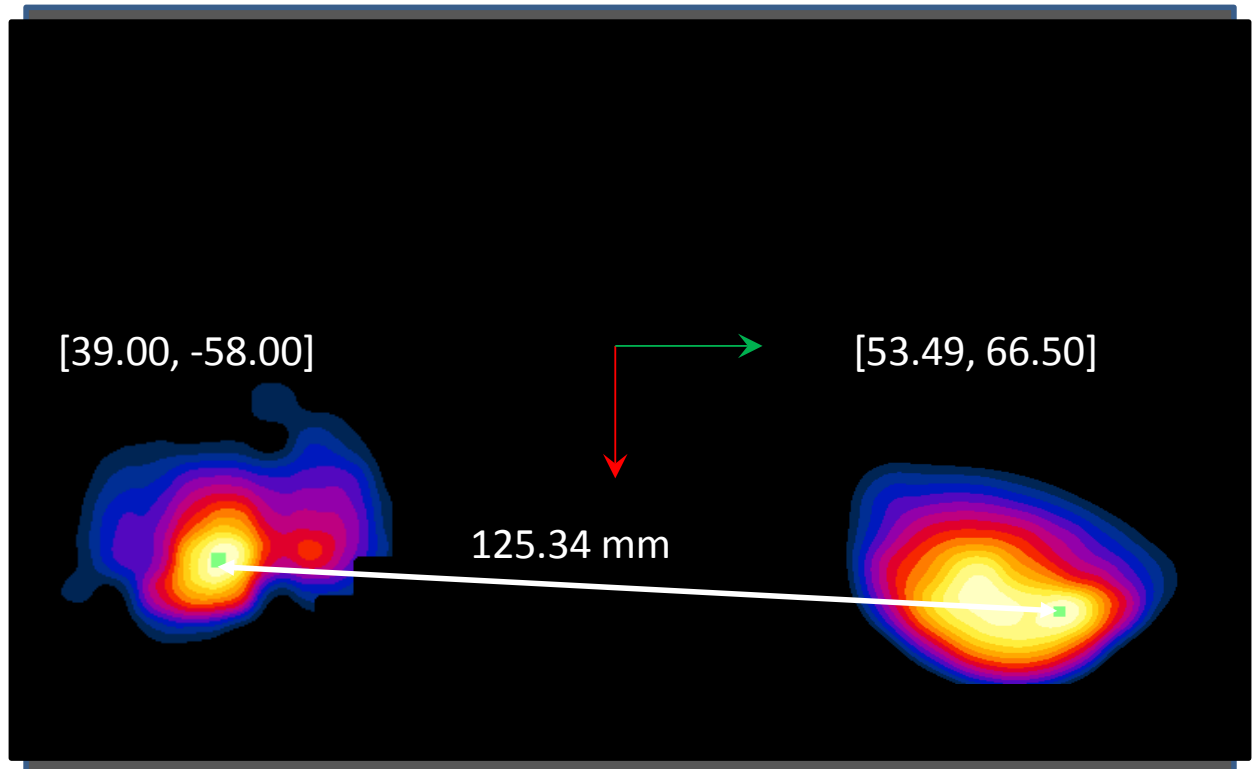


Figure 11-11
Peak SAR Locations for Body Back Side at 0 mm LTE B4 and 2.4 GHz WLAN Antenna

Table 11-32
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B4	IEEE 802.11a	0.764	1.07	1.834	125.34	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B2 antenna operating at reduced output power with 5 GHz WIFI.

Table 11-33
Peak SAR Locations for Body Back Side at 0 mm LTE B2 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	49.50	60.00
IEEE 802.11a	39.00	-58.00

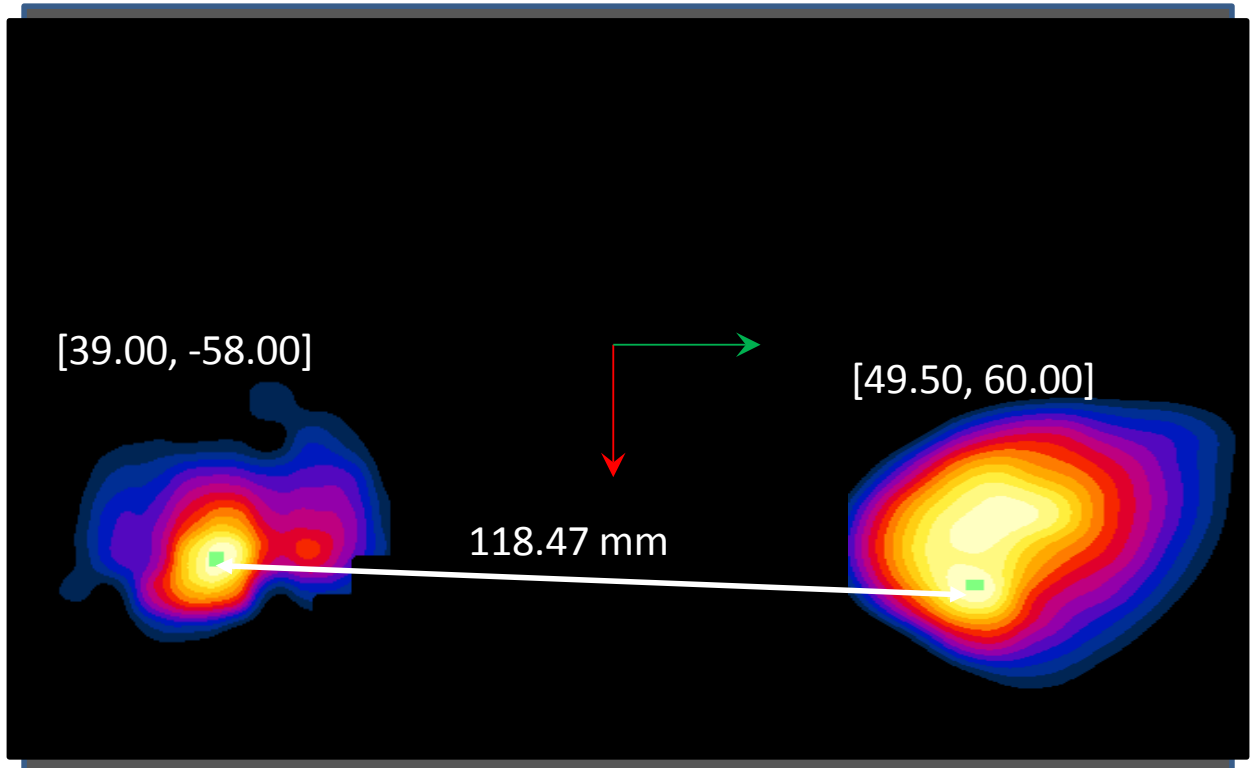


Figure 11-12
Peak SAR Locations for Body Back Side at 0 mm LTE B2 and 5 GHz WLAN Antenna

Table 11-34
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B2	IEEE 802.11a	1.036	1.07	2.106	118.47	0.03

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with PCS EVDO antenna operating at maximum output power with 2.4 GHz WIFI.

Table 11-35
Peak SAR Locations for Body Back Side at 22 mm PCS EVDO and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
PCS EVDO	64.00	65.50
IEEE 802.11b	68.20	-75.60

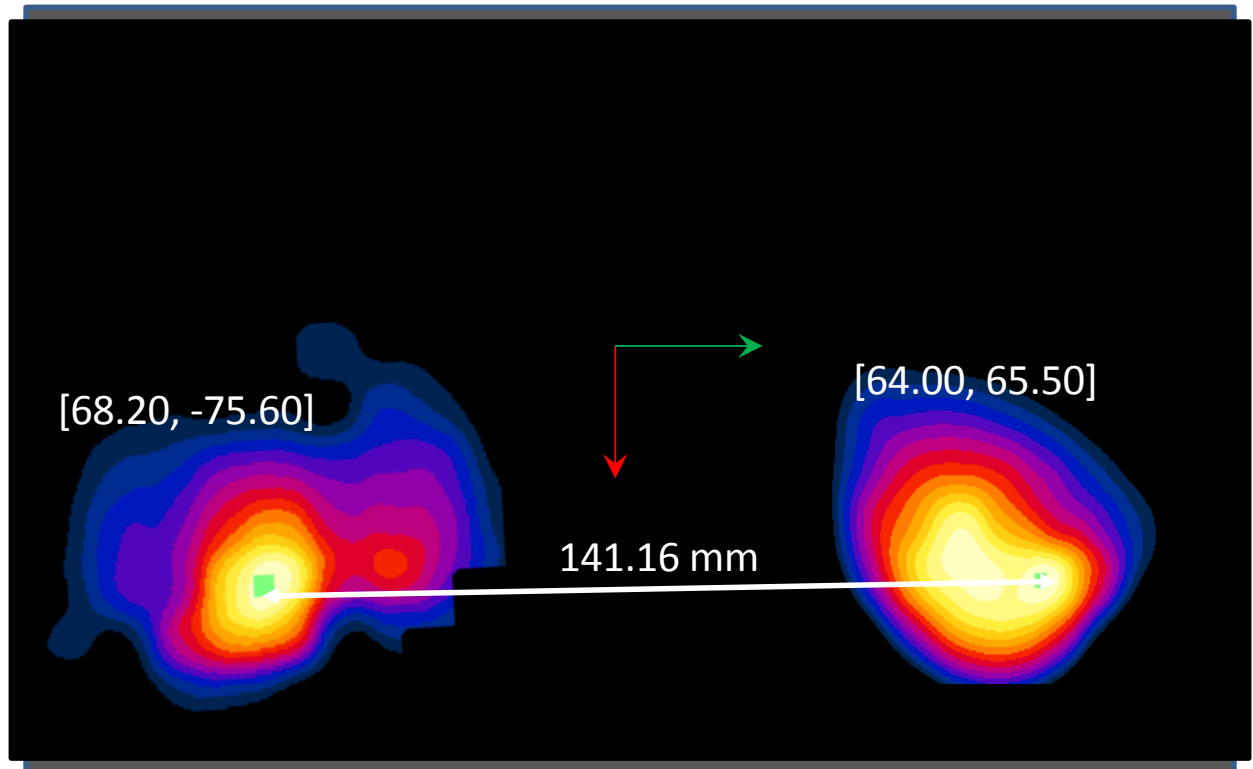


Figure 11-13
Peak SAR Locations for Body Back Side at 22 mm PCS EVDO and 2.4 GHz WLAN Antenna

Table 11-36
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
PCS EVDO	IEEE 802.11b	0.639	< 1.016	< 1.655	141.16	< 0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with LTE B4 antenna operating at maximum output power with 2.4 GHz WIFI.

Table 11-37
Peak SAR Locations for Body Back Side at 22 mm LTE B4 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B4	54.99	40.50
IEEE 802.11b	68.20	-75.60

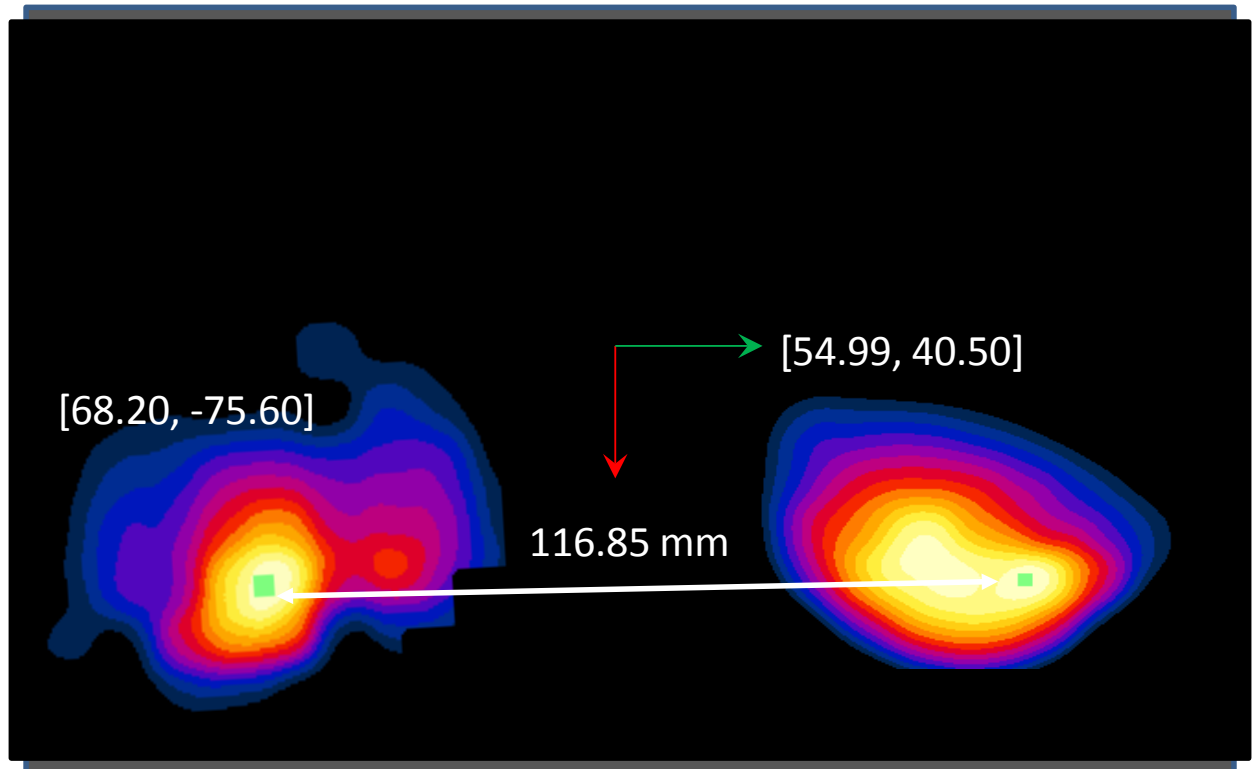


Figure 11-14
Peak SAR Locations for Body Back Side at 22 mm LTE B4 and 2.4 GHz WLAN Antenna

Table 11-38
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B4	IEEE 802.11b	0.696	< 1.016	< 1.712	116.85	< 0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with LTE B2 antenna operating at maximum output power with 2.4 GHz WIFI.

Table 11-39
Peak SAR Locations for Body Back Side at 22 mm LTE B2 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	53.00	55.00
IEEE 802.11b	68.20	-75.60

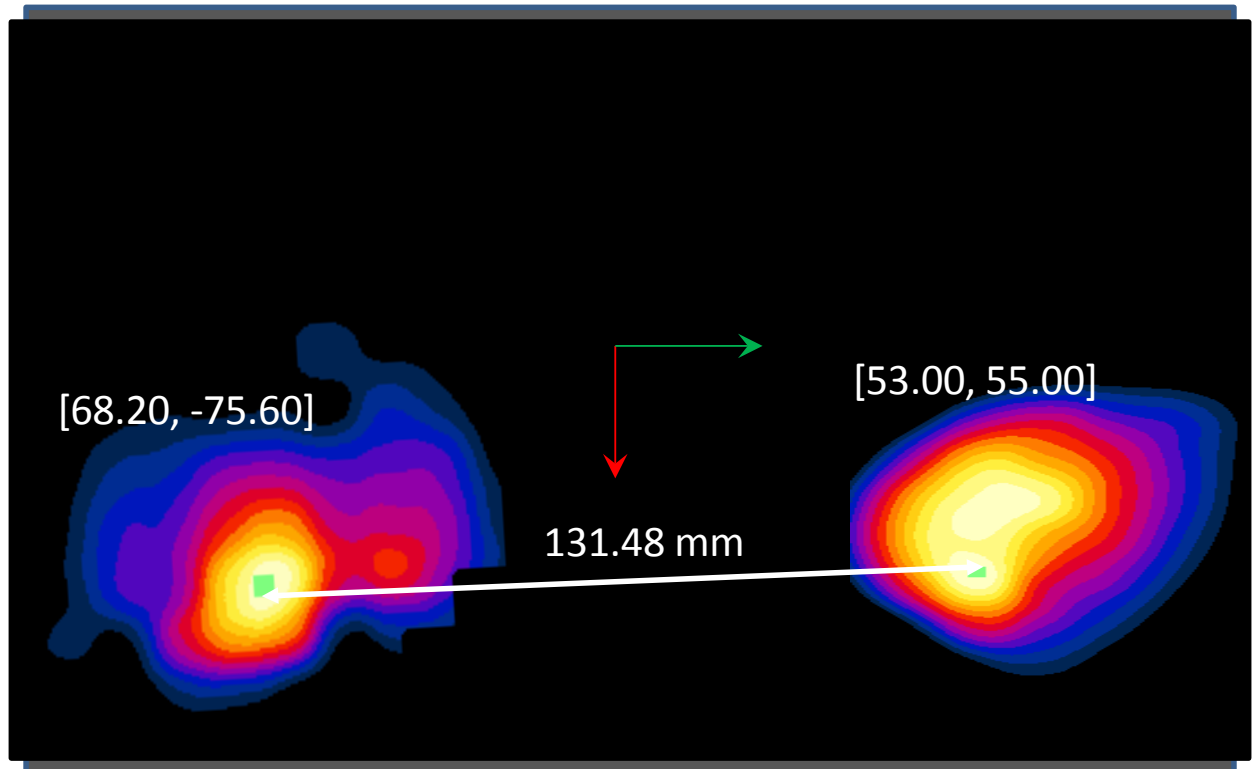


Figure 11-15
Peak SAR Locations for Body Back Side at 22 mm LTE B2 and 2.4 GHz WLAN Antenna

Table 11-40
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B2	IEEE 802.11b	0.850	< 1.016	< 1.866	131.48	< 0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with PCS EVDO antenna operating at maximum output power with 5 GHz WIFI.

Table 11-41
Peak SAR Locations for Body Back Side at 22 mm PCS EVDO and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
PCS EVDO	64.00	65.50
IEEE 802.11a	39.00	-58.00

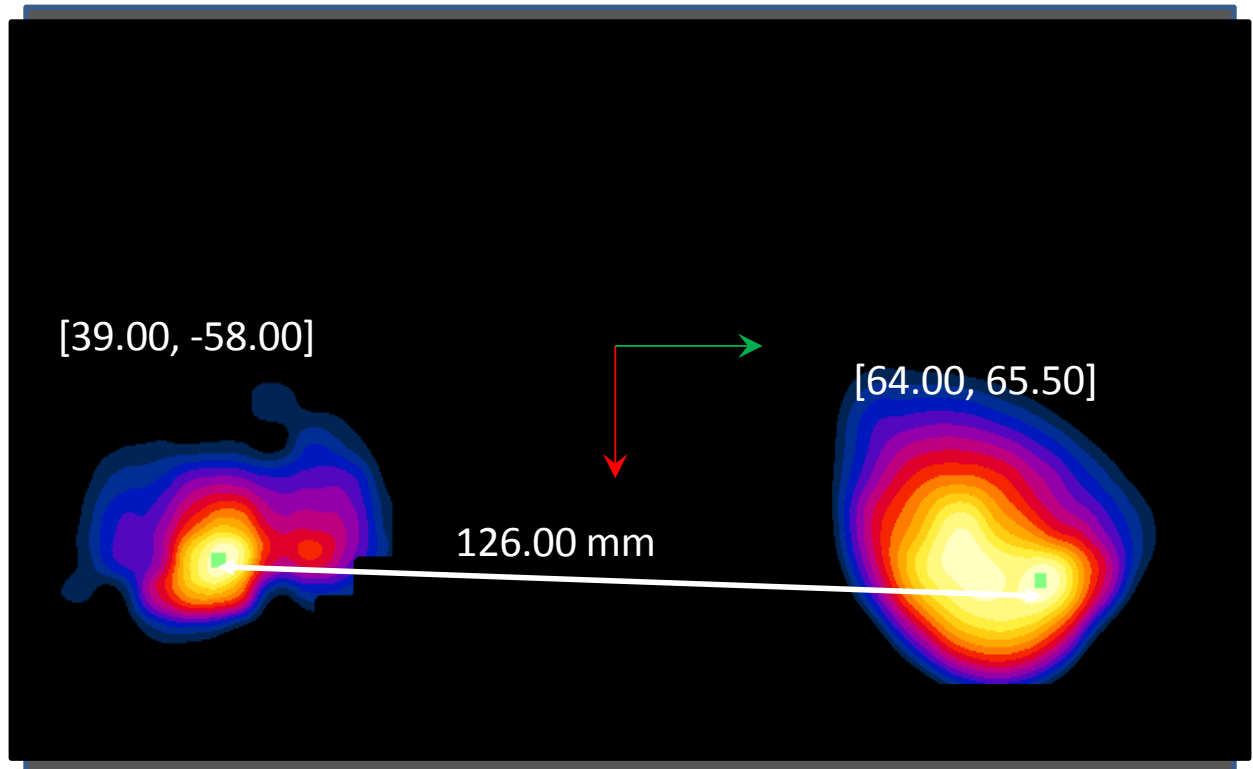


Figure 11-16
Peak SAR Locations for Body Back Side at 22 mm PCS EVDO and 5 GHz WLAN Antenna

Table 11-42
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
PCS EVDO	IEEE 802.11a	0.639	< 1.070	< 1.709	126.00	< 0.02

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 66 of 76	

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with LTE B4 antenna operating at maximum output power with 5 GHz WIFI.

Table 11-43
Peak SAR Locations for Body Back Side at 22 mm LTE B4 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B4	54.99	40.50
IEEE 802.11a	39.00	-58.00

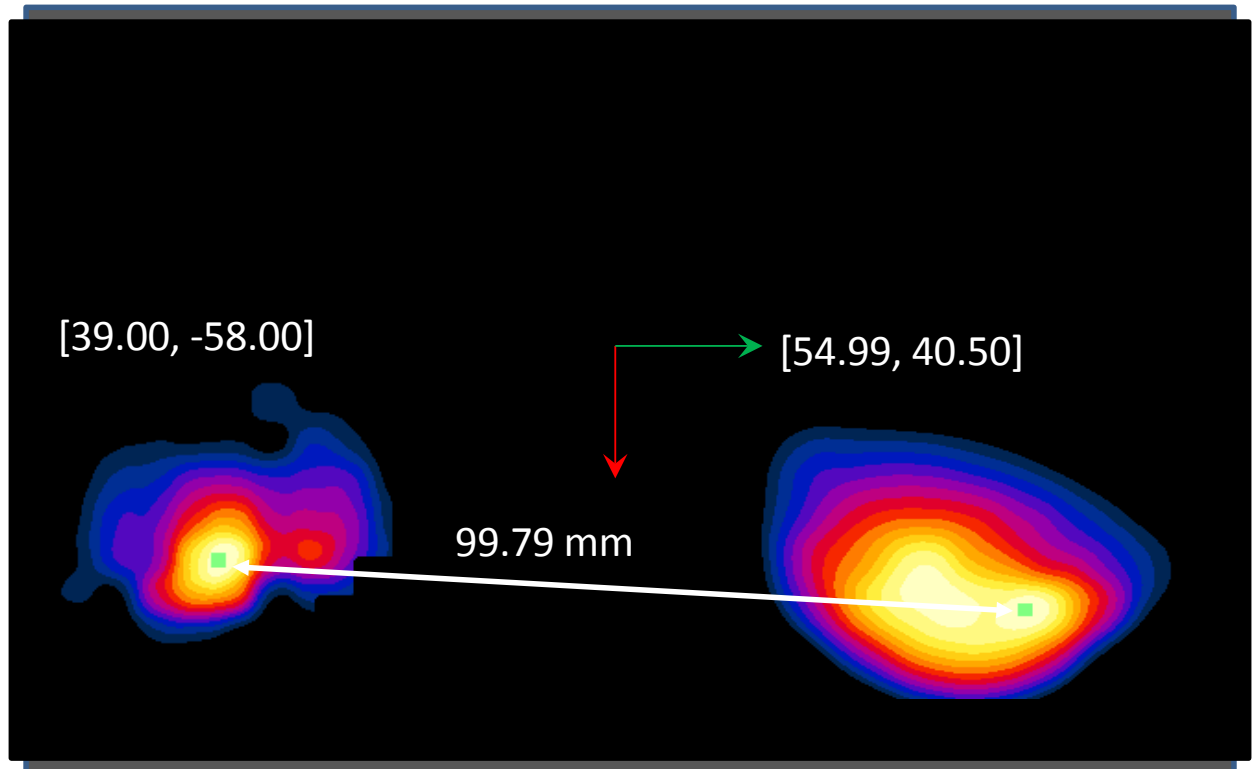


Figure 11-17
Peak SAR Locations for Body Back Side at 22 mm LTE B4 and 5 GHz WLAN Antenna

Table 11-44
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B4	IEEE 802.11a	0.696	< 1.070	< 1.766	99.79	< 0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with LTE B2 antenna operating at maximum output power with 5 GHz WIFI.

Table 11-45
Peak SAR Locations for Body Back Side at 22 mm LTE B2 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	53.00	55.00
IEEE 802.11a	39.00	-58.00

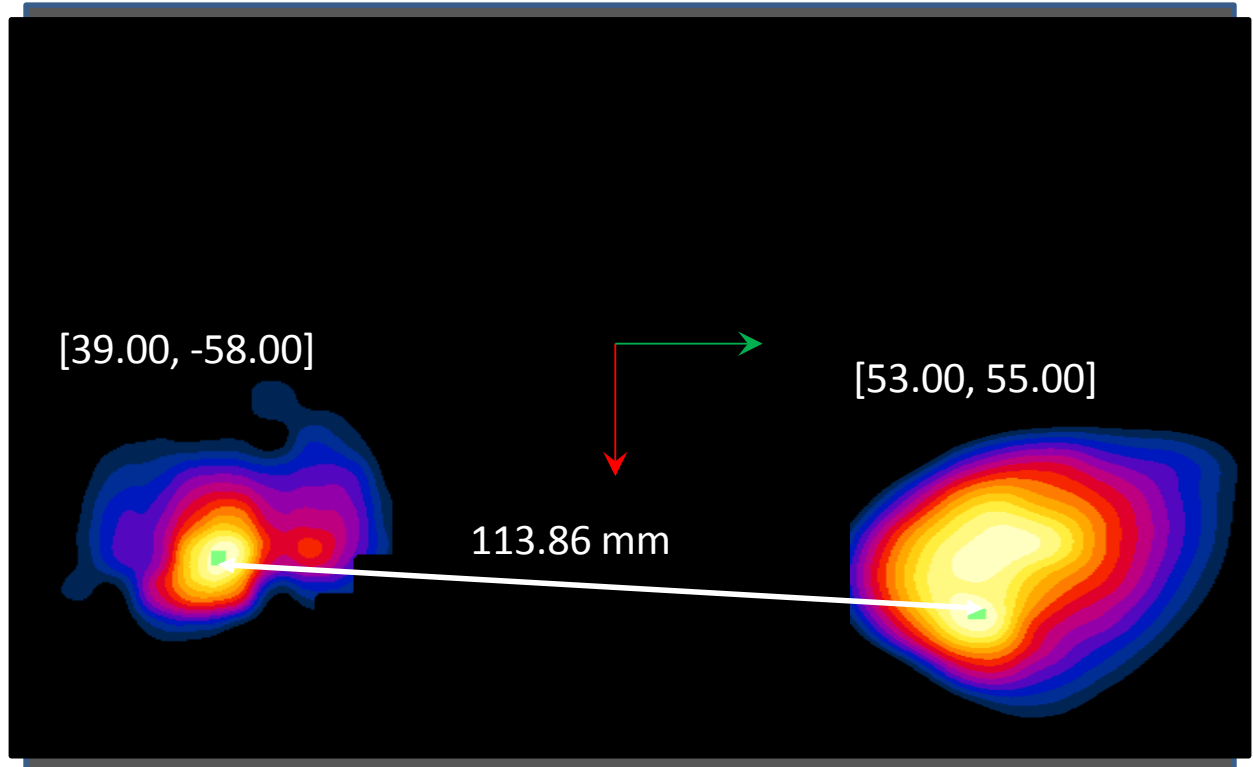


Figure 11-18
Peak SAR Locations for Body Back Side at 22 mm LTE B2 and 5 GHz WLAN Antenna

Table 11-46
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B2	IEEE 802.11a	0.850	< 1.070	< 1.920	113.86	< 0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Top Edge configuration at a separation distance of 22 mm with LTE B2 antenna operating at maximum output power with 2.4 GHz WIFI.

Table 11-47
Peak SAR Locations for Body Top Edge at 22 mm LTE B2 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	-23.00	59.00
IEEE 802.11b	-22.50	-79.20

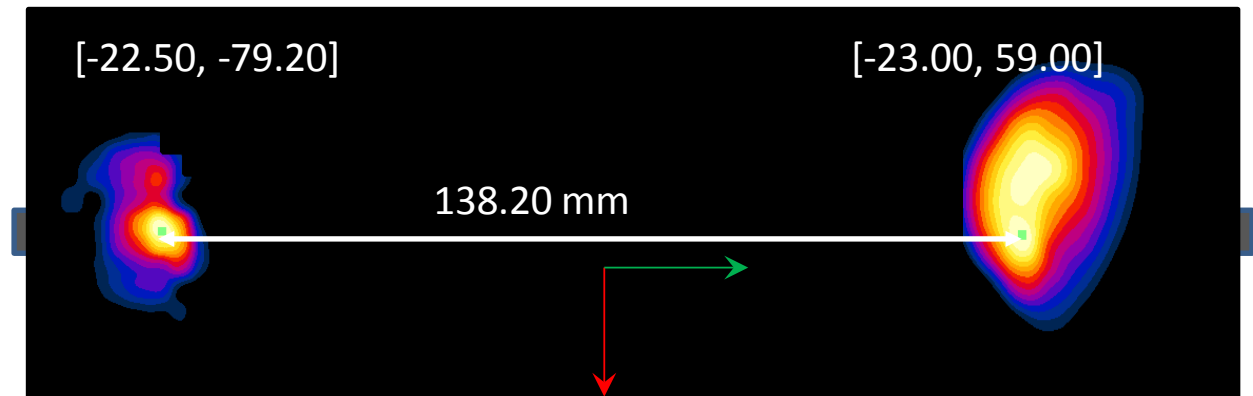


Figure 11-19
Peak SAR Locations for Body Top Edge at 22 mm LTE B2 and 2.4 GHz WLAN Antenna

Table 11-48
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B2	IEEE 802.11b	1.030	< 0.632	< 1.662	138.2	< 0.02

11.5 Simultaneous Transmission Conclusion

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 69 of 76

12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

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

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

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

Table 12-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS														
Band	FREQUENCY		Mode	Service	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.						(W/kg)	(W/kg)		(W/kg)		(W/kg)	
835	824.70	1013	Cell. CDMA	EVDO Rev. 0	N/A	back	0 mm	0.905	0.905	1.00	N/A	N/A	N/A	N/A
750	707.50	23095	LTE Band 12	QPSK, 1 RB, 25 RB Offset	N/A	back	0 mm	0.902	0.898	1.00	N/A	N/A	N/A	N/A
1900	1880.00	18900	LTE Band 2 (PCS)	QPSK, 1 RB, 0 RB Offset	N/A	top	22 mm	1.030	0.956	1.08	N/A	N/A	N/A	N/A
5200	5180.00	36	IEEE 802.11a	OFDM	6	back	0 mm	0.895	0.773	1.16	N/A	N/A	N/A	N/A
5300	5280.00	56	IEEE 802.11a	OFDM	6	back	0 mm	0.895	0.813	1.10	N/A	N/A	N/A	N/A
5500	5540.00	108	IEEE 802.11a	OFDM	6	back	0 mm	0.992	0.852	1.16	N/A	N/A	N/A	N/A
5600	5580.00	116	IEEE 802.11a	OFDM	6	back	0 mm	0.892	0.943	1.06	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT							Body							
Spatial Peak							1.6 W/kg (mW/g)							
Uncontrolled Exposure/General Population							averaged over 1 gram							

12.2 Measurement Uncertainty

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 70 of 76

13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8753E	(30kHz-6GHz) Network Analyzer	7/23/2013	Annual	7/23/2014	US37390350
Agilent	8753ES	S-Parameter Network Analyzer	10/29/2013	Annual	10/29/2014	US39170122
Agilent	E5515C	Wireless Communications Test Set	3/18/2014	Annual	3/18/2015	GB46110872
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/16/2013	Annual	4/16/2014	MY45470194
Agilent	N5182A	MXG Vector Signal Generator	10/28/2013	Annual	10/28/2014	US46240505
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA24106A	USB Power Sensor	12/18/2013	Annual	12/18/2014	1344555
Anritsu	MA24106A	USB Power Sensor	12/18/2013	Annual	12/18/2014	1344556
Anritsu	MA2411B	Pulse Power Sensor	3/25/2014	Annual	3/25/2015	1207470
Anritsu	MA2411B	Pulse Power Sensor	2/3/2014	Annual	2/3/2015	1339018
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
Anritsu	MT8820C	Radio Communication Analyzer	12/12/2013	Annual	12/12/2014	6200901190
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M155A00-009
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764558
Fisher Scientific	S407993	Long Stem Thermometer	11/4/2013	Biennial	11/4/2015	130671801
Fisher Scientific	S407993	Long Stem Thermometer	11/4/2013	Biennial	11/4/2015	130671821
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/30/2013	Annual	10/30/2014	1833460
Gigatronics	8651A	Universal Power Meter	10/30/2013	Annual	10/30/2014	8650319
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	10/18/2013	Annual	10/18/2014	100976
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	2/20/2014	Annual	2/20/2015	128633
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	SME06	Signal Generator	10/30/2013	Annual	10/30/2014	832026
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	22313
SPEAG	D1765V2	1765 MHz SAR Dipole	5/14/2013	Annual	5/14/2014	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	7/22/2013	Annual	7/22/2014	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	8/23/2013	Annual	8/23/2014	719
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/23/2013	Annual	9/23/2014	1007
SPEAG	D750V3	750 MHz Dipole	1/20/2014	Annual	1/20/2015	1003
SPEAG	D835V2	835 MHz SAR Dipole	4/25/2013	Annual	4/25/2014	4d119
SPEAG	DAE4	Dasy Data Acquisition Electronics	12/12/2013	Annual	12/12/2014	649
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/13/2013	Annual	5/13/2014	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/22/2014	Annual	1/22/2015	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/21/2013	Annual	8/21/2014	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1408
SPEAG	ES3DV2	SAR Probe	8/22/2013	Annual	8/22/2014	3022
SPEAG	ES3DV3	SAR Probe	5/16/2013	Annual	5/16/2014	3263
SPEAG	ES3DV3	SAR Probe	11/22/2013	Annual	11/22/2014	3333
SPEAG	EX3DV4	SAR Probe	1/29/2014	Annual	1/29/2015	3589
SPEAG	EX3DV4	SAR Probe	12/18/2013	Annual	12/18/2014	3920
SPEAG	EX3DV4	SAR Probe	10/23/2013	Annual	10/23/2014	3914
VWR	36934-158	Wall-Mounted Thermometer	8/8/2013	Biennial	8/8/2015	130477866

Note:

1. 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.
2. Each equipment item was used solely within its respective calibration period.

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 71 of 76

14 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz:

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

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

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 72 of 76

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: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 73 of 76

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: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 74 of 76

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FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 75 of 76

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FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1403260617-R1.A3L	Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet		Page 76 of 76

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 99

Communication System: UID 0, CDMA; Frequency: 824.7 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 824.7 \text{ MHz}$; $\sigma = 0.995 \text{ S/m}$; $\epsilon_r = 54.247$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-27-2014; Ambient Temp: 24.5°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. EVDO, Body SAR, Back side, Low.ch

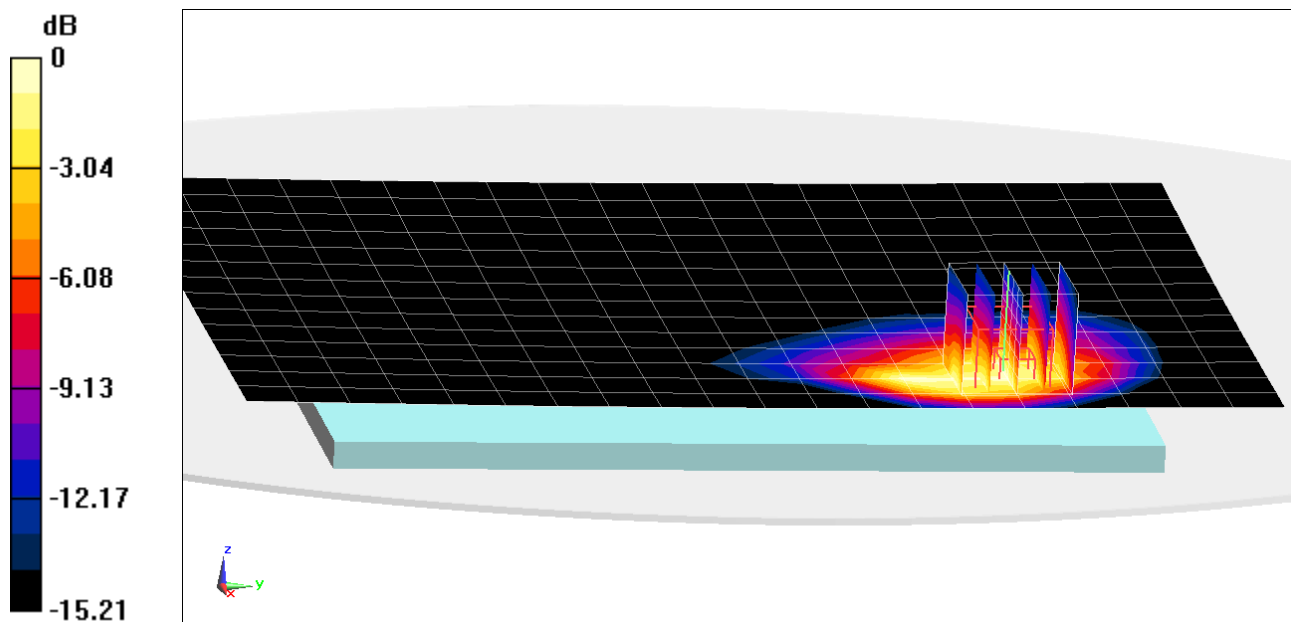
Area Scan (15x21x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 30.248 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.79 W/kg

SAR(1 g) = 0.905 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 99

Communication System: UID 0, CDMA; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.545 \text{ S/m}$; $\epsilon_r = 51.042$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-31-2014; Ambient Temp: 23.2°C; Tissue Temp: 21.6°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/21/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: PCS EVDO, Body SAR, Back side, Mid.ch

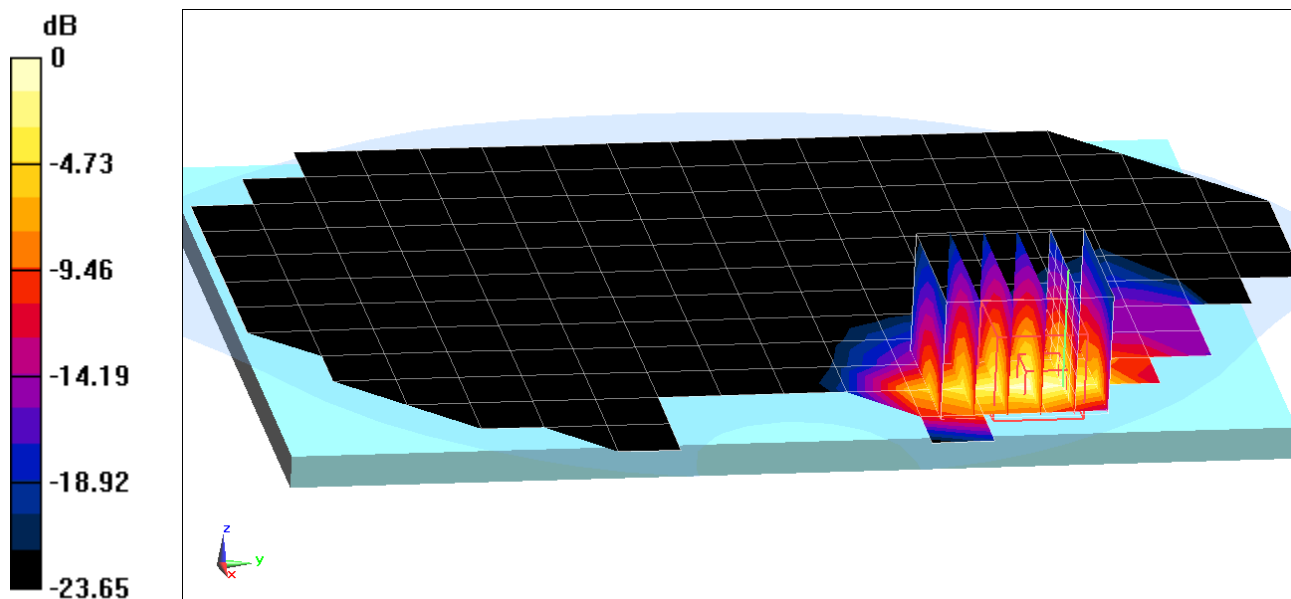
Area Scan (13x18x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 22.269 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 2.01 W/kg

SAR(1 g) = 0.912 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 72

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

Medium: 740 Body Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.933 \text{ S/m}$; $\epsilon_r = 54.374$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-29-2014; Ambient Temp: 24.1°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(9.39, 9.39, 9.39); Calibrated: 10/23/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 12, Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

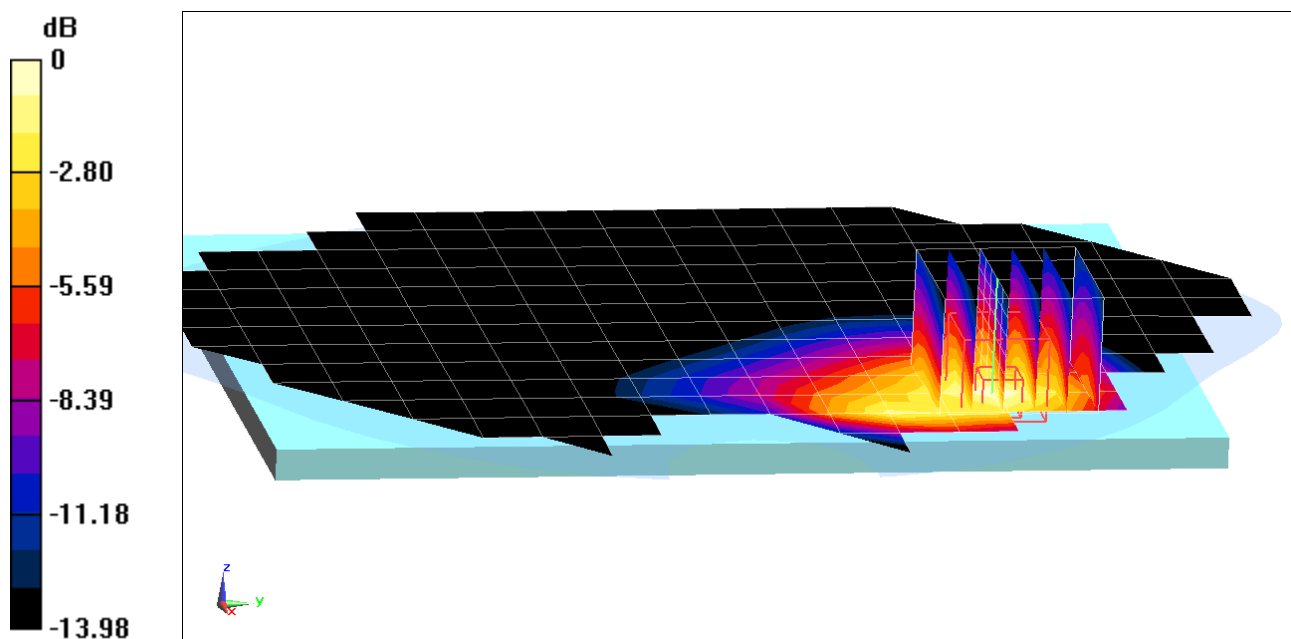
Area Scan (14x19x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 32.555 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 1.71 W/kg

SAR(1 g) = 0.902 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 72

Communication System: UID 0, LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 1.007 \text{ S/m}$; $\epsilon_r = 54.123$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-27-2014; Ambient Temp: 24.5°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 5 (Cell.), Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset**

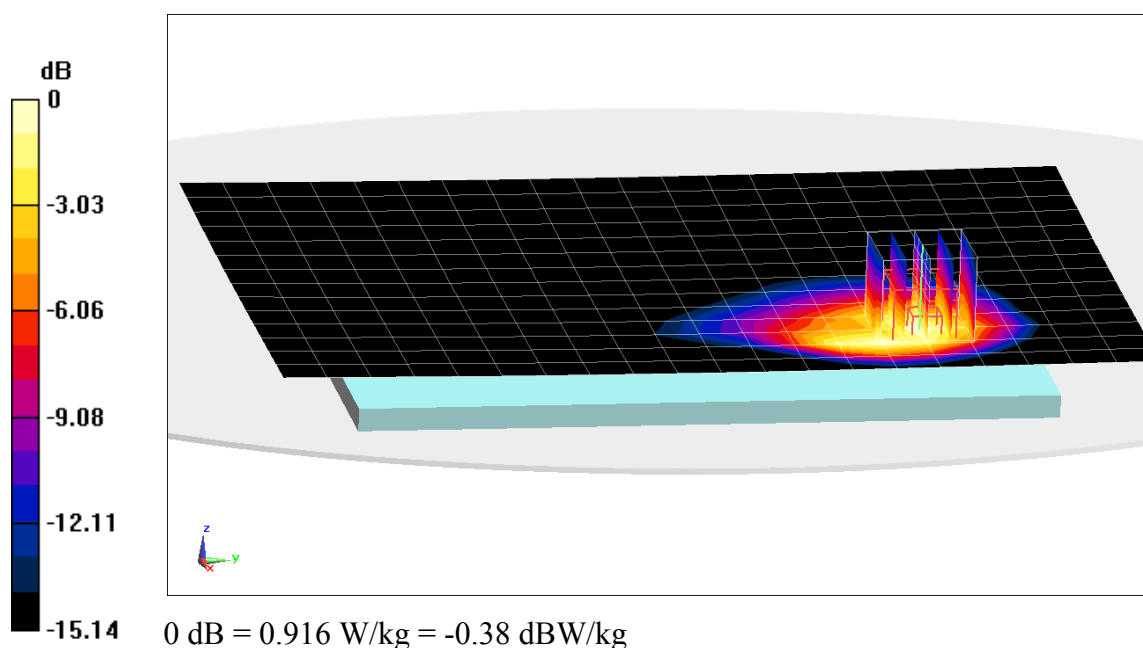
Area Scan (15x21x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 30.528 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 1.65 W/kg

SAR(1 g) = 0.822 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 60

Communication System: UID 0, LTE RF; Frequency: 1715 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
 $f = 1715 \text{ MHz}$; $\sigma = 1.515 \text{ S/m}$; $\epsilon_r = 52.570$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-25-2014; Ambient Temp: 22.0°C; Tissue Temp: 20.2°C

Probe: ES3DV3 - SN3263; ConvF(5.01, 5.01, 5.01); Calibrated: 5/16/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/13/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

**Mode: LTE Band 4 (AWS), Body SAR, Back side, Low.ch,
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

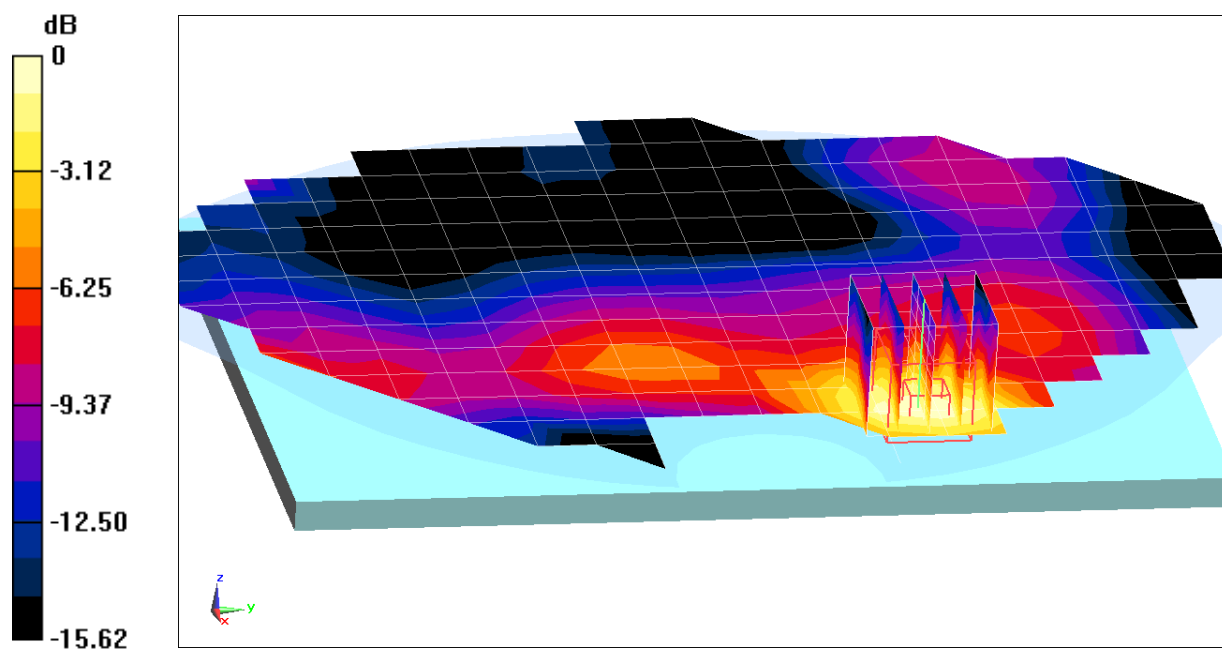
Area Scan (15x19x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 21.153 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.979 W/kg

SAR(1 g) = 0.742 W/kg



0 dB = 0.656 W/kg = -1.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 69

Communication System: UID 0, LTE Band 2 (PCS) (0); Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.545 \text{ S/m}$; $\epsilon_r = 51.042$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section. Space: 2.2 cm

Test Date: 03-31-2014; Ambient Temp: 23.2°C; Tissue Temp: 21.6°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/21/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: LTE Band 2 (PCS), Body SAR, Top Edge, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

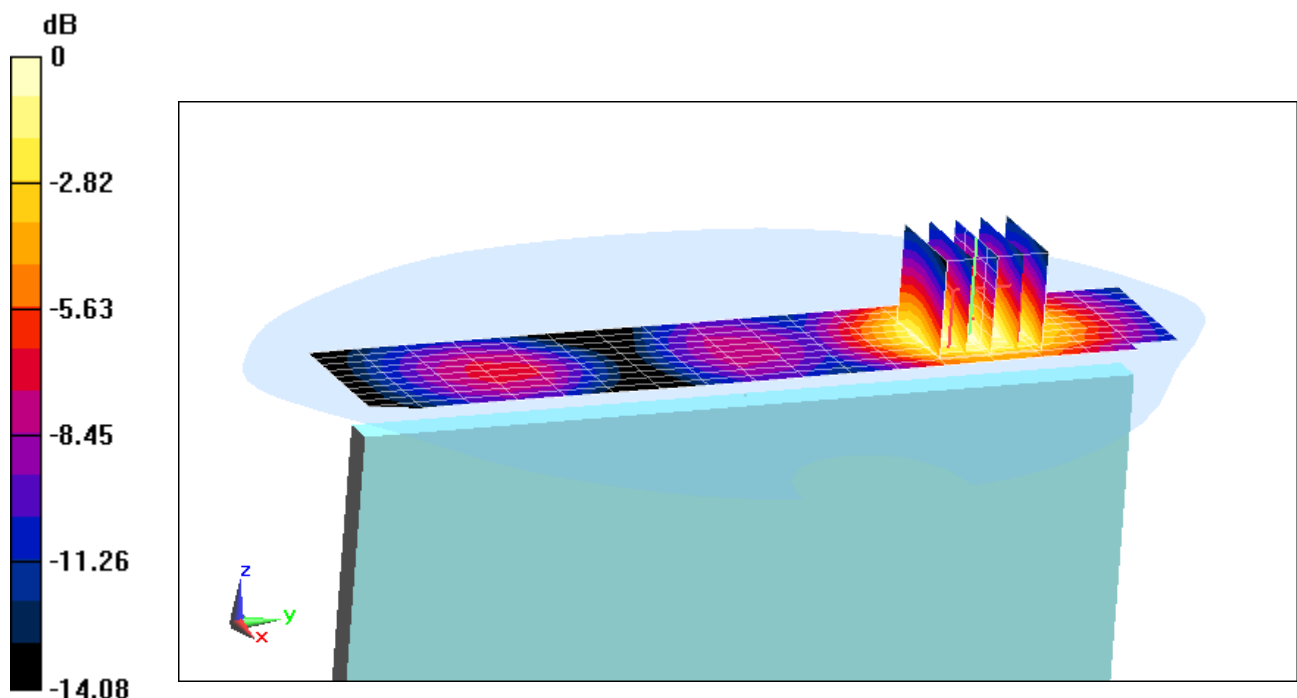
Area Scan (11x18x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 27.450 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.57 W/kg

SAR(1 g) = 1.03 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 70

Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 2.024 \text{ S/m}$; $\epsilon_r = 51.918$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-27-2014; Ambient Temp: 23.8°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3589; ConvF(6.26, 6.26, 6.26); Calibrated: 1/29/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/22/2014

Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

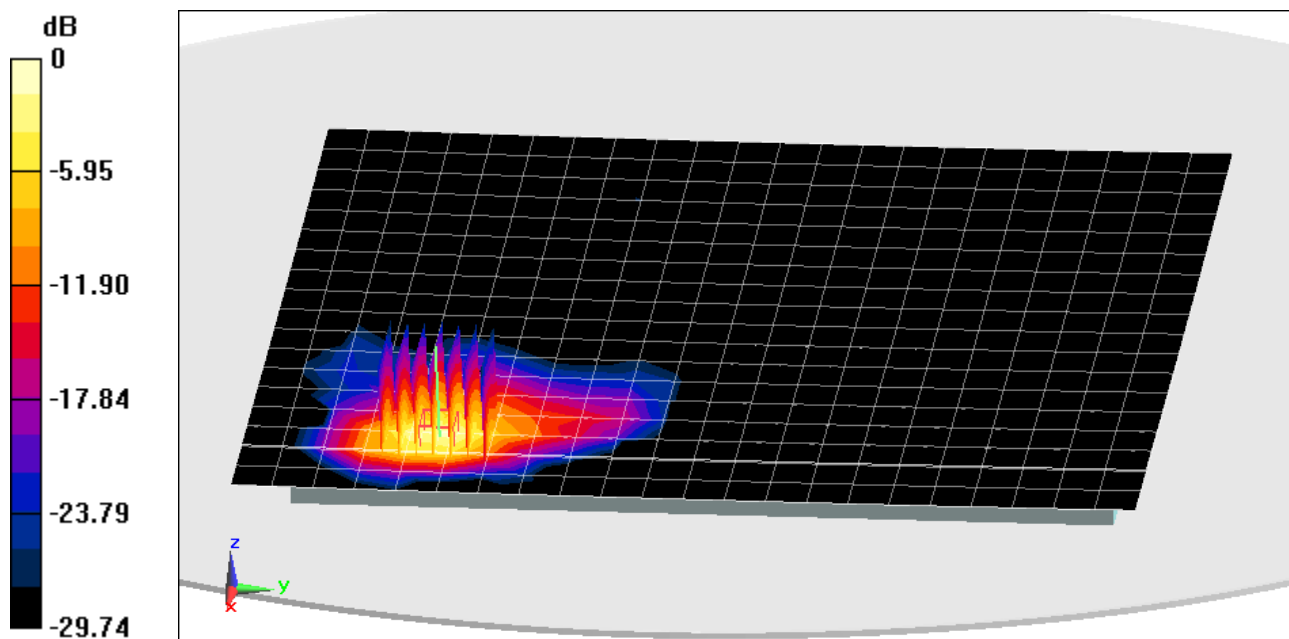
Area Scan (19x23x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 19.685 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 2.05 W/kg

SAR(1 g) = 0.795 W/kg



0 dB = 1.14 W/kg = 0.57 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 68

Communication System: UID 0, IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5745 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5745 \text{ MHz}$; $\sigma = 6.203 \text{ S/m}$; $\epsilon_r = 46.617$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 03-25-2014; Ambient Temp: 22.4°C; Tissue Temp: 21.9°C

Probe: EX3DV4 - SN3920; ConvF(4, 4, 4); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 149, 6 Mbps, Back Side

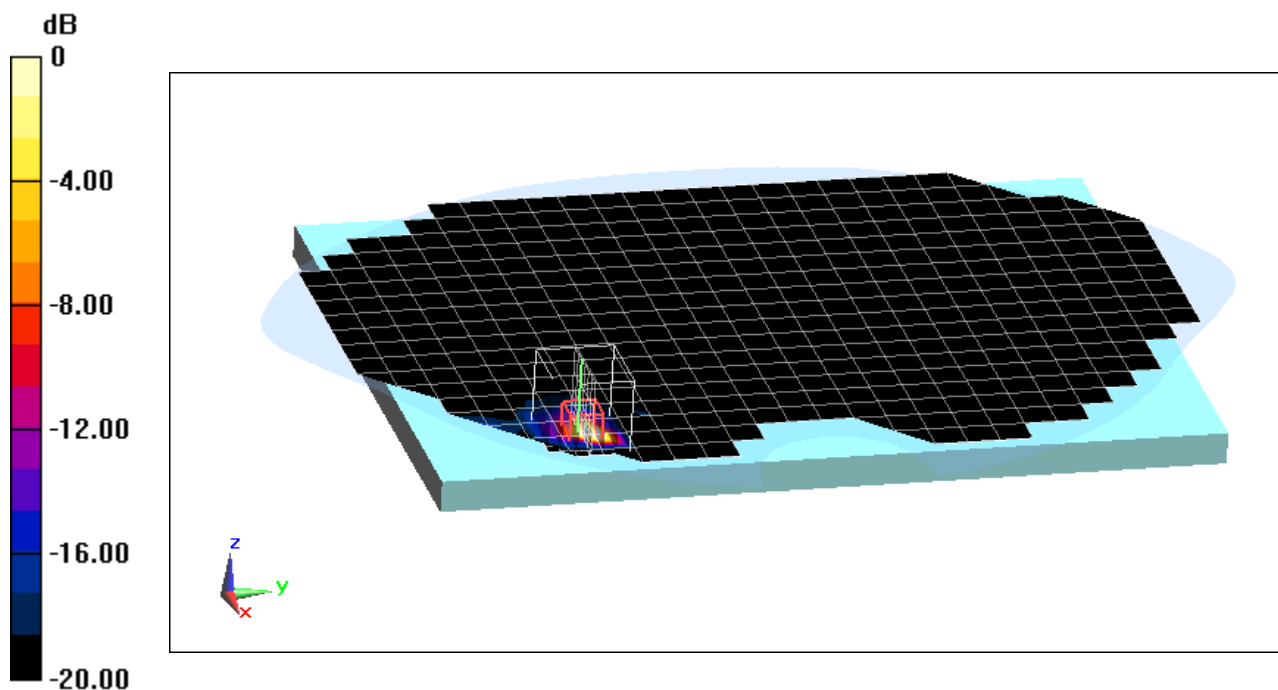
Area Scan (19x27x1): Measurement grid: dx=10mm, dy=10mm

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

Reference Value = 9.992 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 4.35 W/kg

SAR(1 g) = 0.693 W/kg



0 dB = 2.08 W/kg = 3.18 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 68

Communication System: UID 0, IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5540 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5540 \text{ MHz}$; $\sigma = 5.794 \text{ S/m}$; $\epsilon_r = 47.785$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 04-01-2014; Ambient Temp: 23.8°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN3920; ConvF(3.8, 3.8, 3.8); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.5 GHz, Body SAR, Ch 108, 6 Mbps, Back Side

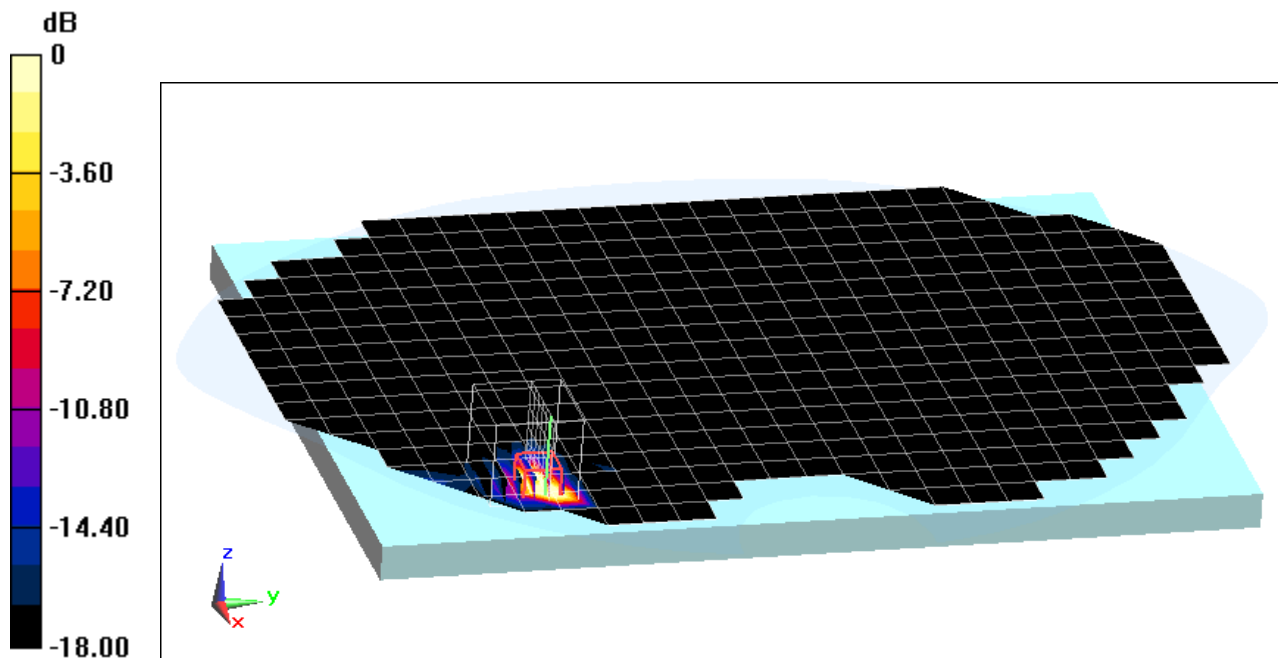
Area Scan (19x27x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

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

Reference Value = 10.850 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 9.85 W/kg

SAR(1 g) = 0.992 W/kg



0 dB = 2.88 W/kg = 4.59 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: 740 Body Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.972 \text{ S/m}$; $\epsilon_r = 53.803$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 03-29-2014; Ambient Temp: 24.1°C; Tissue Temp: 23.4°C

Probe: EX3DV4 - SN3914; ConvF(9.39, 9.39, 9.39); Calibrated: 10/23/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 11/19/2013

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

750 MHz System Verification

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

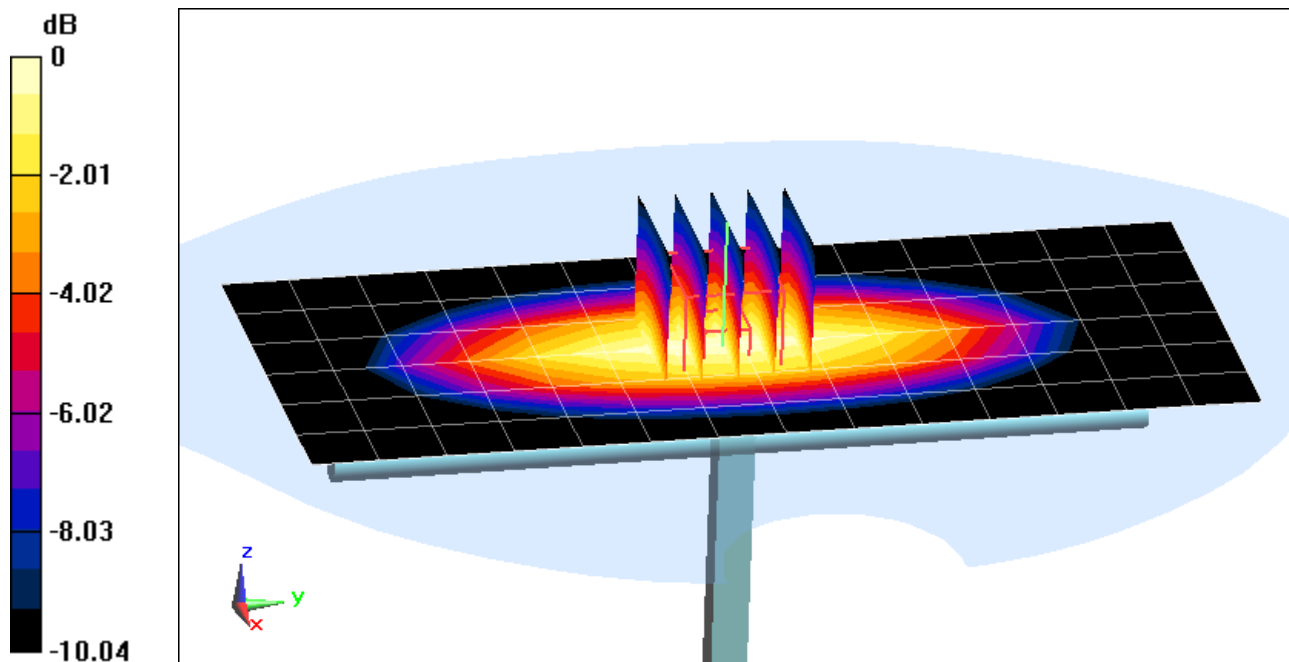
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.28 W/kg

SAR(1 g) = 0.869 W/kg

Deviation = -0.91 %



0 dB = 0.934 W/kg = -0.30 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 1.005 \text{ S/m}$; $\epsilon_r = 54.137$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 03-27-2014; Ambient Temp: 24.5°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3333; ConvF(6.07, 6.07, 6.07); Calibrated: 11/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

835 MHz System Verification

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

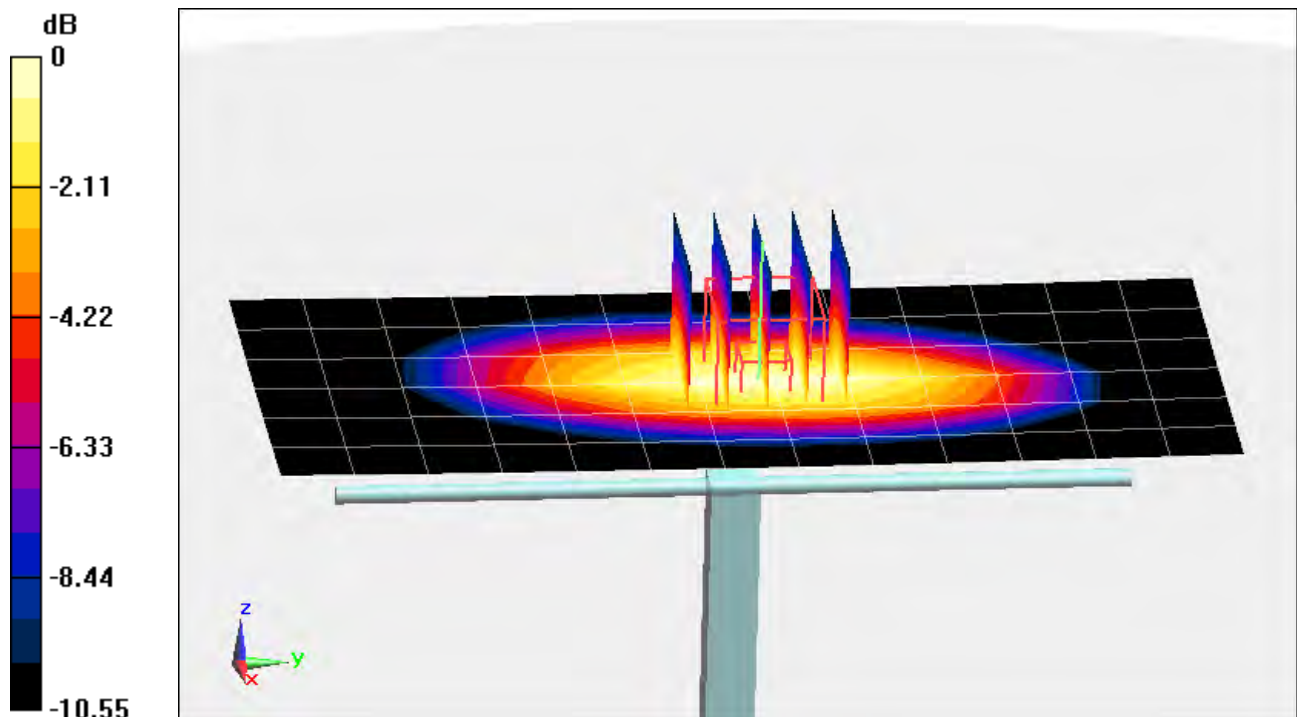
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 1.48 W/kg

SAR(1 g) = 1 W/kg

Deviation = 4.82 %



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1765V2; Serial: 1008

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

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.549 \text{ S/m}$; $\epsilon_r = 52.494$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-25-2014; Ambient Temp: 22.0°C; Tissue Temp: 20.2°C

Probe: ES3DV3 - SN3263; ConvF(5.01, 5.01, 5.01); Calibrated: 5/16/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/13/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

1750 MHz System Verification

Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm

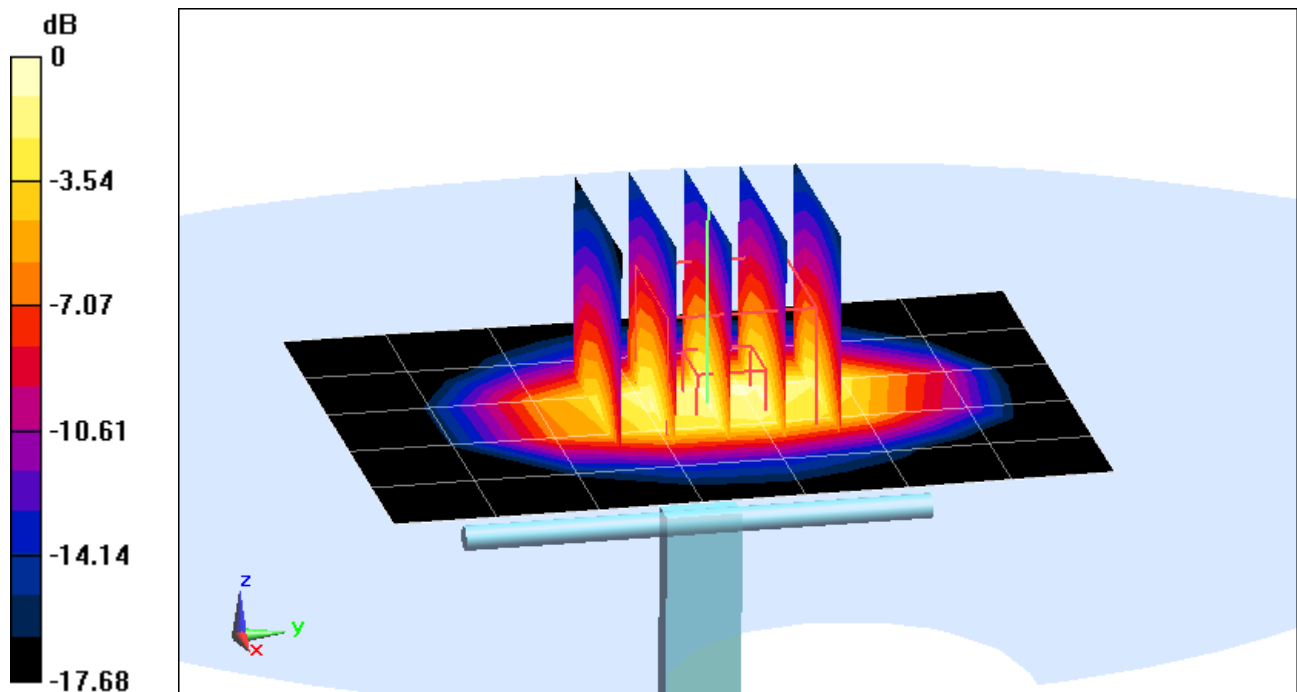
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 7.10 W/kg

SAR(1 g) = 3.88 W/kg

Deviation = 1.57 %



0 dB = 4.29 W/kg = 6.32 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.569 \text{ S/m}$; $\epsilon_r = 50.964$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-31-2014; Ambient Temp: 23.2°C; Tissue Temp: 21.6°C

Probe: ES3DV2 - SN3022; ConvF(4.49, 4.49, 4.49); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/21/2013

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

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

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

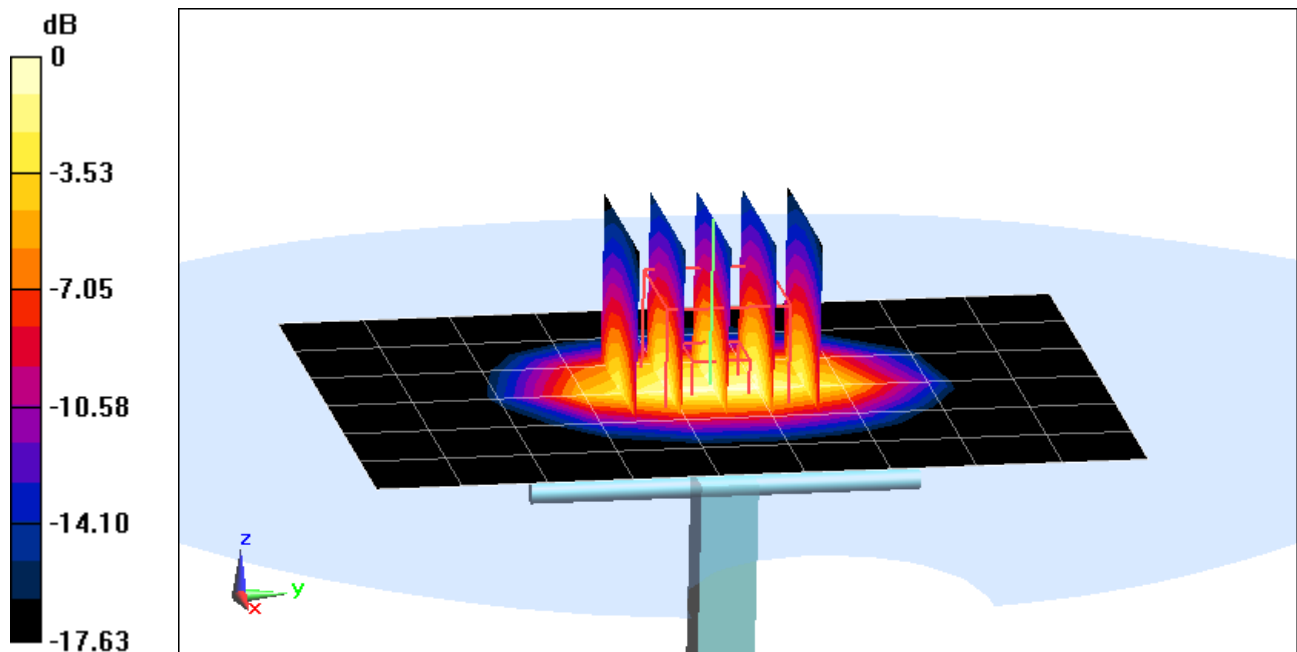
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 7.65 W/kg

SAR(1 g) = 4.2 W/kg

Deviation = 3.70 %



0 dB = 4.73 W/kg = 6.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.042 \text{ S/m}$; $\epsilon_r = 51.875$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-27-2014; Ambient Temp: 23.8°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3589; ConvF(6.26, 6.26, 6.26); Calibrated: 1/29/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 1/22/2014

Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

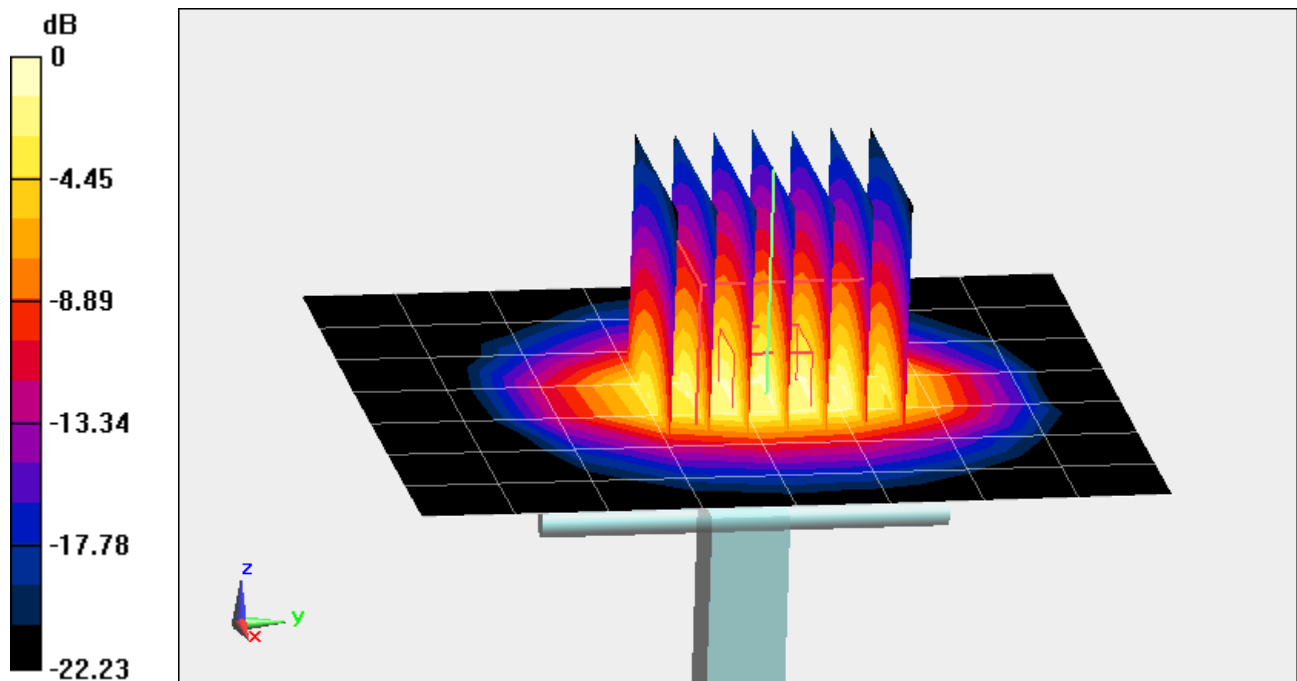
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Input Power = 16 dBm (40 mW)

Peak SAR (extrapolated) = 4.15 W/kg

SAR(1 g) = 2.01 W/kg

Deviation = -2.80 %



0 dB = 2.66 W/kg = 4.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1007

Communication System: UID 0, CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.279 \text{ S/m}$; $\epsilon_r = 46.726$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 03-25-2014; Ambient Temp: 22.4°C; Tissue Temp: 21.9°C

Probe: EX3DV4 - SN3920; ConvF(4, 4, 4); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5800MHz System Verification

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

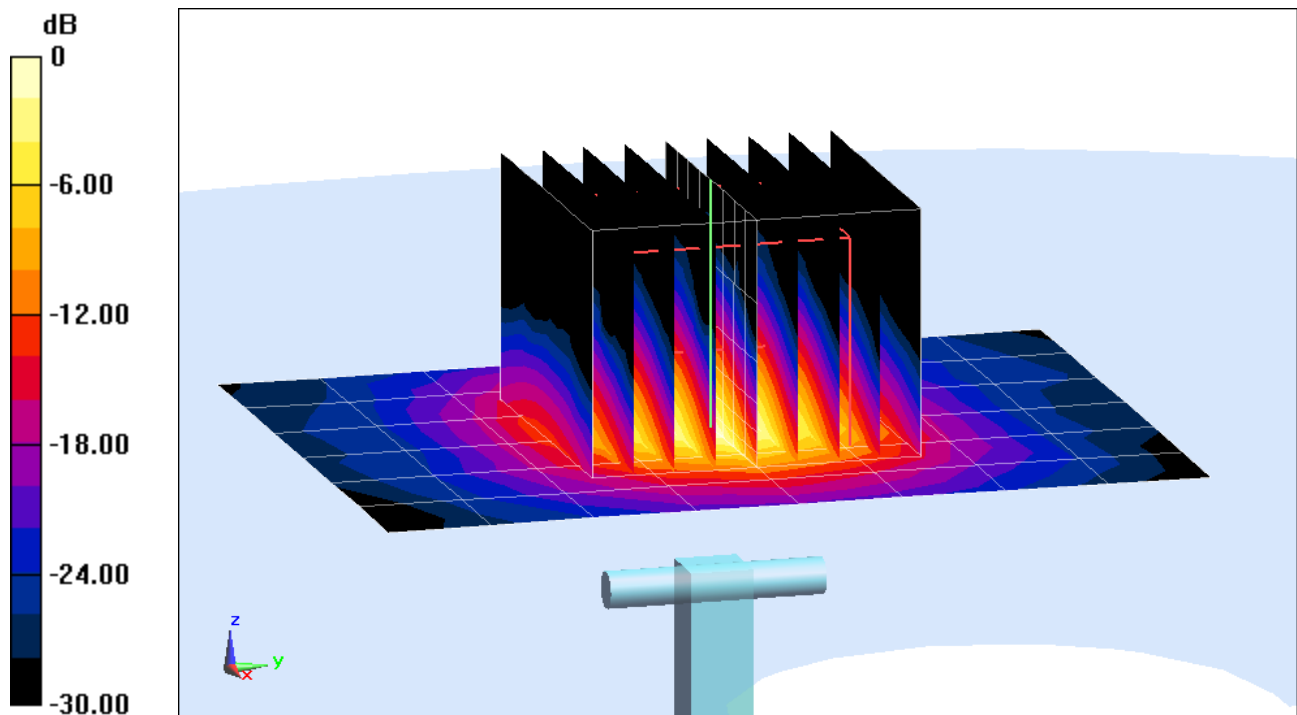
Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio=1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 33.7 W/kg

SAR(1 g) = 7.57 W/kg

Deviation = 3.84%



0 dB = 19.9 W/kg = 12.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1007

Communication System: UID 0, CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5200 \text{ MHz}$; $\sigma = 5.271 \text{ S/m}$; $\epsilon_r = 48.586$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2014; Ambient Temp: 23.8°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN3920; ConvF(4.23, 4.23, 4.23); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5200 MHz System Verification

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

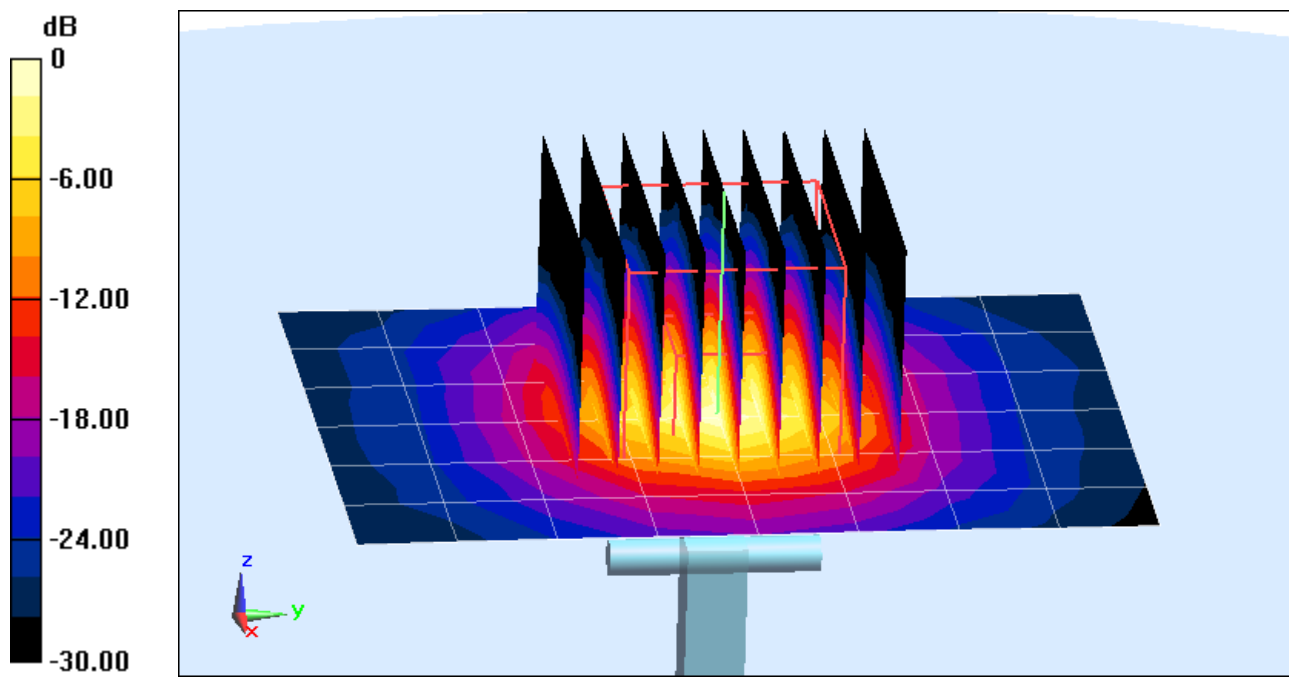
Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio=1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 28.4 W/kg

SAR(1 g) = 7.58 W/kg

Deviation = 4.41 %



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1007

Communication System: UID 0, CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.431 \text{ S/m}$; $\epsilon_r = 48.317$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2014; Ambient Temp: 23.8°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN3920; ConvF(4.11, 4.11, 4.11); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5300 MHz System Verification

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

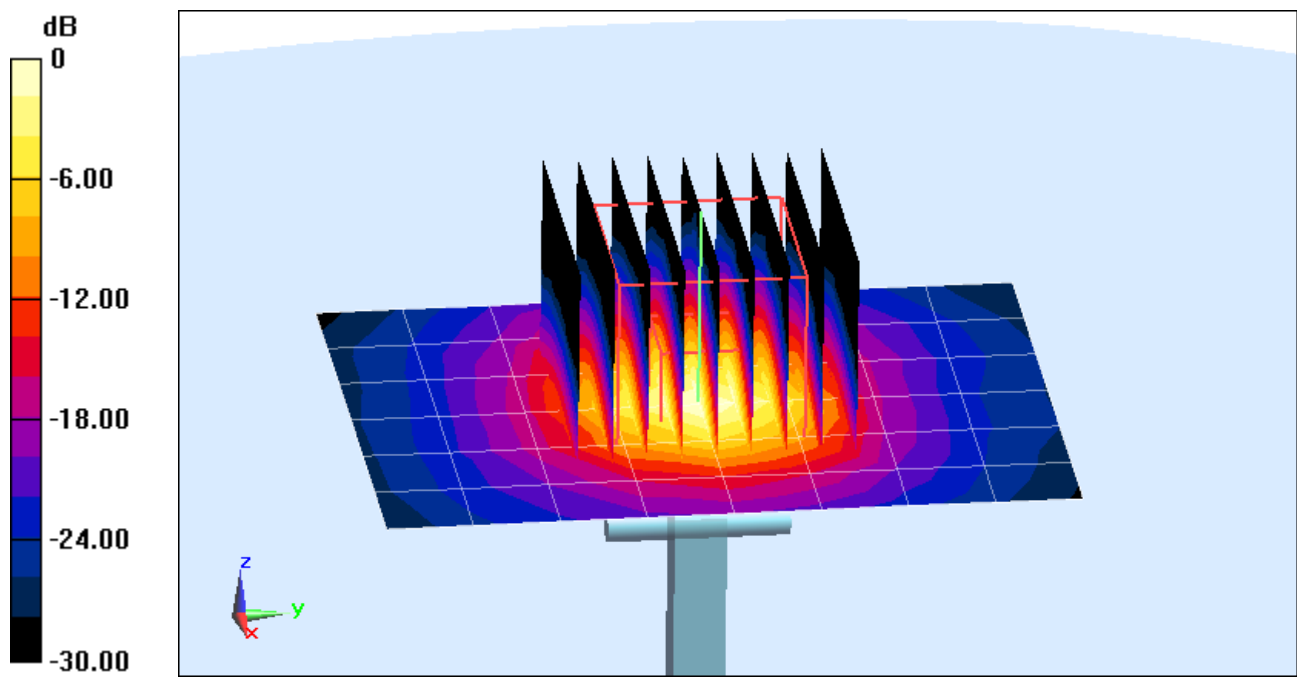
Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio=1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 31.6 W/kg

SAR(1 g) = 7.94 W/kg

Deviation = 6.29 %



0 dB = 19.9 W/kg = 12.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1007

Communication System: UID 0, CW; Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 5.741 \text{ S/m}$; $\epsilon_r = 47.868$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2014; Ambient Temp: 23.8°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN3920; ConvF(3.8, 3.8, 3.8); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5500 MHz System Verification

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

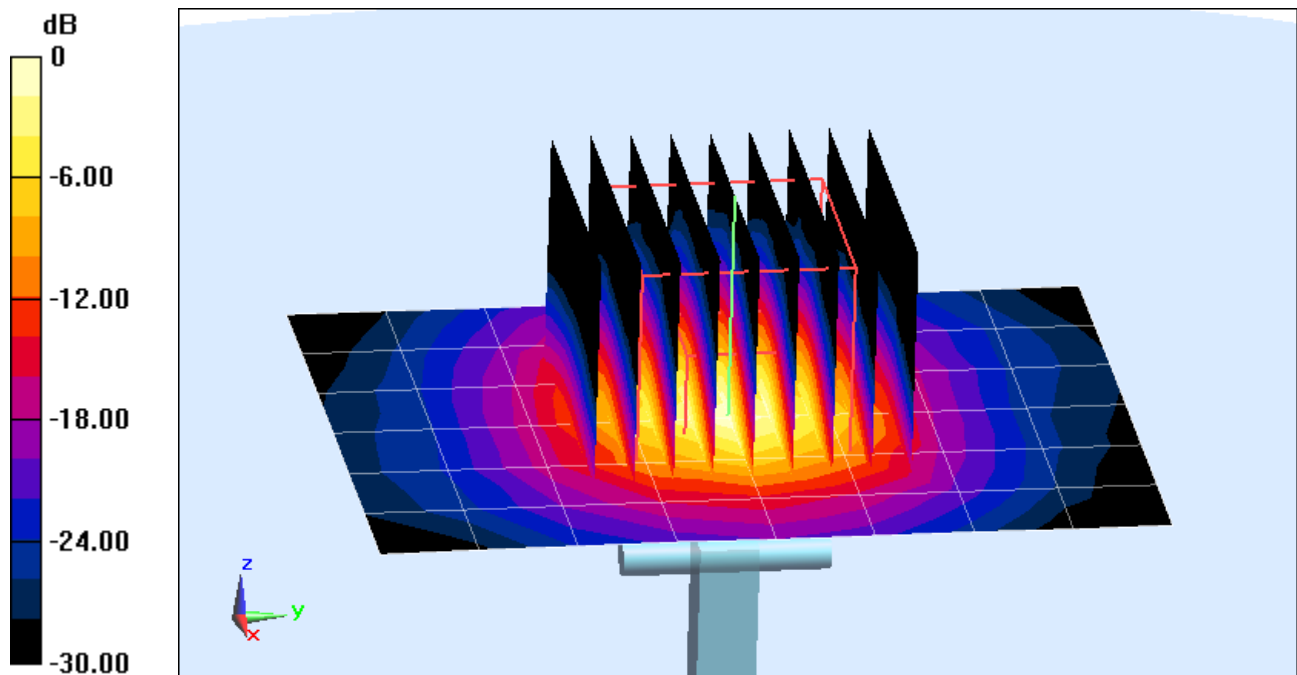
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio=1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 34.5 W/kg

SAR(1 g) = 7.74 W/kg

Deviation = 1.98 %



0 dB = 20.9 W/kg = 13.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1007

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

Medium: 5 GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.879 \text{ S/m}$; $\epsilon_r = 47.624$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-01-2014; Ambient Temp: 23.8°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN3920; ConvF(3.62, 3.62, 3.62); Calibrated: 12/18/2013;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 12/12/2013

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

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5600 MHz System Verification

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

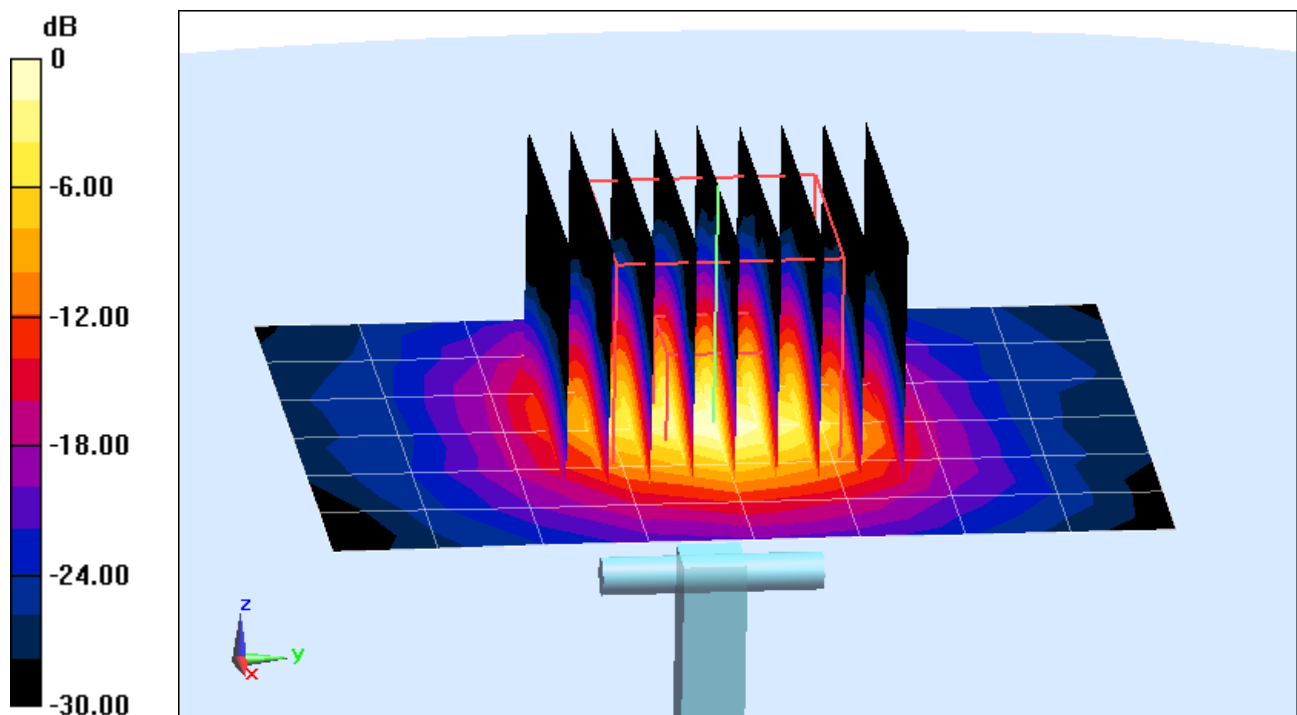
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio=1.4

Input Power = 20 dBm (100 mW)

Peak SAR (extrapolated) = 34.8 W/kg

SAR(1 g) = 7.84 W/kg

Deviation = 1.42 %



0 dB = 20.6 W/kg = 13.14 dBW/kg

APPENDIX C: PROBE CALIBRATION



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d119_Apr13**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d119**

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

Calibration date: **April 25, 2013**

✓
KOK
5/8/13

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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 909	11-Sep-12 (No. DAE4-909_Sep12)	Sep-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: **Claudio Leubler** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

[Signature]

[Signature]

Issued: April 26, 2013

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- 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	V52.8.6
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	40.8 $\pm$ 6 %	0.94 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.68 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.30 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.0 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.54 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.31 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 4.7 j Ω
Return Loss	- 26.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 6.3 j Ω
Return Loss	- 22.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 25.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.94$ S/m; $\epsilon_r = 40.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

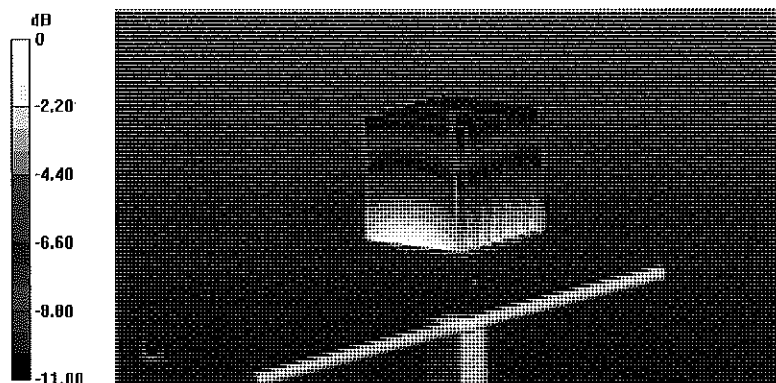
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.387 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.86 W/kg

SAR(1 g) = 2.51 W/kg; SAR(10 g) = 1.62 W/kg

Maximum value of SAR (measured) = 2.93 W/kg



0 dB = 2.93 W/kg = 4.67 dBW/kg

Impedance Measurement Plot for Head TSL

25 Apr 2013 09:11:06
 CH1 S11 1 U FS 1: 50.061 Ω -4.6621 Ω 40.884 pF 835.000 000 MHz

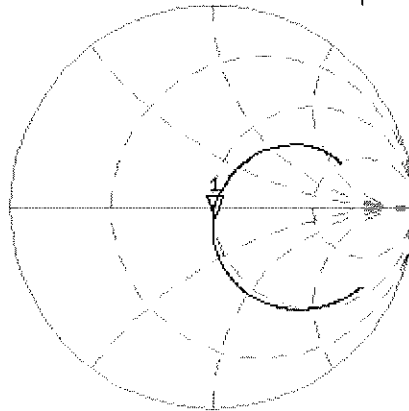
*

Del

CA

Avg
16

H1 d

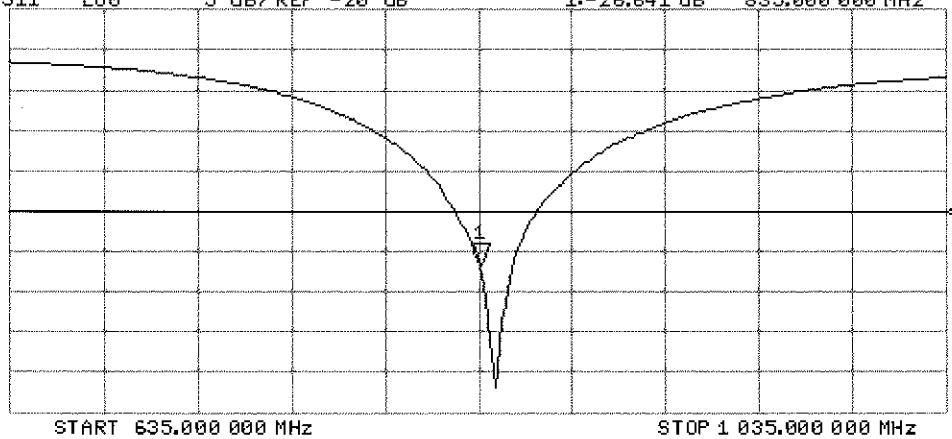


CH2 S11 LOG 5 dB/REF -20 dB 1:-26.641 dB 835.000 000 MHz

CA

Avg
16

H1 d



DASY5 Validation Report for Body TSL

Date: 24.04.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.01 \text{ S/m}$; $\epsilon_r = 54$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn909; Calibrated: 11.09.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

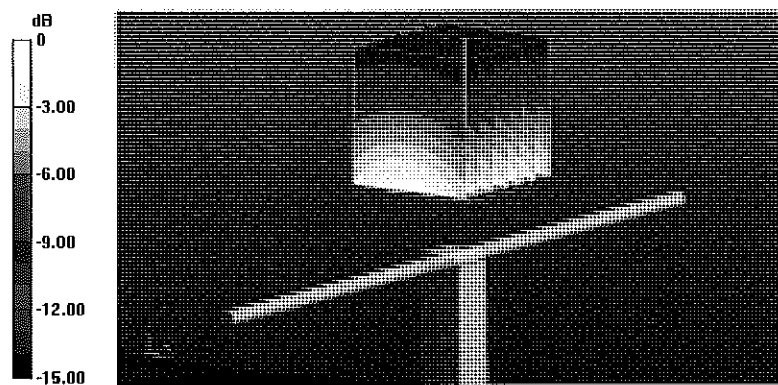
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 55.178 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.68 W/kg

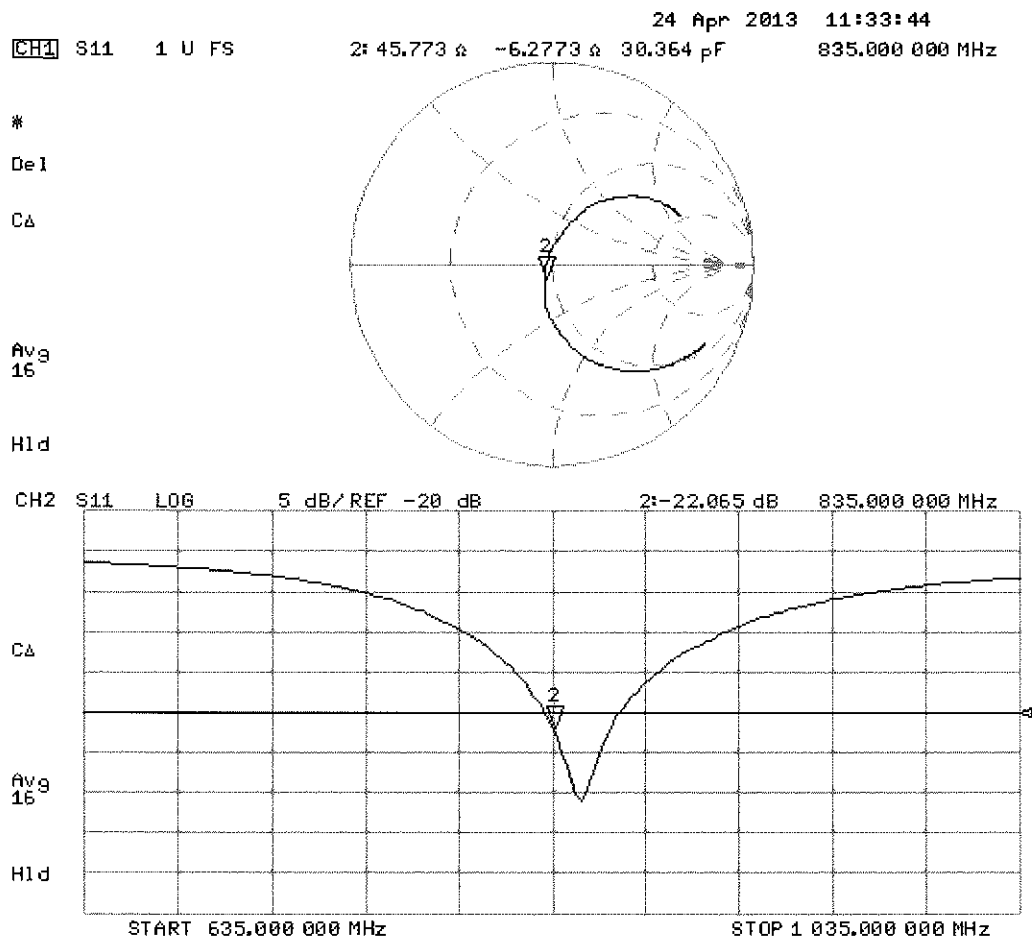
SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.62 W/kg

Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.61 dBW/kg

Impedance Measurement Plot for Body TSL





Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1765V2-1008_May13**

CALIBRATION CERTIFICATE

Object **D1765V2 - SN: 1008**

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

Calibration date: **May 14, 2013**

*✓ 100K
5/23/13*

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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
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: **Jeton Kastrat** Function: **Laboratory Technician** Signature: *[Signature]*

Approved by: **Katja Pokovic** Technical Manager *[Signature]*

Issued: May 15, 2013

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



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Accreditation No.: **SCS 108**

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:

- 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	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.33 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	9.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.8 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	4.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.6 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	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.7 $\pm$ 6 %	1.47 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.53 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	38.2 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	5.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.4 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.3 Ω - 6.4 j Ω
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.8 Ω - 6.1 j Ω
Return Loss	- 20.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.211 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2005

DASY5 Validation Report for Head TSL

Date: 14.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.33$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.18, 5.18, 5.18); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

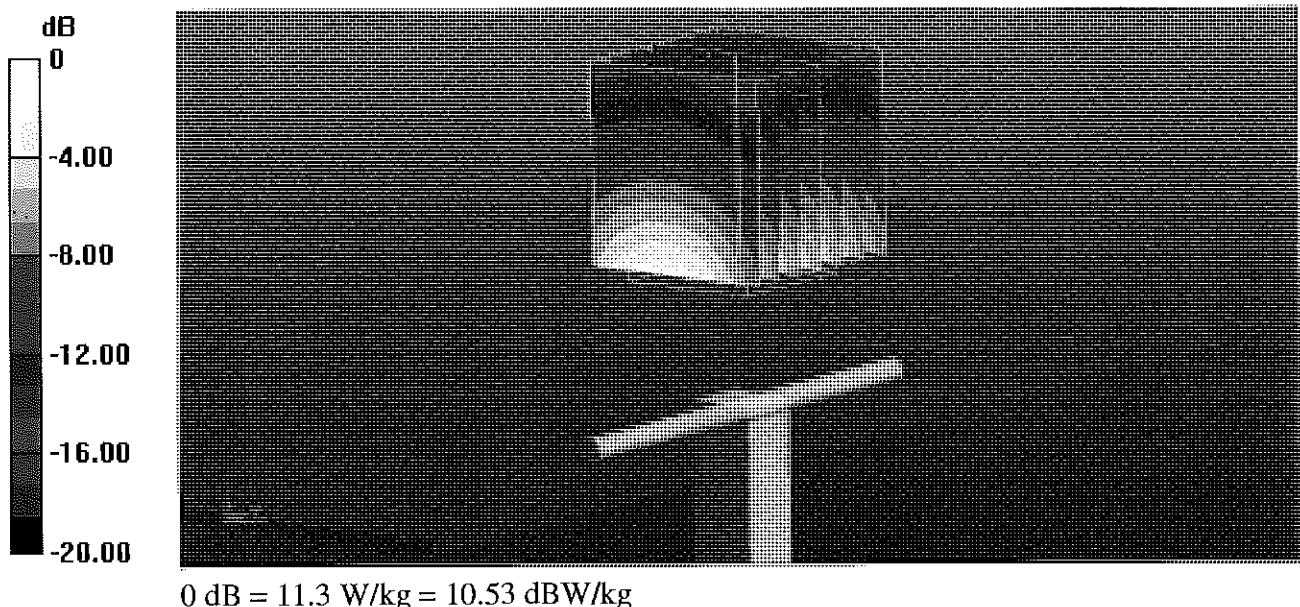
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.430 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.3 W/kg

SAR(1 g) = 9.09 W/kg; SAR(10 g) = 4.85 W/kg

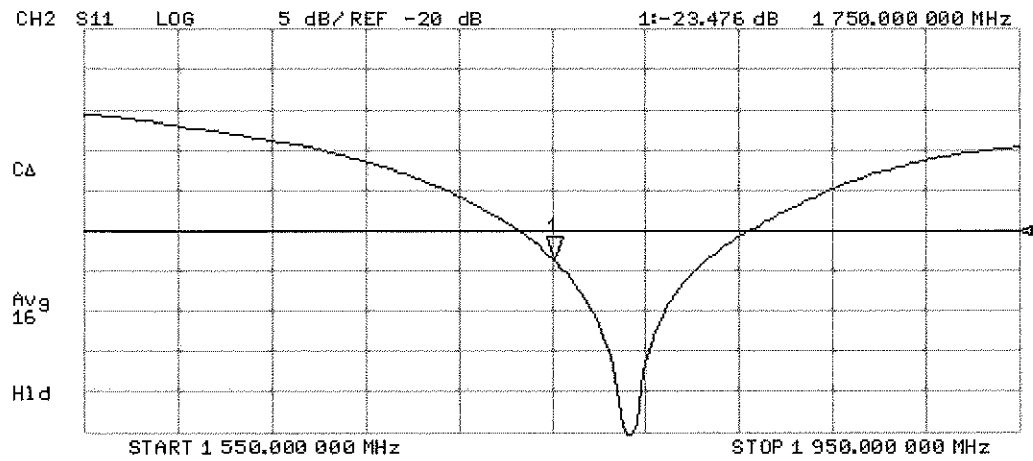
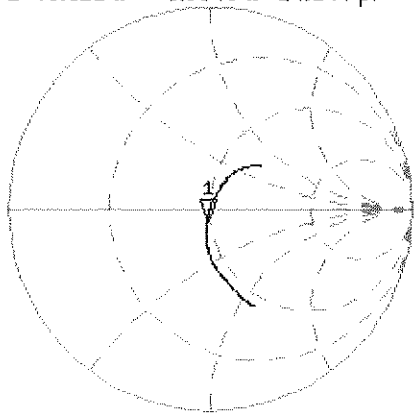
Maximum value of SAR (measured) = 11.3 W/kg



Impedance Measurement Plot for Head TSL

14 May 2013 15:57:39
[CH1] S11 1 U FS 1: 48.322 Ω -6.3848 Ω 14.244 pF 1 750.000 000 MHz

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De1
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16
H1 d



DASY5 Validation Report for Body TSL

Date: 13.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.47$ S/m; $\epsilon_r = 51.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.83, 4.83, 4.83); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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

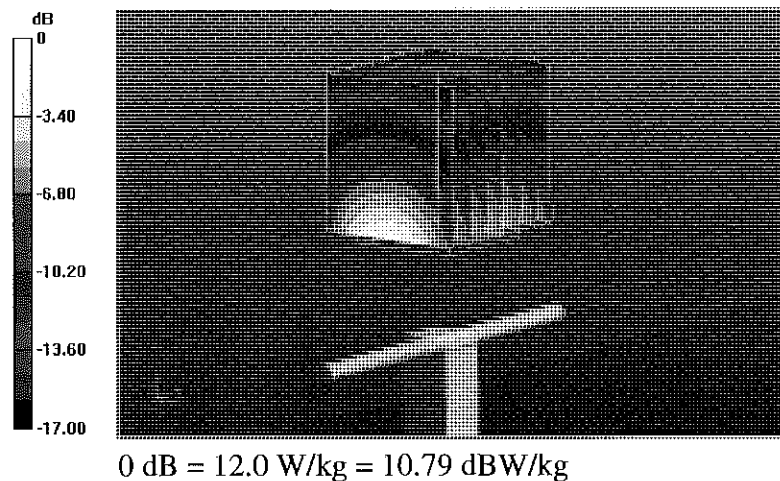
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.430 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.4 W/kg

SAR(1 g) = 9.53 W/kg; SAR(10 g) = 5.1 W/kg

Maximum value of SAR (measured) = 12.0 W/kg



Impedance Measurement Plot for Body TSL

13 May 2013 15:25:53
[CH1] S11 1 U FS 1: 43.775 Ω -6.1426 Ω 14.806 pF 1 750.000 000 MHz

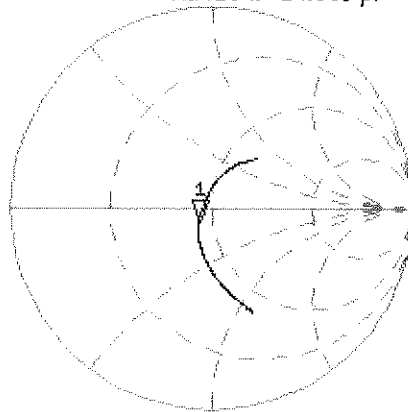
*

De1

Cor

Avg
16

H1d

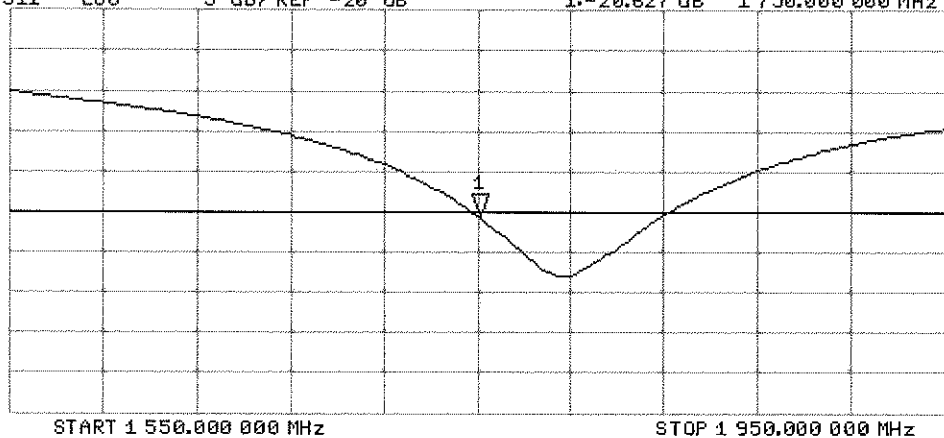


CH2 S11 LOG 5 dB/REF -20 dB 1:-20.627 dB 1 750.000 000 MHz

Cor

Avg
16

H1d





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D750V3-1003_Jan14**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1003**

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

Calibration date: **January 20, 2014**

CC
21/14 ✓

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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

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

Signature

Israe El-Naouq
Katja Pokovic

Issued: January 21, 2014

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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.8 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.37 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.46 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.0 $\pm$ 6 %	0.98 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	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.77 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.78 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.7 Ω - 0.2 j Ω
Return Loss	- 27.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.5 Ω - 2.6 j Ω
Return Loss	- 31.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.043 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 21, 2009

DASY5 Validation Report for Head TSL

Date: 20.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750$ MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 40.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.37, 6.37, 6.37); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

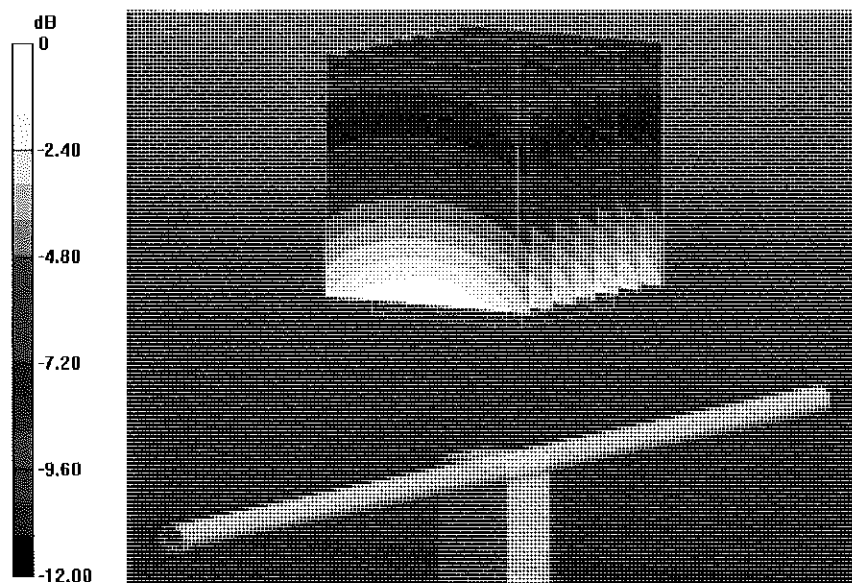
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.711 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.27 W/kg

SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.4 W/kg

Maximum value of SAR (measured) = 2.51 W/kg

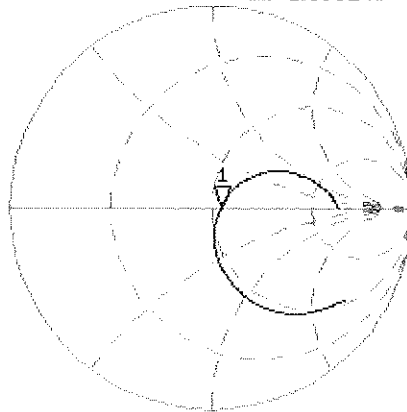


0 dB = 2.51 W/kg = 4.00 dBW/kg

Impedance Measurement Plot for Head TSL

20 Jan 2014 16:36:06
 CH1 S11 1 U FS 1: 54.678 Ω -156.25 m Ω 1.3581 nF 750.000 000 MHz

*
 Del
 CA



Avg
 16

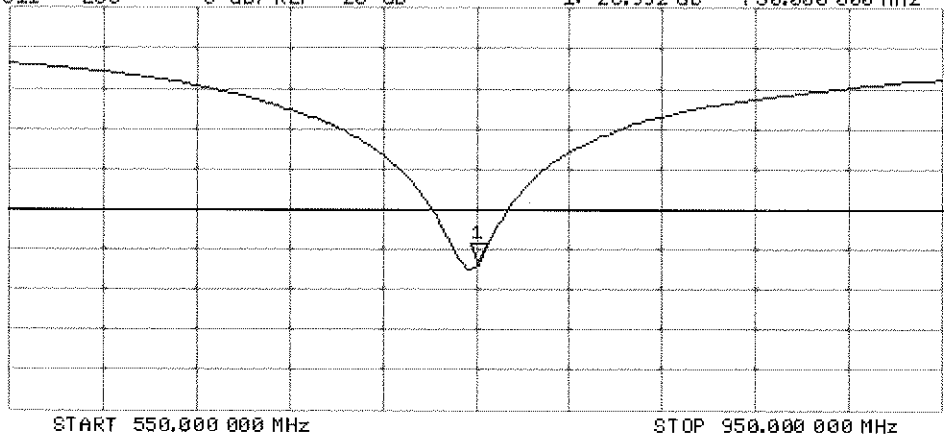
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -26.992 dB 750.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 20.01.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.98 \text{ S/m}$; $\epsilon_r = 54$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.13, 6.13, 6.13); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

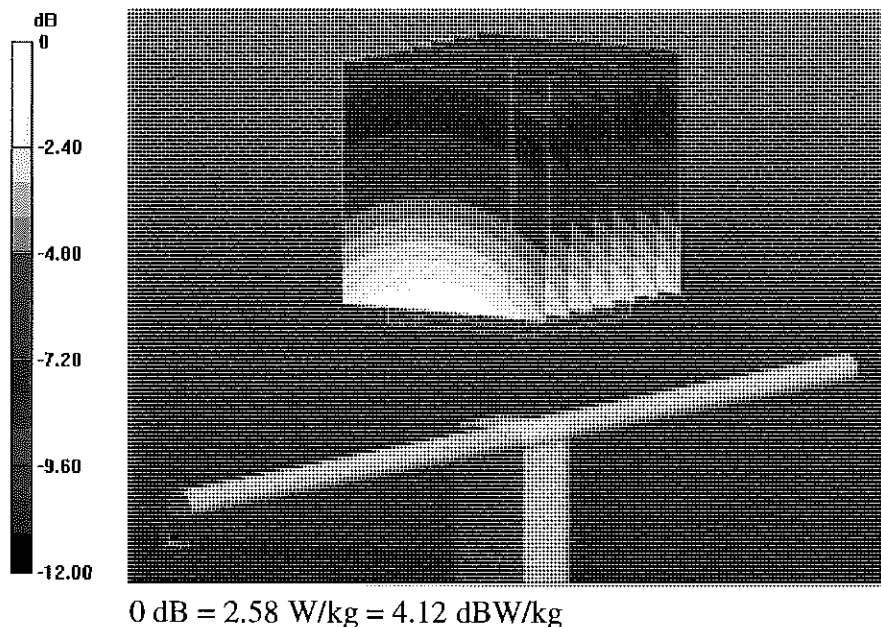
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 53.082 V/m; Power Drift = 0.03 dB

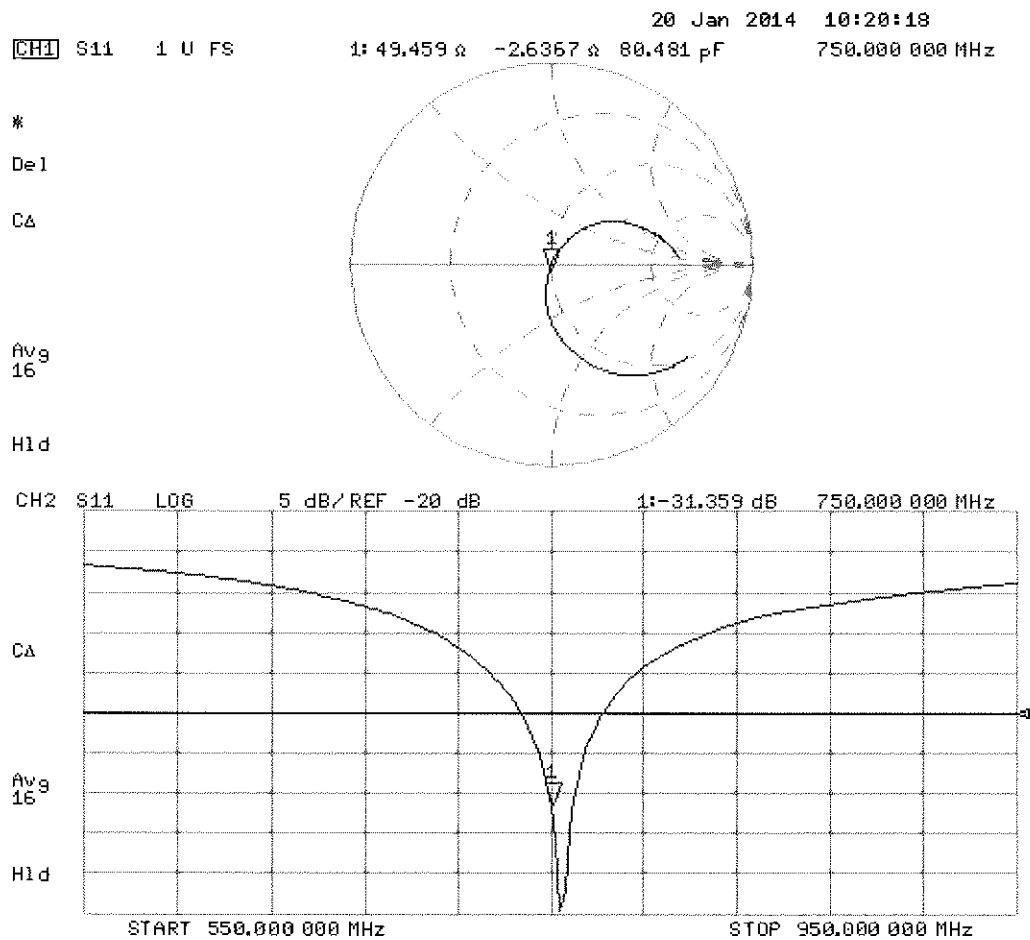
Peak SAR (extrapolated) = 3.31 W/kg

SAR(1 g) = 2.24 W/kg; SAR(10 g) = 1.47 W/kg

Maximum value of SAR (measured) = 2.58 W/kg



Impedance Measurement Plot for Body TSL





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d149_Jul13**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d149**

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

Calibration date: **July 22, 2013**

✓
 KOK
 8/19/13

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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: July 22, 2013

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
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	38.9 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.3 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	53.4 $\pm$ 6 %	1.49 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	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.36 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.9\ \Omega + 6.0\ j\Omega$
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.5\ \Omega + 6.4\ j\Omega$
Return Loss	- 23.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 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: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 1900 MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.36 \text{ S/m}$; $\epsilon_r = 38.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

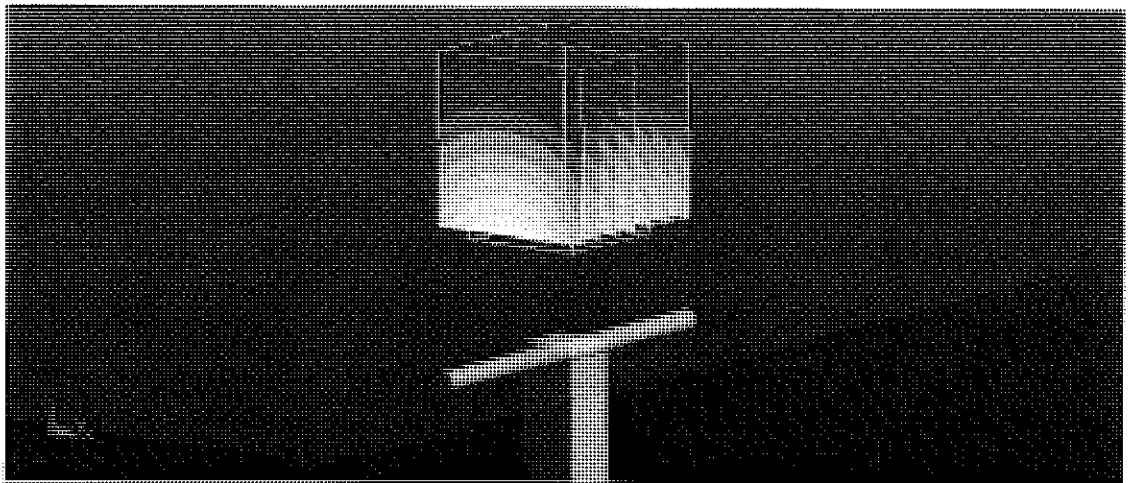
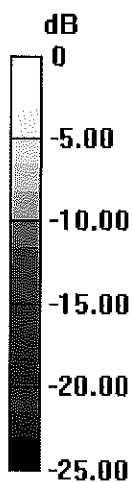
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 96.173 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 9.99 W/kg; SAR(10 g) = 5.28 W/kg

Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

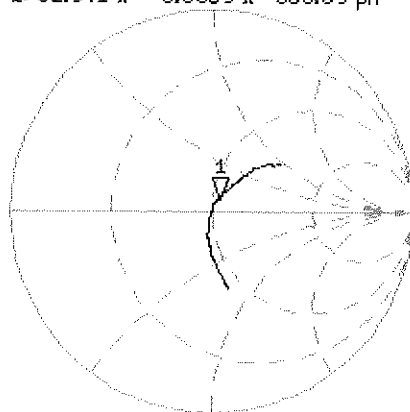
Impedance Measurement Plot for Head TSL

22 Jul 2013 11:59:34
 CH1 S11 1 U FS 1: 52.941 Ω 6.0059 Ω 503.09 μ H 1 900.000 000 MHz

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 Del
 CA

Avg
 16

H1d

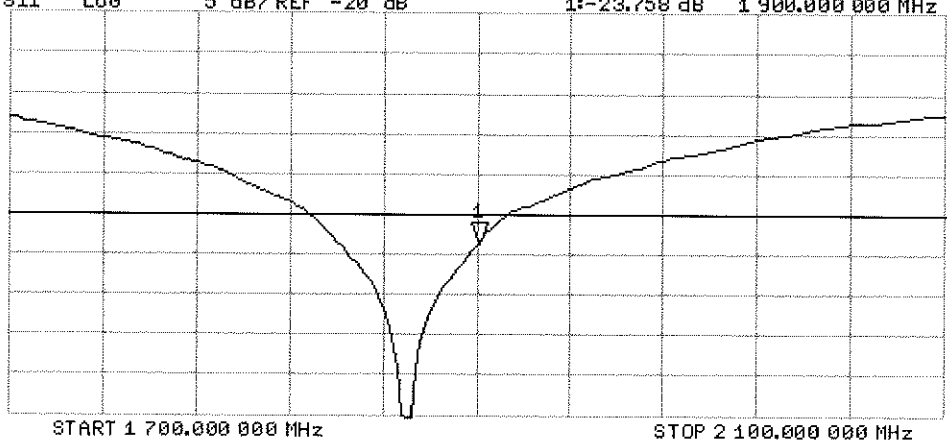


CH2 S11 LOG 5 dB/REF -20 dB 1:-23.758 dB 1 900.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 53.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

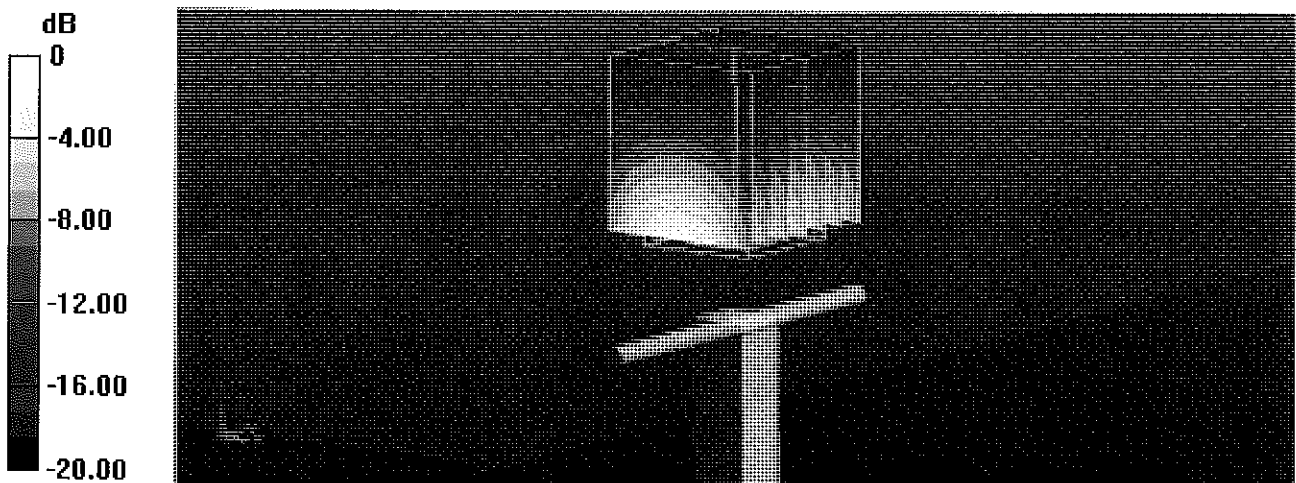
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.173 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 10 W/kg; SAR(10 g) = 5.36 W/kg

Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Body TSL

22 Jul 2013 11:32:14
[CH1] S11 1 U FS 1: 48.525 Δ 6.3906 Δ 535.32 pH 1 900.000 000 MHz

*

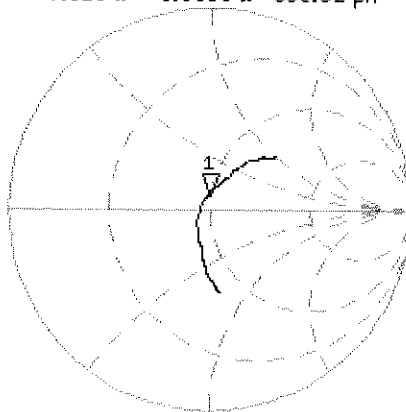
De1

CA

Avg

16

H1d



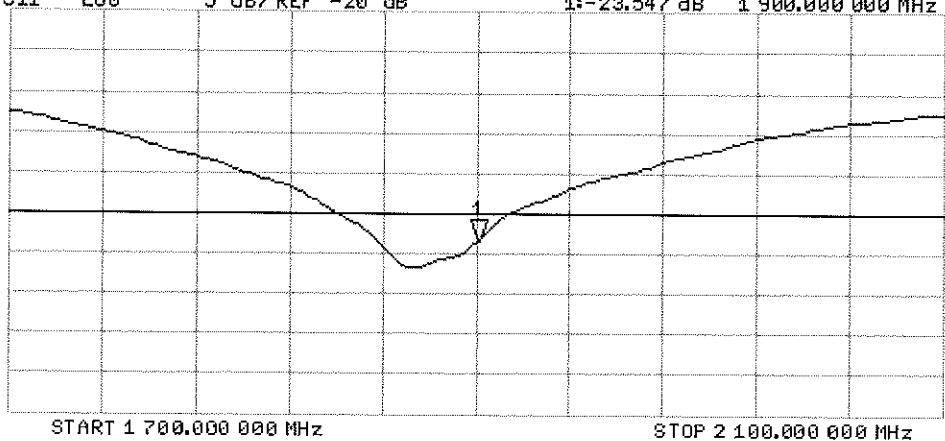
CH2 S11 LOG 5 dB/REF -20 dB 1: -23.547 dB 1 900.000 000 MHz

CA

Avg

16

H1d





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Accreditation No.: **SCS 108**

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Client **PC Test**

Certificate No: **D2450V2-719_Aug13**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 719**

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

Calibration date: **August 23, 2013**

✓cc
9/13/13

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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
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: **Jeton Kastrati** Name: **Jeton Kastrati** Function: **Laboratory Technician** Signature:

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

Issued: August 23, 2013

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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.8 $\pm$ 6 %	1.80 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.2 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.6 $\pm$ 6 %	2.03 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	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.7 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	6.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.1 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.6 \Omega + 3.5 j\Omega$
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$51.1 \Omega + 5.4 j\Omega$
Return Loss	- 25.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 22.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.8$ S/m; $\epsilon_r = 37.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

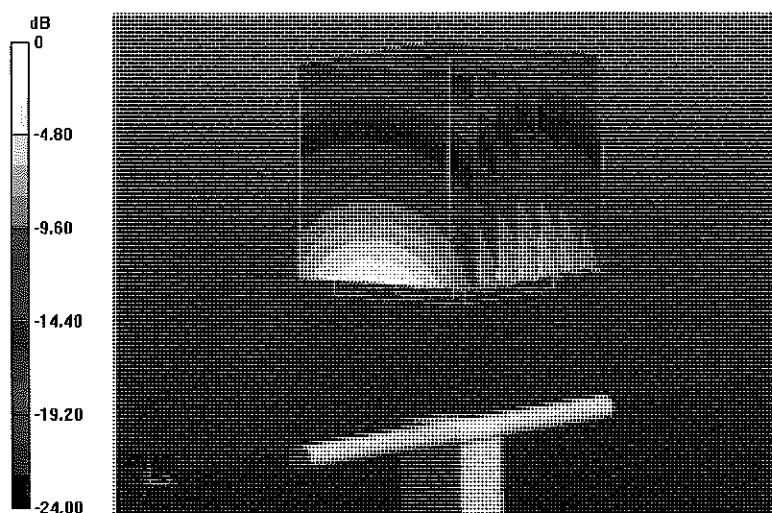
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.7 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.23 W/kg

Maximum value of SAR (measured) = 17.0 W/kg

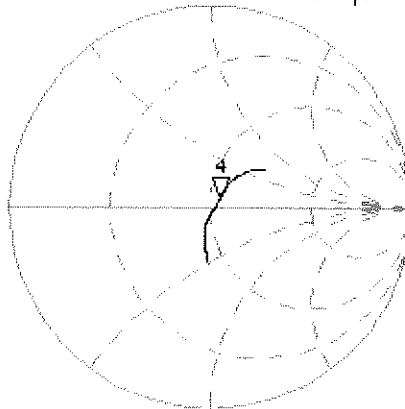


0 dB = 17.0 W/kg = 12.30 dBW/kg

Impedance Measurement Plot for Head TSL

22 Aug 2013 11:00:15
 [CH1] S11 1 U FS 4: 54.639 Ω 3.5215 Ω 228.76 pH 2 450.000 000 MHz

*
 Del
 CA



Avg
 16

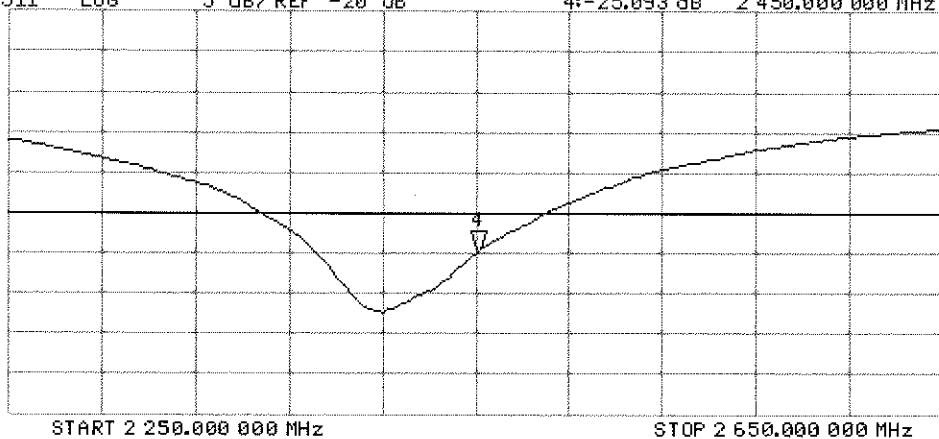
H1d

CH2 S11 LOG 5 dB/REF -20 dB 4: -25.093 dB 2 450.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 23.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 50.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

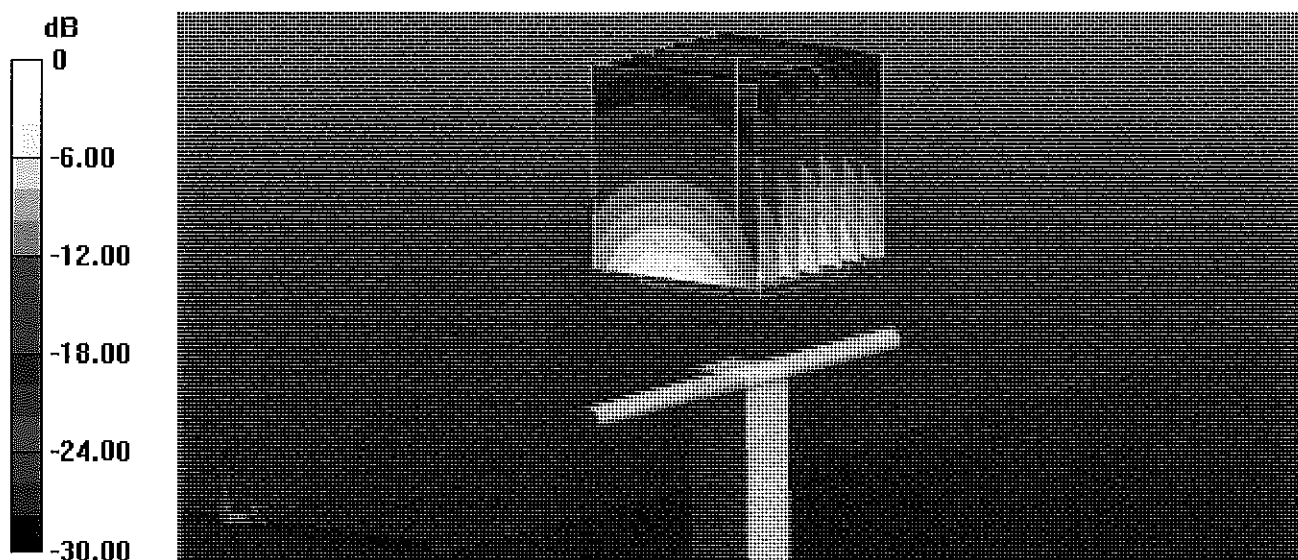
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.688 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.14 W/kg

Maximum value of SAR (measured) = 17.2 W/kg

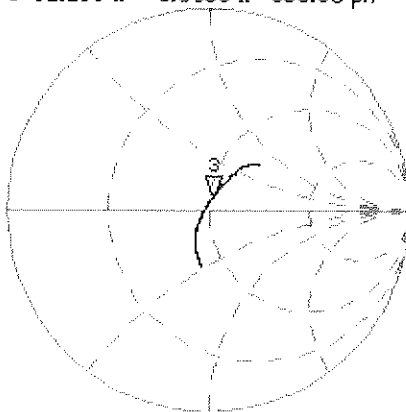


0 dB = 17.2 W/kg = 12.36 dBW/kg

Impedance Measurement Plot for Body TSL

23 Aug 2013 09:00:38
 [CH1] S11 1 U FS 3: 51.135 Ω 5.3965 Ω 350.56 μ H 2 450.000 000 MHz

 Del
 CA



Avg
 16

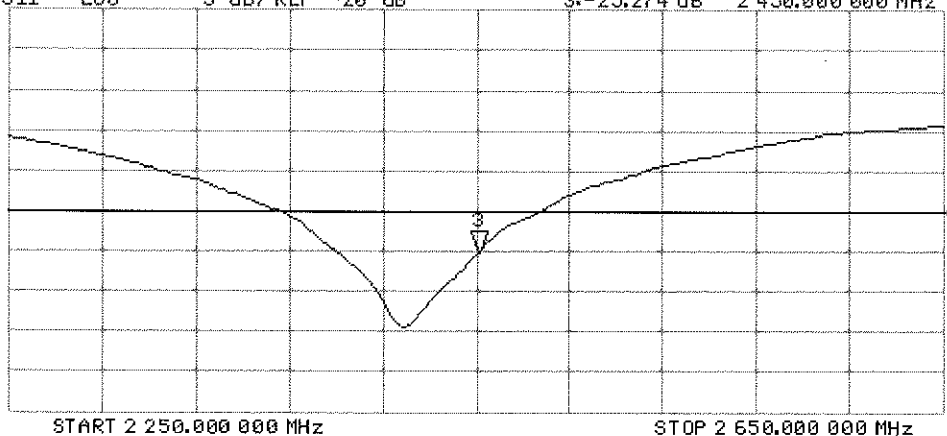
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-25.274 dB 2 450.000 000 MHz

CA

Avg
 16

H1d





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Accreditation No.: **SCS 108**

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Client **PC Test**

Certificate No: **D5GHzV2-1007_Sep13/2**

CALIBRATION CERTIFICATE (Replacement of No: D5GHzV2-1007_Sep13)

Object **D5GHzV2 - SN: 1007**

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

CC✓
 10/15/13

Calibration date: **September 23, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
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** Function: **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** Technical Manager

Issued: October 4, 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**

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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

Additional Documentation:

- 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	V52.8.7
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	35.8 $\pm$ 6 %	4.48 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	7.77 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.5 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.2 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	35.6 ± 6 %	4.62 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.2 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	22.9 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	35.4 ± 6 %	4.76 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 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	35.2 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	22.7 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	35.0 ± 6 %	5.07 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.9 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	48.3 ± 6 %	5.36 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	72.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.2 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	48.1 ± 6 %	5.56 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.7 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	20.8 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	47.8 ± 6 %	5.75 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	7.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.6 ± 6 %	5.88 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	7.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 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	47.3 ± 6 %	6.17 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	7.31 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	72.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.1 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.4 Ω - 11.0 j Ω
Return Loss	- 19.2 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	56.8 Ω - 4.4 j Ω
Return Loss	- 22.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	48.8 Ω - 5.4 j Ω
Return Loss	- 25.1 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.3 Ω - 8.7 j Ω
Return Loss	- 19.5 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.9 Ω + 1.6 j Ω
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.1 Ω - 10.3 j Ω
Return Loss	- 19.7 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	54.3 Ω - 1.5 j Ω
Return Loss	- 27.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	49.7 Ω - 3.6 j Ω
Return Loss	- 28.7 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.2 Ω - 5.2 j Ω
Return Loss	- 20.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	58.7 Ω + 3.9 j Ω
Return Loss	- 21.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 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	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 23.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1007

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.48$ S/m; $\epsilon_r = 35.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.62$ S/m; $\epsilon_r = 35.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.76$ S/m; $\epsilon_r = 35.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.86$ S/m; $\epsilon_r = 35.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.07$ S/m; $\epsilon_r = 35$; $\rho = 1000$ 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: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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 = 63.505 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 28.1 W/kg

SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.23 W/kg

Maximum value of SAR (measured) = 18.1 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 = 63.817 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 29.7 W/kg

SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.3 W/kg

Maximum value of SAR (measured) = 18.7 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 = 64.029 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 32.0 W/kg

SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 19.7 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 = 63.403 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 31.3 W/kg

SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.28 W/kg

Maximum value of SAR (measured) = 19.3 W/kg

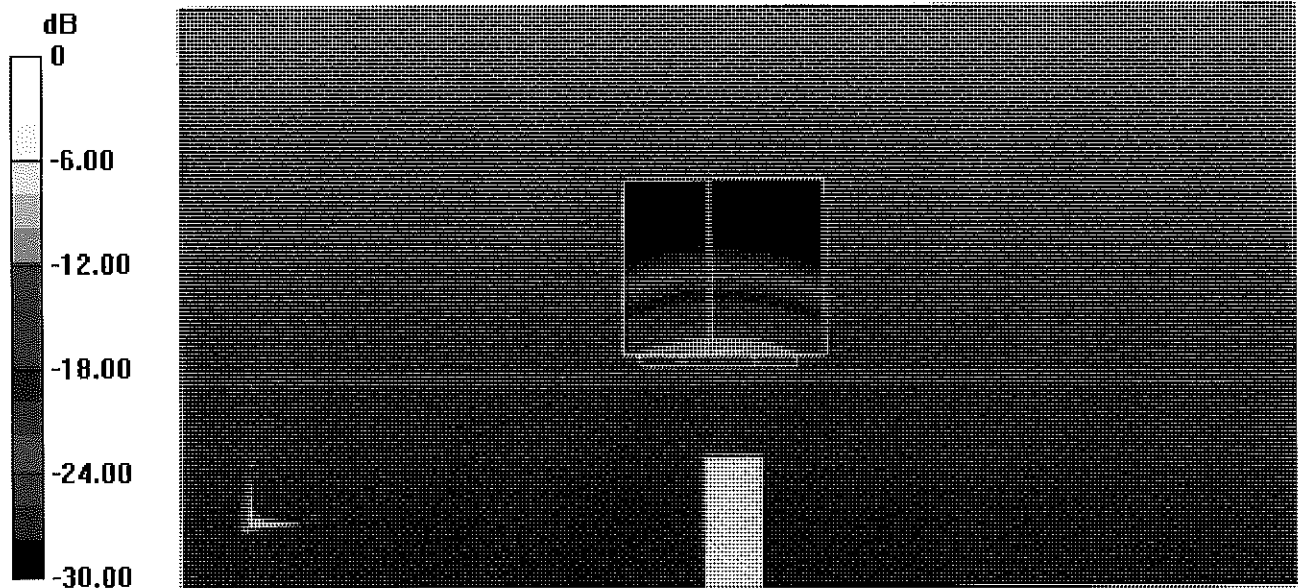
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 60.987 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 31.9 W/kg

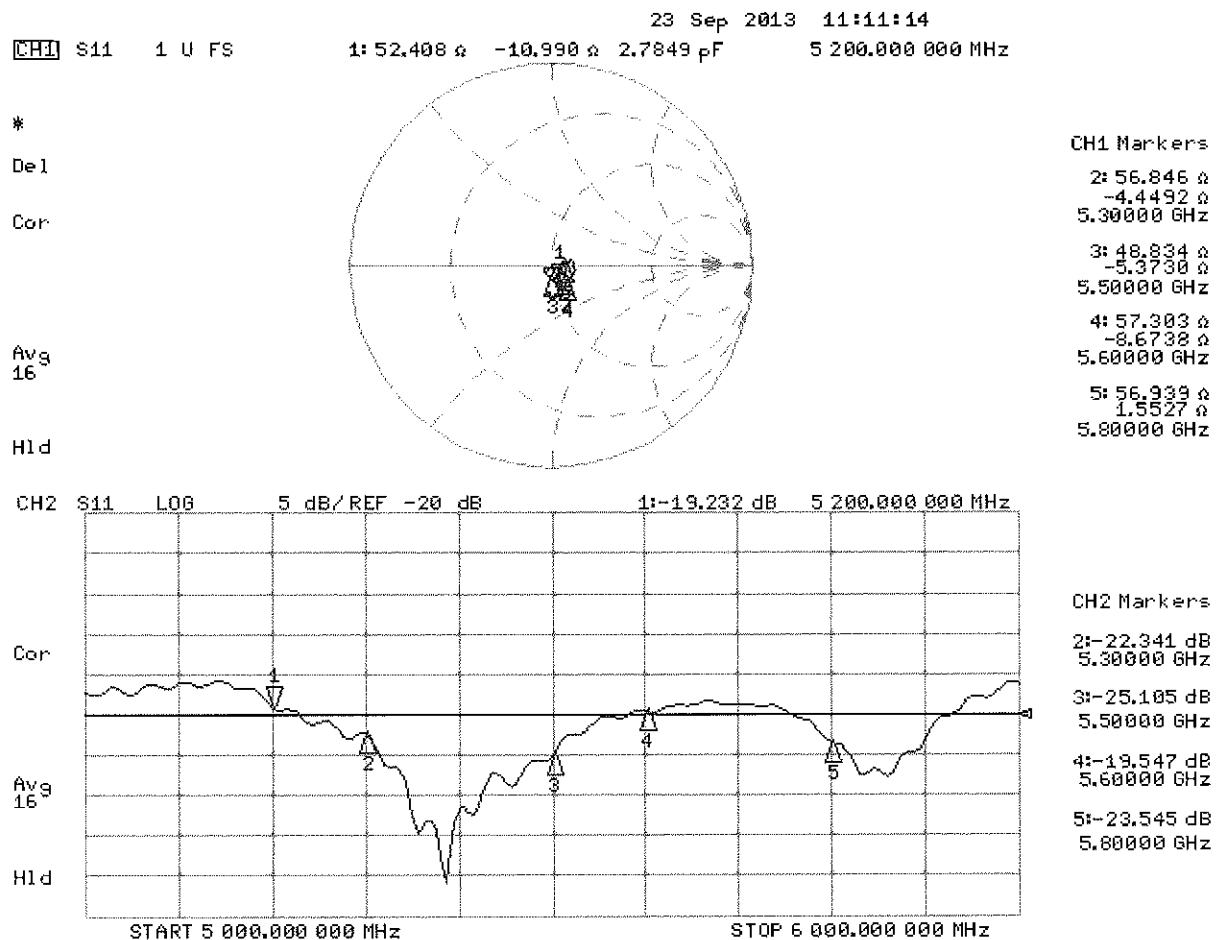
SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.2 W/kg

Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 19.0 W/kg = 12.79 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1007

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.36$ S/m; $\epsilon_r = 48.3$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.56$ S/m; $\epsilon_r = 48.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 5.75$ S/m; $\epsilon_r = 47.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.88$ S/m; $\epsilon_r = 47.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.17$ S/m; $\epsilon_r = 47.3$; $\rho = 1000$ 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: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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 = 58.606 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 28.6 W/kg

SAR(1 g) = 7.28 W/kg; SAR(10 g) = 2.03 W/kg

Maximum value of SAR (measured) = 17.2 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 = 58.305 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.09 W/kg

Maximum value of SAR (measured) = 17.8 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 = 58.471 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 32.4 W/kg

SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 18.5 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 = 58.333 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 33.8 W/kg

SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.16 W/kg

Maximum value of SAR (measured) = 19.1 W/kg

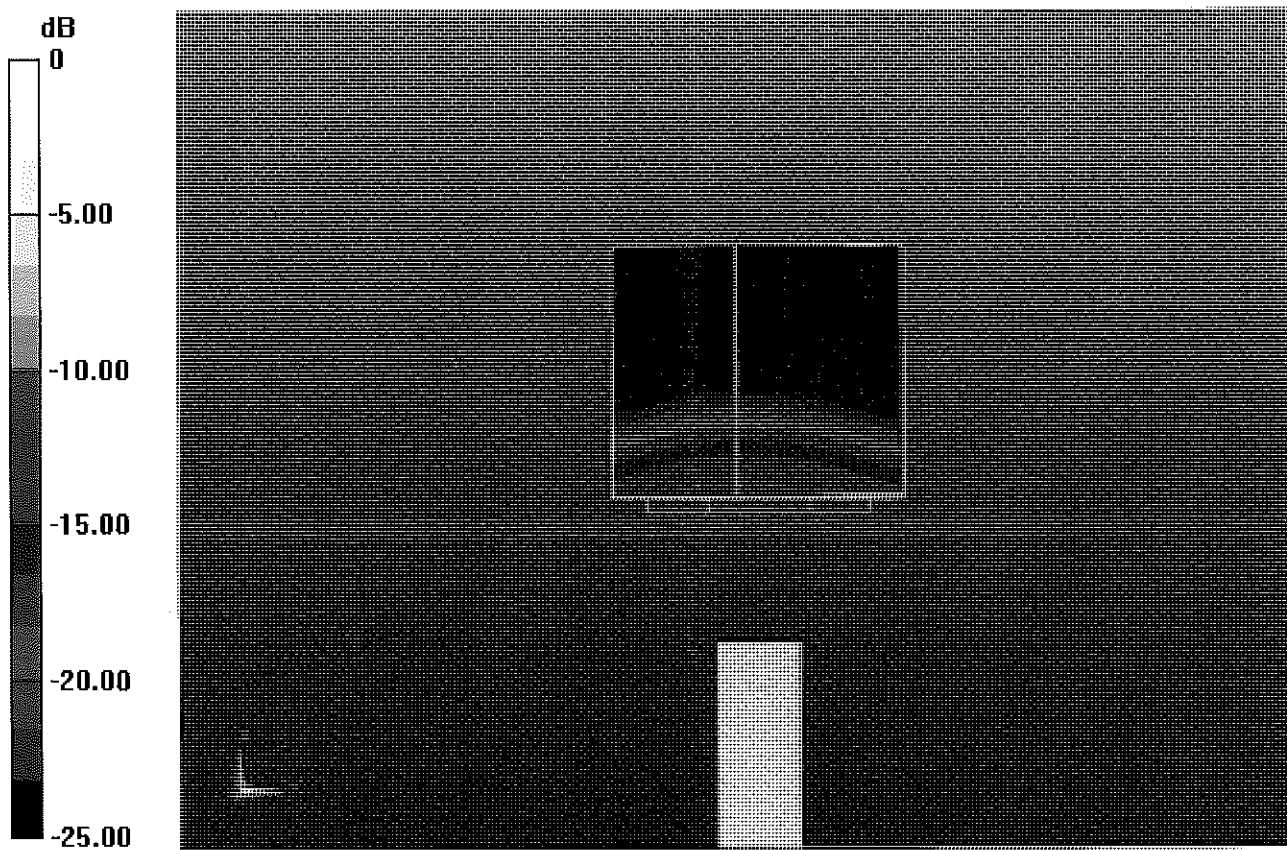
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.389 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 34.1 W/kg

SAR(1 g) = 7.31 W/kg; SAR(10 g) = 2.02 W/kg

Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 18.3 W/kg = 12.62 dBW/kg

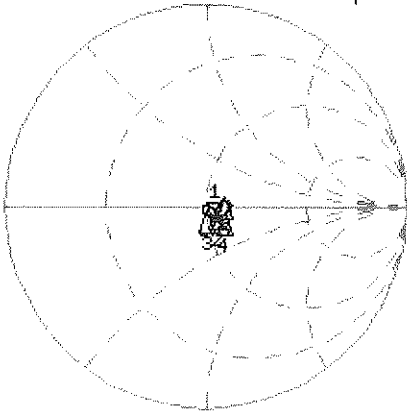
Impedance Measurement Plot for Body TSL

19 Sep 2013 15:38:51
[CH1] S11 1 U FS 1: 53.098 Ω -10.264 Ω 2.9820 pF 5 200.000 000 MHz

*
De1
Cor

Avg
0

H1d



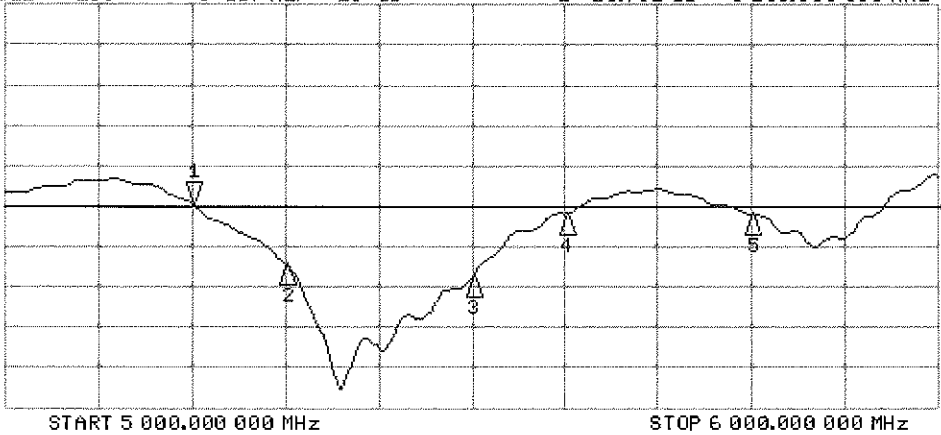
CH1 Markers
2: 54.285 Ω
-1.5293 Ω
5.30000 GHz
3: 49.717 Ω
-3.6367 Ω
5.50000 GHz
4: 58.225 Ω
-5.2344 Ω
5.60000 GHz
5: 58.725 Ω
3.9121 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -19.701 dB 5 200.000 000 MHz

Cor

Avg
0

H1d



CH2 Markers
2: -27.201 dB
5.30000 GHz
3: -28.741 dB
5.50000 GHz
4: -20.917 dB
5.60000 GHz
5: -21.121 dB
5.80000 GHz



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **EX3-3914_Oct13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3914**

Calibration procedure(s) **QA CAL-01 v3, QA CAL-14 v4, QA CAL-23 v5, QA CAL-25 v6**
 Calibration procedure for dosimetric E-field probes

Calibration date: **October 23, 2013**

VCC
11/20/2013

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	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	<i>Leif Klysner</i>
Approved by:	Katja Pokovic	Technical Manager	<i>Katja Pokovic</i>
Issued: October 25, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

PCT # 81072



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3914

Manufactured: December 18, 2012
Calibrated: October 23, 2013

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.47	0.49	0.51	$\pm 10.1 \%$
DCP (mV) ^B	99.2	98.9	98.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	158.3	$\pm 3.0 \%$
		Y	0.0	0.0	1.0		154.6	
		Z	0.0	0.0	1.0		170.8	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.71	53.3	6.1	10.00	48.4	$\pm 2.5 \%$
		Y	2.43	67.0	13.8		39.9	
		Z	4.18	68.7	13.8		45.7	
10011-CAA	UMTS-FDD (WCDMA)	X	3.05	64.4	16.5	2.91	122.4	$\pm 0.5 \%$
		Y	3.31	66.5	18.2		123.5	
		Z	3.34	66.3	17.8		136.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.49	64.8	16.1	1.87	120.6	$\pm 0.5 \%$
		Y	2.94	68.6	18.7		123.6	
		Z	2.63	65.9	17.0		135.4	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	1.52	61.5	10.9	9.39	83.6	$\pm 1.2 \%$
		Y	2.22	67.4	15.0		116.0	
		Z	2.47	66.8	14.7		95.9	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.73	63.3	11.9	9.57	81.5	$\pm 1.7 \%$
		Y	2.11	66.2	14.2		111.8	
		Z	2.76	69.0	16.0		93.6	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	1.34	62.1	9.4	6.56	121.0	$\pm 1.2 \%$
		Y	4.24	78.6	17.9		130.0	
		Z	2.91	70.7	14.9		141.4	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.25	63.5	9.7	4.80	143.5	$\pm 1.4 \%$
		Y	1.59	66.9	12.2		149.7	
		Z	2.98	71.5	14.0		123.3	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	0.51	58.3	7.4	3.55	113.4	$\pm 1.2 \%$
		Y	25.43	100.0	22.6		121.3	
		Z	38.67	97.5	20.6		133.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.28	58.6	5.3	1.16	134.7	$\pm 0.9 \%$
		Y	65.75	99.6	18.6		141.3	
		Z	0.20	55.6	4.1		112.1	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.33	64.6	17.4	4.57	113.8	$\pm 0.7 \%$
		Y	4.55	66.0	18.6		120.8	
		Z	4.85	66.2	18.4		135.9	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	9.83	67.6	20.7	8.68	109.0	$\pm 2.5 \%$
		Y	10.06	68.4	21.5		118.2	
		Z	10.66	69.2	21.7		134.0	

10081-CAA	CDMA2000 (1xRTT, RC3)	X	3.59	63.9	16.9	3.97	113.6	±0.7 %
		Y	3.84	65.6	18.2		119.6	
		Z	3.95	65.4	17.8		134.5	
10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.41	65.2	17.3	3.98	126.0	±0.7 %
		Y	4.73	66.9	18.6		132.5	
		Z	4.51	65.5	17.7		105.6	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.26	66.2	18.6	5.67	130.5	±1.2 %
		Y	6.61	67.7	19.8		139.3	
		Z	6.21	66.0	18.7		107.7	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.13	65.8	18.6	5.80	126.3	±1.2 %
		Y	6.40	67.1	19.6		135.6	
		Z	6.10	65.5	18.5		107.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.78	65.3	18.3	5.75	123.1	±1.2 %
		Y	5.97	66.3	19.2		131.5	
		Z	5.86	65.3	18.4		104.9	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	9.92	67.7	20.3	8.10	115.7	±2.5 %
		Y	10.25	68.7	21.2		126.8	
		Z	10.71	69.4	21.3		146.0	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.95	67.8	20.3	8.07	116.6	±2.5 %
		Y	10.26	68.7	21.1		128.3	
		Z	10.70	69.4	21.3		146.9	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.19	67.3	21.5	9.28	145.0	±2.2 %
		Y	7.40	68.3	22.4		110.8	
		Z	7.79	68.4	22.0		128.0	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.79	65.3	18.3	5.75	124.2	±1.2 %
		Y	6.03	66.5	19.4		131.9	
		Z	6.29	66.9	19.3		149.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.23	65.9	18.6	5.82	128.3	±1.2 %
		Y	6.51	67.2	19.7		136.9	
		Z	6.24	65.7	18.6		107.3	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.83	66.0	18.9	5.73	147.5	±1.2 %
		Y	4.72	65.8	19.2		113.8	
		Z	5.03	66.1	19.1		129.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.83	69.2	22.8	9.21	149.9	±1.9 %
		Y	5.81	69.4	23.4		120.3	
		Z	6.38	70.0	23.2		137.2	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.86	66.1	18.9	5.72	149.8	±1.2 %
		Y	4.72	65.8	19.2		113.3	
		Z	5.09	66.4	19.1		126.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.83	66.0	18.9	5.72	146.3	±1.2 %
		Y	4.69	65.6	19.1		112.2	
		Z	5.02	66.1	19.0		125.1	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.51	67.4	20.2	8.09	108.6	±2.5 %
		Y	9.72	68.1	20.9		118.2	
		Z	10.30	68.9	21.1		135.0	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.52	67.4	20.2	8.10	111.6	±2.5 %
		Y	9.79	68.3	21.1		121.3	
		Z	10.30	68.9	21.2		139.2	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.47	67.4	20.2	8.03	111.8	±2.2 %
		Y	9.67	68.3	21.0		120.0	
		Z	10.20	68.9	21.1		138.0	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	9.96	67.9	20.4	8.06	118.4	±2.5 %
		Y	10.25	68.8	21.2		128.2	
		Z	10.65	69.3	21.3		144.5	
10225-CAA	UMTS-FDD (HSPA+)	X	6.96	66.7	18.9	5.97	140.0	±1.4 %
		Y	7.23	67.9	20.0		148.9	
		Z	7.03	66.4	18.9		115.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.51	67.5	21.8	9.21	114.2	±1.9 %
		Y	5.82	69.4	23.4		123.0	
		Z	6.49	70.6	23.6		140.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.83	67.1	21.4	9.24	136.6	±1.9 %
		Y	7.30	69.4	23.2		147.3	
		Z	7.36	68.1	22.0		117.5	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.26	67.5	21.6	9.30	142.7	±1.9 %
		Y	7.44	68.4	22.4		110.5	
		Z	7.84	68.7	22.2		122.6	
10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.86	66.2	18.2	4.87	135.4	±0.9 %
		Y	6.12	67.5	19.2		142.3	
		Z	5.91	65.9	18.2		107.6	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.17	64.8	17.3	3.96	115.6	±0.7 %
		Y	4.42	66.4	18.5		124.6	
		Z	4.47	66.0	18.0		132.6	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.36	64.7	17.1	3.46	109.4	±0.5 %
		Y	3.55	66.2	18.3		118.2	
		Z	3.60	65.6	17.7		120.9	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.34	64.9	17.2	3.39	110.1	±0.5 %
		Y	3.57	66.7	18.5		121.0	
		Z	3.54	65.6	17.7		123.9	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.14	65.8	18.6	5.81	125.1	±1.2 %
		Y	6.44	67.2	19.7		135.7	
		Z	6.52	67.0	19.3		142.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.76	66.6	19.1	6.06	131.8	±1.4 %
		Y	7.03	67.8	20.0		142.5	
		Z	7.15	67.7	19.7		148.6	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.42	64.6	16.1	1.71	116.8	±0.5 %
		Y	3.00	69.3	19.0		126.9	
		Z	2.61	66.3	17.2		128.2	
10317-AAA	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.71	67.6	20.5	8.36	111.7	±2.5 %
		Y	9.99	68.6	21.4		122.2	
		Z	10.38	68.9	21.3		129.5	

10400-AAA	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.83	67.8	20.6	8.37	112.9	±2.5 %
		Y	10.09	68.7	21.4		123.9	
		Z	10.48	68.9	21.3		130.5	
10402-AAA	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.61	68.3	20.7	8.53	121.1	±2.5 %
		Y	11.25	70.0	21.9		135.4	
		Z	11.15	69.4	21.4		137.4	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.51	67.4	17.8	3.76	119.2	±0.5 %
		Y	4.91	69.5	19.3		128.3	
		Z	4.84	67.5	18.1		135.4	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.51	67.7	18.0	3.77	117.4	±0.5 %
		Y	4.92	69.8	19.5		125.4	
		Z	4.71	67.3	18.0		131.9	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	9.70	9.70	9.70	0.34	1.01	± 12.0 %
835	41.5	0.90	9.34	9.34	9.34	0.67	0.67	± 12.0 %
1750	40.1	1.37	7.99	7.99	7.99	0.79	0.56	± 12.0 %
1900	40.0	1.40	7.69	7.69	7.69	0.80	0.58	± 12.0 %
2450	39.2	1.80	6.95	6.95	6.95	0.41	0.77	± 12.0 %
2600	39.0	1.96	6.79	6.79	6.79	0.40	0.82	± 12.0 %
5200	36.0	4.66	4.99	4.99	4.99	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.82	4.82	4.82	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.55	4.55	4.55	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.37	4.37	4.37	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.52	4.52	4.52	0.35	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.

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	9.39	9.39	9.39	0.63	0.74	± 12.0 %
835	55.2	0.97	9.31	9.31	9.31	0.56	0.76	± 12.0 %
1750	53.4	1.49	7.89	7.89	7.89	0.32	1.03	± 12.0 %
1900	53.3	1.52	7.51	7.51	7.51	0.51	0.76	± 12.0 %
2450	52.7	1.95	7.02	7.02	7.02	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.81	6.81	6.81	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.52	4.52	4.52	0.35	1.90	± 13.1 %
5300	48.9	5.42	4.32	4.32	4.32	0.35	1.90	± 13.1 %
5500	48.6	5.65	4.07	4.07	4.07	0.35	1.90	± 13.1 %
5600	48.5	5.77	3.97	3.97	3.97	0.35	1.90	± 13.1 %
5800	48.2	6.00	4.14	4.14	4.14	0.40	1.90	± 13.1 %

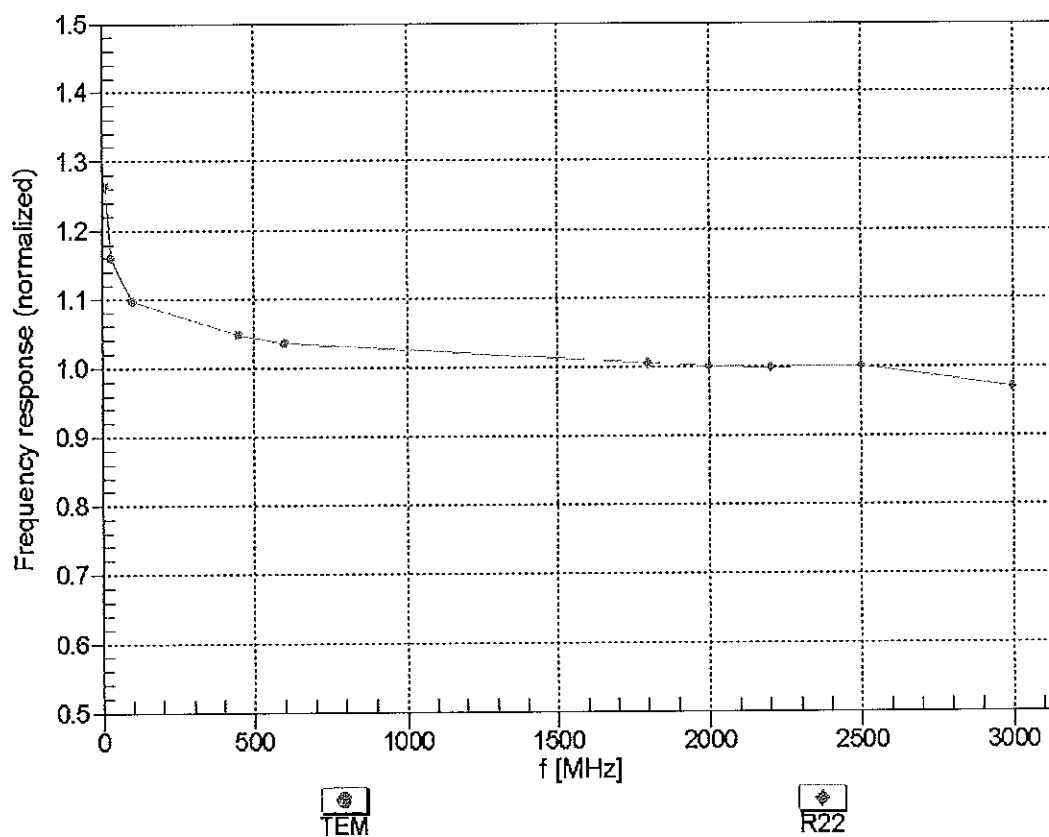
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^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.

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

Frequency Response of E-Field

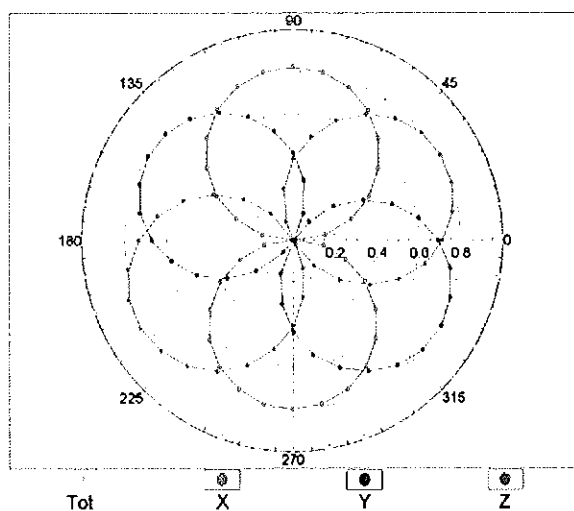
(TEM-Cell: ifi110 EXX, Waveguide: R22)



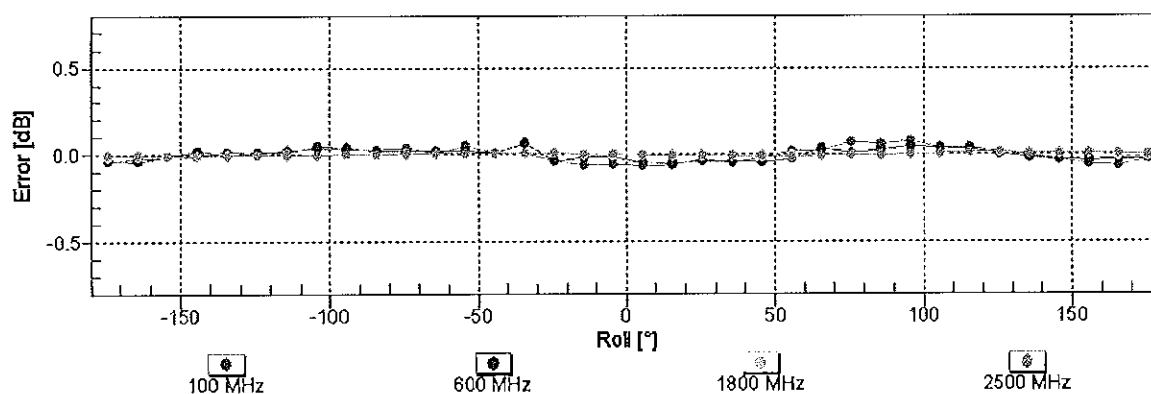
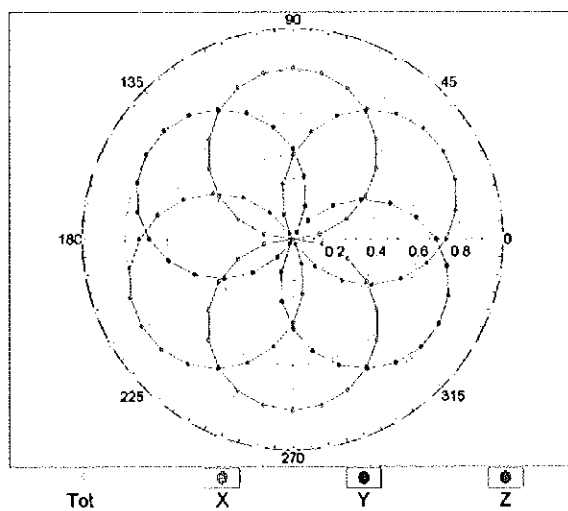
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

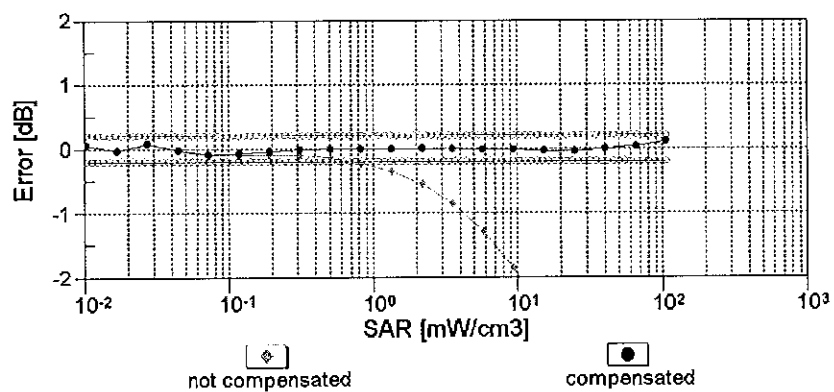
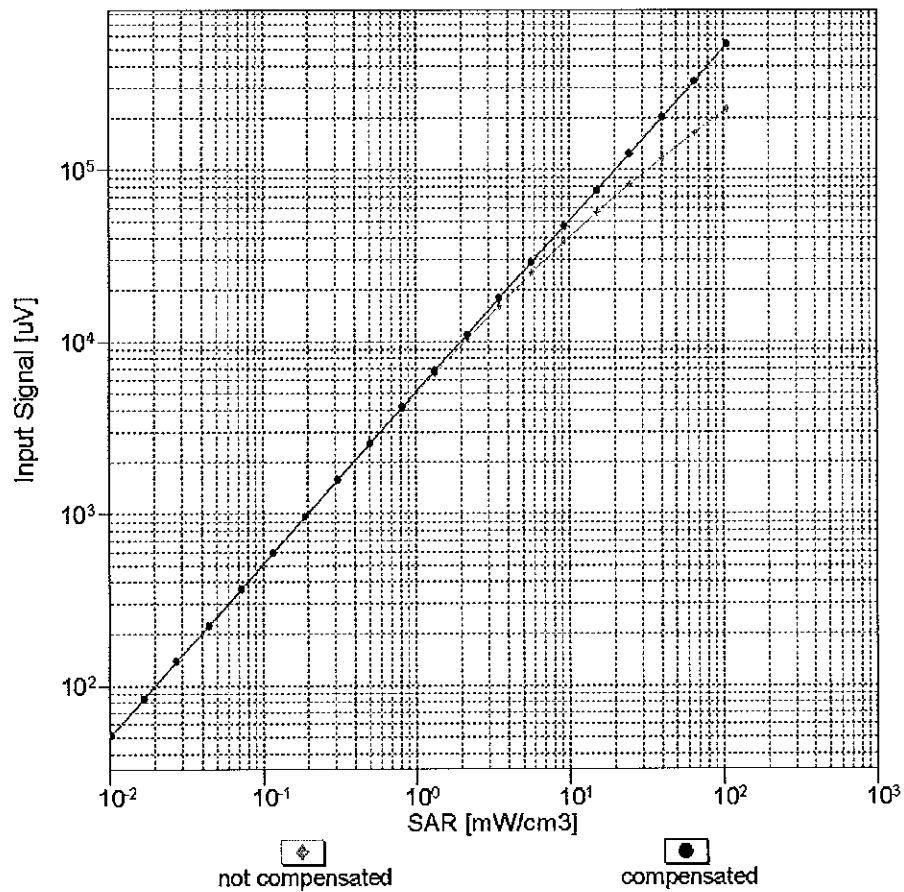


f=1800 MHz,R22



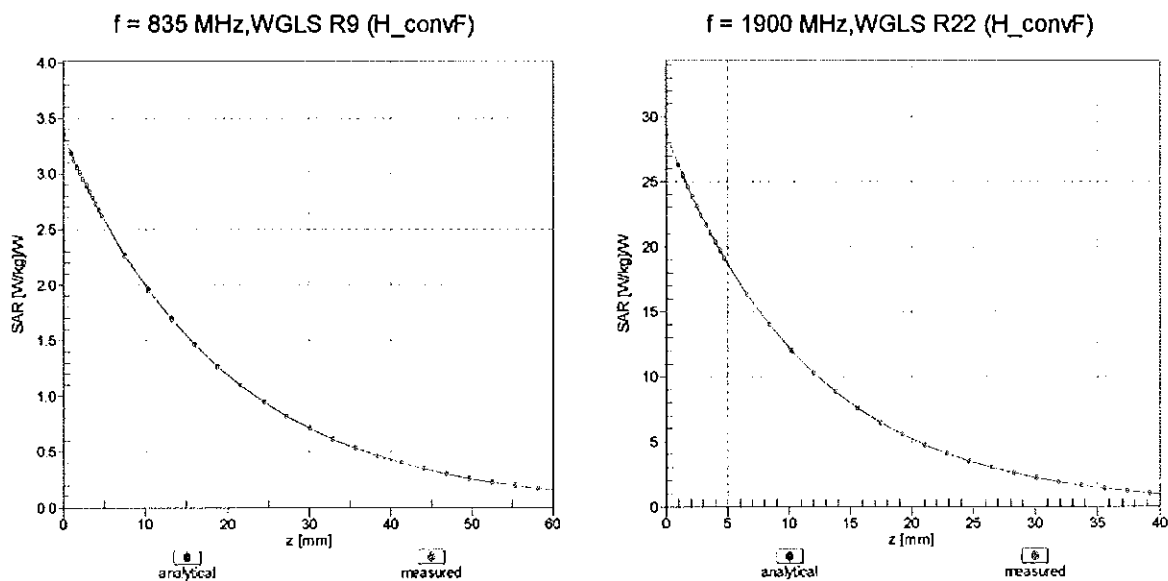
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



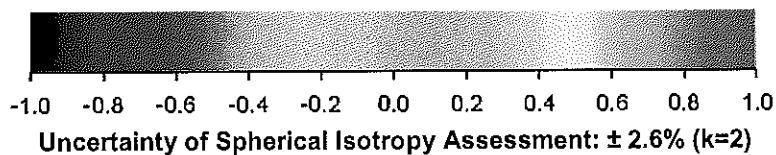
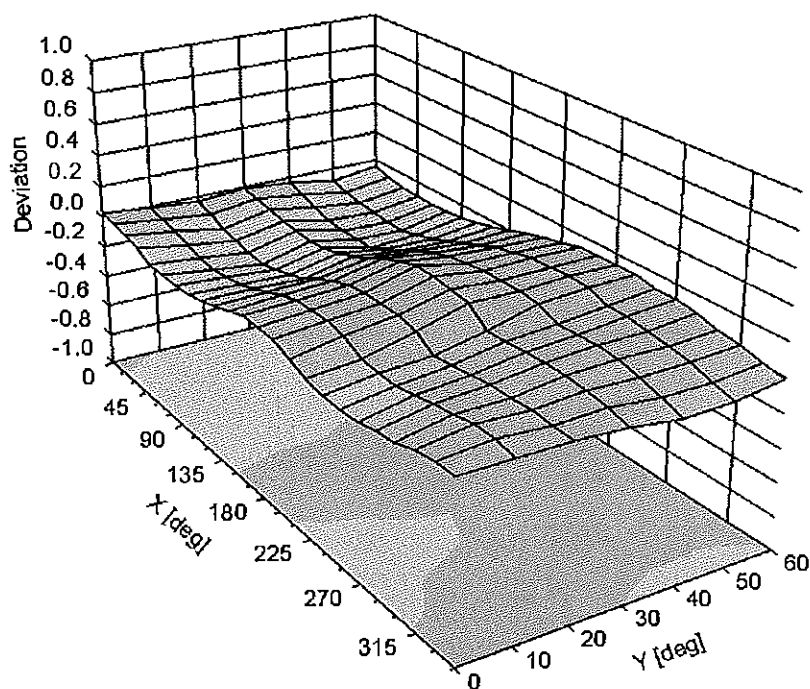
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-24.3
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



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Accreditation No.: **SCS 108**

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Client **PC Test**

Certificate No: **ES3-3333_Nov13**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3333**

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

Calibration date: **November 22, 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
11/14*

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: November 25, 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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

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.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3333

Manufactured: January 24, 2012
Calibrated: November 22, 2013

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.08	0.90	0.88	$\pm 10.1 \%$
DCP (mV) ^B	104.9	103.3	101.7	

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	140.9	$\pm 2.2 \%$
		Y	0.0	0.0	1.0		132.0	
		Z	0.0	0.0	1.0		170.3	

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:3333

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.56	6.56	6.56	0.44	1.54	± 12.0 %
850	41.5	0.92	6.30	6.30	6.30	0.46	1.48	± 12.0 %
1750	40.1	1.37	5.23	5.23	5.23	0.77	1.17	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.80	1.19	± 12.0 %
2450	39.2	1.80	4.42	4.42	4.42	0.74	1.31	± 12.0 %
2600	39.0	1.96	4.28	4.28	4.28	0.80	1.30	± 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.

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

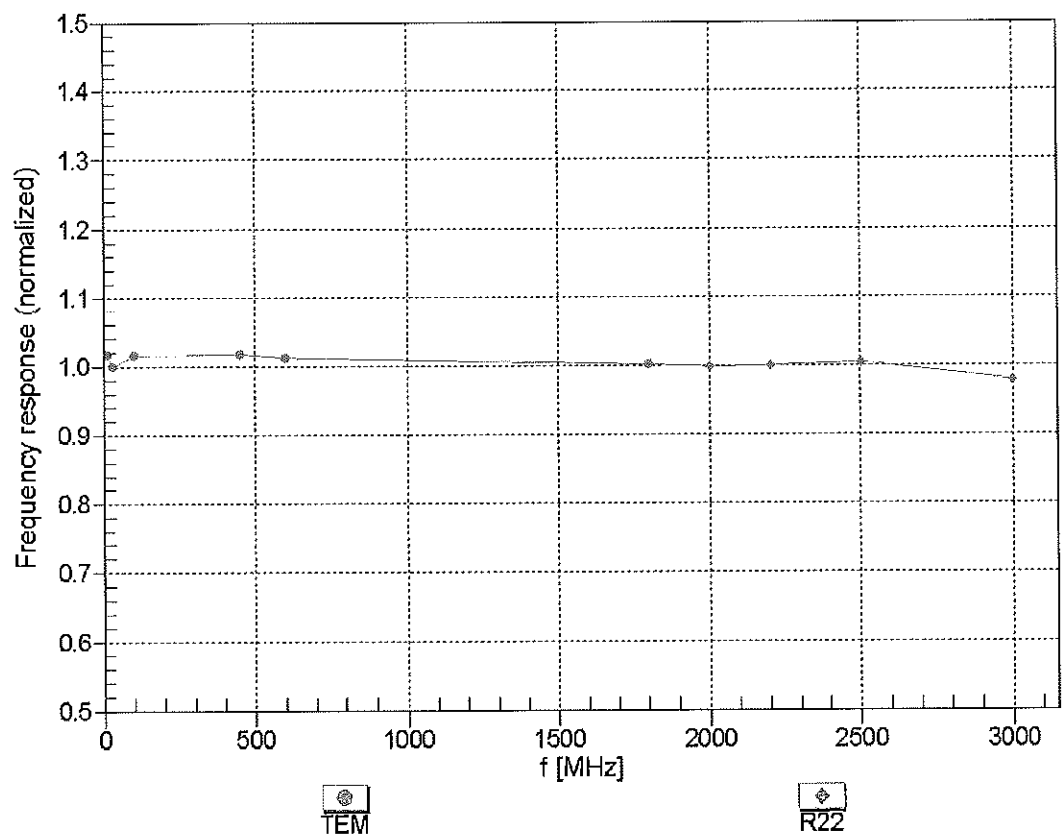
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.11	6.11	6.11	0.33	1.90	± 12.0 %
850	55.2	0.99	6.07	6.07	6.07	0.80	1.19	± 12.0 %
1750	53.4	1.49	4.95	4.95	4.95	0.80	1.26	± 12.0 %
1900	53.3	1.52	4.71	4.71	4.71	0.49	1.54	± 12.0 %
2450	52.7	1.95	4.22	4.22	4.22	0.80	0.95	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.80	1.07	± 12.0 %

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

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

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

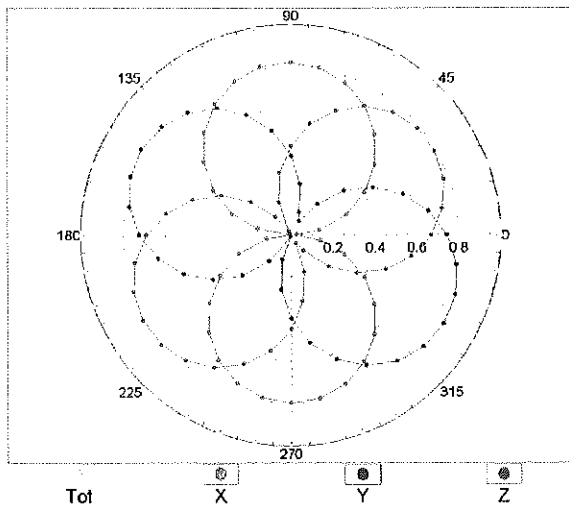
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



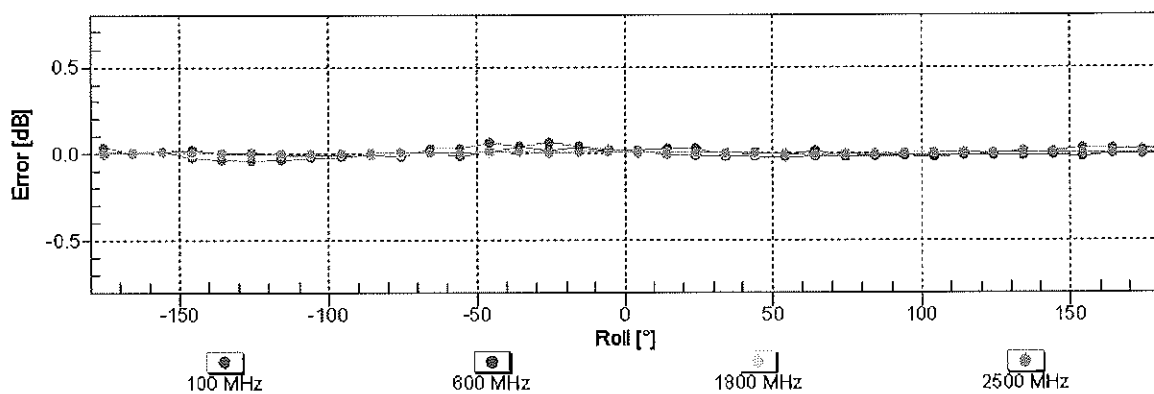
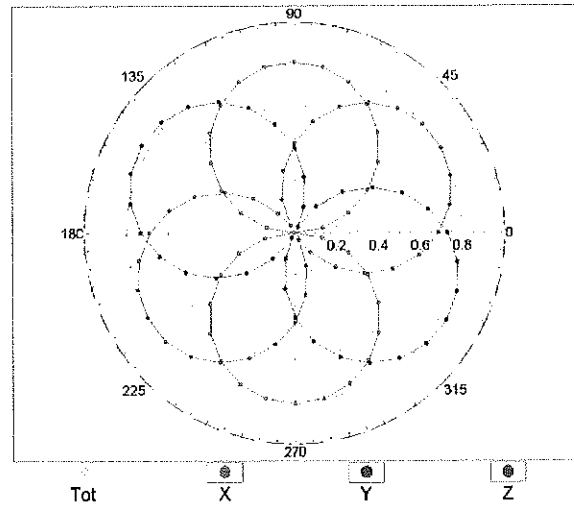
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

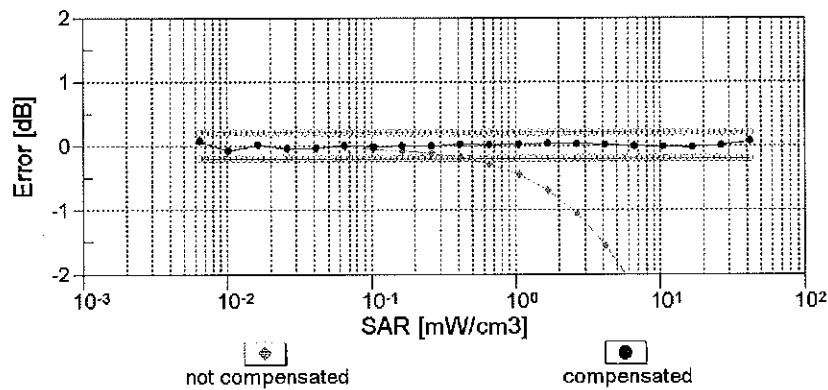
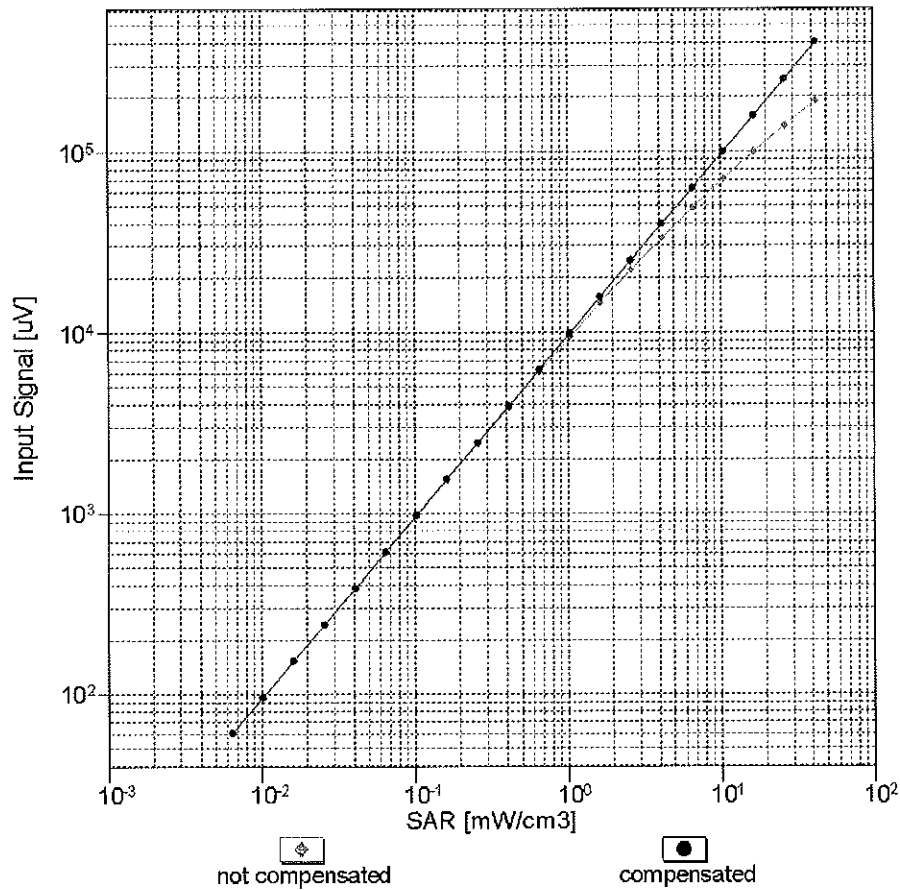


f=1800 MHz,R22



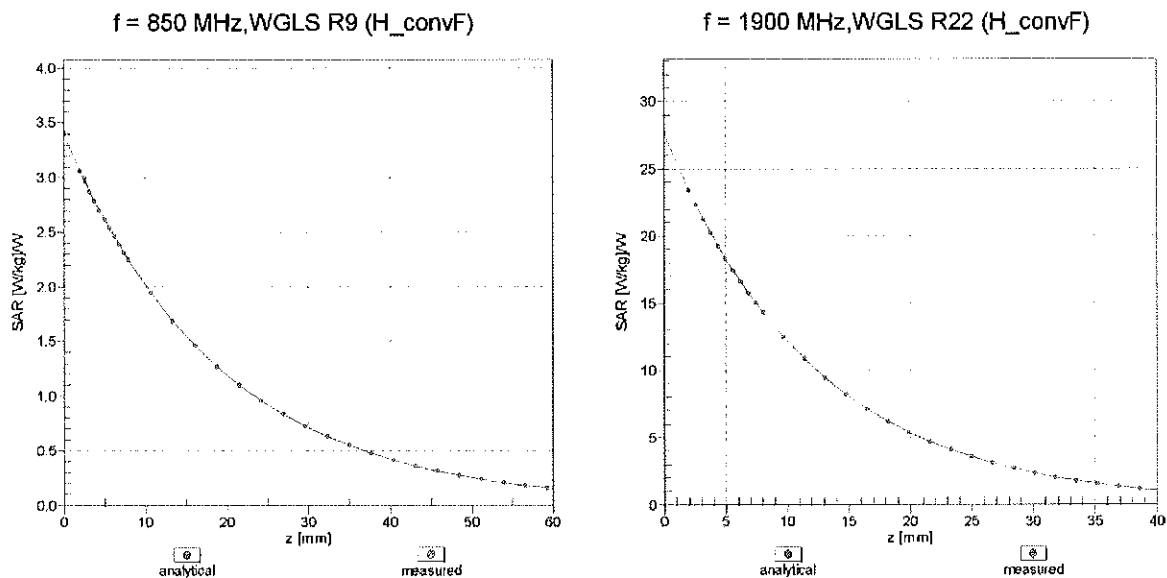
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)



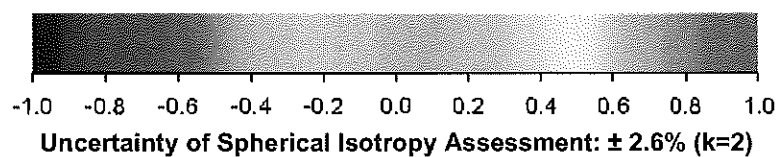
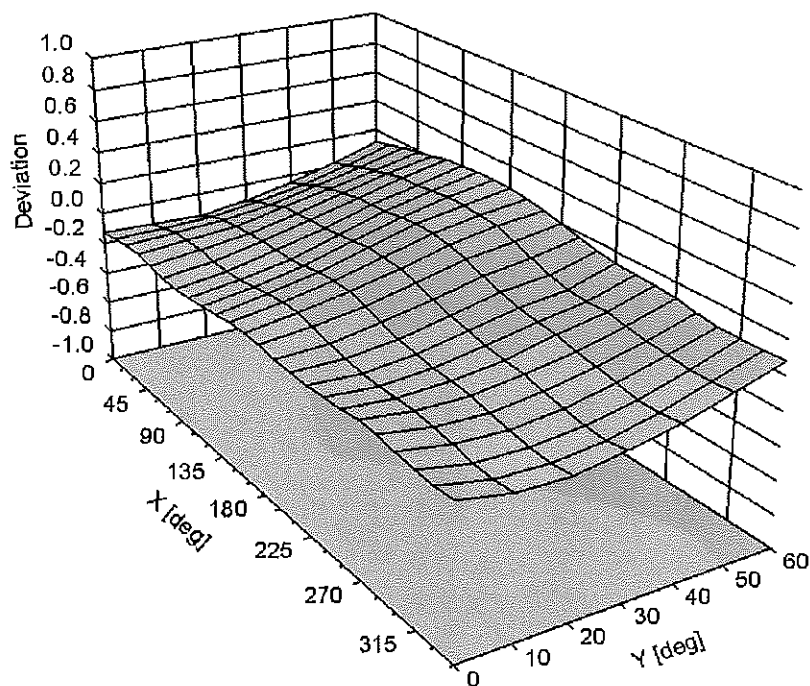
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-35.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Client **PC Test**

Certificate No: **ES3-3263_May13**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3263**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **May 16, 2013**

*✓ KOK
5/23/13*

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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
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-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	<i>Leif Klysner</i>
Approved by:	Katja Pokovic	Technical Manager	<i>Katja Pokovic</i>
Issued: May 17, 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 E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3263

Manufactured: January 25, 2010
Calibrated: May 16, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.21	1.25	1.12	$\pm 10.1 \%$
DCP (mV) ^B	101.2	100.2	103.7	

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	156.5	$\pm 2.5 \%$
		Y	0.0	0.0	1.0		153.2	
		Z	0.0	0.0	1.0		147.2	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 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:3263

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	6.51	6.51	6.51	0.21	2.29	± 12.0 %
835	41.5	0.90	6.29	6.29	6.29	0.50	1.38	± 12.0 %
1750	40.1	1.37	5.30	5.30	5.30	0.45	1.54	± 12.0 %
1900	40.0	1.40	5.11	5.11	5.11	0.57	1.38	± 12.0 %
2450	39.2	1.80	4.47	4.47	4.47	0.59	1.49	± 12.0 %
2600	39.0	1.96	4.31	4.31	4.31	0.80	1.28	± 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:3263

Calibration Parameter Determined in Body Tissue Simulating Media

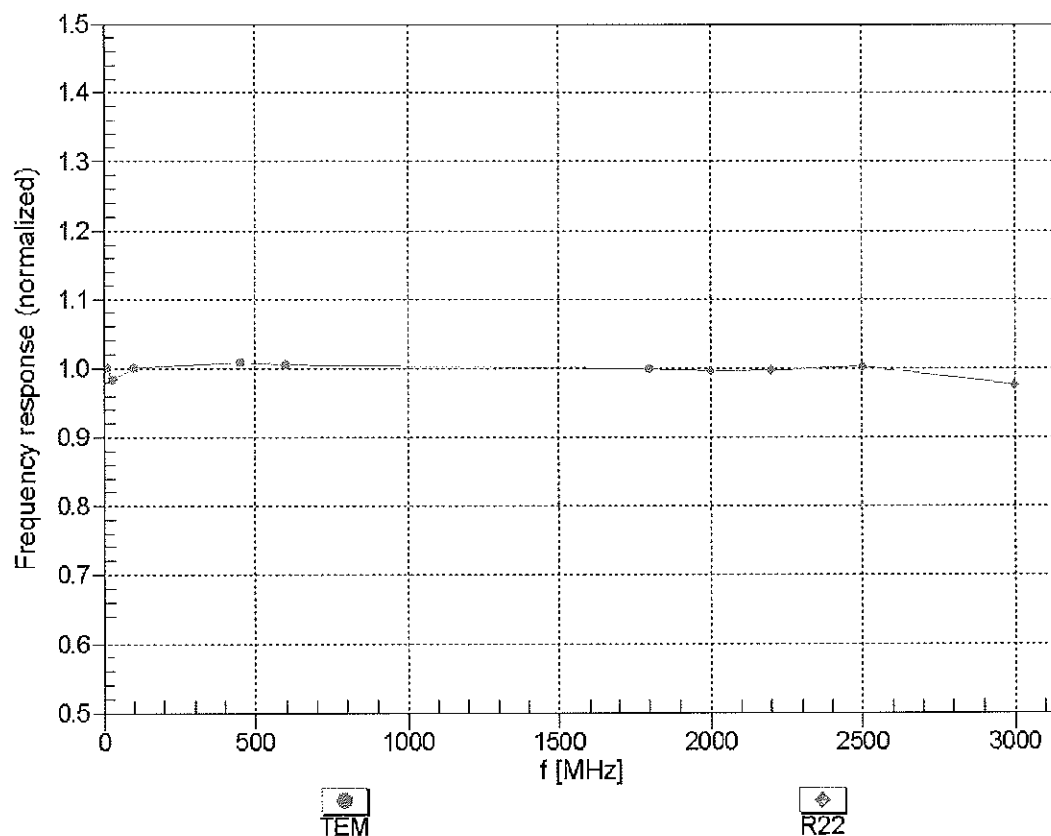
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.37	6.37	6.37	0.34	1.82	± 12.0 %
835	55.2	0.97	6.29	6.29	6.29	0.54	1.39	± 12.0 %
1750	53.4	1.49	5.01	5.01	5.01	0.72	1.27	± 12.0 %
1900	53.3	1.52	4.78	4.78	4.78	0.53	1.56	± 12.0 %
2450	52.7	1.95	4.33	4.33	4.33	0.80	1.14	± 12.0 %
2600	52.5	2.16	4.14	4.14	4.14	0.80	1.02	± 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

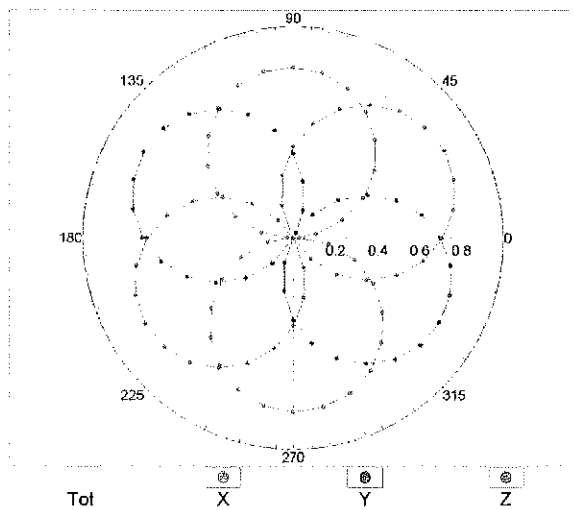
(TEM-Cell:ifi110 EXX, Waveguide: R22)



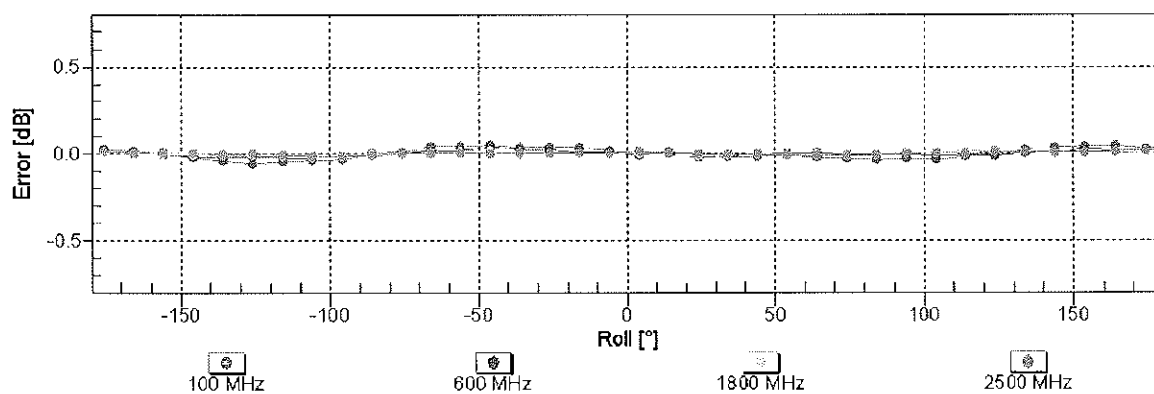
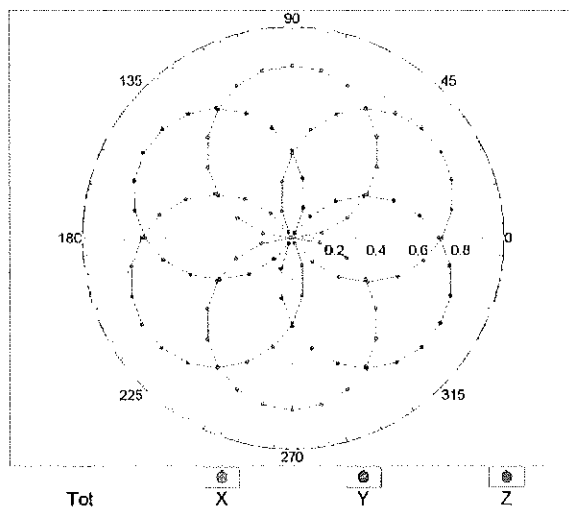
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

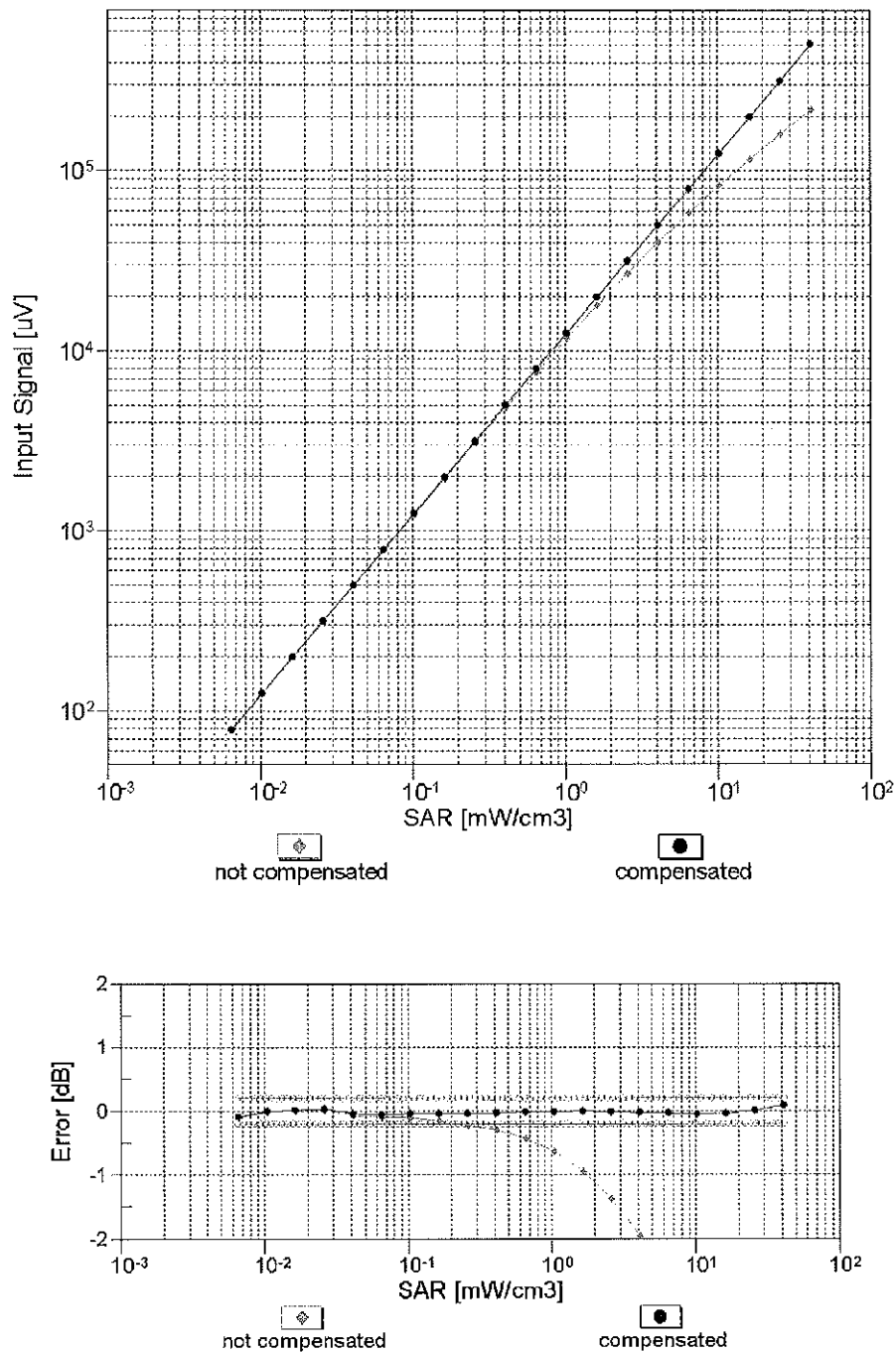


f=1800 MHz,R22



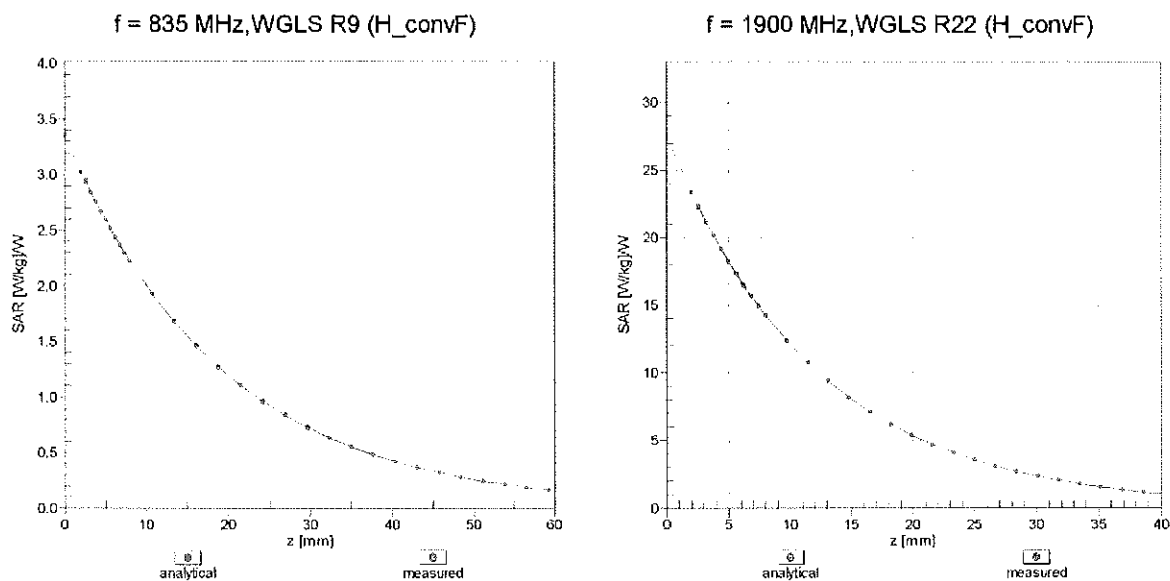
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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



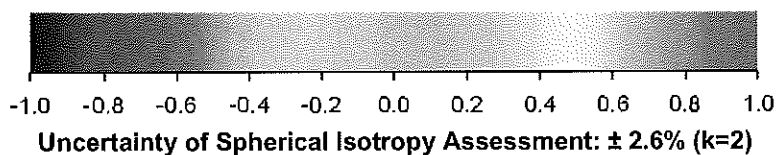
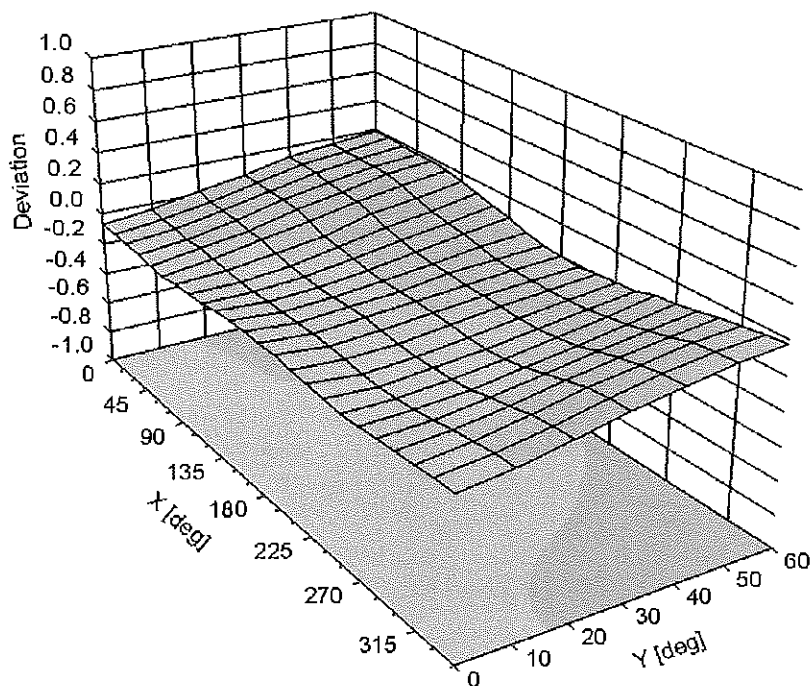
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-116
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3022_Aug13**

CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

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

Calibration date: **August 22, 2013**

UTC
9/13/13

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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
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-13)	In house check: Apr-15
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: August 23, 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 E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 22, 2013

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.00	1.04	0.99	± 10.1 %
DCP (mV) ^B	100.7	97.4	99.7	

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	178.6	±3.0 %
		Y	0.0	0.0	1.0		141.9	
		Z	0.0	0.0	1.0		134.7	

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 E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.21	6.21	6.21	0.19	2.37	± 12.0 %
835	41.5	0.90	6.09	6.09	6.09	0.30	1.70	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.65	1.23	± 12.0 %
1900	40.0	1.40	5.03	5.03	5.03	0.51	1.43	± 12.0 %
2450	39.2	1.80	4.36	4.36	4.36	0.51	1.51	± 12.0 %
2600	39.0	1.96	4.16	4.16	4.16	0.74	1.29	± 12.0 %

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

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

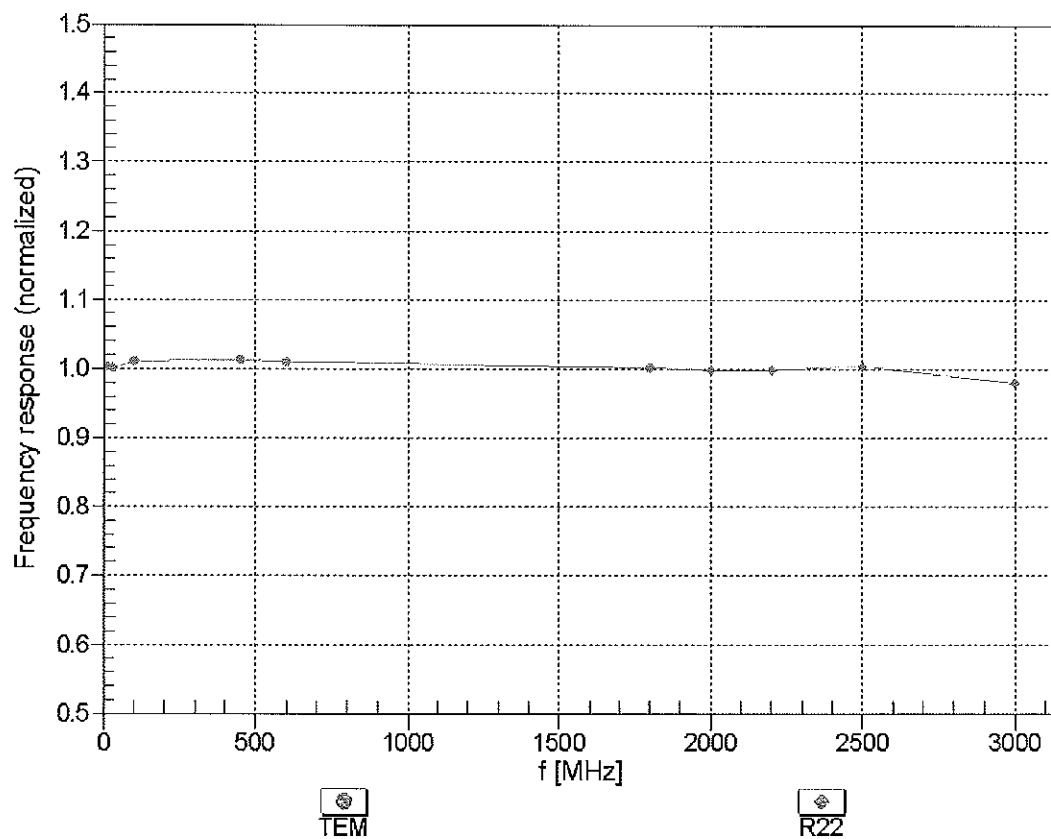
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	5.92	5.92	5.92	0.24	1.99	± 12.0 %
835	55.2	0.97	5.91	5.91	5.91	0.29	1.85	± 12.0 %
1750	53.4	1.49	4.75	4.75	4.75	0.52	1.52	± 12.0 %
1900	53.3	1.52	4.49	4.49	4.49	0.49	1.56	± 12.0 %
2450	52.7	1.95	4.01	4.01	4.01	0.70	1.02	± 12.0 %
2600	52.5	2.16	3.85	3.85	3.85	0.58	0.90	± 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

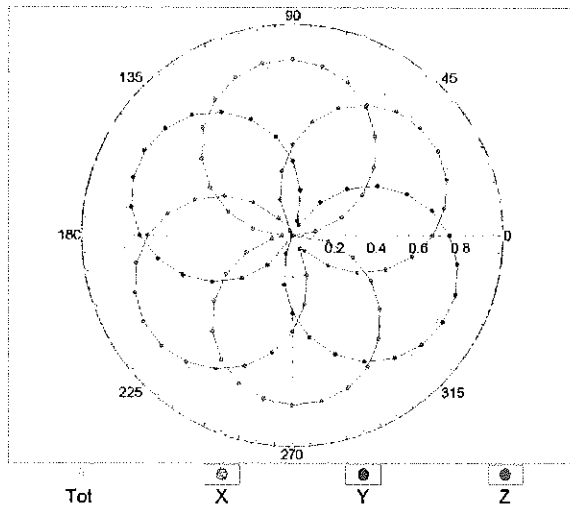
(TEM-Cell:ifi110 EXX, Waveguide: R22)



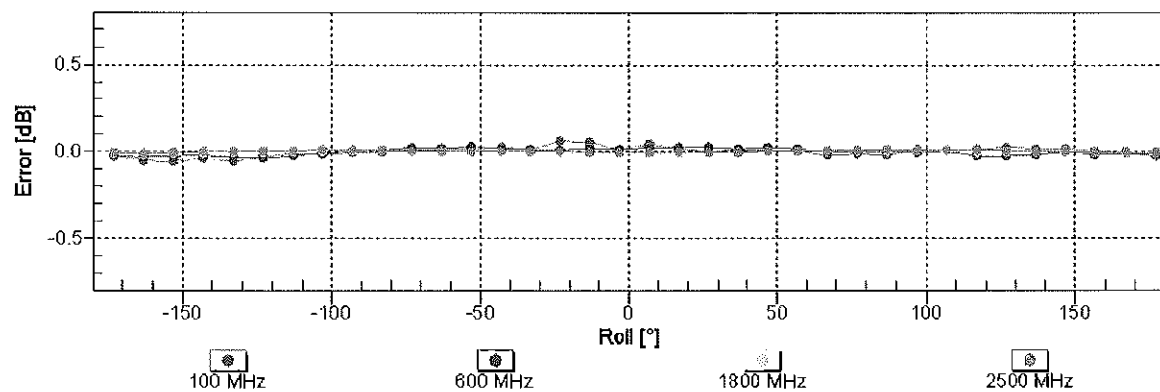
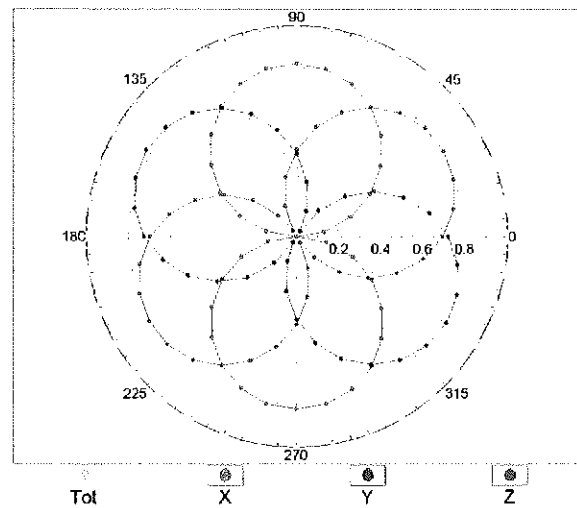
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

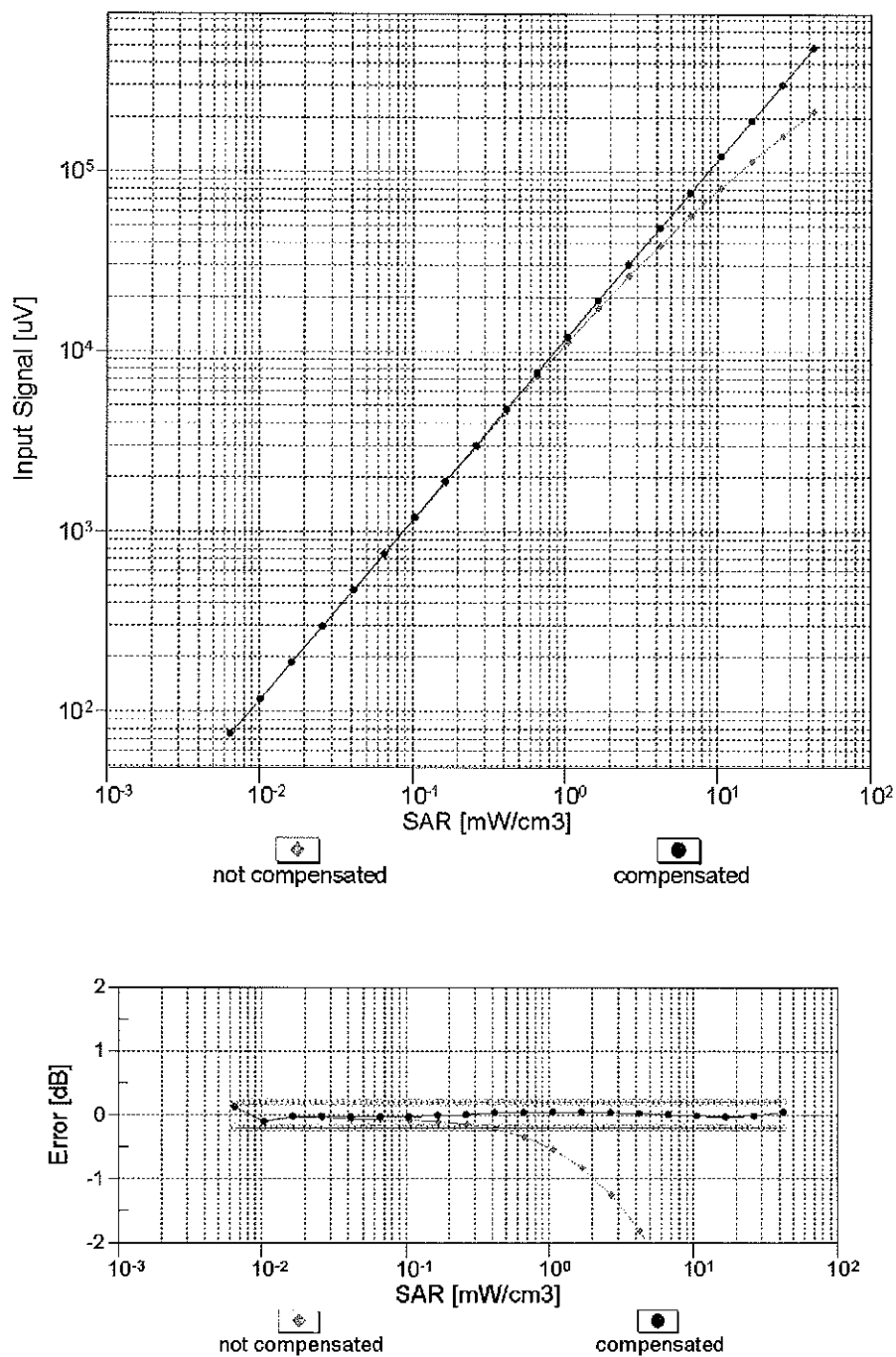


f=1800 MHz,R22



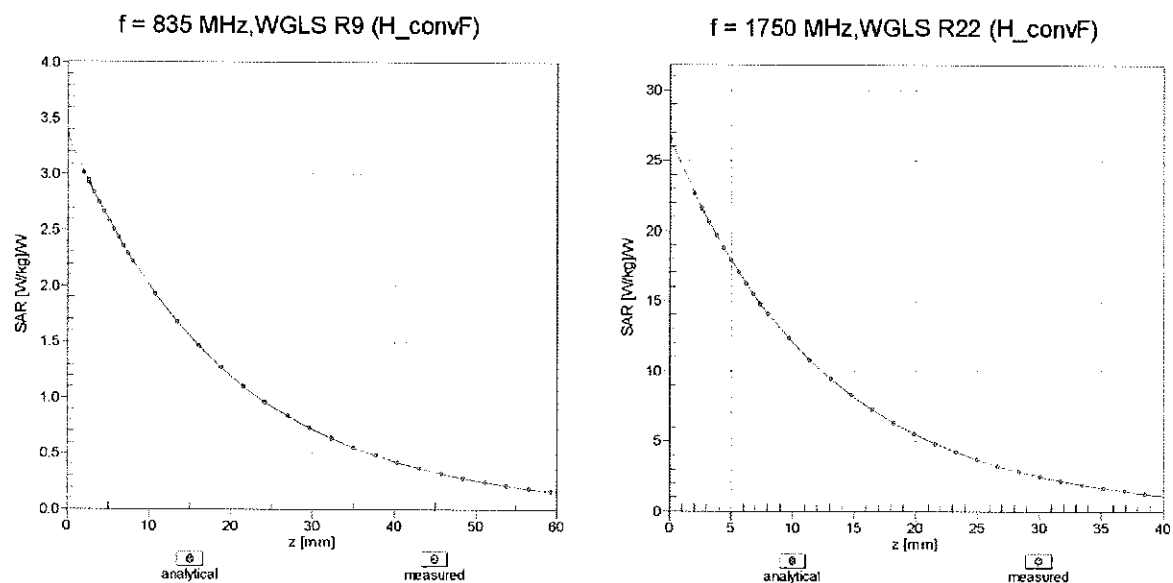
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(SAR_{head}) (TEM cell , f = 900 MHz)



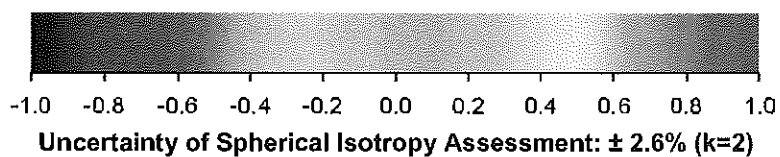
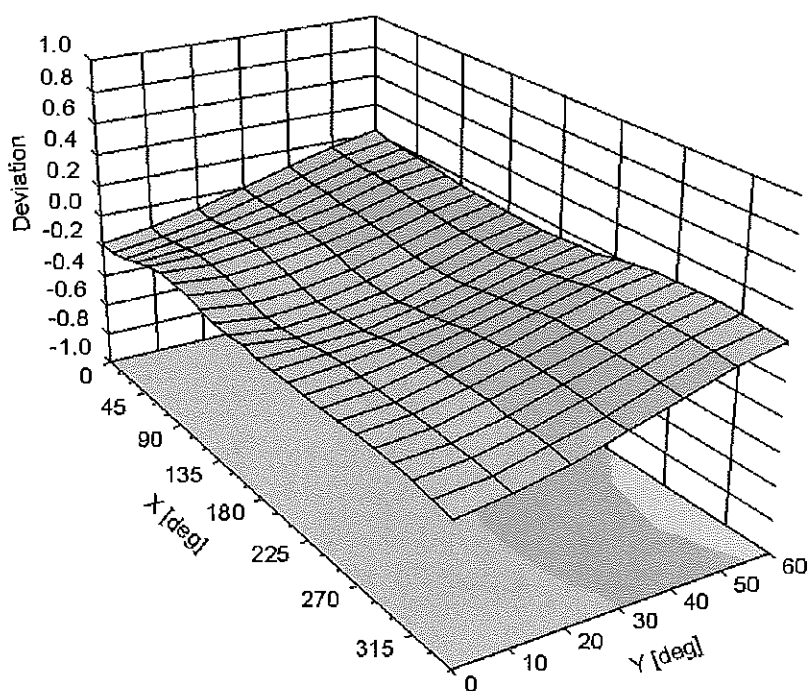
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-83.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **EX3-3920_Dec13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3920**

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

Calibration date: **December 18, 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	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: December 19, 2013			
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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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

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.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3920

Manufactured: December 18, 2012
Calibrated: December 18, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	0.34	0.50	0.49	$\pm 10.1 \%$
DCP (mV) ^B	102.9	99.5	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	182.5	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		164.9	
		Z	0.0	0.0	1.0		153.0	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.76	53.8	6.5	10.00	44.1	$\pm 2.2 \%$
		Y	2.33	62.8	11.4		43.7	
		Z	1.15	55.6	7.5		53.0	
10011-CAA	UMTS-FDD (WCDMA)	X	3.36	66.5	17.5	2.91	142.4	$\pm 0.5 \%$
		Y	3.15	65.0	16.7		131.4	
		Z	3.26	66.0	17.7		121.6	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.69	66.4	16.9	1.87	138.1	$\pm 0.5 \%$
		Y	2.56	65.1	16.2		130.7	
		Z	2.72	66.6	17.2		121.4	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	2.06	63.4	11.7	9.39	99.7	$\pm 1.9 \%$
		Y	2.43	66.1	14.1		94.7	
		Z	2.90	69.9	16.1		121.8	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	1.94	62.4	11.3	9.57	95.1	$\pm 1.9 \%$
		Y	2.31	64.8	13.1		90.1	
		Z	2.98	70.4	16.4		117.0	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	2.19	67.1	12.2	6.56	140.1	$\pm 1.4 \%$
		Y	2.35	67.0	12.9		134.0	
		Z	3.45	73.5	16.1		131.4	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	1.18	61.7	8.5	4.80	121.6	$\pm 1.2 \%$
		Y	1.57	63.4	10.0		116.0	
		Z	1.57	65.5	11.9		109.2	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	3.80	74.5	13.3	3.55	130.3	$\pm 0.9 \%$
		Y	1.00	60.5	8.0		123.9	
		Z	1.58	66.1	11.1		119.0	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.18	55.2	3.4	1.16	111.6	$\pm 0.7 \%$
		Y	0.34	57.4	4.4		143.6	
		Z	0.40	59.2	5.7		136.6	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.49	65.9	18.1	4.57	131.8	$\pm 0.9 \%$
		Y	4.57	65.1	17.5		123.0	
		Z	4.66	65.9	18.3		118.6	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.09	68.6	21.3	8.68	126.5	$\pm 2.5 \%$
		Y	10.31	68.5	21.1		121.9	
		Z	10.12	68.3	21.3		115.8	

10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.64	66.6	18.1	3.98	144.6	±0.7 %
		Y	4.54	65.4	17.4		133.9	
		Z	4.60	66.1	18.0		128.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.00	65.5	18.3	5.67	104.2	±1.4 %
		Y	6.44	66.7	18.8		138.2	
		Z	6.54	67.4	19.4		134.7	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.37	67.0	19.2	5.80	149.0	±1.4 %
		Y	6.40	66.6	18.9		141.2	
		Z	6.40	66.9	19.4		132.1	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.96	66.3	18.9	5.75	142.3	±1.4 %
		Y	6.05	66.1	18.7		136.6	
		Z	6.03	66.3	19.1		128.2	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.28	68.7	20.9	8.10	137.3	±2.5 %
		Y	10.32	68.5	20.7		131.3	
		Z	10.24	68.5	20.9		124.5	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.29	68.8	20.9	8.07	138.5	±2.5 %
		Y	10.34	68.6	20.8		131.9	
		Z	10.26	68.5	20.9		125.5	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.20	67.5	21.6	9.28	118.6	±2.2 %
		Y	7.59	67.9	21.6		116.7	
		Z	7.78	69.2	22.7		110.7	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.98	66.4	18.9	5.75	142.7	±1.2 %
		Y	5.97	65.7	18.4		132.7	
		Z	6.06	66.4	19.1		128.6	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.41	66.8	19.1	5.82	147.7	±1.4 %
		Y	6.48	66.5	18.8		137.3	
		Z	6.53	67.0	19.4		134.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.59	65.5	18.6	5.73	120.3	±1.2 %
		Y	4.76	65.0	18.2		113.9	
		Z	4.82	65.6	18.9		112.0	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.77	69.3	22.7	9.21	128.1	±1.9 %
		Y	6.15	69.3	22.6		123.8	
		Z	6.22	70.3	23.6		120.8	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.62	65.6	18.7	5.72	120.2	±0.9 %
		Y	4.75	65.0	18.2		113.5	
		Z	4.80	65.6	18.8		110.7	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.57	65.4	18.6	5.72	118.9	±0.9 %
		Y	4.72	64.8	18.1		113.1	
		Z	4.81	65.6	18.8		110.4	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.77	68.3	20.8	8.09	128.1	±2.5 %
		Y	9.84	67.9	20.5		117.1	
		Z	9.80	68.1	20.8		116.6	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.78	68.4	20.8	8.10	128.4	±2.5 %
		Y	9.86	68.0	20.5		120.3	
		Z	9.82	68.1	20.9		119.1	

10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.70	68.4	20.8	8.03	128.0	±2.5 %
		Y	9.79	68.0	20.5		119.6	
		Z	9.72	68.1	20.8		118.7	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.27	68.8	20.9	8.06	137.0	±2.5 %
		Y	10.18	68.3	20.6		125.2	
		Z	10.20	68.5	20.9		124.8	
10225-CAA	UMTS-FDD (HSPA+)	X	6.64	66.1	18.7	5.97	108.8	±1.4 %
		Y	7.23	67.1	19.1		148.9	
		Z	7.31	67.7	19.7		146.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.82	69.6	23.0	9.21	130.2	±1.9 %
		Y	6.14	69.2	22.6		123.9	
		Z	6.25	70.4	23.7		122.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.85	67.5	21.7	9.24	112.9	±2.2 %
		Y	7.54	69.0	22.4		149.2	
		Z	7.80	70.6	23.7		147.3	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.23	67.6	21.6	9.30	118.3	±2.2 %
		Y	7.55	67.7	21.5		111.5	
		Z	7.79	69.2	22.7		109.6	
10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.64	65.9	18.1	4.87	105.5	±1.2 %
		Y	6.04	66.4	18.2		142.6	
		Z	6.09	66.9	18.7		138.4	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.42	66.3	18.1	3.96	135.8	±0.7 %
		Y	4.26	65.0	17.3		119.3	
		Z	4.40	65.9	18.0		120.4	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.62	66.7	18.1	3.46	123.6	±0.7 %
		Y	3.38	64.3	16.7		112.5	
		Z	3.59	66.0	17.9		114.3	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.46	66.0	17.7	3.39	127.3	±0.5 %
		Y	3.35	64.5	16.8		113.7	
		Z	3.50	65.7	17.7		115.4	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.35	66.9	19.2	5.81	145.7	±1.2 %
		Y	6.26	66.1	18.7		129.2	
		Z	6.42	67.0	19.4		131.3	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.45	65.9	18.7	6.06	103.7	±1.7 %
		Y	6.90	66.9	19.1		137.2	
		Z	7.04	67.7	19.8		137.5	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.85	67.8	17.7	1.71	135.6	±0.5 %
		Y	2.45	64.7	16.0		121.4	
		Z	2.75	67.3	17.6		122.1	
10317-AAA	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.93	68.5	21.0	8.36	128.1	±2.7 %
		Y	10.02	68.1	20.7		117.9	
		Z	10.01	68.3	21.1		119.4	
10400-AAA	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.09	68.8	21.2	8.37	134.9	±2.5 %
		Y	10.16	68.3	20.8		119.8	
		Z	10.14	68.5	21.2		121.0	

10402-AAA	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	11.18	69.8	21.5	8.53	147.1	±2.7 %
		Y	10.79	68.6	20.8		126.5	
		Z	11.17	69.6	21.6		131.4	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.83	69.6	18.9	3.76	139.6	±0.5 %
		Y	4.70	67.1	17.6		128.1	
		Z	4.90	68.4	18.6		127.8	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.73	69.5	18.9	3.77	134.8	±0.5 %
		Y	4.62	67.1	17.7		124.9	
		Z	4.67	67.7	18.1		125.9	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	10.05	10.05	10.05	0.27	1.13	± 12.0 %
835	41.5	0.90	9.69	9.69	9.69	0.50	0.76	± 12.0 %
1750	40.1	1.37	7.91	7.91	7.91	0.72	0.62	± 12.0 %
1900	40.0	1.40	7.70	7.70	7.70	0.77	0.61	± 12.0 %
2450	39.2	1.80	6.98	6.98	6.98	0.37	0.86	± 12.0 %
2600	39.0	1.96	6.74	6.74	6.74	0.34	0.97	± 12.0 %
5200	36.0	4.66	4.87	4.87	4.87	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.66	4.66	4.66	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.54	4.54	4.54	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.37	4.37	4.37	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.11	4.11	4.11	0.50	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.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	9.54	9.54	9.54	0.32	1.07	± 12.0 %
835	55.2	0.97	9.47	9.47	9.47	0.45	0.85	± 12.0 %
1750	53.4	1.49	7.77	7.77	7.77	0.59	0.74	± 12.0 %
1900	53.3	1.52	7.50	7.50	7.50	0.37	0.91	± 12.0 %
2450	52.7	1.95	7.18	7.18	7.18	0.80	0.56	± 12.0 %
2600	52.5	2.16	6.91	6.91	6.91	0.80	0.57	± 12.0 %
5200	49.0	5.30	4.23	4.23	4.23	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.11	4.11	4.11	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.80	3.80	3.80	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.00	4.00	4.00	0.50	1.90	± 13.1 %

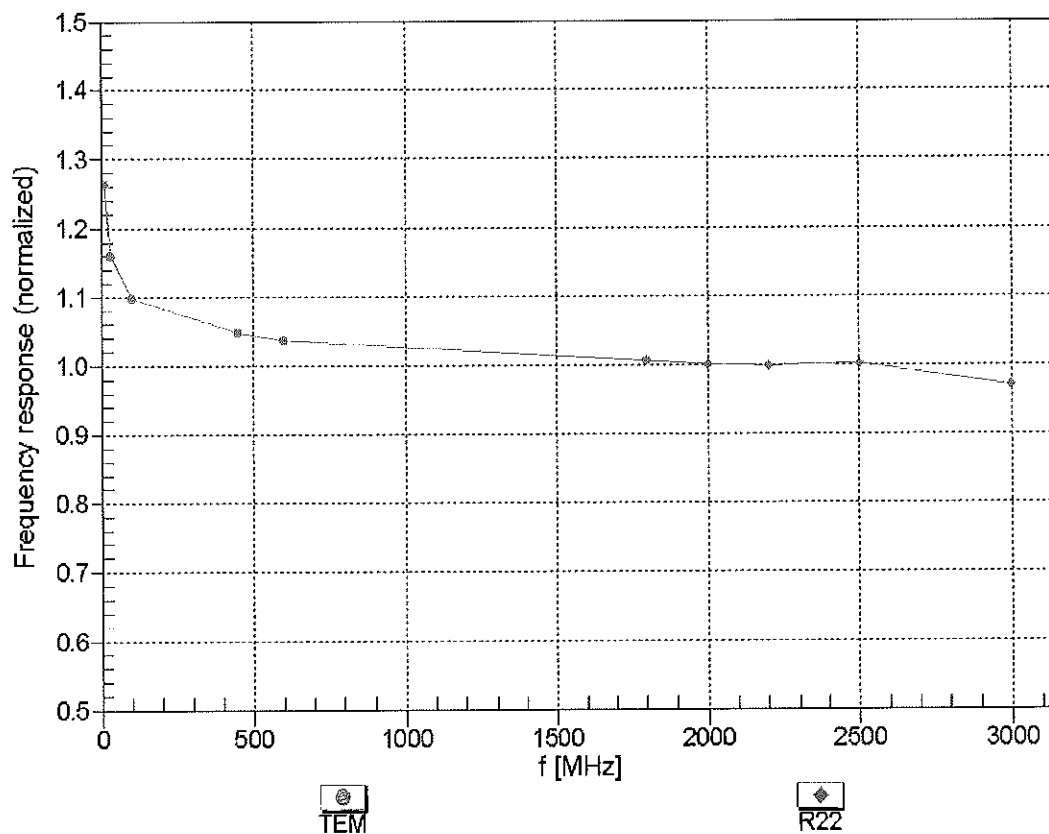
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^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.

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

Frequency Response of E-Field

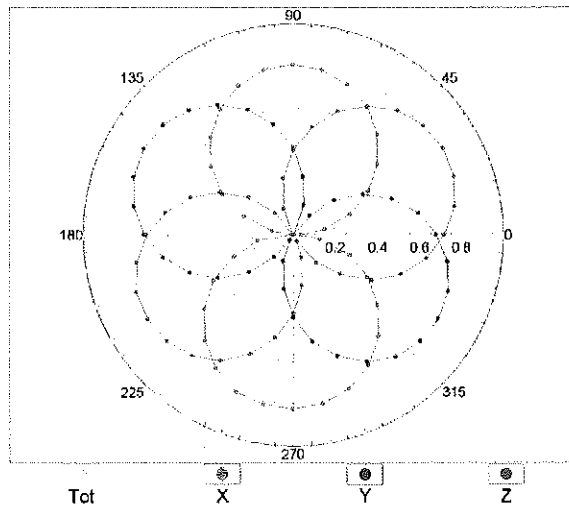
(TEM-Cell:ifi110 EXX, Waveguide: R22)



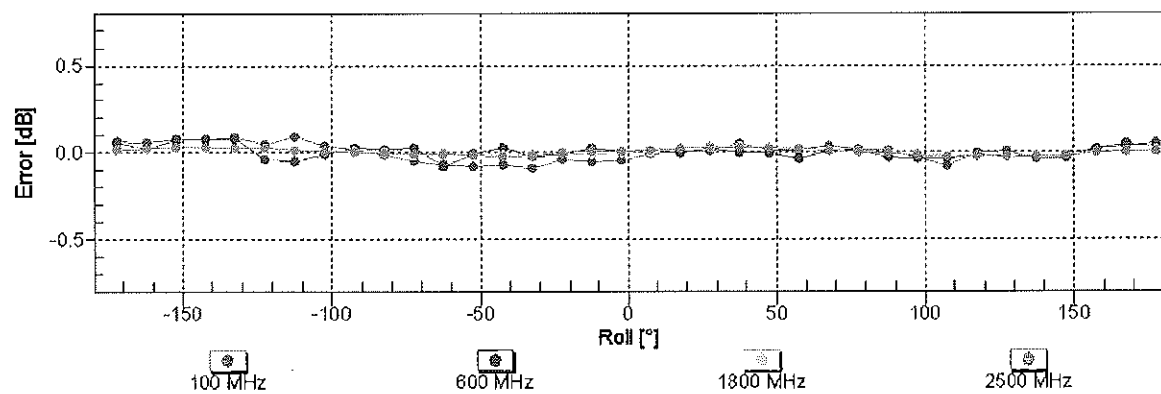
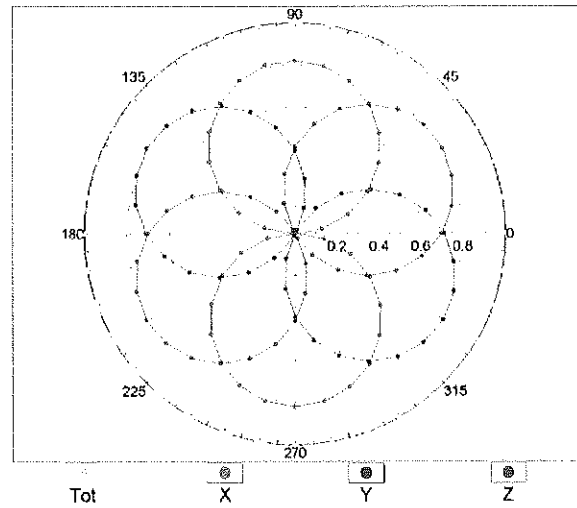
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

$f=600$ MHz, TEM

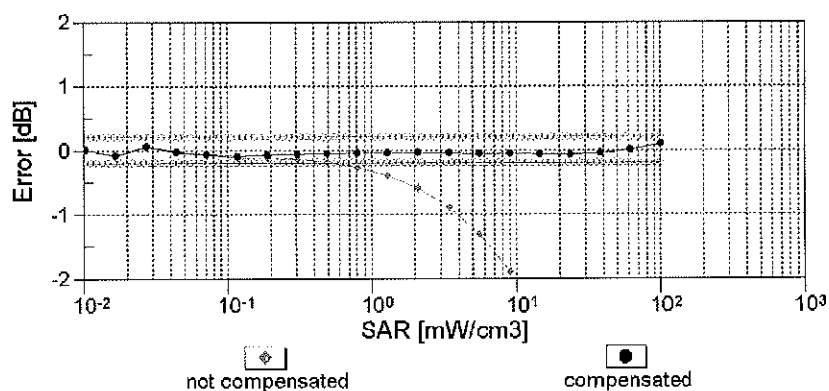
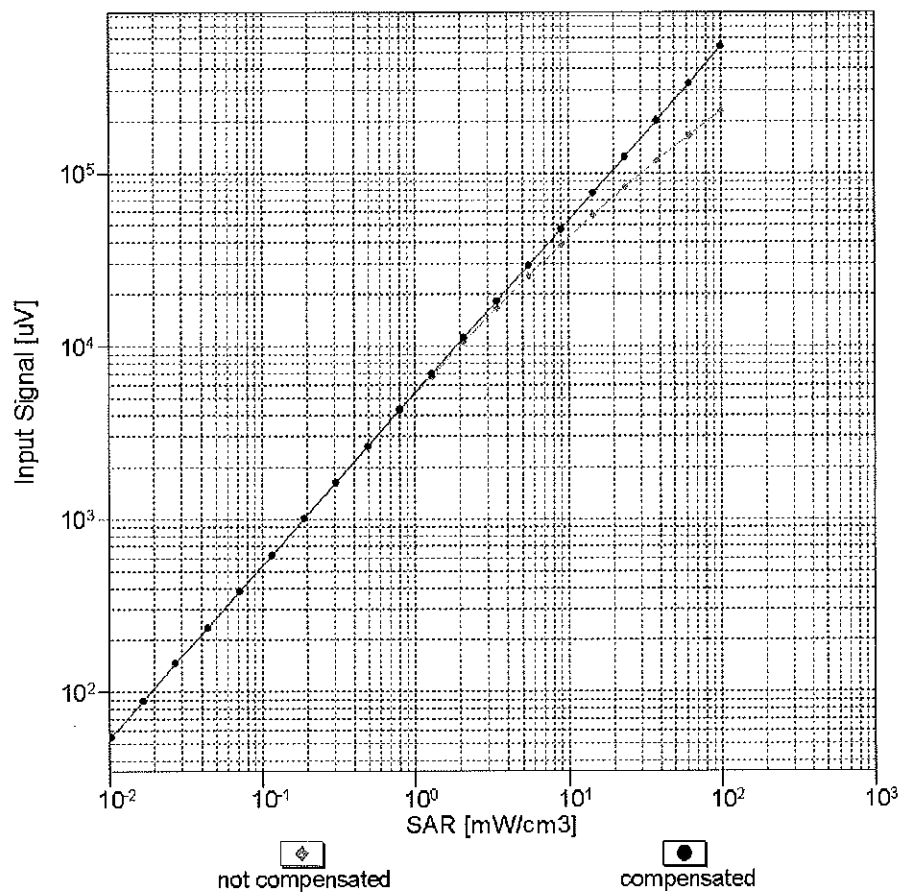


$f=1800$ MHz, R22



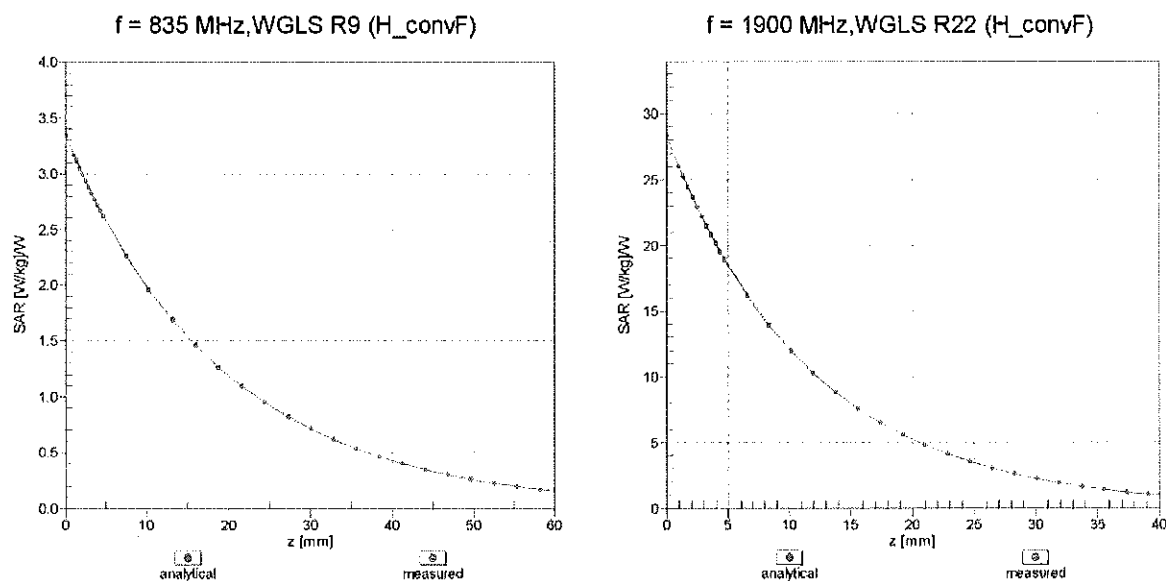
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



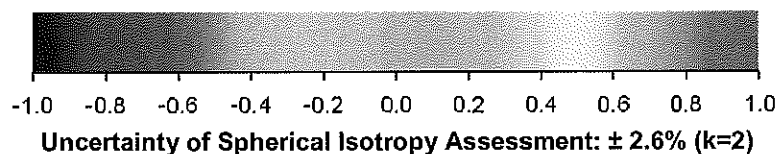
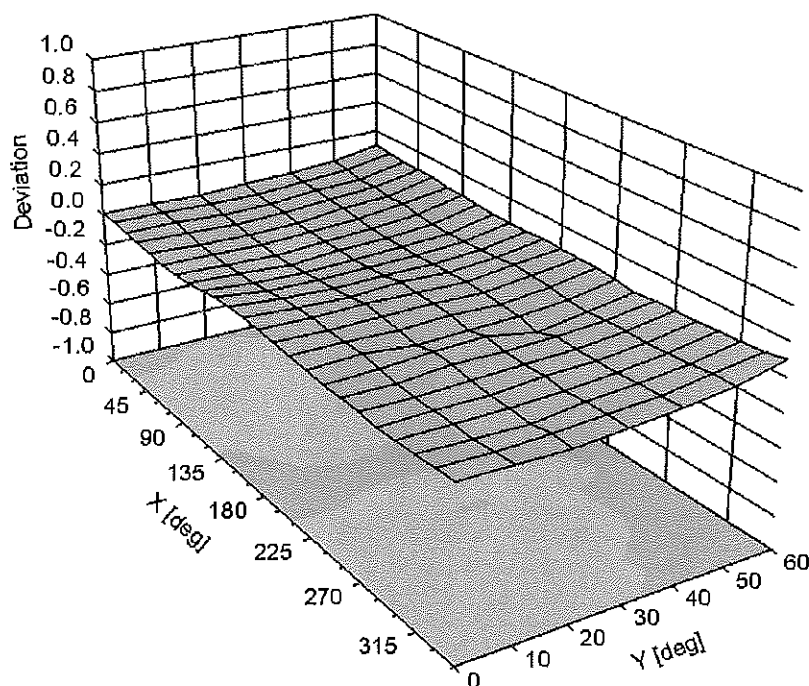
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-22.4
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



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **EX3-3589_Jan14**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3589
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	January 29, 2014
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration)	

CC ✓
2/5/14

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Technical Manager	
			Issued: January 30, 2014
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

PC-T 783



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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 Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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.
- Connector Angle:** The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe EX3DV4

SN:3589

Manufactured: March 30, 2006
Calibrated: January 29, 2014

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 ($\mu V/(V/m)^2$) ^A	0.46	0.40	0.40	± 10.1 %
DCP (mV) ^B	101.2	100.8	98.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	150.4	±3.8 %
		Y	0.0	0.0	1.0		142.3	
		Z	0.0	0.0	1.0		171.7	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	6.00	69.5	14.2	10.00	42.1	±0.9 %
		Y	7.03	71.8	15.0		40.3	
		Z	3.33	64.6	12.1		44.6	
10011-CAA	UMTS-FDD (WCDMA)	X	3.26	66.2	17.8	2.91	117.6	±0.9 %
		Y	3.38	66.8	18.2		113.0	
		Z	2.79	62.4	14.7		133.2	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.77	66.8	17.4	1.87	117.4	±0.7 %
		Y	3.22	69.6	18.8		113.5	
		Z	2.22	62.0	13.8		135.2	
10021-DAA	GSM-FDD (TDMA, GMSK)	X	3.61	69.7	16.6	9.39	91.2	±1.7 %
		Y	5.48	77.1	19.6		125.1	
		Z	2.18	62.5	12.6		75.3	
10023-DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	3.01	66.4	14.9	9.57	86.1	±2.7 %
		Y	7.02	82.0	22.0		120.5	
		Z	2.13	62.9	12.7		71.4	
10024-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	18.01	91.8	22.6	6.56	132.3	±1.7 %
		Y	8.55	83.0	19.9		134.3	
		Z	4.04	72.4	15.7		139.6	
10027-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	4.70	74.7	15.9	4.80	107.5	±1.7 %
		Y	4.94	76.1	16.4		107.8	
		Z	2.97	68.7	12.8		127.1	
10028-DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	67.89	99.9	21.4	3.55	114.7	±2.7 %
		Y	48.02	99.7	21.9		116.6	
		Z	1.36	61.4	7.8		134.4	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	97.41	97.0	17.7	1.16	129.2	±3.0 %
		Y	71.47	99.8	19.3		130.9	
		Z	0.29	53.5	0.9		109.2	
10039-CAA	CDMA2000 (1xRTT, RC1)	X	4.62	65.4	18.0	4.57	113.0	±1.7 %
		Y	4.74	66.1	18.4		111.5	
		Z	4.22	63.3	15.9		133.6	
10062-CAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.10	67.8	20.8	8.68	108.0	±2.7 %
		Y	10.07	68.1	21.1		108.1	
		Z	10.03	67.6	20.2		130.3	

10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.53	65.7	17.8	3.98	122.5	±0.9 %
		Y	4.72	66.6	18.4		123.1	
		Z	4.38	64.5	16.7		147.3	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.32	66.5	18.8	5.67	126.9	±1.2 %
		Y	6.50	67.2	19.4		128.9	
		Z	5.80	64.3	17.3		107.2	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.22	66.1	18.8	5.80	124.2	±1.7 %
		Y	6.39	66.9	19.4		126.7	
		Z	6.10	65.2	17.7		149.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.94	65.8	18.7	5.75	121.3	±1.7 %
		Y	6.05	66.3	19.1		123.1	
		Z	5.80	65.0	17.7		144.5	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.01	67.7	20.3	8.10	113.9	±2.5 %
		Y	10.16	68.3	20.8		117.0	
		Z	9.96	67.5	19.8		135.3	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.07	67.9	20.4	8.07	115.2	±2.5 %
		Y	10.16	68.2	20.7		118.4	
		Z	10.02	67.7	19.9		138.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.89	68.4	21.8	9.28	108.1	±1.9 %
		Y	8.15	69.7	22.8		109.4	
		Z	7.38	66.5	20.4		123.2	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.94	65.7	18.6	5.75	122.1	±1.7 %
		Y	6.03	66.3	19.0		122.5	
		Z	5.79	65.0	17.7		144.0	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.38	66.3	18.9	5.82	126.0	±1.7 %
		Y	6.54	67.0	19.4		128.2	
		Z	6.16	65.3	17.8		146.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.17	66.5	19.2	5.73	149.7	±1.2 %
		Y	4.95	65.8	19.0		108.3	
		Z	4.64	63.9	17.1		125.3	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.79	70.4	23.0	9.21	120.6	±3.0 %
		Y	6.96	72.0	24.2		122.8	
		Z	6.43	69.3	22.0		136.7	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.15	66.4	19.1	5.72	143.0	±1.4 %
		Y	5.23	67.1	19.6		145.8	
		Z	4.60	63.7	17.0		121.1	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.11	66.2	19.0	5.72	141.0	±1.4 %
		Y	5.27	67.3	19.7		144.9	
		Z	4.54	63.4	16.8		119.2	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.57	67.1	20.1	8.09	102.2	±2.2 %
		Y	9.59	67.4	20.4		105.3	
		Z	9.73	67.6	20.0		129.6	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.61	67.3	20.2	8.10	104.6	±2.5 %
		Y	9.63	67.6	20.5		107.8	
		Z	9.63	67.3	19.8		130.9	

10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.61	67.5	20.3	8.03	109.2	±2.7 %
		Y	9.54	67.5	20.4		107.4	
		Z	9.53	67.2	19.7		130.7	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.00	67.8	20.4	8.06	114.1	±2.7 %
		Y	10.01	68.0	20.6		112.3	
		Z	9.96	67.6	19.9		137.1	
10225-CAA	UMTS-FDD (HSPA+)	X	7.18	66.9	19.2	5.97	137.5	±1.4 %
		Y	7.25	67.4	19.5		134.4	
		Z	6.48	64.4	17.3		114.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	6.93	71.0	23.5	9.21	123.5	±3.0 %
		Y	6.88	71.6	24.0		119.3	
		Z	6.63	70.1	22.4		141.3	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.19	70.5	23.1	9.24	142.9	±2.5 %
		Y	8.46	72.0	24.2		143.3	
		Z	7.10	67.0	20.8		119.9	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.83	68.1	21.6	9.30	104.2	±2.2 %
		Y	8.07	69.4	22.7		103.0	
		Z	7.49	67.2	20.9		125.2	
10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.96	66.2	18.3	4.87	128.1	±1.7 %
		Y	6.12	67.0	18.8		126.0	
		Z	5.31	63.8	16.4		110.2	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.30	65.5	17.8	3.96	110.5	±1.2 %
		Y	4.47	66.4	18.4		110.3	
		Z	3.92	63.1	15.6		135.7	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.59	65.7	17.7	3.46	138.1	±1.2 %
		Y	3.85	67.2	18.6		146.7	
		Z	3.08	61.7	14.7		123.3	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.59	66.0	17.8	3.39	144.2	±0.9 %
		Y	3.83	67.5	18.7		148.4	
		Z	3.18	63.1	15.7		128.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.13	65.8	18.7	5.81	116.5	±1.7 %
		Y	6.30	66.6	19.2		119.4	
		Z	6.20	65.9	18.4		145.6	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.70	66.4	19.0	6.06	122.5	±1.4 %
		Y	6.92	67.3	19.6		124.5	
		Z	6.28	65.0	17.9		103.7	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.66	66.7	17.4	1.71	109.5	±0.7 %
		Y	3.18	70.0	19.2		111.5	
		Z	2.08	61.6	13.4		134.4	
10317-AAA	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.78	67.4	20.4	8.36	103.5	±2.5 %
		Y	9.81	67.7	20.7		107.1	
		Z	9.86	67.6	20.3		129.5	
10400-AAA	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.86	67.5	20.4	8.37	104.9	±2.7 %
		Y	9.93	67.9	20.8		107.9	
		Z	9.97	67.7	20.2		134.3	

10402-AAA	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.47	67.9	20.5	8.53	109.9	±3.0 %
		Y	10.86	68.8	21.1		116.0	
		Z	10.68	68.2	20.4		142.5	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.74	67.0	17.9	3.76	114.9	±0.9 %
		Y	5.02	68.5	18.7		116.6	
		Z	4.23	64.4	15.8		145.1	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.71	67.1	17.9	3.77	112.3	±1.4 %
		Y	4.95	68.5	18.7		115.0	
		Z	4.01	63.4	15.1		138.9	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: 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 ^G	Depth ^G (mm)	Uct. (k=2)
750	41.9	0.89	8.86	8.86	8.86	0.80	0.62	± 12.0 %
835	41.5	0.90	8.49	8.49	8.49	0.45	0.82	± 12.0 %
1750	40.1	1.37	7.31	7.31	7.31	0.80	0.60	± 12.0 %
1900	40.0	1.40	7.05	7.05	7.05	0.52	0.73	± 12.0 %
2450	39.2	1.80	6.45	6.45	6.45	0.29	1.08	± 12.0 %
2600	39.0	1.96	6.24	6.24	6.24	0.76	0.62	± 12.0 %
5200	36.0	4.66	4.78	4.78	4.78	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.58	4.58	4.58	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.44	4.44	4.44	0.31	1.80	± 13.1 %
5600	35.5	5.07	4.20	4.20	4.20	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.39	4.39	4.39	0.32	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.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Calibration Parameter Determined in Body Tissue Simulating Media

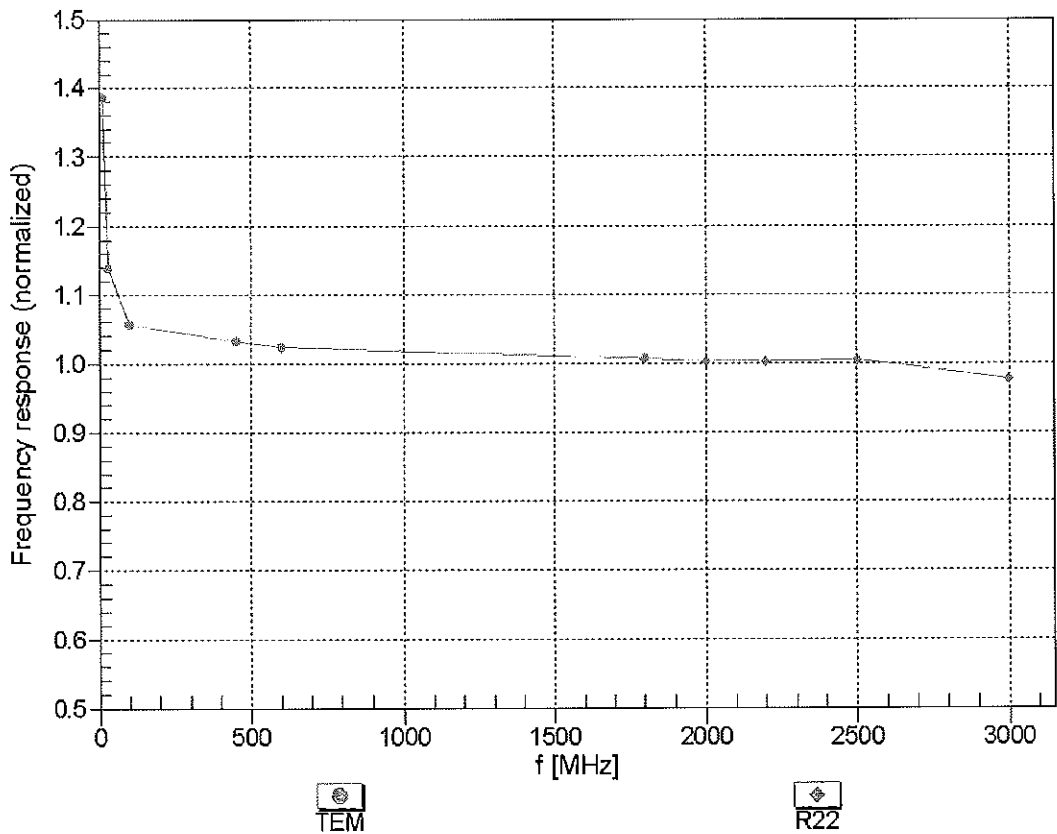
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	8.34	8.34	8.34	0.66	0.72	± 12.0 %
835	55.2	0.97	8.29	8.29	8.29	0.31	1.11	± 12.0 %
1750	53.4	1.49	6.68	6.68	6.68	0.80	0.61	± 12.0 %
1900	53.3	1.52	6.54	6.54	6.54	0.72	0.64	± 12.0 %
2450	52.7	1.95	6.26	6.26	6.26	0.80	0.57	± 12.0 %
2600	52.5	2.16	6.08	6.08	6.08	0.68	0.50	± 12.0 %
5200	49.0	5.30	4.19	4.19	4.19	0.38	1.90	± 13.1 %
5300	48.9	5.42	3.98	3.98	3.98	0.38	1.90	± 13.1 %
5500	48.6	5.65	3.76	3.76	3.76	0.42	1.90	± 13.1 %
5600	48.5	5.77	3.81	3.81	3.81	0.30	1.90	± 13.1 %
5800	48.2	6.00	3.97	3.97	3.97	0.43	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.

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

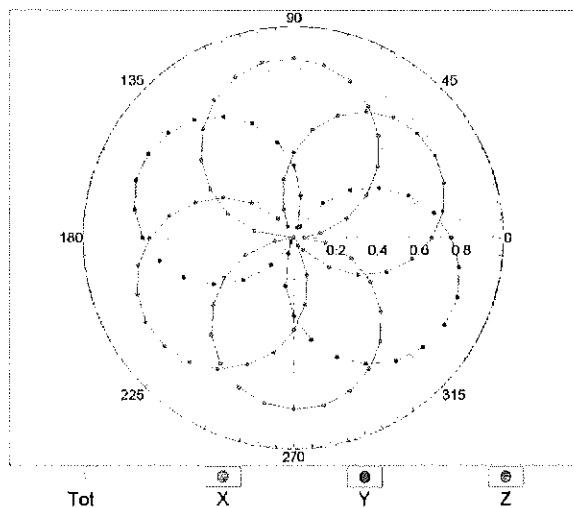
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



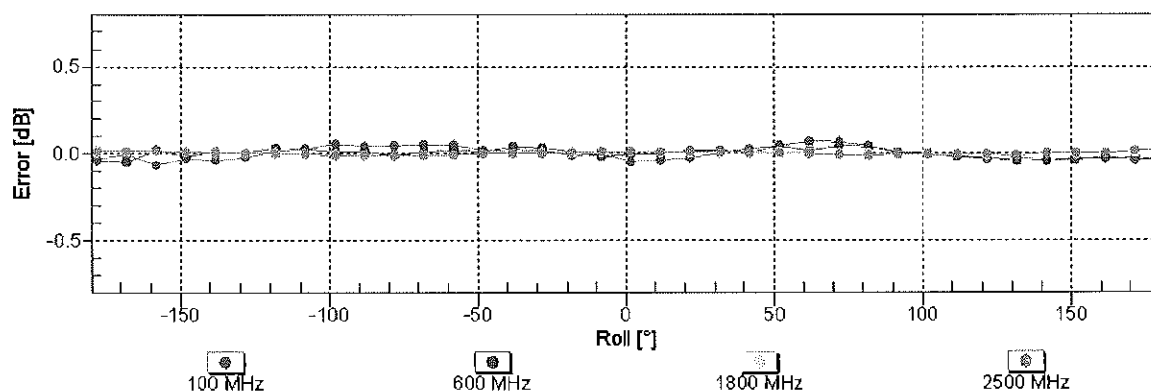
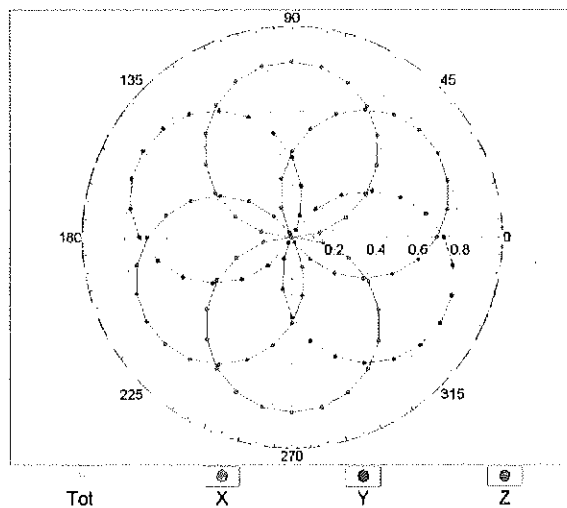
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM



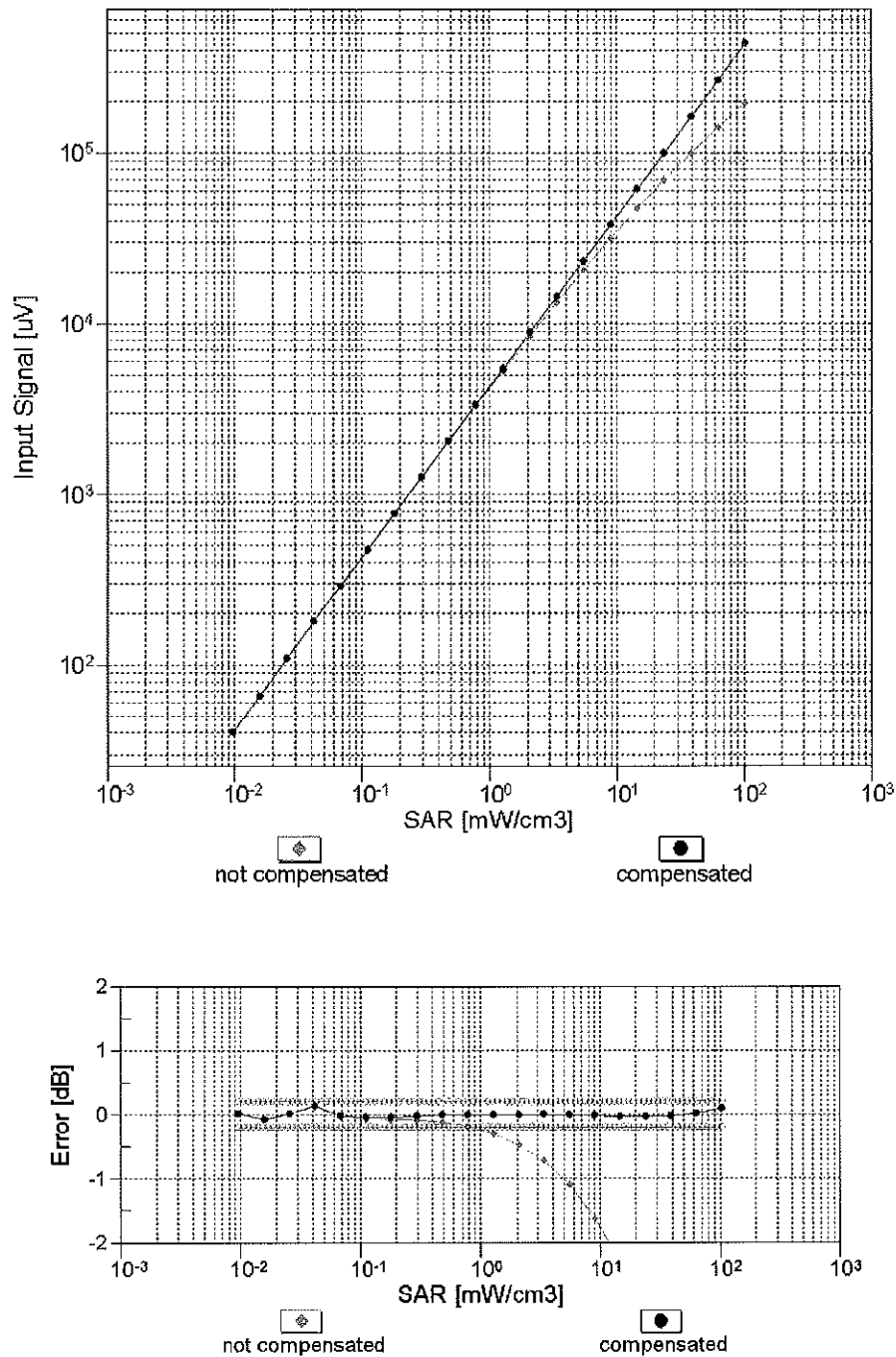
f=1800 MHz,R22



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

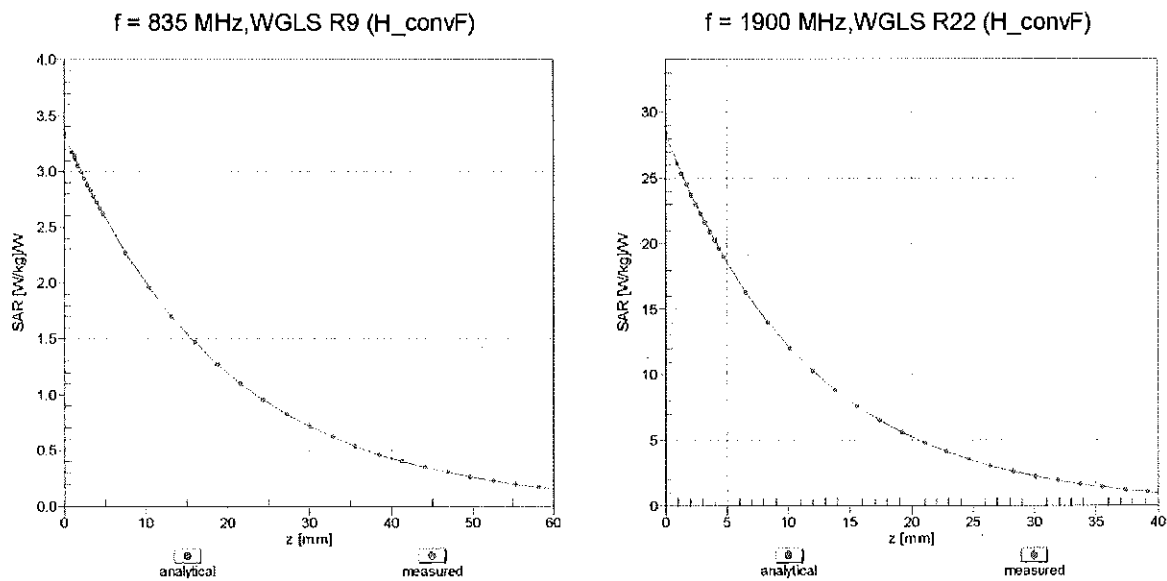
Dynamic Range f(SAR_{head})

(TEM cell , f = 900 MHz)

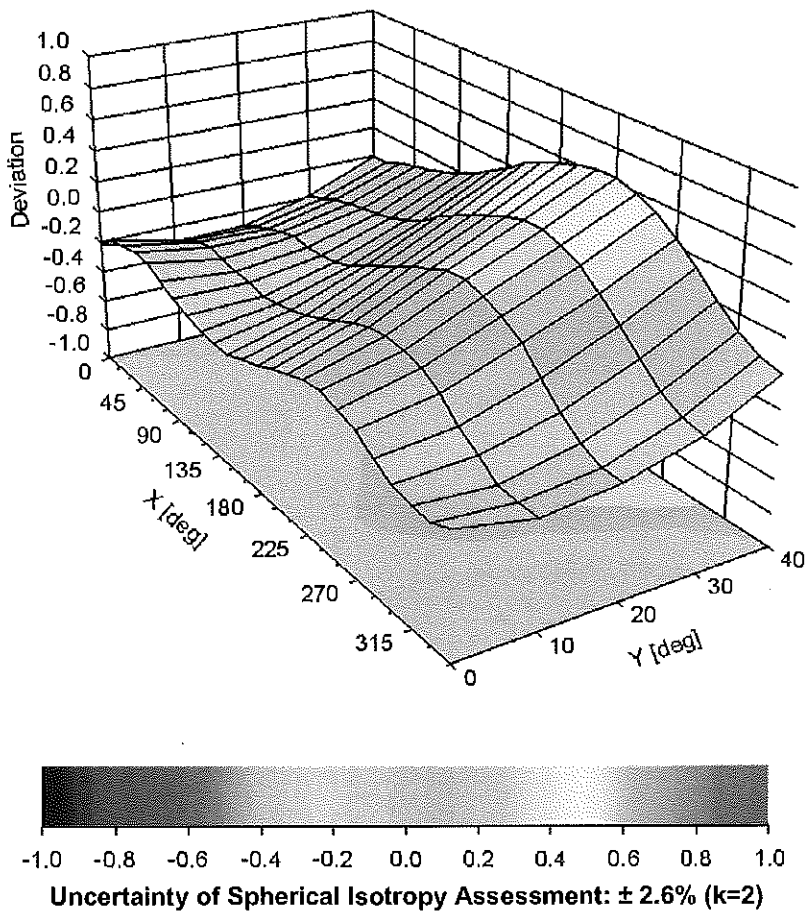


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

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 (°)	-38.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue Verification:

- 1) The network analyzer and probe system was configured and calibrated.
- 2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
- 3) The complex admittance with respect to the probe aperture was measured
- 4) The complex relative permittivity ϵ can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{[\ln(b/a)]^2} \int_a^b \int_a^b \int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\epsilon_r'\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

Table D-I
Composition of the Tissue Equivalent Matter

Frequency (MHz)	750	835	1750	1900	2450	5200-5800
Tissue	Body	Body	Body	Body	Body	Body
Ingredients (% by weight)						
Bactericide	See Next Page	0.1				
DGBE			31	29.44	26.7	
HEC		1				
NaCl		0.94	0.2	0.39	0.1	
Sucrose		44.9				
Polysorbate (Tween) 80						20
Water		53.06	68.8	70.17	73.2	80

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet			APPENDIX D: Page 1 of 2

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H ₂ O	Water, 35 – 58%
Sucrose	Sugar, white, refined, 40 – 60%
NaCl	Sodium Chloride, 0 – 6%
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyl-3(2H)-isothiazolone, 0.1 – 0.7%
Relevant for safety; Refer to the respective Safety Data Sheet*.	

Figure D-1
Composition of 750 MHz Body Tissue Equivalent Matter

Note: 750MHz liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	Body Tissue Simulating Liquid (MSL750V2)
Product No.	SL AAM 075 AA (Charge: 130313-1)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe.

Setup Validation

Validation results were within $\pm 2.5\%$ towards the target values of Methanol.

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

Ambient	Environment temperature (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	13-Mar-13
Operator	IEN

Additional Information

TSL Density	1.212 g/cm ³
TSL Heat-capacity	3.006 kJ/(kg*K)

f [MHz]	Measured			Target		Diff. to Target [%]	
	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
600	57.5	24.64	0.82	56.1	0.95	2.5	-13.6
625	57.2	24.31	0.84	56.0	0.95	2.1	-11.4
650	57.0	23.99	0.87	55.9	0.96	1.8	-9.2
675	56.7	23.69	0.89	55.8	0.96	1.5	-7.1
700	56.4	23.39	0.91	55.7	0.96	1.2	-5.1
725	56.2	23.18	0.93	55.6	0.96	1.0	-2.8
750	55.9	22.97	0.96	55.5	0.96	0.7	-0.5
775	55.7	22.78	0.98	55.4	0.97	0.4	1.7
800	55.4	22.60	1.01	55.3	0.97	0.1	4.0
825	55.2	22.44	1.03	55.2	0.98	-0.2	5.3
850	55.0	22.38	1.04	55.2	0.98	-0.3	5.9
875	54.9	22.28	1.05	55.2	0.98	-0.4	6.6
900	54.7	22.16	1.08	55.1	1.02	-0.7	5.8
925	54.5	22.03	1.10	55.0	1.05	-1.0	5.1
950	54.2	21.93	1.13	55.0	1.06	-1.3	6.2
975	54.0	21.82	1.15	54.9	1.08	-1.7	7.2
995	53.8	21.74	1.18	54.9	1.09	-2.0	8.5
1000	53.6	21.66	1.21	54.8	1.10	-2.3	9.7

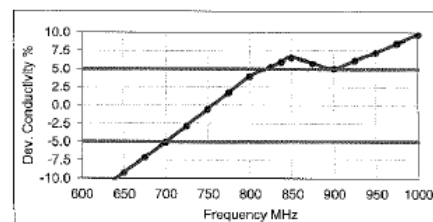
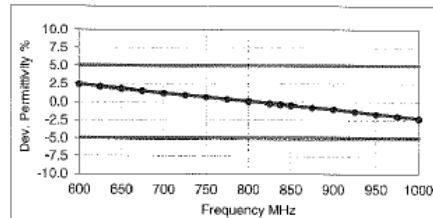


Figure D-2
750MHz Body Tissue Equivalent Matter

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet			APPENDIX D: Page 2 of 2

APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 v01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ϵ_r)	SENSI- TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
E	750	12/26/2013	3914	EX3DV4	750	Body	0.974	54.86	PASS	PASS	PASS	N/A	N/A	N/A
K	835	12/19/2013	3333	ES3DV3	835	Body	1.006	53.18	PASS	PASS	PASS	GMSK	PASS	N/A
C	1750	8/21/2013	3263	ES3DV3	1750	Body	1.491	52.58	PASS	PASS	PASS	N/A	N/A	N/A
D	1900	9/10/2013	3022	ES3DV2	1900	Body	1.516	52.49	PASS	PASS	PASS	GMSK	PASS	N/A
H	2450	3/10/2014	3589	EX3DV4	2450	Body	1.998	51.24	PASS	PASS	PASS	OFDM	N/A	PASS
A	5200	1/13/2014	3920	EX3DV4	5200	Body	5.344	47.27	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	1/13/2014	3920	EX3DV4	5300	Body	5.500	46.91	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	1/13/2014	3920	EX3DV4	5500	Body	5.826	46.38	PASS	PASS	PASS	OFDM	N/A	PASS
A	5600	1/13/2014	3920	EX3DV4	5600	Body	5.991	46.16	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	1/23/2014	3920	EX3DV4	5800	Body	6.282	46.05	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK and TDD, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664

FCC ID: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 03/25/14 - 04/01/14	DUT Type: Portable Tablet			APPENDIX E: Page 1 of 1

APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 03/25/2014 – 04/01/2014	DUT Type: Portable Tablet			APPENDIX G: Page 1 of 4

A3LSMT537R4 Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D04v01, this device was tested by the manufacturer to determine the proximity sensor triggering distances for the back and top edge of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1 mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D04v01) with the device at maximum output power without power reduction. These SAR Tests are included in addition 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.

FCC ID: A3LSMT537R4	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Test Dates: 03/25/2014 – 04/01/2014	DUT Type: Portable Tablet	APPENDIX G: Page 2 of 4

Back Side

Moving device toward the phantom:

KDB616217 6.2.6 Measured Power [dBm]											
Distance	28	27	26	25	24	23	22	21	20	19	18
CDMA 850	24.58	24.64	24.46	24.45	24.40	20.08	20.06	20.13	19.99	19.92	20.12
CDMA 1900	23.98	24.24	24.07	24.21	23.96	12.69	12.46	12.60	12.61	12.45	12.78
LTE B2	23.18	23.15	23.30	23.26	23.24	12.30	12.24	11.93	12.00	12.08	12.05
LTE B4	23.78	23.50	23.58	23.74	23.73	12.07	12.30	12.26	12.02	11.90	12.02
LTE B5	24.59	24.40	24.70	24.74	24.76	20.05	20.12	20.10	20.17	20.26	19.96
LTE B12	24.07	23.96	23.91	24.14	23.95	20.30	19.91	20.04	19.97	20.02	19.99
LTE B17	24.10	24.27	24.17	24.21	24.24	19.99	19.90	20.20	20.26	20.09	20.30

Moving device away from the phantom:

KDB616217 6.2.8 Measured Power [dBm]																			
Distance	34	31	28	27	26	25	24	23	22	21	20	19	18	15	12	9	6	3	0
CDMA 850	24.78	24.49	24.56	24.53	24.47	24.58	24.67	20.15	19.92	20.11	19.93	20.12	20.00	20.07	19.95	19.98	20.24	19.97	20.15
CDMA 1900	24.21	23.97	24.10	23.96	23.93	24.30	24.11	12.45	12.71	12.56	12.60	12.80	12.54	12.47	12.74	12.73	12.79	12.65	12.77
LTE B2	23.13	23.21	23.04	23.05	23.02	23.15	22.91	11.98	12.08	12.19	12.18	11.94	12.01	12.30	12.01	12.16	12.03	11.90	11.94
LTE B4	23.46	23.40	23.77	23.71	23.62	23.56	23.44	11.97	11.91	12.11	12.16	11.98	12.22	12.17	12.12	12.21	11.90	12.29	12.16
LTE B5	24.42	24.53	24.62	24.77	24.51	24.43	24.42	20.18	20.13	19.91	20.09	20.03	20.25	20.09	20.24	20.20	20.30	20.18	20.11
LTE B12	24.21	24.27	24.11	23.90	24.30	24.03	24.14	20.16	20.10	20.16	19.91	19.91	19.94	20.21	20.06	20.09	20.29	20.04	19.94
LTE B17	24.22	24.07	24.03	24.23	24.02	24.23	24.19	19.96	20.30	20.30	20.01	20.06	20.29	20.11	19.93	20.23	20.16	20.22	20.09

Based on the most conservative measured triggering distance of 23 mm, additional SAR measurements were required at 22 mm from the back side.

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 03/25/2014 – 04/01/2014	DUT Type: Portable Tablet			APPENDIX G: Page 3 of 4

Top Edge

Moving device toward the phantom:

KDB616217 6.2.6 Measured Power [dBm]											
Distance	28	27	26	25	24	23	22	21	20	19	18
CDMA 850	24.41	24.72	24.42	24.61	24.61	20.25	19.99	20.28	19.90	20.23	19.96
CDMA 1900	24.08	24.00	23.99	23.93	24.04	12.60	12.52	12.64	12.61	12.67	12.66
LTE B2	23.25	22.96	23.19	23.05	22.93	12.11	12.02	12.06	12.21	11.90	12.06
LTE B4	23.77	23.54	23.51	23.58	23.48	12.02	12.27	11.95	11.96	11.90	12.04
LTE B5	24.75	24.56	24.62	24.53	24.42	20.02	20.05	19.97	19.91	20.11	19.97
LTE B12	24.29	24.18	23.94	24.02	24.05	19.93	20.09	19.99	19.96	20.03	20.08
LTE B17	23.91	24.16	24.20	24.04	24.05	20.23	20.14	20.29	19.90	20.21	20.30

Moving device away from the phantom:

KDB616217 6.2.8 Measured Power [dBm]																			
Distance	34	31	28	27	26	25	24	23	22	21	20	19	18	15	12	9	6	3	0
CDMA 850	24.52	24.73	24.78	24.60	24.72	24.41	24.61	20.03	19.92	19.91	20.07	20.00	19.92	20.06	19.96	19.90	20.09	20.25	20.29
CDMA 1900	24.29	24.19	24.00	23.91	23.90	24.21	24.03	12.53	12.49	12.60	12.46	12.48	12.68	12.80	12.41	12.64	12.56	12.63	12.68
LTE B2	22.97	22.94	23.13	23.08	23.04	22.96	23.25	12.21	12.00	12.30	12.21	12.01	12.00	12.30	12.23	11.97	12.08	12.22	12.22
LTE B4	23.68	23.79	23.50	23.66	23.59	23.41	23.50	12.10	12.19	12.08	12.21	12.02	12.30	12.21	12.18	11.92	12.22	12.04	11.94
LTE B5	24.59	24.74	24.63	24.64	24.80	24.40	24.57	20.01	19.99	20.04	20.30	20.19	20.15	20.09	20.02	20.01	19.93	20.18	20.17
LTE B12	24.00	23.90	24.23	24.13	24.11	23.94	24.23	19.95	19.90	20.23	20.17	20.19	19.94	20.11	20.23	20.27	19.94	20.29	20.01
LTE B17	24.28	24.08	24.09	24.21	24.25	24.05	23.93	20.26	20.11	20.04	20.17	20.26	19.90	20.23	19.97	19.92	20.22	19.96	20.29

Based on the most conservative measured triggering distance of 23 mm, additional SAR measurements were required at 22 mm from the top edge.

FCC ID: A3LSMT537R4	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 03/25/2014 – 04/01/2014	DUT Type: Portable Tablet			APPENDIX G: Page 4 of 4