



SAR EVALUATION REPORT

Applicant Name:

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Date of Testing:

01/26/15 - 02/03/15

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

OY1501300306.A3L

FCC ID:

A3LSMG920T

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Handset

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SM-G920T

Equipment Class	Band & Mode	Tx Frequency	SAR		
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)
PCE	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	0.12	0.25	0.35
PCE	UMTS 850	826.40 - 846.60 MHz	0.12	0.26	0.29
PCE	UMTS 1750	1712.4 - 1752.5 MHz	0.39	0.78	1.07
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	0.25	0.80	1.09
PCE	UMTS 1900	1852.4 - 1907.6 MHz	0.40	0.39	0.78
PCE	LTE Band 12	699.7 - 715.3 MHz	0.22	0.58	0.58
PCE	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.10	0.22	0.27
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.47	1.07	1.08
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.41	0.62	0.93
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.64	< 0.1	0.12
NII	U-NII-1	5180 - 5240 MHz	N/A		
NII	U-NII-2A	5260 - 5320 MHz	0.19	< 0.1	
NII	U-NII-2C < 5.65 GHz	5500 - 5580 MHz	0.21	< 0.1	
NII	U-NII-2C > 5.65 GHz + U-NII-3	5660 - 5825 MHz	0.22	< 0.1	< 0.1
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A		
Simultaneous SAR per KDB 690783 D01v01r03:			1.11	1.26	1.31

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 1.8 of this report; for North American frequency bands only.

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


Randy Ortanez
President



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FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: OY1501300306.A3L	Test Dates: 01/26/15 - 02/03/15	DUT Type: Portable Handset		Page 1 of 87

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

1	DEVICE UNDER TEST	3
2	LTE INFORMATION	9
3	INTRODUCTION	10
4	DOSIMETRIC ASSESSMENT	11
5	DEFINITION OF REFERENCE POINTS	12
6	TEST CONFIGURATION POSITIONS FOR HANDSETS	13
7	RF EXPOSURE LIMITS	16
8	FCC MEASUREMENT PROCEDURES.....	17
9	RF CONDUCTED POWERS.....	22
10	SYSTEM VERIFICATION.....	61
11	SAR DATA SUMMARY	63
12	FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS.....	73
13	SAR MEASUREMENT VARIABILITY	81
14	EQUIPMENT LIST	82
15	MEASUREMENT UNCERTAINTIES	83
16	CONCLUSION.....	85
17	REFERENCES	86
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: DUT ANTENNA DIAGRAM & SAR TEST SETUP PHOTOGRAPHS		

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 2 of 87	

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1750	Voice/Data	1712.4 - 1752.5 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 17	Voice/Data	706.5 - 713.5 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2462 MHz
U-NII-1	Voice/Data	5180 - 5240 MHz
U-NII-2A	Voice/Data	5260 - 5320 MHz
U-NII-2C < 5.65 GHz	Voice/Data	5500 - 5580 MHz
U-NII-2C > 5.65 GHz + U-NII-3	Voice/Data	5660 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz
ANT+	Data	2402 - 2480 MHz
MST	Data	1 - 8.3 kHz

1.2 Power Reduction for SAR

This device utilizes two single step independent power reduction mechanisms for SAR compliance. For the main transmitter, the device utilizes power reduction under portable hotspot conditions for UMTS Band 4/2, and LTE Band 4/2. All hotspot SAR evaluations for this device were performed with the maximum allowed output power in hotspot mode. Additionally for the unlicensed transmitter, this device utilizes a proximity sensor to reduce the output power for 2.4 GHz WLAN during voice or VoIP held to ear scenarios. Per FCC Guidance, the held-to-ear exposure conditions were evaluated at reduced power. There is no power reduction for GSM/GPRS/EDGE 850/1900, UMTS Band 5, LTE Bands 17/12/5, and 5 GHz WLAN modes. The reduced powers for both mechanisms were confirmed via conducted power measurements at the RF port (See Section 9). Detailed descriptions of the hotspot power reduction and proximity sensor mechanisms are included in the operational description.

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 3 of 87

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.

1.3.1 Maximum Power

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots
GSM/GPRS/EDGE 850	Maximum	33.5	33.5	31.0	29.0	28.0	26.5	25.5	23.0	22.0
	Nominal	33.0	33.0	30.5	28.5	27.5	26.0	25.0	22.5	21.5
GSM/GPRS/EDGE 1900	Maximum	30.8	30.8	28.0	26.5	26.0	25.5	24.0	22.0	20.0
	Nominal	30.3	30.3	27.5	26.0	25.5	25.0	23.5	21.5	19.5

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA Rel 99	3GPP HSDPA Rel 5	3GPP HSUPA Rel 6	3GPP DC-HSDPA Rel 8
UMTS Band 5 (850 MHz)	Maximum	24.5	24.0	23.0	23.0
	Nominal	24.0	23.5	22.5	22.5
UMTS Band 4 (1750 MHz)	Maximum	24.5	23.5	23.0	23.0
	Nominal	24.0	23.0	22.5	22.5
UMTS Band 2 (1900 MHz)	Maximum	24.0	23.0	23.0	23.0
	Nominal	23.5	22.5	22.5	22.5
Mode / Band		Modulated Average (dBm)			
LTE Band 17	Maximum	24.0			
	Nominal	23.5			
LTE Band 12	Maximum	24.8			
	Nominal	24.3			
LTE Band 5 (Cell)	Maximum	24.0			
	Nominal	23.5			
LTE Band 4 (AWS)	Maximum	24.5			
	Nominal	24.0			
LTE Band 2 (PCS)	Maximum	24.0			
	Nominal	23.5			
Mode / Band		Modulated Average (dBm)			
IEEE 802.11b (2.4 GHz) - SISO	Maximum	15.5			
	Nominal	15.0			
IEEE 802.11g (2.4 GHz) - SISO	Maximum	14.5			
	Nominal	14.0			
IEEE 802.11n (2.4 GHz) - SISO	Maximum	13.5			
	Nominal	13.0			
IEEE 802.11n (2.4 GHz) - MIMO	Maximum	13.5			
	Nominal	13.0			
Bluetooth	Maximum	11.5			
	Nominal	11.0			
Bluetooth LE	Maximum	9.0			
	Nominal	8.5			

Mode / Band		Modulated Average (dBm)		
		20 MHz Bandwidth	40 MHz Bandwidth	80 MHz Bandwidth
IEEE 802.11a (5 GHz) - SISO	Maximum	12.5		
	Nominal	12.0		
IEEE 802.11n (5 GHz) - SISO	Maximum	12.5	11.5	
	Nominal	12.0	11.0	
IEEE 802.11n (5 GHz) - MIMO	Maximum	15.5	14.5	
	Nominal	15.0	14.0	
IEEE 802.11ac (5 GHz) - SISO	Maximum	12.5	11.5	10.5
	Nominal	12.0	11.0	10.0
IEEE 802.11ac (5 GHz) - MIMO	Maximum	15.5	14.5	13.5
	Nominal	15.0	14.0	13.0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 4 of 87	

1.3.2 Reduced Power – Representing Hotspot Active

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA Rel 99	3GPP HSDPA Rel 5	3GPP HSUPA Rel 6	3GPP DC-HSDPA Rel 8
UMTS Band 4 (1750 MHz)	Maximum	21.5	21.0	21.0	21.0
	Nominal	21.0	20.5	20.5	20.5
UMTS Band 2 (1900 MHz)	Maximum	22.0	21.0	21.0	21.0
	Nominal	21.5	20.5	20.5	20.5
Mode / Band		Modulated Average (dBm)			
LTE Band 4 (AWS)	Maximum	22.0			
	Nominal	21.5			
LTE Band 2 (PCS)	Maximum	22.0			
	Nominal	21.5			

1.3.3 Reduced Power – Held-To-Ear

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz) - SISO	Maximum	14.5
	Nominal	14.0
IEEE 802.11n (2.4 GHz) - SISO	Maximum	12.5
	Nominal	12.0
IEEE 802.11n (2.4 GHz) - MIMO	Maximum	12.5
	Nominal	12.0

Note: The proximity sensor does not trigger held-to-ear power reduction for IEEE 802.11g.

1.4 DUT Antenna Locations

- A diagram showing the location of the device antennas can be found in Appendix F. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing.
- The overall dimensions of this device are > 9 x 5 cm. The overall diagonal dimension of the device is <160 mm and the diagonal display is <150 mm.

**Table 1-1
Sides for SAR Testing**

Sides for SAR Testing						
Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	Yes	Yes
UMTS 850	Yes	Yes	No	Yes	Yes	Yes
UMTS 1750	Yes	Yes	No	Yes	Yes	Yes
GPRS 1900	Yes	Yes	No	Yes	Yes	Yes
UMTS 1900	Yes	Yes	No	Yes	Yes	Yes
LTE Band 12	Yes	Yes	No	Yes	Yes	Yes
LTE Band 5 (Cell)	Yes	Yes	No	Yes	Yes	Yes
LTE Band 4 (AWS)	Yes	Yes	No	Yes	Yes	Yes
LTE Band 2 (PCS)	Yes	Yes	No	Yes	Yes	Yes
2.4 GHz WLAN Antenna 1	Yes	Yes	Yes	No	No	Yes
2.4 GHz WLAN Antenna 2	Yes	Yes	Yes	No	Yes	No
U-NII-3 WLAN Antenna 1	Yes	Yes	Yes	No	No	Yes
U-NII-3 WLAN Antenna 2	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01 guidance, page 2. The distances between the transmit antennas and the edges of the device are included in the filing. When wireless router mode is enabled, U-NII-1, U-NII-2A & U-NII-2C WLAN operations are disabled. Therefore U-NII-1, U-NII-2A & U-NII-2C WLAN operations are not considered in this section.

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 5 of 87

1.5 Near Field Communications (NFC) Antenna

This DUT has NFC Operations. The NFC antenna is integrated into the device for this model. Therefore, all SAR tests were performed with the device which already incorporates the NFC antenna. A diagram showing the location of the NFC antenna can be found in Appendix F.

1.6 Simultaneous Transmission Capabilities

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

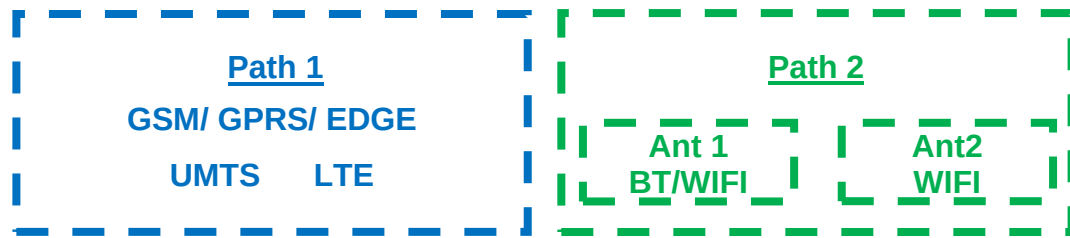


Figure 1-1
Simultaneous Transmission Paths

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

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router
1	GSM voice + 2.4 GHz Wi-Fi	Yes	Yes	N/A
2	GSM voice + 5 GHz Wi-Fi	Yes	Yes	N/A
3	GSM voice + 2.4 GHz Bluetooth	N/A	Yes	N/A
4	UMTS + 2.4 GHz Wi-Fi	Yes	Yes	Yes
5	UMTS + 5 GHz Wi-Fi	Yes	Yes	Yes
6	UMTS + 2.4 GHz Bluetooth	N/A	Yes	N/A
7	LTE + 2.4 GHz Wi-Fi	Yes	Yes	Yes
8	LTE + 5 GHz Wi-Fi	Yes	Yes	Yes
9	LTE + 2.4 GHz Bluetooth	N/A	Yes	N/A
10	GPRS/EDGE + 2.4 GHz Wi-Fi	N/A	N/A	Yes
11	GPRS/EDGE + 5 GHz Wi-Fi	N/A	N/A	Yes

- 2.4 GHz WLAN, 5 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
- All licensed modes share the same antenna path and cannot transmit simultaneously.
- When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
- Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.
- 5 GHz Wireless Router is only supported for the U-NII-3 Band by S/W, therefore U-NII1, U-NII-2A, & U-NII-2C Bands were not evaluated for wireless router conditions.
- This device supports 2x2 MIMO Tx for WLAN 802.11n/ac. Each WLAN antenna can transmit independently or together when operating with MIMO.
- This device supports VoLTE.

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 6 of 87

1.7 Miscellaneous SAR Test Considerations

(A) WIFI/BT

Since Wireless Router operations are not allowed by the chipset firmware using U-NII-1, U-NII-2A & U-NII-2C WIFI, only 2.4 GHz and UNII-3 WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v02.

Since U-NII-1 and U-NII-2A bands have the same maximum output power and the highest reported SAR for U-NII-2A is less than 1.2 W/kg, SAR is not required for U-NII-1 band according to FCC KDB 248227 D01 DR02-41929.

Since this device supports the band gap channels, the channels in the U-NII-2C band above 5.65 GHz were grouped with the channels in the U-NII-3 as a single aggregate band. The channels in UNII-2C below 5.65 GHz were considered separately for SAR evaluation.

This device supports IEEE 802.11ac with the following features:

- a) Up to 80 MHz Bandwidth only
- b) No aggregate channel configurations
- c) 2 Tx antenna output
- d) 256 QAM is supported
- e) Band gap channels are supported

Per FCC KDB 447498 D01v05, the 1g SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, body-worn Bluetooth SAR was not required; $[(14/15) * \sqrt{2.480}] = 1.5 < 3.0$. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Licensed Transmitter(s)

GSM/GPRS DTM is not supported for US bands. Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS Data.

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

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.

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

This device supports inter-band LTE Carrier Aggregation (CA) in the downlink only. All uplink communications are identical to Release 8 specifications. Per FCC KDB Publication 941225 D05A v01r01, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

FCC ID: A3LSMG920T	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset
		Page 7 of 87

1.8 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01v03, D05v02r03, D05Av01r01, D06v01r01 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01 DR02-41929 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r03, D02v01r01 (SAR Measurements up to 6 GHz)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)

1.9 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.

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
GSM/GPRS/EDGE 850	11520	11520	11520
UMTS 850	11518	11518	11518
UMTS 1750	11518	11520	N/A
UMTS 1750 - Representing Hotspot Mode Active	N/A	N/A	11521
GSM/GPRS/EDGE 1900	11520	11518	11518
UMTS 1900	11520	11518	N/A
UMTS 1900 - Representing Hotspot Mode Active	N/A	N/A	11521
LTE Band 12	11518	11518	11518
LTE Band 5 (Cell)	11518	11518	11518
LTE Band 4 (AWS)	11525	11520	N/A
LTE Band 4 (AWS) - Representing Hotspot Mode Active	N/A	N/A	11521
LTE Band 2 (PCS)	11520	11525	N/A
LTE Band 2 (PCS) - Representing Hotspot Mode Active	N/A	N/A	11521
2.4 GHz WLAN	N/A	1164B	1164B
2.4 GHz WLAN - Reduced Power	119C8	N/A	N/A
5 GHz WLAN	11656	11656	11656

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 8 of 87

LTE Information							
FCC ID	A3LSMG920T						
Form Factor	Portable Handset						
Frequency Range of each LTE transmission band	LTE Band 17 (706.5 - 713.5 MHz)						
	LTE Band 12 (699.7 - 715.3 MHz)						
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)						
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)						
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)						
Channel Bandwidths	LTE Band 17: 5 MHz, 10 MHz						
	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz						
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz						
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz						
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz						
Channel Numbers and Frequencies (MHz)	Low	Mid	High				
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)				
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)				
LTE Band 12: 1.4 MHz	699.7 (23017)	707.5 (23095)	715.3 (23173)				
LTE Band 12: 3 MHz	700.5 (23025)	707.5 (23095)	714.5 (23165)				
LTE Band 12: 5 MHz	701.5 (23035)	707.5 (23095)	713.5 (23155)				
LTE Band 12: 10 MHz	704 (23060)	707.5 (23095)	711 (23130)				
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)				
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)				
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)				
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)				
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)				
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)				
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)				
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)				
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)				
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)				
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)				
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)				
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)				
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)				
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)				
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)				
UE Category	6						
Modulations Supported in UL	QPSK, 16QAM						
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3-6.2.5? (manufacturer attestation to be provided)	YES						
A-MPR (Additional MPR) disabled for SAR Testing?	YES						
LTE Carrier Aggregation Possible Combinations	B12 (PDCI) + B4 (SCD)	B12 (PDCI) + B2 (SCD)	B4 (PDCI) + B12 (SCD)	B4 (PDCI) + B4 (SCD)	B4 (PDCI) + B2 (SCD)	B2 (PDCI) + B12 (SCD)	B2 (PDCI) + B4 (SCD)
	5MHz (B12) + 5MHz (B4)	5MHz (B12) + 5MHz (B2)	5MHz (B4) + 5MHz (B12)	5MHz (B4) + 5MHz (B4)	5MHz (B4) + 5MHz (B2)	5MHz (B2) + 5MHz (B12)	5MHz (B2) + 5MHz (B4)
	10MHz (B12) + 10MHz (B4)	10MHz (B12) + 10MHz (B2)	10MHz (B4) + 10MHz (B12)	10MHz (B4) + 10MHz (B4)	10MHz (B4) + 10MHz (B2)	10MHz (B2) + 10MHz (B12)	10MHz (B2) + 10MHz (B4)
	5MHz (B12) + 15MHz (B4)	5MHz (B12) + 20MHz (B2)	5MHz (B4) + 20MHz (B12)	5MHz (B4) + 20MHz (B4)	5MHz (B4) + 20MHz (B2)	5MHz (B2) + 20MHz (B12)	5MHz (B2) + 20MHz (B4)
	10MHz (B12) + 15MHz (B4)	10MHz (B12) + 10MHz (B2)	10MHz (B4) + 10MHz (B12)	10MHz (B4) + 10MHz (B4)	10MHz (B4) + 10MHz (B2)	10MHz (B2) + 10MHz (B12)	10MHz (B2) + 10MHz (B4)
	10MHz (B12) + 20MHz (B4)	10MHz (B12) + 20MHz (B2)	10MHz (B4) + 20MHz (B12)	10MHz (B4) + 20MHz (B4)	10MHz (B4) + 20MHz (B2)	10MHz (B2) + 20MHz (B12)	10MHz (B2) + 20MHz (B4)
	15MHz (B12) + 15MHz (B4)	15MHz (B12) + 10MHz (B2)	15MHz (B4) + 10MHz (B12)	15MHz (B4) + 10MHz (B4)	15MHz (B4) + 10MHz (B2)	15MHz (B2) + 10MHz (B12)	15MHz (B2) + 10MHz (B4)
	15MHz (B12) + 20MHz (B4)	15MHz (B12) + 20MHz (B2)	15MHz (B4) + 20MHz (B12)	15MHz (B4) + 20MHz (B4)	15MHz (B4) + 20MHz (B2)	15MHz (B2) + 20MHz (B12)	15MHz (B2) + 20MHz (B4)
	20MHz (B12) + 15MHz (B4)	20MHz (B12) + 10MHz (B2)	20MHz (B4) + 10MHz (B12)	20MHz (B4) + 10MHz (B4)	20MHz (B4) + 10MHz (B2)	20MHz (B2) + 10MHz (B12)	20MHz (B2) + 10MHz (B4)
	20MHz (B12) + 20MHz (B4)	20MHz (B12) + 20MHz (B2)	20MHz (B4) + 20MHz (B12)	20MHz (B4) + 20MHz (B4)	20MHz (B4) + 20MHz (B2)	20MHz (B2) + 20MHz (B12)	20MHz (B2) + 20MHz (B4)
	10MHz (B12) + 10MHz (B4)	10MHz (B12) + 10MHz (B2)	10MHz (B4) + 10MHz (B12)	10MHz (B4) + 10MHz (B4)	10MHz (B4) + 10MHz (B2)	10MHz (B2) + 10MHz (B12)	10MHz (B2) + 10MHz (B4)
	10MHz (B12) + 15MHz (B4)	10MHz (B12) + 15MHz (B2)	10MHz (B4) + 15MHz (B12)	10MHz (B4) + 15MHz (B4)	10MHz (B4) + 15MHz (B2)	10MHz (B2) + 15MHz (B12)	10MHz (B2) + 15MHz (B4)
	10MHz (B12) + 20MHz (B4)	10MHz (B12) + 20MHz (B2)	10MHz (B4) + 20MHz (B12)	10MHz (B4) + 20MHz (B4)	10MHz (B4) + 20MHz (B2)	10MHz (B2) + 20MHz (B12)	10MHz (B2) + 20MHz (B4)
	15MHz (B12) + 15MHz (B4)	15MHz (B12) + 15MHz (B2)	15MHz (B4) + 15MHz (B12)	15MHz (B4) + 15MHz (B4)	15MHz (B4) + 15MHz (B2)	15MHz (B2) + 15MHz (B12)	15MHz (B2) + 15MHz (B4)
	15MHz (B12) + 20MHz (B4)	15MHz (B12) + 20MHz (B2)	15MHz (B4) + 20MHz (B12)	15MHz (B4) + 20MHz (B4)	15MHz (B4) + 20MHz (B2)	15MHz (B2) + 20MHz (B12)	15MHz (B2) + 20MHz (B4)
	20MHz (B12) + 15MHz (B4)	20MHz (B12) + 15MHz (B2)	20MHz (B4) + 15MHz (B12)	20MHz (B4) + 15MHz (B4)	20MHz (B4) + 15MHz (B2)	20MHz (B2) + 15MHz (B12)	20MHz (B2) + 15MHz (B4)
	20MHz (B12) + 20MHz (B4)	20MHz (B12) + 20MHz (B2)	20MHz (B4) + 20MHz (B12)	20MHz (B4) + 20MHz (B4)	20MHz (B4) + 20MHz (B2)	20MHz (B2) + 20MHz (B12)	20MHz (B2) + 20MHz (B4)
LTE Carrier Aggregation Additional Information	This device does not support full CA features on 3GPP Release 10. It supports a maximum of 2 carriers in the downlink only. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. Due to carrier capability, only the combinations listed above are supported. The following LTE Release 10 Features are not supported: Relay, HetNet, Enhanced MIMO, eIC, WIFi Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.						

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 9 of 87

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: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 10 of 87

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.

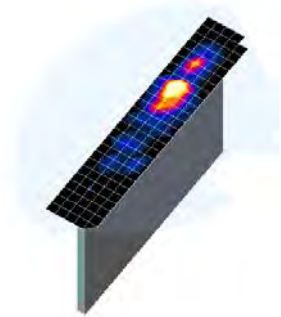


Figure 4-1
Sample SAR Area
Scan

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

*Also compliant to IEEE 1528-2013 Table 6

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 11 of 87

5

DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

Figure 5-2 shows the front, back and side views of the SAM Twin Phantom. The point “M” is the reference point for the center of the mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front), also called the Reference Pivoting Line, is not perpendicular to the reference plane (see Figure 5-1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

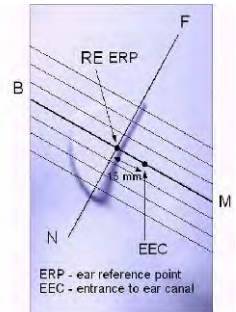


Figure 5-1
Close-Up Side view
of ERP

5.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the acoustic output located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Figure 5-3). The acoustic output was then located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at its top and bottom edges, positioning the “ear reference point” on the outer surface of the both the left and right head phantoms on the ear reference point.



Figure 5-2
Front, back and side view of SAM Twin Phantom

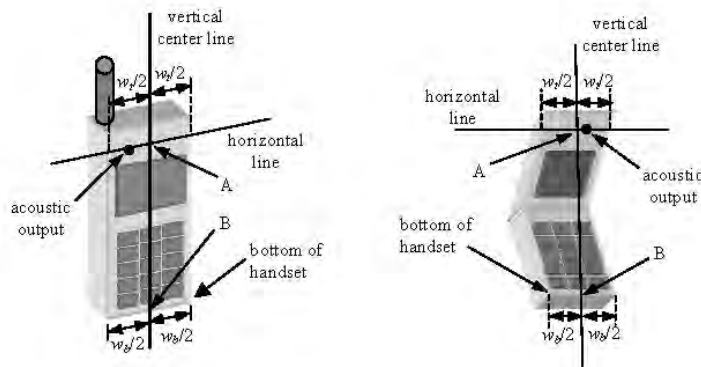


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 12 of 87

6

TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

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

6.2 Positioning for Cheek

1. The test device was positioned with the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

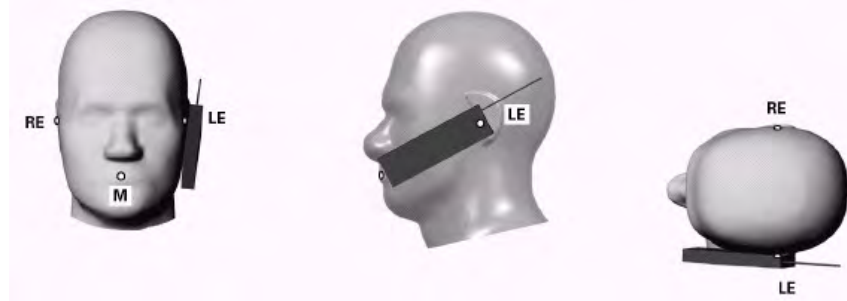


Figure 6-1 Front, Side and Top View of Cheek Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the pinna.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the reference plane.
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the device contact with the ear, the device was rotated about the NF line until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 6-2).

6.3 Positioning for Ear / 15° Tilt

With the test device aligned in the “Cheek Position”:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degrees.
2. The phone was then rotated around the horizontal line by 15 degrees.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the handset touched the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. In this situation, the tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 6-2).

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 13 of 87

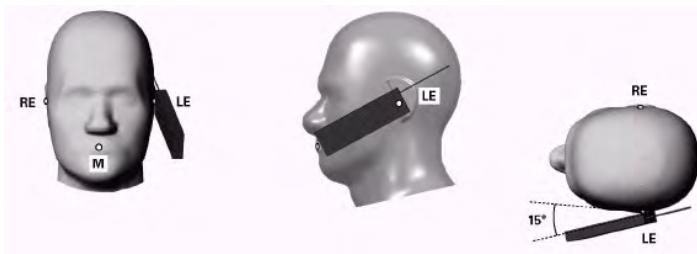


Figure 6-2 Front, Side and Top View of Ear/15° Tilt Position

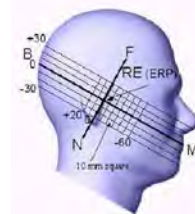


Figure 6-3 Side view w/ relevant markings

6.4 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-4). Per FCC KDB Publication 648474 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is $> 1.2 \text{ W/kg}$, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

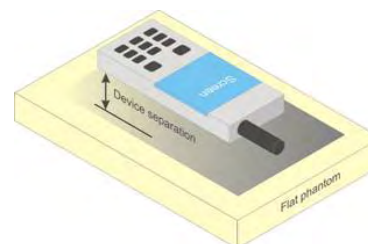


Figure 6-4 Sample Body-Worn Diagram

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

FCC ID: A3LSMG920T	PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT	SAMSUNG	Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 14 of 87

6.5 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 44798 D01v05 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v05, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

6.6 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v01 where SAR test considerations for handsets ($L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

FCC ID: A3LSMG920T	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset
		Page 15 of 87

7 RF EXPOSURE LIMITS

7.1 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.

7.2 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 7-1
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: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 16 of 87

8.1 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.

8.2 3G SAR Test Reduction Procedure

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

8.3 Procedures Used to Establish RF Signal for SAR

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

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

8.4 SAR Measurement Conditions for UMTS

8.4.1 Output Power Verification

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

8.4.2 Head SAR Measurements

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all “1’s”. The 3G SAR test reduction procedure is applied to AMR configurations with

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 17 of 87

12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest reported SAR configuration in 12.2 kbps RMC for head exposure.

8.4.3 Body SAR Measurements

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

8.4.4 SAR Measurements for Handsets with Rel 5 HSDPA

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

8.4.5 SAR Measurements for Handsets with Rel 6 HSUPA

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

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

8.4.6 SAR Measurement Conditions for DC-HSDPA

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

8.5 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).

8.5.1 Spectrum Plots for RB Configurations

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

8.5.2 MPR

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

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 18 of 87

8.5.3 A-MPR

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

8.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

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

8.5.5 Carrier Aggregation

LTE Carrier Aggregation (CA) measurements were made in accordance to 3GPP TS 36.521-1 V10.4.0 (2012-12). The RRC connection is only handled by one cell, the Primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds the Secondary component carrier (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to release 8 specifications on the PCC. Additional output powers were measured using two carriers in the downlink for the release 8 configurations with the highest output power among all channels, RB configurations and bandwidths for each uplink band. Per FCC Guidance, no SAR measurements were required.

8.6 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 D01v DR02-41929 for more details.

8.6.1 General Device Setup

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

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 19 of 87

required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

8.6.2 U-NII-1 and U-NII-2A

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

8.6.3 U-NII-2C and U-NII-3

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

Unless band gap channels are permanently disabled, SAR must be considered for these channels. To maintain SAR measurement accuracy and to facilitate test reduction, the channels in U-NII-2C band above 5.65 GHz are grouped with the 5.8 GHz channels in U-NII-3 band or §15.247 5.8 GHz band to enable two SAR probe calibration frequency points to cover the bands, including the band gap channels. When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

8.6.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.

8.6.5 2.4 GHz SAR Test Requirements

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

- 1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- 2) When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

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

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 20 of 87

8.6.6 OFDM Transmission Mode and SAR Test Channel Selection

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

8.6.7 Initial Test Configuration Procedure

For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output power is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 8.6.6)

8.6.8 Subsequent Test Configuration Procedures

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

8.6.9 MIMO SAR considerations

Per KDB 248227 D01 DR02-41929, the simultaneous SAR provisions in KDB Publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6 W/kg, no additional SAR measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 21 of 87

9 RF CONDUCTED POWERS

9.1 GSM Conducted Powers

		Maximum Burst-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	32.33	32.34	30.82	28.70	27.73	26.47	25.40	22.96	21.94
	190	32.20	32.26	30.94	28.94	27.79	26.42	25.32	23.00	21.89
	251	32.31	32.36	30.99	28.92	27.84	26.50	25.38	22.93	22.00
GSM 1900	512	29.23	29.26	27.96	26.01	25.30	25.50	24.00	21.79	19.91
	661	29.36	29.03	27.82	25.56	25.04	25.23	23.67	21.39	20.00
	810	29.04	29.02	27.65	25.32	25.03	25.11	23.75	21.33	19.95
		Calculated Maximum Frame-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	23.30	23.31	24.80	24.44	24.72	17.44	19.38	18.70	18.93
	190	23.17	23.23	24.92	24.68	24.78	17.39	19.30	18.74	18.88
	251	23.28	23.33	24.97	24.66	24.83	17.47	19.36	18.67	18.99
GSM 1900	512	20.20	20.23	21.94	21.75	22.29	16.47	17.98	17.53	16.90
	661	20.33	20.00	21.80	21.30	22.03	16.20	17.65	17.13	16.99
	810	20.01	19.99	21.63	21.06	22.02	16.08	17.73	17.07	16.94
GSM 850	Frame Avg.Targets:	23.97	23.97	24.48	24.24	24.49	16.97	18.98	18.24	18.49
GSM 1900		21.27	21.27	21.48	21.74	22.49	15.97	17.48	17.24	16.49

Note:

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

GSM Class: B
GPRS Multislot class: 12 (Max 4 Tx uplink slots)
EDGE Multislot class: 12 (Max 4 Tx uplink slots)
DTM Multislot Class: N/A



Figure 9-1
Power Measurement Setup

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 22 of 87

9.2 UMTS Conducted Powers

Table 9-1
Maximum Average RF Output Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	1312	1412	1862	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.85	23.78	23.72	23.74	23.64	23.62	23.02	23.07	22.70	-
99		12.2 kbps AMR	23.84	23.71	23.76	23.79	23.66	23.54	22.90	22.91	22.72	-
6	HSDPA	Subtest 1	23.74	23.69	23.52	23.25	23.13	23.32	22.95	22.96	22.88	0
6		Subtest 2	23.63	23.65	23.43	23.29	23.30	23.50	22.93	22.91	22.90	0
6		Subtest 3	23.11	22.92	22.80	22.88	23.05	23.17	22.95	22.89	22.51	0.5
6		Subtest 4	22.04	21.90	21.86	22.00	22.02	22.22	22.02	21.88	21.93	0.5
6	HSUPA	Subtest 1	22.95	22.91	22.86	22.73	22.68	22.82	22.57	22.36	22.25	0
6		Subtest 2	19.75	19.76	19.63	21.55	21.75	21.92	20.25	20.05	19.75	2
6		Subtest 3	22.31	22.10	22.11	22.41	22.40	22.56	22.53	22.34	22.27	1
6		Subtest 4	19.82	19.82	19.68	21.77	21.75	21.94	20.34	20.12	19.81	2
6		Subtest 5	22.98	22.96	22.90	22.80	22.78	22.93	22.62	22.45	22.30	0
8	DC-HSDPA	Subtest 1	22.80	22.76	22.95	22.92	22.21	22.82	22.61	22.98	22.44	0
8		Subtest 2	21.87	21.74	22.00	22.33	21.74	22.20	22.49	22.71	22.32	0
8		Subtest 3	21.07	20.85	21.16	21.52	20.85	21.37	21.49	21.73	21.22	0.5
8		Subtest 4	21.19	20.94	21.38	21.58	20.91	21.39	21.44	21.78	21.26	0.5

Table 9-2
Hotspot Reduced Average RF Output Powers - Representing Hotspot Mode Active

3GPP Release Version	Mode	3GPP 34.121 Subtest	AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			1312	1412	1862	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	21.36	21.45	21.49	21.12	21.21	21.18	-
99		12.2 kbps AMR	21.30	21.37	21.41	21.08	21.17	21.10	-
6	HSDPA	Subtest 1	20.71	20.91	20.98	19.84	20.04	20.02	0
6		Subtest 2	20.61	20.77	20.92	19.88	20.01	19.85	0
6		Subtest 3	20.32	19.95	20.03	19.32	19.41	19.33	0.5
6		Subtest 4	20.27	19.99	19.99	19.23	19.39	19.38	0.5
6	HSUPA	Subtest 1	20.86	20.48	20.93	19.37	19.61	19.86	0
6		Subtest 2	20.08	19.57	20.44	19.29	19.58	19.68	2
6		Subtest 3	19.66	19.40	19.82	19.36	19.45	19.61	1
6		Subtest 4	19.88	19.62	19.99	19.32	19.49	19.52	2
6		Subtest 5	20.81	20.72	20.86	19.55	19.68	19.72	0
8	DC-HSDPA	Subtest 1	20.84	20.66	20.78	19.49	19.66	19.72	0
8		Subtest 2	20.92	20.74	20.79	19.51	19.68	19.81	0
8		Subtest 3	20.39	20.15	20.27	18.91	19.18	19.13	0.5
8		Subtest 4	20.41	20.17	20.35	19.05	19.17	19.24	0.5

DC-HSDPA considerations

- 3GPP Specification 34.121-1 Release 8 Ver 8.10.0 was used for DC-HSDPA guidance
- H-Set 12 (QPSK) was confirmed to be used during DC-HSDPA measurements
- Measured maximum output powers for DC-HSDPA were not greater than 1/4 dB higher than the WCDMA 12.2 kbps RMC maximum output, as a result, SAR is not required for DC-HSDPA
- The DUT supports UE category 24 for HSDPA

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



Figure 9-2
Power Measurement Setup

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 23 of 87

9.3 LTE Conducted Powers

9.3.1 LTE Band 12

Table 9-3
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	24.31	0	0
	707.5	23095	10	QPSK	1	25	24.80	0	0
	707.5	23095	10	QPSK	1	49	24.74	0	0
	707.5	23095	10	QPSK	25	0	23.56	0-1	1
	707.5	23095	10	QPSK	25	12	23.62	0-1	1
	707.5	23095	10	QPSK	25	25	23.60	0-1	1
	707.5	23095	10	QPSK	50	0	23.54	0-1	1
	707.5	23095	10	16QAM	1	0	23.55	0-1	1
	707.5	23095	10	16QAM	1	25	23.80	0-1	1
	707.5	23095	10	16QAM	1	49	23.70	0-1	1
	707.5	23095	10	16QAM	25	0	22.53	0-2	2
	707.5	23095	10	16QAM	25	12	22.56	0-2	2
	707.5	23095	10	16QAM	25	25	22.60	0-2	2
	707.5	23095	10	16QAM	50	0	22.56	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: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 24 of 87

Table 9-4
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	24.00	0	0
	701.5	23035	5	QPSK	1	12	24.39	0	0
	701.5	23035	5	QPSK	1	24	24.65	0	0
	701.5	23035	5	QPSK	12	0	23.55	0-1	1
	701.5	23035	5	QPSK	12	6	23.32	0-1	1
	701.5	23035	5	QPSK	12	13	23.46	0-1	1
	701.5	23035	5	QPSK	25	0	23.25	0-1	1
	701.5	23035	5	16-QAM	1	0	23.64	0-1	1
	701.5	23035	5	16-QAM	1	12	23.38	0-1	1
	701.5	23035	5	16-QAM	1	24	23.51	0-1	1
	701.5	23035	5	16-QAM	12	0	22.58	0-2	2
	701.5	23035	5	16-QAM	12	6	22.46	0-2	2
Mid	701.5	23035	5	16-QAM	12	13	22.45	0-2	2
	701.5	23035	5	16-QAM	25	0	22.31	0-2	2
	707.5	23095	5	QPSK	1	0	24.33	0	0
	707.5	23095	5	QPSK	1	12	24.61	0	0
	707.5	23095	5	QPSK	1	24	24.78	0	0
	707.5	23095	5	QPSK	12	0	23.62	0-1	1
	707.5	23095	5	QPSK	12	6	23.46	0-1	1
	707.5	23095	5	QPSK	12	13	23.69	0-1	1
	707.5	23095	5	QPSK	25	0	23.50	0-1	1
	707.5	23095	5	16-QAM	1	0	23.37	0-1	1
	707.5	23095	5	16-QAM	1	12	23.24	0-1	1
	707.5	23095	5	16-QAM	1	24	23.61	0-1	1
High	707.5	23095	5	16-QAM	12	0	22.37	0-2	2
	707.5	23095	5	16-QAM	12	6	22.56	0-2	2
	707.5	23095	5	16-QAM	12	13	22.63	0-2	2
	707.5	23095	5	16-QAM	25	0	22.58	0-2	2
	713.5	23155	5	QPSK	1	0	24.26	0	0
	713.5	23155	5	QPSK	1	12	24.54	0	0
	713.5	23155	5	QPSK	1	24	24.70	0	0
	713.5	23155	5	QPSK	12	0	23.45	0-1	1
	713.5	23155	5	QPSK	12	6	23.57	0-1	1
	713.5	23155	5	QPSK	12	13	23.46	0-1	1
	713.5	23155	5	QPSK	25	0	23.80	0-1	1
	713.5	23155	5	16-QAM	1	0	23.62	0-1	1
	713.5	23155	5	16-QAM	1	12	23.10	0-1	1
	713.5	23155	5	16-QAM	1	24	23.73	0-1	1
	713.5	23155	5	16-QAM	12	0	22.61	0-2	2
	713.5	23155	5	16-QAM	12	6	22.40	0-2	2
	713.5	23155	5	16-QAM	12	13	22.61	0-2	2
	713.5	23155	5	16-QAM	25	0	22.78	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 25 of 87

Table 9-5
LTE Band 12 Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	700.5	23025	3	QPSK	1	0	24.13	0	0
	700.5	23025	3	QPSK	1	7	24.56	0	0
	700.5	23025	3	QPSK	1	14	24.78	0	0
	700.5	23025	3	QPSK	8	0	23.56	0-1	1
	700.5	23025	3	QPSK	8	4	23.42	0-1	1
	700.5	23025	3	QPSK	8	7	23.72	0-1	1
	700.5	23025	3	QPSK	15	0	23.36	0-1	1
	700.5	23025	3	16-QAM	1	0	23.18	0-1	1
	700.5	23025	3	16-QAM	1	7	23.24	0-1	1
	700.5	23025	3	16-QAM	1	14	23.71	0-1	1
	700.5	23025	3	16-QAM	8	0	22.39	0-2	2
	700.5	23025	3	16-QAM	8	4	22.20	0-2	2
Mid	707.5	23095	3	QPSK	1	0	24.10	0	0
	707.5	23095	3	QPSK	1	7	24.43	0	0
	707.5	23095	3	QPSK	1	14	24.56	0	0
	707.5	23095	3	QPSK	8	0	23.70	0-1	1
	707.5	23095	3	QPSK	8	4	23.54	0-1	1
	707.5	23095	3	QPSK	8	7	23.19	0-1	1
	707.5	23095	3	QPSK	15	0	23.50	0-1	1
	707.5	23095	3	16-QAM	1	0	23.21	0-1	1
	707.5	23095	3	16-QAM	1	7	23.06	0-1	1
	707.5	23095	3	16-QAM	1	14	23.52	0-1	1
	707.5	23095	3	16-QAM	8	0	22.41	0-2	2
	707.5	23095	3	16-QAM	8	4	22.32	0-2	2
High	714.5	23165	3	QPSK	1	0	24.47	0	0
	714.5	23165	3	QPSK	1	7	24.29	0	0
	714.5	23165	3	QPSK	1	14	24.40	0	0
	714.5	23165	3	QPSK	8	0	23.51	0-1	1
	714.5	23165	3	QPSK	8	4	23.69	0-1	1
	714.5	23165	3	QPSK	8	7	23.74	0-1	1
	714.5	23165	3	QPSK	15	0	23.56	0-1	1
	714.5	23165	3	16-QAM	1	0	23.78	0-1	1
	714.5	23165	3	16-QAM	1	7	23.09	0-1	1
	714.5	23165	3	16-QAM	1	14	23.61	0-1	1
	714.5	23165	3	16-QAM	8	0	22.44	0-2	2
	714.5	23165	3	16-QAM	8	4	22.59	0-2	2
	714.5	23165	3	16-QAM	8	7	22.74	0-2	2
	714.5	23165	3	16-QAM	15	0	22.47	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 26 of 87

Table 9-6
LTE Band 12 Conducted Powers – 1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	699.7	23017	1.4	QPSK	1	0	24.23	0	0
	699.7	23017	1.4	QPSK	1	2	24.36	0	0
	699.7	23017	1.4	QPSK	1	5	24.75	0	0
	699.7	23017	1.4	QPSK	3	0	24.36	0	0
	699.7	23017	1.4	QPSK	3	2	24.52	0	0
	699.7	23017	1.4	QPSK	3	3	24.57	0	0
	699.7	23017	1.4	QPSK	6	0	23.54	0-1	1
	699.7	23017	1.4	16-QAM	1	0	23.34	0-1	1
	699.7	23017	1.4	16-QAM	1	2	22.98	0-1	1
	699.7	23017	1.4	16-QAM	1	5	23.66	0-1	1
	699.7	23017	1.4	16-QAM	3	0	23.57	0-1	1
	699.7	23017	1.4	16-QAM	3	2	23.15	0-1	1
Mid	707.5	23095	1.4	QPSK	1	0	24.29	0	0
	707.5	23095	1.4	QPSK	1	2	24.30	0	0
	707.5	23095	1.4	QPSK	1	5	24.62	0	0
	707.5	23095	1.4	QPSK	3	0	24.48	0	0
	707.5	23095	1.4	QPSK	3	2	24.67	0	0
	707.5	23095	1.4	QPSK	3	3	24.26	0	0
	707.5	23095	1.4	QPSK	6	0	23.62	0-1	1
	707.5	23095	1.4	16-QAM	1	0	23.11	0-1	1
	707.5	23095	1.4	16-QAM	1	2	23.01	0-1	1
	707.5	23095	1.4	16-QAM	1	5	23.45	0-1	1
	707.5	23095	1.4	16-QAM	3	0	23.45	0-1	1
	707.5	23095	1.4	16-QAM	3	2	23.62	0-1	1
High	715.3	23173	1.4	QPSK	3	3	23.57	0-1	1
	707.5	23095	1.4	16-QAM	3	3	23.57	0-1	1
	707.5	23095	1.4	16-QAM	6	0	22.13	0-2	2
	715.3	23173	1.4	QPSK	1	0	24.68	0	0
	715.3	23173	1.4	QPSK	1	2	24.11	0	0
	715.3	23173	1.4	QPSK	1	5	24.59	0	0
	715.3	23173	1.4	QPSK	3	0	24.44	0	0
	715.3	23173	1.4	QPSK	3	2	24.61	0	0
	715.3	23173	1.4	QPSK	3	3	24.68	0	0
	715.3	23173	1.4	QPSK	6	0	23.36	0-1	1
	715.3	23173	1.4	16-QAM	1	0	23.76	0-1	1
	715.3	23173	1.4	16-QAM	1	2	23.27	0-1	1
	715.3	23173	1.4	16-QAM	1	5	23.60	0-1	1
	715.3	23173	1.4	16-QAM	3	0	23.43	0-1	1
	715.3	23173	1.4	16-QAM	3	2	23.55	0-1	1
	715.3	23173	1.4	16-QAM	3	3	23.09	0-1	1
	715.3	23173	1.4	16-QAM	6	0	22.18	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 27 of 87	

9.3.2 LTE Band 5 (Cell)

Table 9-7
LTE Band 5 (Cell) 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	23.91	0	0
	836.5	20525	10	QPSK	1	25	23.87	0	0
	836.5	20525	10	QPSK	1	49	23.84	0	0
	836.5	20525	10	QPSK	25	0	22.62	0-1	1
	836.5	20525	10	QPSK	25	12	22.60	0-1	1
	836.5	20525	10	QPSK	25	25	22.54	0-1	1
	836.5	20525	10	QPSK	50	0	22.59	0-1	1
	836.5	20525	10	16QAM	1	0	22.83	0-1	1
	836.5	20525	10	16QAM	1	25	22.84	0-1	1
	836.5	20525	10	16QAM	1	49	22.80	0-1	1
	836.5	20525	10	16QAM	25	0	21.67	0-2	2
	836.5	20525	10	16QAM	25	12	21.53	0-2	2
	836.5	20525	10	16QAM	25	25	21.48	0-2	2
	836.5	20525	10	16QAM	50	0	21.49	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: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 28 of 87

Table 9-8
LTE Band 5 (Cell) 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	23.72	0	0
	826.5	20425	5	QPSK	1	12	23.69	0	0
	826.5	20425	5	QPSK	1	24	23.89	0	0
	826.5	20425	5	QPSK	12	0	22.76	0-1	1
	826.5	20425	5	QPSK	12	6	22.51	0-1	1
	826.5	20425	5	QPSK	12	13	22.58	0-1	1
	826.5	20425	5	QPSK	25	0	22.54	0-1	1
	826.5	20425	5	16-QAM	1	0	22.68	0-1	1
	826.5	20425	5	16-QAM	1	12	22.63	0-1	1
	826.5	20425	5	16-QAM	1	24	22.83	0-1	1
	826.5	20425	5	16-QAM	12	0	21.35	0-2	2
	826.5	20425	5	16-QAM	12	6	21.69	0-2	2
Mid	836.5	20525	5	QPSK	1	0	23.75	0	0
	836.5	20525	5	QPSK	1	12	23.87	0	0
	836.5	20525	5	QPSK	1	24	23.87	0	0
	836.5	20525	5	QPSK	12	0	22.85	0-1	1
	836.5	20525	5	QPSK	12	6	22.70	0-1	1
	836.5	20525	5	QPSK	12	13	22.51	0-1	1
	836.5	20525	5	QPSK	25	0	22.47	0-1	1
	836.5	20525	5	16-QAM	1	0	22.91	0-1	1
	836.5	20525	5	16-QAM	1	12	22.76	0-1	1
	836.5	20525	5	16-QAM	1	24	22.67	0-1	1
	836.5	20525	5	16-QAM	12	0	21.50	0-2	2
	836.5	20525	5	16-QAM	12	6	21.72	0-2	2
High	846.5	20625	5	QPSK	1	0	23.78	0	0
	846.5	20625	5	QPSK	1	12	23.79	0	0
	846.5	20625	5	QPSK	1	24	23.83	0	0
	846.5	20625	5	QPSK	12	0	22.97	0-1	1
	846.5	20625	5	QPSK	12	6	22.62	0-1	1
	846.5	20625	5	QPSK	12	13	22.76	0-1	1
	846.5	20625	5	QPSK	25	0	22.36	0-1	1
	846.5	20625	5	16-QAM	1	0	23.00	0-1	1
	846.5	20625	5	16-QAM	1	12	22.56	0-1	1
	846.5	20625	5	16-QAM	1	24	22.64	0-1	1
	846.5	20625	5	16-QAM	12	0	21.53	0-2	2
	846.5	20625	5	16-QAM	12	6	21.82	0-2	2
	846.5	20625	5	16-QAM	12	13	21.41	0-2	2
	846.5	20625	5	16-QAM	25	0	21.53	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 29 of 87

Table 9-9
LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	825.5	20415	3	QPSK	1	0	23.75	0	0
	825.5	20415	3	QPSK	1	7	23.61	0	0
	825.5	20415	3	QPSK	1	14	23.75	0	0
	825.5	20415	3	QPSK	8	0	22.90	0-1	1
	825.5	20415	3	QPSK	8	4	22.30	0-1	1
	825.5	20415	3	QPSK	8	7	22.47	0-1	1
	825.5	20415	3	QPSK	15	0	22.67	0-1	1
	825.5	20415	3	16-QAM	1	0	22.59	0-1	1
	825.5	20415	3	16-QAM	1	7	22.52	0-1	1
	825.5	20415	3	16-QAM	1	14	22.68	0-1	1
	825.5	20415	3	16-QAM	8	0	21.12	0-2	2
	825.5	20415	3	16-QAM	8	4	21.47	0-2	2
	825.5	20415	3	16-QAM	8	7	21.37	0-2	2
	825.5	20415	3	16-QAM	15	0	21.43	0-2	2
Mid	836.5	20525	3	QPSK	1	0	24.00	0	0
	836.5	20525	3	QPSK	1	7	23.72	0	0
	836.5	20525	3	QPSK	1	14	23.82	0	0
	836.5	20525	3	QPSK	8	0	22.55	0-1	1
	836.5	20525	3	QPSK	8	4	22.57	0-1	1
	836.5	20525	3	QPSK	8	7	22.64	0-1	1
	836.5	20525	3	QPSK	15	0	22.41	0-1	1
	836.5	20525	3	16-QAM	1	0	22.72	0-1	1
	836.5	20525	3	16-QAM	1	7	22.56	0-1	1
	836.5	20525	3	16-QAM	1	14	22.66	0-1	1
	836.5	20525	3	16-QAM	8	0	21.37	0-2	2
	836.5	20525	3	16-QAM	8	4	21.47	0-2	2
	836.5	20525	3	16-QAM	8	7	21.77	0-2	2
	836.5	20525	3	16-QAM	15	0	21.83	0-2	2
High	847.5	20635	3	QPSK	1	0	23.55	0	0
	847.5	20635	3	QPSK	1	7	23.70	0	0
	847.5	20635	3	QPSK	1	14	23.74	0	0
	847.5	20635	3	QPSK	8	0	22.71	0-1	1
	847.5	20635	3	QPSK	8	4	22.44	0-1	1
	847.5	20635	3	QPSK	8	7	22.55	0-1	1
	847.5	20635	3	QPSK	15	0	22.39	0-1	1
	847.5	20635	3	16-QAM	1	0	22.85	0-1	1
	847.5	20635	3	16-QAM	1	7	22.30	0-1	1
	847.5	20635	3	16-QAM	1	14	22.34	0-1	1
	847.5	20635	3	16-QAM	8	0	21.49	0-2	2
	847.5	20635	3	16-QAM	8	4	21.71	0-2	2
	847.5	20635	3	16-QAM	8	7	21.16	0-2	2
	847.5	20635	3	16-QAM	15	0	21.43	0-2	2

Table 9-10
LTE Band 5 (Cell) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	824.7	20407	1.4	QPSK	1	0	23.93	0	0
	824.7	20407	1.4	QPSK	1	2	23.74	0	0
	824.7	20407	1.4	QPSK	1	5	23.79	0	0
	824.7	20407	1.4	QPSK	3	0	23.80	0	0
	824.7	20407	1.4	QPSK	3	2	23.52	0	0
	824.7	20407	1.4	QPSK	3	3	23.17	0	0
	824.7	20407	1.4	QPSK	6	0	22.47	0-1	1
	824.7	20407	1.4	16-QAM	1	0	22.41	0-1	1
	824.7	20407	1.4	16-QAM	1	2	22.30	0-1	1
	824.7	20407	1.4	16-QAM	1	5	22.89	0-1	1
	824.7	20407	1.4	16-QAM	3	0	22.32	0-1	1
	824.7	20407	1.4	16-QAM	3	2	22.51	0-1	1
Mid	824.7	20407	1.4	16-QAM	3	3	22.67	0-1	1
	824.7	20407	1.4	16-QAM	6	0	21.56	0-2	2
	836.5	20525	1.4	QPSK	1	0	23.99	0	0
	836.5	20525	1.4	QPSK	1	2	23.60	0	0
	836.5	20525	1.4	QPSK	1	5	23.87	0	0
	836.5	20525	1.4	QPSK	3	0	23.64	0	0
	836.5	20525	1.4	QPSK	3	2	23.61	0	0
	836.5	20525	1.4	QPSK	3	3	23.85	0	0
	836.5	20525	1.4	QPSK	6	0	22.43	0-1	1
	836.5	20525	1.4	16-QAM	1	0	22.43	0-1	1
	836.5	20525	1.4	16-QAM	1	2	22.75	0-1	1
	836.5	20525	1.4	16-QAM	1	5	22.82	0-1	1
High	836.5	20525	1.4	16-QAM	3	0	22.51	0-1	1
	836.5	20525	1.4	16-QAM	3	2	22.59	0-1	1
	836.5	20525	1.4	16-QAM	3	3	22.74	0-1	1
	836.5	20525	1.4	16-QAM	6	0	21.93	0-2	2
	848.3	20643	1.4	QPSK	1	0	23.32	0	0
	848.3	20643	1.4	QPSK	1	2	23.63	0	0
	848.3	20643	1.4	QPSK	1	5	23.89	0	0
	848.3	20643	1.4	QPSK	3	0	23.44	0	0
	848.3	20643	1.4	QPSK	3	2	23.33	0	0
	848.3	20643	1.4	QPSK	3	3	23.45	0	0
	848.3	20643	1.4	QPSK	6	0	22.51	0-1	1
	848.3	20643	1.4	16-QAM	1	0	22.83	0-1	1
	848.3	20643	1.4	16-QAM	1	2	22.16	0-1	1
	848.3	20643	1.4	16-QAM	1	5	22.07	0-1	1
	848.3	20643	1.4	16-QAM	3	0	22.76	0-1	1
	848.3	20643	1.4	16-QAM	3	2	22.83	0-1	1
	848.3	20643	1.4	16-QAM	3	3	22.25	0-1	1
	848.3	20643	1.4	16-QAM	6	0	21.50	0-2	2

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 31 of 87

9.3.3 LTE Band 4 (AWS) – Maximum Powers

Table 9-11
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	23.48	0	0
	1732.5	20175	20	QPSK	1	50	23.43	0	0
	1732.5	20175	20	QPSK	1	99	23.50	0	0
	1732.5	20175	20	QPSK	50	0	22.33	0-1	1
	1732.5	20175	20	QPSK	50	25	22.19	0-1	1
	1732.5	20175	20	QPSK	50	50	22.18	0-1	1
	1732.5	20175	20	QPSK	100	0	22.17	0-1	1
	1732.5	20175	20	16QAM	1	0	22.43	0-1	1
	1732.5	20175	20	16QAM	1	50	22.22	0-1	1
	1732.5	20175	20	16QAM	1	99	22.32	0-1	1
	1732.5	20175	20	16QAM	50	0	21.50	0-2	2
	1732.5	20175	20	16QAM	50	25	21.17	0-2	2
	1732.5	20175	20	16QAM	50	50	21.16	0-2	2
	1732.5	20175	20	16QAM	100	0	21.09	0-2	2

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

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 32 of 87

Table 9-12
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	23.55	0	0
	1717.5	20025	15	QPSK	1	36	23.62	0	0
	1717.5	20025	15	QPSK	1	74	23.46	0	0
	1717.5	20025	15	QPSK	36	0	22.26	0-1	1
	1717.5	20025	15	QPSK	36	18	22.28	0-1	1
	1717.5	20025	15	QPSK	36	37	22.26	0-1	1
	1717.5	20025	15	QPSK	75	0	22.11	0-1	1
	1717.5	20025	15	16QAM	1	0	22.27	0-1	1
	1717.5	20025	15	16QAM	1	36	22.20	0-1	1
	1717.5	20025	15	16QAM	1	74	22.24	0-1	1
	1717.5	20025	15	16QAM	36	0	21.45	0-2	2
	1717.5	20025	15	16QAM	36	18	21.15	0-2	2
Mid	1717.5	20025	15	16QAM	36	37	21.44	0-2	2
	1717.5	20025	15	16QAM	75	0	21.50	0-2	2
	1732.5	20175	15	QPSK	1	0	23.60	0	0
	1732.5	20175	15	QPSK	1	36	23.43	0	0
	1732.5	20175	15	QPSK	1	74	23.50	0	0
	1732.5	20175	15	QPSK	36	0	22.41	0-1	1
	1732.5	20175	15	QPSK	36	18	22.17	0-1	1
	1732.5	20175	15	QPSK	36	37	22.40	0-1	1
	1732.5	20175	15	QPSK	75	0	22.25	0-1	1
	1732.5	20175	15	16QAM	1	0	22.24	0-1	1
	1732.5	20175	15	16QAM	1	36	22.23	0-1	1
	1732.5	20175	15	16QAM	1	74	22.38	0-1	1
High	1732.5	20175	15	16QAM	36	0	21.57	0-2	2
	1732.5	20175	15	16QAM	36	18	21.27	0-2	2
	1732.5	20175	15	16QAM	36	37	21.36	0-2	2
	1732.5	20175	15	16QAM	75	0	21.34	0-2	2
	1747.5	20325	15	QPSK	1	0	23.37	0	0
	1747.5	20325	15	QPSK	1	36	23.49	0	0
	1747.5	20325	15	QPSK	1	74	23.29	0	0
	1747.5	20325	15	QPSK	36	0	22.18	0-1	1
	1747.5	20325	15	QPSK	36	18	22.08	0-1	1
	1747.5	20325	15	QPSK	36	37	22.37	0-1	1
	1747.5	20325	15	QPSK	75	0	22.06	0-1	1
	1747.5	20325	15	16QAM	1	0	22.16	0-1	1
	1747.5	20325	15	16QAM	1	36	22.15	0-1	1
	1747.5	20325	15	16QAM	1	74	22.24	0-1	1
	1747.5	20325	15	16QAM	36	0	21.59	0-2	2
	1747.5	20325	15	16QAM	36	18	21.20	0-2	2
	1747.5	20325	15	16QAM	36	37	21.35	0-2	2
	1747.5	20325	15	16QAM	75	0	21.66	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 33 of 87

Table 9-13
LTE Band 4 (AWS) 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	23.39	0	0
	1715	20000	10	QPSK	1	25	23.74	0	0
	1715	20000	10	QPSK	1	49	23.31	0	0
	1715	20000	10	QPSK	25	0	22.15	0-1	1
	1715	20000	10	QPSK	25	12	22.03	0-1	1
	1715	20000	10	QPSK	25	25	22.43	0-1	1
	1715	20000	10	QPSK	50	0	21.95	0-1	1
	1715	20000	10	16QAM	1	0	22.49	0-1	1
	1715	20000	10	16QAM	1	25	21.93	0-1	1
	1715	20000	10	16QAM	1	49	22.25	0-1	1
	1715	20000	10	16QAM	25	0	21.61	0-2	2
	1715	20000	10	16QAM	25	12	21.03	0-2	2
Mid	1715	20000	10	16QAM	25	25	21.19	0-2	2
	1715	20000	10	16QAM	50	0	21.70	0-2	2
	1732.5	20175	10	QPSK	1	0	23.72	0	0
	1732.5	20175	10	QPSK	1	25	23.66	0	0
	1732.5	20175	10	QPSK	1	49	23.40	0	0
	1732.5	20175	10	QPSK	25	0	22.25	0-1	1
	1732.5	20175	10	QPSK	25	12	21.93	0-1	1
	1732.5	20175	10	QPSK	25	25	22.17	0-1	1
	1732.5	20175	10	QPSK	50	0	22.24	0-1	1
	1732.5	20175	10	16QAM	1	0	22.37	0-1	1
	1732.5	20175	10	16QAM	1	25	22.10	0-1	1
	1732.5	20175	10	16QAM	1	49	22.13	0-1	1
High	1732.5	20175	10	16QAM	25	0	21.51	0-2	2
	1732.5	20175	10	16QAM	25	12	21.43	0-2	2
	1732.5	20175	10	16QAM	25	25	21.19	0-2	2
	1732.5	20175	10	16QAM	50	0	21.38	0-2	2
	1750	20350	10	QPSK	1	0	23.19	0	0
	1750	20350	10	QPSK	1	25	23.19	0	0
	1750	20350	10	QPSK	1	49	23.18	0	0
	1750	20350	10	QPSK	25	0	22.27	0-1	1
	1750	20350	10	QPSK	25	12	22.37	0-1	1
	1750	20350	10	QPSK	25	25	22.23	0-1	1
	1750	20350	10	QPSK	50	0	22.28	0-1	1
	1750	20350	10	16QAM	1	0	22.11	0-1	1
	1750	20350	10	16QAM	1	25	22.05	0-1	1
	1750	20350	10	16QAM	1	49	22.00	0-1	1
	1750	20350	10	16QAM	25	0	21.33	0-2	2
	1750	20350	10	16QAM	25	12	21.22	0-2	2
	1750	20350	10	16QAM	25	25	21.28	0-2	2
	1750	20350	10	16QAM	50	0	21.61	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 34 of 87

Table 9-14

LTE Band 4 (AWS) 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	23.59	0	0
	1712.5	19975	5	QPSK	1	12	23.73	0	0
	1712.5	19975	5	QPSK	1	24	23.13	0	0
	1712.5	19975	5	QPSK	12	0	22.09	0-1	1
	1712.5	19975	5	QPSK	12	6	22.07	0-1	1
	1712.5	19975	5	QPSK	12	13	22.34	0-1	1
	1712.5	19975	5	QPSK	25	0	22.24	0-1	1
	1712.5	19975	5	16-QAM	1	0	22.31	0-1	1
	1712.5	19975	5	16-QAM	1	12	21.92	0-1	1
	1712.5	19975	5	16-QAM	1	24	22.12	0-1	1
	1712.5	19975	5	16-QAM	12	0	21.80	0-2	2
	1712.5	19975	5	16-QAM	12	6	21.14	0-2	2
Mid	1712.5	19975	5	16-QAM	12	13	21.44	0-2	2
	1712.5	19975	5	16-QAM	25	0	21.70	0-2	2
	1732.5	20175	5	QPSK	1	0	23.66	0	0
	1732.5	20175	5	QPSK	1	12	23.71	0	0
	1732.5	20175	5	QPSK	1	24	23.13	0	0
	1732.5	20175	5	QPSK	12	0	22.22	0-1	1
	1732.5	20175	5	QPSK	12	6	21.96	0-1	1
	1732.5	20175	5	QPSK	12	13	22.30	0-1	1
	1732.5	20175	5	QPSK	25	0	22.21	0-1	1
	1732.5	20175	5	16-QAM	1	0	22.45	0-1	1
	1732.5	20175	5	16-QAM	1	12	21.93	0-1	1
	1732.5	20175	5	16-QAM	1	24	22.29	0-1	1
High	1732.5	20175	5	16-QAM	12	0	21.31	0-2	2
	1732.5	20175	5	16-QAM	12	6	21.34	0-2	2
	1732.5	20175	5	16-QAM	12	13	21.34	0-2	2
	1732.5	20175	5	16-QAM	25	0	21.25	0-2	2
	1752.5	20375	5	QPSK	1	0	23.38	0	0
	1752.5	20375	5	QPSK	1	12	23.33	0	0
	1752.5	20375	5	QPSK	1	24	23.31	0	0
	1752.5	20375	5	QPSK	12	0	22.26	0-1	1
	1752.5	20375	5	QPSK	12	6	22.46	0-1	1
	1752.5	20375	5	QPSK	12	13	22.11	0-1	1
	1752.5	20375	5	QPSK	25	0	22.55	0-1	1
	1752.5	20375	5	16-QAM	1	0	21.98	0-1	1
	1752.5	20375	5	16-QAM	1	12	21.99	0-1	1
	1752.5	20375	5	16-QAM	1	24	21.95	0-1	1
	1752.5	20375	5	16-QAM	12	0	21.25	0-2	2
	1752.5	20375	5	16-QAM	12	6	20.96	0-2	2
	1752.5	20375	5	16-QAM	12	13	21.56	0-2	2
	1752.5	20375	5	16-QAM	25	0	21.86	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 35 of 87

Table 9-15
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1711.5	19965	3	QPSK	1	0	23.73	0	0
	1711.5	19965	3	QPSK	1	7	23.74	0	0
	1711.5	19965	3	QPSK	1	14	23.17	0	0
	1711.5	19965	3	QPSK	8	0	22.13	0-1	1
	1711.5	19965	3	QPSK	8	4	22.01	0-1	1
	1711.5	19965	3	QPSK	8	7	22.31	0-1	1
	1711.5	19965	3	QPSK	15	0	22.38	0-1	1
	1711.5	19965	3	16-QAM	1	0	22.29	0-1	1
	1711.5	19965	3	16-QAM	1	7	22.06	0-1	1
	1711.5	19965	3	16-QAM	1	14	22.22	0-1	1
	1711.5	19965	3	16-QAM	8	0	21.60	0-2	2
	1711.5	19965	3	16-QAM	8	4	21.27	0-2	2
Mid	1732.5	20175	3	QPSK	1	0	23.55	0	0
	1732.5	20175	3	QPSK	1	7	23.68	0	0
	1732.5	20175	3	QPSK	1	14	23.12	0	0
	1732.5	20175	3	QPSK	8	0	22.20	0-1	1
	1732.5	20175	3	QPSK	8	4	22.09	0-1	1
	1732.5	20175	3	QPSK	8	7	22.14	0-1	1
	1732.5	20175	3	QPSK	15	0	22.10	0-1	1
	1732.5	20175	3	16-QAM	1	0	22.26	0-1	1
	1732.5	20175	3	16-QAM	1	7	22.39	0-1	1
	1732.5	20175	3	16-QAM	1	14	22.32	0-1	1
	1732.5	20175	3	16-QAM	8	0	21.26	0-2	2
	1732.5	20175	3	16-QAM	8	4	21.31	0-2	2
High	1753.5	20385	3	QPSK	1	0	23.48	0	0
	1753.5	20385	3	QPSK	1	7	23.22	0	0
	1753.5	20385	3	QPSK	1	14	23.48	0	0
	1753.5	20385	3	QPSK	8	0	22.16	0-1	1
	1753.5	20385	3	QPSK	8	4	22.51	0-1	1
	1753.5	20385	3	QPSK	8	7	22.11	0-1	1
	1753.5	20385	3	QPSK	15	0	22.53	0-1	1
	1753.5	20385	3	16-QAM	1	0	21.99	0-1	1
	1753.5	20385	3	16-QAM	1	7	22.02	0-1	1
	1753.5	20385	3	16-QAM	1	14	21.92	0-1	1
	1753.5	20385	3	16-QAM	8	0	21.29	0-2	2
	1753.5	20385	3	16-QAM	8	4	21.04	0-2	2
	1753.5	20385	3	16-QAM	8	7	21.42	0-2	2
	1753.5	20385	3	16-QAM	15	0	21.45	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 36 of 87

Table 9-16
LTE Band 4 (AWS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1710.7	19957	1.4	QPSK	1	0	23.29	0	0
	1710.7	19957	1.4	QPSK	1	2	23.73	0	0
	1710.7	19957	1.4	QPSK	1	5	23.46	0	0
	1710.7	19957	1.4	QPSK	3	0	22.97	0	0
	1710.7	19957	1.4	QPSK	3	2	23.36	0	0
	1710.7	19957	1.4	QPSK	3	3	23.54	0	0
	1710.7	19957	1.4	QPSK	6	0	22.07	0-1	1
	1710.7	19957	1.4	16-QAM	1	0	21.93	0-1	1
	1710.7	19957	1.4	16-QAM	1	2	21.98	0-1	1
	1710.7	19957	1.4	16-QAM	1	5	22.30	0-1	1
	1710.7	19957	1.4	16-QAM	3	0	22.35	0-1	1
	1710.7	19957	1.4	16-QAM	3	2	22.40	0-1	1
Mid	1710.7	19957	1.4	16-QAM	3	3	22.37	0-1	1
	1710.7	19957	1.4	16-QAM	6	0	21.66	0-2	2
	1732.5	20175	1.4	QPSK	1	0	23.57	0	0
	1732.5	20175	1.4	QPSK	1	2	23.70	0	0
	1732.5	20175	1.4	QPSK	1	5	23.17	0	0
	1732.5	20175	1.4	QPSK	3	0	23.01	0	0
	1732.5	20175	1.4	QPSK	3	2	22.99	0	0
	1732.5	20175	1.4	QPSK	3	3	23.02	0	0
	1732.5	20175	1.4	QPSK	6	0	22.60	0-1	1
	1732.5	20175	1.4	16-QAM	1	0	22.60	0-1	1
	1732.5	20175	1.4	16-QAM	1	2	22.64	0-1	1
	1732.5	20175	1.4	16-QAM	1	5	22.67	0-1	1
High	1732.5	20175	1.4	16-QAM	3	0	22.06	0-1	1
	1732.5	20175	1.4	16-QAM	3	2	21.98	0-1	1
	1732.5	20175	1.4	16-QAM	3	3	22.69	0-1	1
	1732.5	20175	1.4	16-QAM	6	0	21.29	0-2	2
	1754.3	20393	1.4	QPSK	1	0	23.49	0	0
	1754.3	20393	1.4	QPSK	1	2	23.49	0	0
	1754.3	20393	1.4	QPSK	1	5	23.22	0	0
	1754.3	20393	1.4	QPSK	3	0	23.48	0	0
	1754.3	20393	1.4	QPSK	3	2	23.29	0	0
	1754.3	20393	1.4	QPSK	3	3	23.61	0	0
	1754.3	20393	1.4	QPSK	6	0	22.32	0-1	1
	1754.3	20393	1.4	16-QAM	1	0	22.37	0-1	1
	1754.3	20393	1.4	16-QAM	1	2	22.02	0-1	1
	1754.3	20393	1.4	16-QAM	1	5	22.42	0-1	1
	1754.3	20393	1.4	16-QAM	3	0	22.69	0-1	1
	1754.3	20393	1.4	16-QAM	3	2	22.52	0-1	1
	1754.3	20393	1.4	16-QAM	3	3	22.09	0-1	1
	1754.3	20393	1.4	16-QAM	6	0	21.60	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 37 of 87

9.3.4 LTE Band 4 (AWS) – Representing Hotspot Mode Active

Table 9-17
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	21.96	0	0
	1732.5	20175	20	QPSK	1	50	21.87	0	0
	1732.5	20175	20	QPSK	1	99	21.83	0	0
	1732.5	20175	20	QPSK	50	0	21.88	0-1	0
	1732.5	20175	20	QPSK	50	25	21.89	0-1	0
	1732.5	20175	20	QPSK	50	50	21.82	0-1	0
	1732.5	20175	20	QPSK	100	0	21.83	0-1	0
	1732.5	20175	20	16QAM	1	0	21.95	0-1	0
	1732.5	20175	20	16QAM	1	50	21.89	0-1	0
	1732.5	20175	20	16QAM	1	99	21.94	0-1	0
	1732.5	20175	20	16QAM	50	0	21.94	0-2	0
	1732.5	20175	20	16QAM	50	25	21.91	0-2	0
	1732.5	20175	20	16QAM	50	50	21.96	0-2	0
	1732.5	20175	20	16QAM	100	0	21.95	0-2	0

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

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 38 of 87

Table 9-18
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	21.68	0	0
	1717.5	20025	15	QPSK	1	36	21.71	0	0
	1717.5	20025	15	QPSK	1	74	21.52	0	0
	1717.5	20025	15	QPSK	36	0	21.72	0-1	0
	1717.5	20025	15	QPSK	36	18	21.83	0-1	0
	1717.5	20025	15	QPSK	36	37	21.93	0-1	0
	1717.5	20025	15	QPSK	75	0	21.85	0-1	0
	1717.5	20025	15	16QAM	1	0	21.67	0-1	0
	1717.5	20025	15	16QAM	1	36	21.95	0-1	0
	1717.5	20025	15	16QAM	1	74	21.87	0-1	0
	1717.5	20025	15	16QAM	36	0	21.84	0-2	0
	1717.5	20025	15	16QAM	36	18	21.70	0-2	0
Mid	1717.5	20025	15	16QAM	36	37	21.83	0-2	0
	1717.5	20025	15	16QAM	75	0	21.45	0-2	0
	1732.5	20175	15	QPSK	1	0	21.88	0	0
	1732.5	20175	15	QPSK	1	36	21.91	0	0
	1732.5	20175	15	QPSK	1	74	21.72	0	0
	1732.5	20175	15	QPSK	36	0	21.66	0-1	0
	1732.5	20175	15	QPSK	36	18	21.69	0-1	0
	1732.5	20175	15	QPSK	36	37	21.89	0-1	0
	1732.5	20175	15	QPSK	75	0	21.90	0-1	0
	1732.5	20175	15	16QAM	1	0	21.90	0-1	0
	1732.5	20175	15	16QAM	1	36	21.93	0-1	0
	1732.5	20175	15	16QAM	1	74	21.95	0-1	0
High	1732.5	20175	15	16QAM	36	0	21.92	0-2	0
	1732.5	20175	15	16QAM	36	18	21.92	0-2	0
	1732.5	20175	15	16QAM	36	37	21.76	0-2	0
	1732.5	20175	15	16QAM	75	0	21.64	0-2	0
	1747.5	20325	15	QPSK	1	0	21.69	0	0
	1747.5	20325	15	QPSK	1	36	21.58	0	0
	1747.5	20325	15	QPSK	1	74	21.61	0	0
	1747.5	20325	15	QPSK	36	0	21.68	0-1	0
	1747.5	20325	15	QPSK	36	18	21.58	0-1	0
	1747.5	20325	15	QPSK	36	37	21.95	0-1	0
	1747.5	20325	15	QPSK	75	0	21.69	0-1	0
	1747.5	20325	15	16QAM	1	0	21.92	0-1	0
	1747.5	20325	15	16QAM	1	36	21.90	0-1	0
	1747.5	20325	15	16QAM	1	74	21.79	0-1	0
	1747.5	20325	15	16QAM	36	0	21.74	0-2	0
	1747.5	20325	15	16QAM	36	18	21.94	0-2	0
	1747.5	20325	15	16QAM	36	37	21.55	0-2	0
	1747.5	20325	15	16QAM	75	0	21.70	0-2	0

FCC ID: A3LSMG920T	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset
Page 39 of 87		

Table 9-19
LTE Band 4 (AWS) 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	21.44	0	0
	1715	20000	10	QPSK	1	25	21.56	0	0
	1715	20000	10	QPSK	1	49	21.79	0	0
	1715	20000	10	QPSK	25	0	21.52	0-1	0
	1715	20000	10	QPSK	25	12	21.76	0-1	0
	1715	20000	10	QPSK	25	25	21.88	0-1	0
	1715	20000	10	QPSK	50	0	21.88	0-1	0
	1715	20000	10	16QAM	1	0	21.59	0-1	0
	1715	20000	10	16QAM	1	25	21.85	0-1	0
	1715	20000	10	16QAM	1	49	21.77	0-1	0
	1715	20000	10	16QAM	25	0	21.89	0-2	0
	1715	20000	10	16QAM	25	12	21.68	0-2	0
Mid	1715	20000	10	16QAM	25	25	21.56	0-2	0
	1715	20000	10	16QAM	50	0	21.34	0-2	0
	1732.5	20175	10	QPSK	1	0	21.84	0	0
	1732.5	20175	10	QPSK	1	25	21.90	0	0
	1732.5	20175	10	QPSK	1	49	21.81	0	0
	1732.5	20175	10	QPSK	25	0	21.28	0-1	0
	1732.5	20175	10	QPSK	25	12	21.84	0-1	0
	1732.5	20175	10	QPSK	25	25	21.90	0-1	0
	1732.5	20175	10	QPSK	50	0	21.73	0-1	0
	1732.5	20175	10	16QAM	1	0	21.58	0-1	0
	1732.5	20175	10	16QAM	1	25	21.52	0-1	0
	1732.5	20175	10	16QAM	1	49	21.53	0-1	0
High	1732.5	20175	10	16QAM	25	0	21.90	0-2	0
	1732.5	20175	10	16QAM	25	12	21.76	0-2	0
	1732.5	20175	10	16QAM	25	25	21.87	0-2	0
	1732.5	20175	10	16QAM	50	0	21.58	0-2	0
	1750	20350	10	QPSK	1	0	21.89	0	0
	1750	20350	10	QPSK	1	25	21.72	0	0
	1750	20350	10	QPSK	1	49	21.56	0	0
	1750	20350	10	QPSK	25	0	21.62	0-1	0
	1750	20350	10	QPSK	25	12	21.85	0-1	0
	1750	20350	10	QPSK	25	25	21.94	0-1	0
	1750	20350	10	QPSK	50	0	21.62	0-1	0
	1750	20350	10	16QAM	1	0	21.90	0-1	0
	1750	20350	10	16QAM	1	25	21.94	0-1	0
	1750	20350	10	16QAM	1	49	21.91	0-1	0
	1750	20350	10	16QAM	25	0	21.85	0-2	0
	1750	20350	10	16QAM	25	12	21.79	0-2	0
	1750	20350	10	16QAM	25	25	21.54	0-2	0
	1750	20350	10	16QAM	50	0	21.86	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 40 of 87

Table 9-20
LTE Band 4 (AWS) 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	21.44	0	0
	1712.5	19975	5	QPSK	1	12	21.56	0	0
	1712.5	19975	5	QPSK	1	24	21.79	0	0
	1712.5	19975	5	QPSK	12	0	21.52	0-1	0
	1712.5	19975	5	QPSK	12	6	21.76	0-1	0
	1712.5	19975	5	QPSK	12	13	21.88	0-1	0
	1712.5	19975	5	QPSK	25	0	21.88	0-1	0
	1712.5	19975	5	16-QAM	1	0	21.59	0-1	0
	1712.5	19975	5	16-QAM	1	12	21.85	0-1	0
	1712.5	19975	5	16-QAM	1	24	21.77	0-1	0
	1712.5	19975	5	16-QAM	12	0	21.89	0-2	0
	1712.5	19975	5	16-QAM	12	6	21.68	0-2	0
Mid	1712.5	19975	5	16-QAM	12	13	21.56	0-2	0
	1712.5	19975	5	16-QAM	25	0	21.34	0-2	0
	1732.5	20175	5	QPSK	1	0	21.84	0	0
	1732.5	20175	5	QPSK	1	12	21.94	0	0
	1732.5	20175	5	QPSK	1	24	21.81	0	0
	1732.5	20175	5	QPSK	12	0	21.28	0-1	0
	1732.5	20175	5	QPSK	12	6	21.84	0-1	0
	1732.5	20175	5	QPSK	12	13	21.90	0-1	0
	1732.5	20175	5	QPSK	25	0	21.70	0-1	0
	1732.5	20175	5	16-QAM	1	0	21.58	0-1	0
	1732.5	20175	5	16-QAM	1	12	21.52	0-1	0
	1732.5	20175	5	16-QAM	1	24	21.53	0-1	0
High	1732.5	20175	5	16-QAM	12	0	21.90	0-2	0
	1732.5	20175	5	16-QAM	12	6	21.76	0-2	0
	1732.5	20175	5	16-QAM	12	13	21.87	0-2	0
	1732.5	20175	5	16-QAM	25	0	21.58	0-2	0
	1752.5	20375	5	QPSK	1	0	21.89	0	0
	1752.5	20375	5	QPSK	1	12	21.72	0	0
	1752.5	20375	5	QPSK	1	24	21.56	0	0
	1752.5	20375	5	QPSK	12	0	21.62	0-1	0
	1752.5	20375	5	QPSK	12	6	21.85	0-1	0
	1752.5	20375	5	QPSK	12	13	21.94	0-1	0
	1752.5	20375	5	QPSK	25	0	21.62	0-1	0
	1752.5	20375	5	16-QAM	1	0	21.90	0-1	0
	1752.5	20375	5	16-QAM	1	12	21.92	0-1	0
	1752.5	20375	5	16-QAM	1	24	21.91	0-1	0
	1752.5	20375	5	16-QAM	12	0	21.85	0-2	0
	1752.5	20375	5	16-QAM	12	6	21.79	0-2	0
	1752.5	20375	5	16-QAM	12	13	21.54	0-2	0
	1752.5	20375	5	16-QAM	25	0	21.86	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 41 of 87	

Table 9-21
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1711.5	19965	3	QPSK	1	0	21.55	0	0
	1711.5	19965	3	QPSK	1	7	21.67	0	0
	1711.5	19965	3	QPSK	1	14	21.78	0	0
	1711.5	19965	3	QPSK	8	0	21.39	0-1	0
	1711.5	19965	3	QPSK	8	4	21.81	0-1	0
	1711.5	19965	3	QPSK	8	7	21.95	0-1	0
	1711.5	19965	3	QPSK	15	0	21.95	0-1	0
	1711.5	19965	3	16-QAM	1	0	21.55	0-1	0
	1711.5	19965	3	16-QAM	1	7	21.94	0-1	0
	1711.5	19965	3	16-QAM	1	14	21.65	0-1	0
	1711.5	19965	3	16-QAM	8	0	21.74	0-2	0
	1711.5	19965	3	16-QAM	8	4	21.73	0-2	0
Mid	1711.5	19965	3	16-QAM	8	7	21.56	0-2	0
	1711.5	19965	3	16-QAM	15	0	21.16	0-2	0
	1732.5	20175	3	QPSK	1	0	21.68	0	0
	1732.5	20175	3	QPSK	1	7	21.88	0	0
	1732.5	20175	3	QPSK	1	14	21.86	0	0
	1732.5	20175	3	QPSK	8	0	21.33	0-1	0
	1732.5	20175	3	QPSK	8	4	21.68	0-1	0
	1732.5	20175	3	QPSK	8	7	21.92	0-1	0
	1732.5	20175	3	QPSK	15	0	21.61	0-1	0
	1732.5	20175	3	16-QAM	1	0	21.46	0-1	0
	1732.5	20175	3	16-QAM	1	7	21.42	0-1	0
	1732.5	20175	3	16-QAM	1	14	21.58	0-1	0
High	1732.5	20175	3	16-QAM	8	0	21.66	0-2	0
	1732.5	20175	3	16-QAM	8	4	21.74	0-2	0
	1732.5	20175	3	16-QAM	8	7	21.85	0-2	0
	1732.5	20175	3	16-QAM	15	0	21.71	0-2	0
	1753.5	20385	3	QPSK	1	0	21.94	0	0
	1753.5	20385	3	QPSK	1	7	21.86	0	0
	1753.5	20385	3	QPSK	1	14	21.36	0	0
	1753.5	20385	3	QPSK	8	0	21.45	0-1	0
	1753.5	20385	3	QPSK	8	4	21.95	0-1	0
	1753.5	20385	3	QPSK	8	7	21.90	0-1	0
	1753.5	20385	3	QPSK	15	0	21.70	0-1	0
	1753.5	20385	3	16-QAM	1	0	21.76	0-1	0
	1753.5	20385	3	16-QAM	1	7	21.95	0-1	0
	1753.5	20385	3	16-QAM	1	14	21.61	0-1	0
	1753.5	20385	3	16-QAM	8	0	21.96	0-2	0
	1753.5	20385	3	16-QAM	8	4	21.89	0-2	0
	1753.5	20385	3	16-QAM	8	7	21.66	0-2	0
	1753.5	20385	3	16-QAM	15	0	21.75	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 42 of 87

Table 9-22
LTE Band 4 (AWS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1710.7	19957	1.4	QPSK	1	0	21.44	0	0
	1710.7	19957	1.4	QPSK	1	2	21.50	0	0
	1710.7	19957	1.4	QPSK	1	5	21.76	0	0
	1710.7	19957	1.4	QPSK	3	0	21.40	0	0
	1710.7	19957	1.4	QPSK	3	2	21.95	0	0
	1710.7	19957	1.4	QPSK	3	3	21.91	0	0
	1710.7	19957	1.4	QPSK	6	0	21.91	0-1	0
	1710.7	19957	1.4	16-QAM	1	0	21.65	0-1	0
	1710.7	19957	1.4	16-QAM	1	2	21.80	0-1	0
	1710.7	19957	1.4	16-QAM	1	5	21.50	0-1	0
	1710.7	19957	1.4	16-QAM	3	0	21.68	0-1	0
	1710.7	19957	1.4	16-QAM	3	2	21.77	0-1	0
Mid	1710.7	19957	1.4	16-QAM	3	3	21.41	0-1	0
	1710.7	19957	1.4	16-QAM	6	0	21.00	0-2	0
	1732.5	20175	1.4	QPSK	1	0	21.88	0	0
	1732.5	20175	1.4	QPSK	1	2	21.94	0	0
	1732.5	20175	1.4	QPSK	1	5	21.86	0	0
	1732.5	20175	1.4	QPSK	3	0	21.41	0	0
	1732.5	20175	1.4	QPSK	3	2	21.86	0	0
	1732.5	20175	1.4	QPSK	3	3	21.65	0	0
	1732.5	20175	1.4	QPSK	6	0	21.47	0-1	0
	1732.5	20175	1.4	16-QAM	1	0	21.52	0-1	0
	1732.5	20175	1.4	16-QAM	1	2	21.24	0-1	0
	1732.5	20175	1.4	16-QAM	1	5	21.77	0-1	0
High	1732.5	20175	1.4	16-QAM	3	0	21.79	0-1	0
	1732.5	20175	1.4	16-QAM	3	2	21.63	0-1	0
	1732.5	20175	1.4	16-QAM	3	3	21.95	0-1	0
	1732.5	20175	1.4	16-QAM	6	0	21.84	0-2	0
	1754.3	20393	1.4	QPSK	1	0	21.91	0	0
	1754.3	20393	1.4	QPSK	1	2	21.90	0	0
	1754.3	20393	1.4	QPSK	1	5	21.48	0	0
	1754.3	20393	1.4	QPSK	3	0	21.62	0	0
	1754.3	20393	1.4	QPSK	3	2	21.94	0	0
	1754.3	20393	1.4	QPSK	3	3	21.86	0	0
	1754.3	20393	1.4	QPSK	6	0	21.77	0-1	0
	1754.3	20393	1.4	16-QAM	1	0	21.64	0-1	0
	1754.3	20393	1.4	16-QAM	1	2	21.95	0-1	0
	1754.3	20393	1.4	16-QAM	1	5	21.65	0-1	0
	1754.3	20393	1.4	16-QAM	3	0	21.92	0-1	0
	1754.3	20393	1.4	16-QAM	3	2	21.85	0-1	0
	1754.3	20393	1.4	16-QAM	3	3	21.72	0-1	0
	1754.3	20393	1.4	16-QAM	6	0	21.55	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 43 of 87	

9.3.5 LTE Band 2 (PCS) – Maximum Powers

Table 9-23
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	18700	20	QPSK	1	0	23.39	0	0
	1860	18700	20	QPSK	1	50	23.38	0	0
	1860	18700	20	QPSK	1	99	23.32	0	0
	1860	18700	20	QPSK	50	0	22.30	0-1	1
	1860	18700	20	QPSK	50	25	22.07	0-1	1
	1860	18700	20	QPSK	50	50	22.03	0-1	1
	1860	18700	20	QPSK	100	0	22.00	0-1	1
	1860	18700	20	16QAM	1	0	22.48	0-1	1
	1860	18700	20	16QAM	1	50	22.47	0-1	1
	1860	18700	20	16QAM	1	99	22.18	0-1	1
	1860	18700	20	16QAM	50	0	20.98	0-2	2
	1860	18700	20	16QAM	50	25	20.93	0-2	2
	1860	18700	20	16QAM	50	50	20.91	0-2	2
	1860	18700	20	16QAM	100	0	20.99	0-2	2
Mid	1880.0	18900	20	QPSK	1	0	23.17	0	0
	1880.0	18900	20	QPSK	1	50	23.16	0	0
	1880.0	18900	20	QPSK	1	99	23.19	0	0
	1880.0	18900	20	QPSK	50	0	22.23	0-1	1
	1880.0	18900	20	QPSK	50	25	21.76	0-1	1
	1880.0	18900	20	QPSK	50	50	21.79	0-1	1
	1880.0	18900	20	QPSK	100	0	21.77	0-1	1
	1880.0	18900	20	16QAM	1	0	22.24	0-1	1
	1880.0	18900	20	16QAM	1	50	22.32	0-1	1
	1880.0	18900	20	16QAM	1	99	22.38	0-1	1
	1880.0	18900	20	16QAM	50	0	21.31	0-2	2
	1880.0	18900	20	16QAM	50	25	20.78	0-2	2
	1880.0	18900	20	16QAM	50	50	20.77	0-2	2
	1880.0	18900	20	16QAM	100	0	20.74	0-2	2
High	1900	19100	20	QPSK	1	0	23.13	0	0
	1900	19100	20	QPSK	1	50	23.05	0	0
	1900	19100	20	QPSK	1	99	23.00	0	0
	1900	19100	20	QPSK	50	0	22.28	0-1	1
	1900	19100	20	QPSK	50	25	21.95	0-1	1
	1900	19100	20	QPSK	50	50	21.86	0-1	1
	1900	19100	20	QPSK	100	0	21.85	0-1	1
	1900	19100	20	16QAM	1	0	22.39	0-1	1
	1900	19100	20	16QAM	1	50	22.16	0-1	1
	1900	19100	20	16QAM	1	99	22.34	0-1	1
	1900	19100	20	16QAM	50	0	21.07	0-2	2
	1900	19100	20	16QAM	50	25	20.91	0-2	2
	1900	19100	20	16QAM	50	50	20.81	0-2	2
	1900	19100	20	16QAM	100	0	20.86	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 44 of 87

Table 9-24
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	18675	15	QPSK	1	0	23.28	0	0
	1857.5	18675	15	QPSK	1	36	23.28	0	0
	1857.5	18675	15	QPSK	1	74	23.29	0	0
	1857.5	18675	15	QPSK	36	0	22.39	0-1	1
	1857.5	18675	15	QPSK	36	18	22.07	0-1	1
	1857.5	18675	15	QPSK	36	37	22.02	0-1	1
	1857.5	18675	15	QPSK	75	0	21.94	0-1	1
	1857.5	18675	15	16QAM	1	0	22.42	0-1	1
	1857.5	18675	15	16QAM	1	36	22.29	0-1	1
	1857.5	18675	15	16QAM	1	74	22.33	0-1	1
	1857.5	18675	15	16QAM	36	0	20.88	0-2	2
	1857.5	18675	15	16QAM	36	18	20.72	0-2	2
Mid	1857.5	18675	15	16QAM	36	37	20.75	0-2	2
	1857.5	18675	15	16QAM	75	0	20.73	0-2	2
	1880.0	18900	15	QPSK	1	0	22.99	0	0
	1880.0	18900	15	QPSK	1	36	23.07	0	0
	1880.0	18900	15	QPSK	1	74	23.05	0	0
	1880.0	18900	15	QPSK	36	0	22.17	0-1	1
	1880.0	18900	15	QPSK	36	18	21.76	0-1	1
	1880.0	18900	15	QPSK	36	37	21.54	0-1	1
	1880.0	18900	15	QPSK	75	0	21.55	0-1	1
	1880.0	18900	15	16QAM	1	0	22.42	0-1	1
	1880.0	18900	15	16QAM	1	36	22.37	0-1	1
	1880.0	18900	15	16QAM	1	74	22.28	0-1	1
High	1880.0	18900	15	16QAM	36	0	21.24	0-2	2
	1880.0	18900	15	16QAM	36	18	20.95	0-2	2
	1880.0	18900	15	16QAM	36	37	20.98	0-2	2
	1880.0	18900	15	16QAM	75	0	20.74	0-2	2
	1902.5	19125	15	QPSK	1	0	23.38	0	0
	1902.5	19125	15	QPSK	1	36	23.08	0	0
	1902.5	19125	15	QPSK	1	74	23.18	0	0
	1902.5	19125	15	QPSK	36	0	22.20	0-1	1
	1902.5	19125	15	QPSK	36	18	21.82	0-1	1
	1902.5	19125	15	QPSK	36	37	21.58	0-1	1
	1902.5	19125	15	QPSK	75	0	21.58	0-1	1
	1902.5	19125	15	16QAM	1	0	22.28	0-1	1
	1902.5	19125	15	16QAM	1	36	21.92	0-1	1
	1902.5	19125	15	16QAM	1	74	22.45	0-1	1
	1902.5	19125	15	16QAM	36	0	21.21	0-2	2
	1902.5	19125	15	16QAM	36	18	21.04	0-2	2
	1902.5	19125	15	16QAM	36	37	20.76	0-2	2
	1902.5	19125	15	16QAM	75	0	20.76	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 45 of 87	

Table 9-25
LTE Band 2 (PCS) 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	23.34	0	0
	1855	18650	10	QPSK	1	25	23.05	0	0
	1855	18650	10	QPSK	1	49	23.12	0	0
	1855	18650	10	QPSK	25	0	22.20	0-1	1
	1855	18650	10	QPSK	25	12	22.10	0-1	1
	1855	18650	10	QPSK	25	25	22.16	0-1	1
	1855	18650	10	QPSK	50	0	21.83	0-1	1
	1855	18650	10	16QAM	1	0	22.20	0-1	1
	1855	18650	10	16QAM	1	25	22.20	0-1	1
	1855	18650	10	16QAM	1	49	22.35	0-1	1
	1855	18650	10	16QAM	25	0	20.99	0-2	2
	1855	18650	10	16QAM	25	12	20.60	0-2	2
	1855	18650	10	16QAM	25	25	20.72	0-2	2
Mid	1855	18650	10	16QAM	50	0	20.79	0-2	2
	1880.0	18900	10	QPSK	1	0	22.85	0	0
	1880.0	18900	10	QPSK	1	25	23.23	0	0
	1880.0	18900	10	QPSK	1	49	23.06	0	0
	1880.0	18900	10	QPSK	25	0	22.19	0-1	1
	1880.0	18900	10	QPSK	25	12	21.53	0-1	1
	1880.0	18900	10	QPSK	25	25	21.93	0-1	1
	1880.0	18900	10	QPSK	50	0	21.65	0-1	1
	1880.0	18900	10	16QAM	1	0	22.28	0-1	1
	1880.0	18900	10	16QAM	1	25	22.23	0-1	1
	1880.0	18900	10	16QAM	1	49	22.30	0-1	1
	1880.0	18900	10	16QAM	25	0	21.07	0-2	2
	1880.0	18900	10	16QAM	25	12	20.70	0-2	2
High	1880.0	18900	10	16QAM	25	25	21.04	0-2	2
	1880.0	18900	10	16QAM	50	0	20.97	0-2	2
	1905	19150	10	QPSK	1	0	23.38	0	0
	1905	19150	10	QPSK	1	25	22.96	0	0
	1905	19150	10	QPSK	1	49	23.13	0	0
	1905	19150	10	QPSK	25	0	22.21	0-1	1
	1905	19150	10	QPSK	25	12	21.74	0-1	1
	1905	19150	10	QPSK	25	25	21.72	0-1	1
	1905	19150	10	QPSK	50	0	21.76	0-1	1
	1905	19150	10	16QAM	1	0	22.37	0-1	1
	1905	19150	10	16QAM	1	25	22.07	0-1	1
	1905	19150	10	16QAM	1	49	22.44	0-1	1
	1905	19150	10	16QAM	25	0	21.36	0-2	2
	1905	19150	10	16QAM	25	12	20.90	0-2	2
	1905	19150	10	16QAM	25	25	20.95	0-2	2
	1905	19150	10	16QAM	50	0	20.71	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 46 of 87	

Table 9-26
LTE Band 2 (PCS) 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	23.31	0	0
	1852.5	18625	5	QPSK	1	12	23.22	0	0
	1852.5	18625	5	QPSK	1	24	23.16	0	0
	1852.5	18625	5	QPSK	12	0	22.34	0-1	1
	1852.5	18625	5	QPSK	12	6	21.88	0-1	1
	1852.5	18625	5	QPSK	12	13	22.01	0-1	1
	1852.5	18625	5	QPSK	25	0	21.60	0-1	1
	1852.5	18625	5	16-QAM	1	0	22.26	0-1	1
	1852.5	18625	5	16-QAM	1	12	22.15	0-1	1
	1852.5	18625	5	16-QAM	1	24	22.45	0-1	1
	1852.5	18625	5	16-QAM	12	0	20.94	0-2	2
	1852.5	18625	5	16-QAM	12	6	20.59	0-2	2
Mid	1852.5	18625	5	16-QAM	12	13	20.82	0-2	2
	1852.5	18625	5	16-QAM	25	0	20.91	0-2	2
	1880.0	18900	5	QPSK	1	0	23.07	0	0
	1880.0	18900	5	QPSK	1	12	23.20	0	0
	1880.0	18900	5	QPSK	1	24	23.07	0	0
	1880.0	18900	5	QPSK	12	0	22.42	0-1	1
	1880.0	18900	5	QPSK	12	6	21.60	0-1	1
	1880.0	18900	5	QPSK	12	13	21.66	0-1	1
	1880.0	18900	5	QPSK	25	0	21.63	0-1	1
	1880.0	18900	5	16-QAM	1	0	22.45	0-1	1
	1880.0	18900	5	16-QAM	1	12	22.25	0-1	1
	1880.0	18900	5	16-QAM	1	24	22.29	0-1	1
	1880.0	18900	5	16-QAM	12	0	21.10	0-2	2
	1880.0	18900	5	16-QAM	12	6	20.74	0-2	2
High	1880.0	18900	5	16-QAM	12	13	21.11	0-2	2
	1880.0	18900	5	16-QAM	25	0	20.92	0-2	2
	1907.5	19175	5	QPSK	1	0	23.26	0	0
	1907.5	19175	5	QPSK	1	12	22.95	0	0
	1907.5	19175	5	QPSK	1	24	22.96	0	0
	1907.5	19175	5	QPSK	12	0	22.18	0-1	1
	1907.5	19175	5	QPSK	12	6	21.83	0-1	1
	1907.5	19175	5	QPSK	12	13	21.58	0-1	1
	1907.5	19175	5	QPSK	25	0	21.82	0-1	1
	1907.5	19175	5	16-QAM	1	0	22.27	0-1	1
	1907.5	19175	5	16-QAM	1	12	21.95	0-1	1
	1907.5	19175	5	16-QAM	1	24	22.05	0-1	1
	1907.5	19175	5	16-QAM	12	0	21.07	0-2	2
	1907.5	19175	5	16-QAM	12	6	20.94	0-2	2
	1907.5	19175	5	16-QAM	12	13	20.72	0-2	2
	1907.5	19175	5	16-QAM	25	0	20.71	0-2	2

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 47 of 87	

Table 9-27
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1851.5	18615	3	QPSK	1	0	23.33	0	0
	1851.5	18615	3	QPSK	1	7	23.07	0	0
	1851.5	18615	3	QPSK	1	14	22.94	0	0
	1851.5	18615	3	QPSK	8	0	22.18	0-1	1
	1851.5	18615	3	QPSK	8	4	21.86	0-1	1
	1851.5	18615	3	QPSK	8	7	21.95	0-1	1
	1851.5	18615	3	QPSK	15	0	21.80	0-1	1
	1851.5	18615	3	16-QAM	1	0	22.02	0-1	1
	1851.5	18615	3	16-QAM	1	7	22.03	0-1	1
	1851.5	18615	3	16-QAM	1	14	21.93	0-1	1
	1851.5	18615	3	16-QAM	8	0	20.88	0-2	2
	1851.5	18615	3	16-QAM	8	4	20.66	0-2	2
Mid	1851.5	18615	3	16-QAM	8	7	21.05	0-2	2
	1851.5	18615	3	16-QAM	15	0	20.92	0-2	2
	1880.0	18900	3	QPSK	1	0	23.14	0	0
	1880.0	18900	3	QPSK	1	7	23.18	0	0
	1880.0	18900	3	QPSK	1	14	23.25	0	0
	1880.0	18900	3	QPSK	8	0	22.23	0-1	1
	1880.0	18900	3	QPSK	8	4	21.60	0-1	1
	1880.0	18900	3	QPSK	8	7	21.55	0-1	1
	1880.0	18900	3	QPSK	15	0	21.78	0-1	1
	1880.0	18900	3	16-QAM	1	0	22.26	0-1	1
	1880.0	18900	3	16-QAM	1	7	22.19	0-1	1
	1880.0	18900	3	16-QAM	1	14	22.48	0-1	1
High	1880.0	18900	3	16-QAM	8	0	21.30	0-2	2
	1880.0	18900	3	16-QAM	8	4	20.92	0-2	2
	1880.0	18900	3	16-QAM	8	7	21.23	0-2	2
	1880.0	18900	3	16-QAM	15	0	21.06	0-2	2
	1908.5	19185	3	QPSK	1	0	23.38	0	0
	1908.5	19185	3	QPSK	1	7	22.70	0	0
	1908.5	19185	3	QPSK	1	14	22.76	0	0
	1908.5	19185	3	QPSK	8	0	22.14	0-1	1
	1908.5	19185	3	QPSK	8	4	21.62	0-1	1
	1908.5	19185	3	QPSK	8	7	21.54	0-1	1
	1908.5	19185	3	QPSK	15	0	21.77	0-1	1
	1908.5	19185	3	16-QAM	1	0	22.11	0-1	1
	1908.5	19185	3	16-QAM	1	7	22.08	0-1	1
	1908.5	19185	3	16-QAM	1	14	22.31	0-1	1
	1908.5	19185	3	16-QAM	8	0	21.36	0-2	2
	1908.5	19185	3	16-QAM	8	4	20.76	0-2	2
	1908.5	19185	3	16-QAM	8	7	20.97	0-2	2
	1908.5	19185	3	16-QAM	15	0	20.70	0-2	2

Table 9-28
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1850.7	18607	1.4	QPSK	1	0	23.37	0	0
	1850.7	18607	1.4	QPSK	1	2	23.31	0	0
	1850.7	18607	1.4	QPSK	1	5	22.78	0	0
	1850.7	18607	1.4	QPSK	3	0	23.00	0	0
	1850.7	18607	1.4	QPSK	3	2	22.85	0	0
	1850.7	18607	1.4	QPSK	3	3	22.94	0	0
	1850.7	18607	1.4	QPSK	6	0	21.65	0-1	1
	1850.7	18607	1.4	16-QAM	1	0	22.02	0-1	1
	1850.7	18607	1.4	16-QAM	1	2	22.24	0-1	1
	1850.7	18607	1.4	16-QAM	1	5	22.39	0-1	1
	1850.7	18607	1.4	16-QAM	3	0	22.08	0-1	1
	1850.7	18607	1.4	16-QAM	3	2	22.28	0-1	1
	1850.7	18607	1.4	16-QAM	3	3	21.98	0-1	1
	1850.7	18607	1.4	16-QAM	6	0	20.81	0-2	2
Mid	1880.0	18900	1.4	QPSK	1	0	22.98	0	0
	1880.0	18900	1.4	QPSK	1	2	23.10	0	0
	1880.0	18900	1.4	QPSK	1	5	23.21	0	0
	1880.0	18900	1.4	QPSK	3	0	23.28	0	0
	1880.0	18900	1.4	QPSK	3	2	23.30	0	0
	1880.0	18900	1.4	QPSK	3	3	23.12	0	0
	1880.0	18900	1.4	QPSK	6	0	21.99	0-1	1
	1880.0	18900	1.4	16-QAM	1	0	22.33	0-1	1
	1880.0	18900	1.4	16-QAM	1	2	22.22	0-1	1
	1880.0	18900	1.4	16-QAM	1	5	22.01	0-1	1
	1880.0	18900	1.4	16-QAM	3	0	22.41	0-1	1
	1880.0	18900	1.4	16-QAM	3	2	21.84	0-1	1
	1880.0	18900	1.4	16-QAM	3	3	21.99	0-1	1
	1880.0	18900	1.4	16-QAM	6	0	21.26	0-2	2
High	1909.3	19193	1.4	QPSK	1	0	23.38	0	0
	1909.3	19193	1.4	QPSK	1	2	22.71	0	0
	1909.3	19193	1.4	QPSK	1	5	22.59	0	0
	1909.3	19193	1.4	QPSK	3	0	23.35	0	0
	1909.3	19193	1.4	QPSK	3	2	22.99	0	0
	1909.3	19193	1.4	QPSK	3	3	23.02	0	0
	1909.3	19193	1.4	QPSK	6	0	21.75	0-1	1
	1909.3	19193	1.4	16-QAM	1	0	21.87	0-1	1
	1909.3	19193	1.4	16-QAM	1	2	22.28	0-1	1
	1909.3	19193	1.4	16-QAM	1	5	22.25	0-1	1
	1909.3	19193	1.4	16-QAM	3	0	22.28	0-1	1
	1909.3	19193	1.4	16-QAM	3	2	21.90	0-1	1
	1909.3	19193	1.4	16-QAM	3	3	21.86	0-1	1
	1909.3	19193	1.4	16-QAM	6	0	20.81	0-2	2

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 49 of 87

9.3.6 LTE Band 2 (PCS) – Representing Hotspot Mode Active

Table 9-29
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	18700	20	QPSK	1	0	21.92	0	0
	1860	18700	20	QPSK	1	50	21.93	0	0
	1860	18700	20	QPSK	1	99	21.93	0	0
	1860	18700	20	QPSK	50	0	21.84	0-1	0
	1860	18700	20	QPSK	50	25	21.83	0-1	0
	1860	18700	20	QPSK	50	50	21.80	0-1	0
	1860	18700	20	QPSK	100	0	21.76	0-1	0
	1860	18700	20	16QAM	1	0	21.98	0-1	0
	1860	18700	20	16QAM	1	50	21.75	0-1	0
	1860	18700	20	16QAM	1	99	21.93	0-1	0
	1860	18700	20	16QAM	50	0	21.92	0-2	0
	1860	18700	20	16QAM	50	25	21.69	0-2	0
	1860	18700	20	16QAM	50	50	21.62	0-2	0
	1860	18700	20	16QAM	100	0	21.55	0-2	0
Mid	1880.0	18900	20	QPSK	1	0	21.92	0	0
	1880.0	18900	20	QPSK	1	50	21.99	0	0
	1880.0	18900	20	QPSK	1	99	21.90	0	0
	1880.0	18900	20	QPSK	50	0	21.72	0-1	0
	1880.0	18900	20	QPSK	50	25	21.73	0-1	0
	1880.0	18900	20	QPSK	50	50	21.70	0-1	0
	1880.0	18900	20	QPSK	100	0	21.77	0-1	0
	1880.0	18900	20	16QAM	1	0	21.91	0-1	0
	1880.0	18900	20	16QAM	1	50	21.95	0-1	0
	1880.0	18900	20	16QAM	1	99	21.91	0-1	0
	1880.0	18900	20	16QAM	50	0	21.81	0-2	0
	1880.0	18900	20	16QAM	50	25	21.77	0-2	0
	1880.0	18900	20	16QAM	50	50	21.72	0-2	0
	1880.0	18900	20	16QAM	100	0	21.72	0-2	0
High	1900	19100	20	QPSK	1	0	21.81	0	0
	1900	19100	20	QPSK	1	50	21.85	0	0
	1900	19100	20	QPSK	1	99	21.77	0	0
	1900	19100	20	QPSK	50	0	21.74	0-1	0
	1900	19100	20	QPSK	50	25	21.66	0-1	0
	1900	19100	20	QPSK	50	50	21.63	0-1	0
	1900	19100	20	QPSK	100	0	21.76	0-1	0
	1900	19100	20	16QAM	1	0	21.73	0-1	0
	1900	19100	20	16QAM	1	50	21.80	0-1	0
	1900	19100	20	16QAM	1	99	21.88	0-1	0
	1900	19100	20	16QAM	50	0	21.87	0-2	0
	1900	19100	20	16QAM	50	25	21.73	0-2	0
	1900	19100	20	16QAM	50	50	21.72	0-2	0
	1900	19100	20	16QAM	100	0	21.79	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 50 of 87

Table 9-30
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	18675	15	QPSK	1	0	21.75	0	0
	1857.5	18675	15	QPSK	1	36	21.86	0	0
	1857.5	18675	15	QPSK	1	74	21.94	0	0
	1857.5	18675	15	QPSK	36	0	21.98	0-1	0
	1857.5	18675	15	QPSK	36	18	21.77	0-1	0
	1857.5	18675	15	QPSK	36	37	21.74	0-1	0
	1857.5	18675	15	QPSK	75	0	21.92	0-1	0
	1857.5	18675	15	16QAM	1	0	21.86	0-1	0
	1857.5	18675	15	16QAM	1	36	21.55	0-1	0
	1857.5	18675	15	16QAM	1	74	21.96	0-1	0
	1857.5	18675	15	16QAM	36	0	21.97	0-2	0
	1857.5	18675	15	16QAM	36	18	21.75	0-2	0
Mid	1857.5	18675	15	16QAM	36	37	21.68	0-2	0
	1857.5	18675	15	16QAM	75	0	21.55	0-2	0
	1880.0	18900	15	QPSK	1	0	21.72	0	0
	1880.0	18900	15	QPSK	1	36	21.88	0	0
	1880.0	18900	15	QPSK	1	74	21.96	0	0
	1880.0	18900	15	QPSK	36	0	21.84	0-1	0
	1880.0	18900	15	QPSK	36	18	21.84	0-1	0
	1880.0	18900	15	QPSK	36	37	21.64	0-1	0
	1880.0	18900	15	QPSK	75	0	21.62	0-1	0
	1880.0	18900	15	16QAM	1	0	21.73	0-1	0
	1880.0	18900	15	16QAM	1	36	21.91	0-1	0
	1880.0	18900	15	16QAM	1	74	21.72	0-1	0
High	1880.0	18900	15	16QAM	36	0	21.74	0-2	0
	1880.0	18900	15	16QAM	36	18	21.82	0-2	0
	1880.0	18900	15	16QAM	36	37	21.59	0-2	0
	1880.0	18900	15	16QAM	75	0	21.92	0-2	0
	1902.5	19125	15	QPSK	1	0	21.86	0	0
	1902.5	19125	15	QPSK	1	36	21.67	0	0
	1902.5	19125	15	QPSK	1	74	21.91	0	0
	1902.5	19125	15	QPSK	36	0	21.90	0-1	0
	1902.5	19125	15	QPSK	36	18	21.78	0-1	0
	1902.5	19125	15	QPSK	36	37	21.74	0-1	0
	1902.5	19125	15	QPSK	75	0	21.94	0-1	0
	1902.5	19125	15	16QAM	1	0	21.59	0-1	0
	1902.5	19125	15	16QAM	1	36	21.82	0-1	0
	1902.5	19125	15	16QAM	1	74	21.98	0-1	0
	1902.5	19125	15	16QAM	36	0	21.83	0-2	0
	1902.5	19125	15	16QAM	36	18	21.77	0-2	0
	1902.5	19125	15	16QAM	36	37	21.52	0-2	0
	1902.5	19125	15	16QAM	75	0	21.75	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 51 of 87	

Table 9-31
LTE Band 2 (PCS) 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	21.80	0	0
	1855	18650	10	QPSK	1	25	21.96	0	0
	1855	18650	10	QPSK	1	49	21.92	0	0
	1855	18650	10	QPSK	25	0	21.89	0-1	0
	1855	18650	10	QPSK	25	12	21.79	0-1	0
	1855	18650	10	QPSK	25	25	21.84	0-1	0
	1855	18650	10	QPSK	50	0	21.97	0-1	0
	1855	18650	10	16QAM	1	0	21.71	0-1	0
	1855	18650	10	16QAM	1	25	21.67	0-1	0
	1855	18650	10	16QAM	1	49	21.83	0-1	0
	1855	18650	10	16QAM	25	0	21.93	0-2	0
	1855	18650	10	16QAM	25	12	21.89	0-2	0
	1855	18650	10	16QAM	25	25	21.48	0-2	0
Mid	1855	18650	10	16QAM	50	0	21.50	0-2	0
	1880.0	18900	10	QPSK	1	0	21.90	0	0
	1880.0	18900	10	QPSK	1	25	21.93	0	0
	1880.0	18900	10	QPSK	1	49	21.85	0	0
	1880.0	18900	10	QPSK	25	0	21.80	0-1	0
	1880.0	18900	10	QPSK	25	12	21.75	0-1	0
	1880.0	18900	10	QPSK	25	25	21.79	0-1	0
	1880.0	18900	10	QPSK	50	0	21.56	0-1	0
	1880.0	18900	10	16QAM	1	0	21.72	0-1	0
	1880.0	18900	10	16QAM	1	25	21.93	0-1	0
	1880.0	18900	10	16QAM	1	49	21.61	0-1	0
	1880.0	18900	10	16QAM	25	0	21.84	0-2	0
	1880.0	18900	10	16QAM	25	12	21.87	0-2	0
High	1880.0	18900	10	16QAM	25	25	21.39	0-2	0
	1880.0	18900	10	16QAM	50	0	21.81	0-2	0
	1905	19150	10	QPSK	1	0	21.95	0	0
	1905	19150	10	QPSK	1	25	21.66	0	0
	1905	19150	10	QPSK	1	49	21.99	0	0
	1905	19150	10	QPSK	25	0	21.99	0-1	0
	1905	19150	10	QPSK	25	12	21.95	0-1	0
	1905	19150	10	QPSK	25	25	21.91	0-1	0
	1905	19150	10	QPSK	50	0	21.99	0-1	0
	1905	19150	10	16QAM	1	0	21.54	0-1	0
	1905	19150	10	16QAM	1	25	21.73	0-1	0
	1905	19150	10	16QAM	1	49	21.84	0-1	0
	1905	19150	10	16QAM	25	0	21.88	0-2	0
	1905	19150	10	16QAM	25	12	21.80	0-2	0
	1905	19150	10	16QAM	25	25	21.49	0-2	0
	1905	19150	10	16QAM	50	0	21.70	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 52 of 87

Table 9-32
LTE Band 2 (PCS) 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	21.69	0	0
	1852.5	18625	5	QPSK	1	12	21.70	0	0
	1852.5	18625	5	QPSK	1	24	21.87	0	0
	1852.5	18625	5	QPSK	12	0	21.97	0-1	0
	1852.5	18625	5	QPSK	12	6	21.95	0-1	0
	1852.5	18625	5	QPSK	12	13	21.95	0-1	0
	1852.5	18625	5	QPSK	25	0	21.86	0-1	0
	1852.5	18625	5	16-QAM	1	0	21.79	0-1	0
	1852.5	18625	5	16-QAM	1	12	21.54	0-1	0
	1852.5	18625	5	16-QAM	1	24	21.83	0-1	0
	1852.5	18625	5	16-QAM	12	0	21.88	0-2	0
	1852.5	18625	5	16-QAM	12	6	21.95	0-2	0
Mid	1852.5	18625	5	16-QAM	12	13	21.55	0-2	0
	1852.5	18625	5	16-QAM	25	0	21.54	0-2	0
	1880.0	18900	5	QPSK	1	0	21.83	0	0
	1880.0	18900	5	QPSK	1	12	21.80	0	0
	1880.0	18900	5	QPSK	1	24	21.80	0	0
	1880.0	18900	5	QPSK	12	0	21.80	0-1	0
	1880.0	18900	5	QPSK	12	6	21.70	0-1	0
	1880.0	18900	5	QPSK	12	13	21.94	0-1	0
	1880.0	18900	5	QPSK	25	0	21.45	0-1	0
	1880.0	18900	5	16-QAM	1	0	21.86	0-1	0
	1880.0	18900	5	16-QAM	1	12	21.98	0-1	0
	1880.0	18900	5	16-QAM	1	24	21.49	0-1	0
	1880.0	18900	5	16-QAM	12	0	21.99	0-2	0
	1880.0	18900	5	16-QAM	12	6	21.80	0-2	0
High	1880.0	18900	5	16-QAM	12	13	21.24	0-2	0
	1880.0	18900	5	16-QAM	25	0	21.97	0-2	0
	1907.5	19175	5	QPSK	1	0	21.90	0	0
	1907.5	19175	5	QPSK	1	12	21.85	0	0
	1907.5	19175	5	QPSK	1	24	21.99	0	0
	1907.5	19175	5	QPSK	12	0	21.98	0-1	0
	1907.5	19175	5	QPSK	12	6	21.96	0-1	0
	1907.5	19175	5	QPSK	12	13	21.89	0-1	0
	1907.5	19175	5	QPSK	25	0	21.92	0-1	0
	1907.5	19175	5	16-QAM	1	0	21.50	0-1	0
	1907.5	19175	5	16-QAM	1	12	21.76	0-1	0
	1907.5	19175	5	16-QAM	1	24	21.92	0-1	0
	1907.5	19175	5	16-QAM	12	0	21.83	0-2	0
	1907.5	19175	5	16-QAM	12	6	21.61	0-2	0
	1907.5	19175	5	16-QAM	12	13	21.59	0-2	0
	1907.5	19175	5	16-QAM	25	0	21.55	0-2	0

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 53 of 87	

Table 9-33
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1851.5	18615	3	QPSK	1	0	21.80	0	0
	1851.5	18615	3	QPSK	1	7	21.96	0	0
	1851.5	18615	3	QPSK	1	14	21.81	0	0
	1851.5	18615	3	QPSK	8	0	21.69	0-1	0
	1851.5	18615	3	QPSK	8	4	21.75	0-1	0
	1851.5	18615	3	QPSK	8	7	21.51	0-1	0
	1851.5	18615	3	QPSK	15	0	21.73	0-1	0
	1851.5	18615	3	16-QAM	1	0	21.76	0-1	0
	1851.5	18615	3	16-QAM	1	7	21.39	0-1	0
	1851.5	18615	3	16-QAM	1	14	21.72	0-1	0
	1851.5	18615	3	16-QAM	8	0	21.86	0-2	0
	1851.5	18615	3	16-QAM	8	4	21.77	0-2	0
	1851.5	18615	3	16-QAM	8	7	21.39	0-2	0
	1851.5	18615	3	16-QAM	15	0	21.44	0-2	0
Mid	1880.0	18900	3	QPSK	1	0	21.94	0	0
	1880.0	18900	3	QPSK	1	7	21.94	0	0
	1880.0	18900	3	QPSK	1	14	21.54	0	0
	1880.0	18900	3	QPSK	8	0	21.80	0-1	0
	1880.0	18900	3	QPSK	8	4	21.59	0-1	0
	1880.0	18900	3	QPSK	8	7	21.87	0-1	0
	1880.0	18900	3	QPSK	15	0	21.60	0-1	0
	1880.0	18900	3	16-QAM	1	0	21.98	0-1	0
	1880.0	18900	3	16-QAM	1	7	21.88	0-1	0
	1880.0	18900	3	16-QAM	1	14	21.69	0-1	0
	1880.0	18900	3	16-QAM	8	0	21.55	0-2	0
	1880.0	18900	3	16-QAM	8	4	21.78	0-2	0
	1880.0	18900	3	16-QAM	8	7	21.44	0-2	0
	1880.0	18900	3	16-QAM	15	0	21.84	0-2	0
High	1908.5	19185	3	QPSK	1	0	21.98	0	0
	1908.5	19185	3	QPSK	1	7	21.90	0	0
	1908.5	19185	3	QPSK	1	14	21.65	0	0
	1908.5	19185	3	QPSK	8	0	21.99	0-1	0
	1908.5	19185	3	QPSK	8	4	21.88	0-1	0
	1908.5	19185	3	QPSK	8	7	21.73	0-1	0
	1908.5	19185	3	QPSK	15	0	21.99	0-1	0
	1908.5	19185	3	16-QAM	1	0	21.42	0-1	0
	1908.5	19185	3	16-QAM	1	7	21.90	0-1	0
	1908.5	19185	3	16-QAM	1	14	21.95	0-1	0
	1908.5	19185	3	16-QAM	8	0	21.98	0-2	0
	1908.5	19185	3	16-QAM	8	4	21.53	0-2	0
	1908.5	19185	3	16-QAM	8	7	21.48	0-2	0
	1908.5	19185	3	16-QAM	15	0	21.63	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 54 of 87	

Table 9-34
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1850.7	18607	1.4	QPSK	1	0	21.60	0	0
	1850.7	18607	1.4	QPSK	1	2	21.93	0	0
	1850.7	18607	1.4	QPSK	1	5	21.94	0	0
	1850.7	18607	1.4	QPSK	3	0	21.75	0	0
	1850.7	18607	1.4	QPSK	3	2	21.63	0	0
	1850.7	18607	1.4	QPSK	3	3	21.80	0	0
	1850.7	18607	1.4	QPSK	6	0	21.90	0-1	0
	1850.7	18607	1.4	16-QAM	1	0	21.62	0-1	0
	1850.7	18607	1.4	16-QAM	1	2	21.55	0-1	0
	1850.7	18607	1.4	16-QAM	1	5	21.82	0-1	0
	1850.7	18607	1.4	16-QAM	3	0	21.88	0-1	0
	1850.7	18607	1.4	16-QAM	3	2	21.61	0-1	0
	1850.7	18607	1.4	16-QAM	3	3	21.19	0-1	0
	1850.7	18607	1.4	16-QAM	6	0	21.41	0-2	0
Mid	1880.0	18900	1.4	QPSK	1	0	21.53	0	0
	1880.0	18900	1.4	QPSK	1	2	21.54	0	0
	1880.0	18900	1.4	QPSK	1	5	21.91	0	0
	1880.0	18900	1.4	QPSK	3	0	21.91	0	0
	1880.0	18900	1.4	QPSK	3	2	21.45	0	0
	1880.0	18900	1.4	QPSK	3	3	21.68	0	0
	1880.0	18900	1.4	QPSK	6	0	21.62	0-1	0
	1880.0	18900	1.4	16-QAM	1	0	21.94	0-1	0
	1880.0	18900	1.4	16-QAM	1	2	21.56	0-1	0
	1880.0	18900	1.4	16-QAM	1	5	21.67	0-1	0
	1880.0	18900	1.4	16-QAM	3	0	21.96	0-1	0
	1880.0	18900	1.4	16-QAM	3	2	21.61	0-1	0
	1880.0	18900	1.4	16-QAM	3	3	21.52	0-1	0
	1880.0	18900	1.4	16-QAM	6	0	21.90	0-2	0
High	1909.3	19193	1.4	QPSK	1	0	21.78	0	0
	1909.3	19193	1.4	QPSK	1	2	21.76	0	0
	1909.3	19193	1.4	QPSK	1	5	21.96	0	0
	1909.3	19193	1.4	QPSK	3	0	21.64	0	0
	1909.3	19193	1.4	QPSK	3	2	21.93	0	0
	1909.3	19193	1.4	QPSK	3	3	21.79	0	0
	1909.3	19193	1.4	QPSK	6	0	21.92	0-1	0
	1909.3	19193	1.4	16-QAM	1	0	21.43	0-1	0
	1909.3	19193	1.4	16-QAM	1	2	21.88	0-1	0
	1909.3	19193	1.4	16-QAM	1	5	21.80	0-1	0
	1909.3	19193	1.4	16-QAM	3	0	21.98	0-1	0
	1909.3	19193	1.4	16-QAM	3	2	21.41	0-1	0
	1909.3	19193	1.4	16-QAM	3	3	21.56	0-1	0
	1909.3	19193	1.4	16-QAM	6	0	21.65	0-2	0

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset	Page 55 of 87	

9.4 LTE Carrier Aggregation Conducted Powers

Table 9-35
Maximum LTE Carrier Aggregation Conducted Powers
– Band 12 (PCC) 10MHz BW + Band 4 (SCC) 20 MHz BW

Band 12 (PCC) 10 MHz BW + Band 4 (SCC) 20 MHz BW				
707.5 MHz / ch.23095 + 2132.5 MHz / ch. 2175	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	25	24.69	24.80

Table 9-36
Maximum LTE Carrier Aggregation Conducted Powers
– Band 12 (PCC) 10 MHz BW+ Band 2 (SCC) 20 MHz BW

Band 12 (PCC) 10 MHz BW + Band 2 (SCC) 20 MHz BW				
707.5 MHz / ch.23095 + 1960.0 MHz / ch. 900	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	25	24.59	24.80

Table 9-37
Maximum LTE Carrier Aggregation Conducted Powers
– Band 4 (PCC) 10MHz BW + Band 12 (SCC) 10 MHz BW

Band 4 (PCC) 10 MHz BW + Band 12 (SCC) 10 MHz BW				
1715 MHz / ch.20000 + 737.5 MHz / ch. 5095	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	25	23.21	23.74

Table 9-38
Reduced LTE Carrier Aggregation Conducted Powers
– Band 4 (PCC) 20MHz BW + Band 12 (SCC) 10 MHz BW

Band 4 (PCC) 20 MHz BW + Band 12 (SCC) 10 MHz BW				
1732.5 MHz / ch.20175 + 737.5 MHz / ch. 5095	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	0	21.62	21.96

Table 9-39
Maximum LTE Carrier Aggregation Conducted Powers
– Band 4 (PCC) 10MHz BW + Band 4 (SCC) 20 MHz BW

Band 4 (PCC) 10 MHz BW + Band 4 (SCC) 20 MHz BW				
1715 MHz / ch.20000 + 2145 MHz / ch. 2300	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	25	23.15	23.74

Table 9-40
Reduced LTE Carrier Aggregation Conducted Powers
– Band 4 (PCC) 20MHz BW + Band 4 (SCC) 20 MHz BW

Band 4 (PCC) 20 MHz BW + Band 4 (SCC) 20 MHz BW				
1720 MHz / ch.20050 + 2145 MHz / ch. 2300	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	0	21.60	21.96

Table 9-41
Maximum LTE Carrier Aggregation Conducted Powers
– Band 4 (PCC) 10MHz BW + Band 2 (SCC) 20 MHz BW

Band 4 (PCC) 10 MHz BW + Band 2 (SCC) 20 MHz BW				
1715 MHz / ch.20000 + 1960.0 MHz / ch. 900	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	25	23.20	23.74

Table 9-42
Reduced LTE Carrier Aggregation Conducted Powers
– Band 4 (PCC) 20MHz BW + Band 2 (SCC) 20 MHz BW

Band 4 (PCC) 20 MHz BW + Band 2 (SCC) 20 MHz BW				
1732.5 MHz / ch.20175 + 1960.0 MHz / ch. 900	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	0	21.50	21.96

Table 9-43
Maximum LTE Carrier Aggregation Conducted Powers
– Band 2 (PCC) 20MHz BW + Band 12 (SCC) 10 MHz BW

Band 2 (PCC) 20 MHz BW + Band 12 (SCC) 10 MHz BW				
1860 MHz / ch.18700 + 737.5 MHz / ch. 5095	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	0	23.04	23.39

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 56 of 87

Table 9-44
Reduced LTE Carrier Aggregation Conducted Powers
– Band 2 (PCC) 20MHz BW + Band 12 (SCC) 10 MHz BW

Band 2 (PCC) 20 MHz BW + Band 12 (SCC) 10 MHz BW				
1880 MHz / ch.18900 + 737.5 MHz / ch. 5095	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	50	21.53	21.99

Table 9-45
Maximum LTE Carrier Aggregation Conducted Powers
– Band 2 (PCC) 20MHz BW + Band 4 (SCC) 20 MHz BW

Band 2 (PCC) 20 MHz BW + Band 4 (SCC) 20 MHz BW				
1860 MHz / ch.18700 + 2132.5 MHz / ch. 2175	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	0	23.02	23.39

Table 9-46
Reduced LTE Carrier Aggregation Conducted Powers
– Band 2 (PCC) 20MHz BW + Band 4 (SCC) 20 MHz BW

Band 2 (PCC) 20 MHz BW + Band 4 (SCC) 20 MHz BW				
1880 MHz / ch.18900 + 2132.5 MHz / ch. 2175	PCC UL# RB	PCC UL RB Offset	LTE Rel 10 Tx.Power (dBm)	Rel. 8 Tx.Power (dBm)
	1	50	21.58	21.99

Notes:

1. The device does not support all Rel. 10 Carrier Aggregation features due to modem chipset limitation.
2. The device only supports downlink Carrier Aggregation. Uplink Carrier Aggregation is not supported. Power measurements were performed with two DL carriers for the Release 8 configuration that had the highest output power (across all bandwidths, channels and RB Configurations) for each band
3. This device supports inter-band CA with 2 carriers (B12+B4, B12+B2, B4+B12, B4+B2, B2+B12, B2+B4) with a maximum of 10 MHz of spectrum for LTE Band 12 and a maximum of 20 MHz of spectrum for LTE Band 4/2. This device supports intra-band CA with 2 carriers (B4+B4).
4. All control and acknowledge data is sent on uplink channels that operate identical to release 8 specifications.

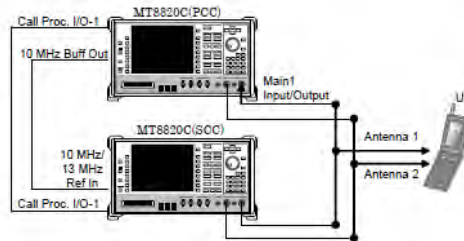


Figure 9-3
Power Measurement Setup

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 57 of 87

9.5 WLAN Conducted Powers

Table 9-47
2.4 GHz Antenna 1 Maximum Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11b
2412	1	15.26
2437	6	14.65
2462	11	15.42

Table 9-48
2.4 GHz Antenna 2 Maximum Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11b
2412	1	14.72
2437	6	15.13
2462	11	15.41

Table 9-49
2.4 GHz Antenna 1 Reduced Average RF Power – Held-to-Ear

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11b
2412	1	14.10
2437	6	13.83
2462	11	14.30

Table 9-50
2.4 GHz Antenna 2 Reduced Average RF Power – Held-to-Ear

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11b
2412	1	13.60
2437	6	13.96
2462	11	14.21

Table 9-51
2.4 GHz MIMO Reduced Average RF Power – Held-to-Ear

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11n
2412	1	12.07
2437	6	11.71
2462	11	12.35

Table 9-51
5 GHz Antenna 1 Average RF Power - 20 MHz Bandwidth

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11a	802.11n	802.11ac
5180	36	12.09	12.12	12.21
5200	40	12.08	12.11	12.16
5220	44	11.96	11.97	12.08
5240	48	11.90	12.11	12.21
5260	52	12.15	12.16	12.40
5280	56	12.27	12.23	12.34
5300	60	12.13	12.26	12.19
5320	64	12.19	12.26	12.09
5500	100	12.42	12.49	11.87
5540	108	12.34	12.42	12.45
5580	116	12.42	12.20	12.18
5660	132	12.36	12.22	12.34
5745	149	11.92	11.91	11.84
5825	165	11.94	11.94	11.93

Table 9-52
5 GHz Antenna 2 Average RF Power - 20 MHz Bandwidth

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11a	802.11n	802.11ac
5180	36	11.91	11.62	11.70
5200	40	11.83	11.51	11.51
5220	44	11.73	11.56	11.52
5240	48	11.73	11.58	11.51
5260	52	11.89	11.58	11.55
5280	56	11.75	11.42	11.52
5300	60	11.86	11.50	11.50
5320	64	11.94	11.40	11.51
5500	100	11.87	11.55	11.57
5540	108	11.58	11.98	11.98
5580	116	11.64	11.99	11.73
5660	132	12.23	11.85	11.81
5745	149	12.16	11.81	11.73
5825	165	12.12	11.67	11.80

Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929:

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

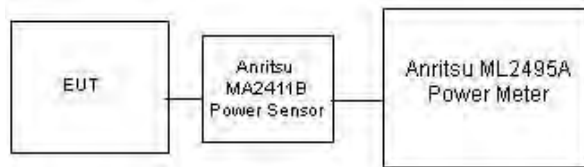


Figure 9-4
Power Measurement Setup

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Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 60 of 87

10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
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
02/03/2015	750H	22.1	695	0.870	42.296	0.889	42.227	-2.14%	0.16%
			710	0.881	42.038	0.890	42.149	-1.01%	-0.26%
			725	0.894	41.895	0.891	42.071	0.34%	-0.42%
			740	0.910	41.684	0.893	41.994	1.90%	-0.74%
			755	0.923	41.442	0.894	41.916	3.24%	-1.13%
01/28/2015	835H	23.0	820	0.886	42.217	0.899	41.578	-1.45%	1.54%
			835	0.897	42.105	0.900	41.500	-0.33%	1.46%
			850	0.917	41.934	0.916	41.500	0.11%	1.05%
01/26/2015	1750H	21.7	1710	1.349	39.410	1.348	40.142	0.07%	-1.82%
			1750	1.392	39.242	1.371	40.079	1.53%	-2.09%
			1790	1.430	39.043	1.394	40.016	2.58%	-2.43%
01/26/2015	1900H	22.1	1850	1.361	38.362	1.400	40.000	-2.79%	-4.10%
			1880	1.391	38.258	1.400	40.000	-0.64%	-4.35%
			1910	1.421	38.116	1.400	40.000	1.50%	-4.71%
02/02/2015	2450H	21.9	2401	1.745	38.159	1.756	39.287	-0.63%	-2.87%
			2450	1.797	37.953	1.800	39.200	-0.17%	-3.18%
			2499	1.853	37.796	1.853	39.138	0.00%	-3.43%
01/27/2015	5200H-5800H	21.6	5260	4.600	37.180	4.717	35.917	-2.48%	3.52%
			5300	4.627	37.125	4.758	35.871	-2.75%	3.50%
			5320	4.658	37.090	4.778	35.849	-2.51%	3.46%
			5500	4.847	36.818	4.963	35.643	-2.34%	3.30%
			5580	4.921	36.704	5.045	35.551	-2.46%	3.24%
			5600	4.951	36.628	5.065	35.529	-2.25%	3.09%
01/29/2015	750B	21.7	5660	5.022	36.602	5.127	35.460	-2.05%	3.22%
			695	0.919	54.331	0.959	55.745	-4.17%	-2.54%
			710	0.935	54.216	0.960	55.687	-2.60%	-2.64%
			725	0.949	54.050	0.961	55.629	-1.25%	-2.84%
			740	0.961	53.909	0.963	55.570	-0.21%	-2.99%
01/28/2015	835B	21.5	755	0.975	53.734	0.964	55.512	1.14%	-3.20%
			820	0.988	54.012	0.969	55.258	1.96%	-2.25%
			835	1.002	53.848	0.970	55.200	3.30%	-2.45%
01/28/2015	1750B	22.5	850	1.017	53.695	0.988	55.154	2.94%	-2.65%
			1710	1.409	51.986	1.463	53.537	-3.69%	-2.90%
			1750	1.454	51.870	1.488	53.432	-2.28%	-2.92%
01/29/2015	1900B	22.9	1790	1.496	51.704	1.514	53.326	-1.19%	-3.04%
			1850	1.494	52.412	1.520	53.300	-1.71%	-1.67%
			1880	1.527	52.312	1.520	53.300	0.46%	-1.85%
01/26/2015	2450B	23.5	1910	1.563	52.220	1.520	53.300	2.83%	-2.03%
			2401	1.931	51.976	1.903	52.765	1.47%	-1.50%
			2450	1.997	51.723	1.950	52.700	2.41%	-1.85%
01/30/2015	5200B-5800B	20.8	2499	2.062	51.582	2.019	52.638	2.13%	-2.01%
			5260	5.540	47.774	5.369	48.933	3.18%	-2.37%
			5300	5.592	47.736	5.416	48.879	3.25%	-2.34%
			5320	5.601	47.596	5.439	48.851	2.98%	-2.57%
			5500	5.863	47.307	5.650	48.607	3.77%	-2.67%
			5580	5.937	47.241	5.743	48.499	3.38%	-2.59%
			5600	5.989	47.154	5.766	48.471	3.87%	-2.72%
			5660	6.049	47.094	5.837	48.390	3.63%	-2.68%
			5745	6.190	46.889	5.936	48.275	4.28%	-2.87%
			5800	6.257	46.878	6.000	48.200	4.28%	-2.74%
			5825	6.302	46.809	6.029	48.166	4.53%	-2.82%

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

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 61 of 87

10.2 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 10-2
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} (%)
K	750	HEAD	02/03/2015	24.5	22.5	0.100	1054	3288	0.800	8.330	8.000	-3.96%
G	835	HEAD	01/28/2015	24.4	23.0	0.100	4d133	3258	0.949	9.200	9.490	3.15%
J	1750	HEAD	01/26/2015	22.9	21.7	0.100	1008	3022	3.450	36.900	34.500	-6.50%
D	1900	HEAD	01/26/2015	23.5	22.1	0.100	5d149	3263	4.320	40.200	43.200	7.46%
G	2450	HEAD	02/02/2015	24.1	23.0	0.100	719	3258	5.070	52.100	50.700	-2.69%
H	5300	HEAD	01/27/2015	24.5	21.6	0.100	1120	3920	8.170	83.400	81.700	-2.04%
H	5500	HEAD	01/27/2015	24.0	21.6	0.100	1120	3920	8.360	84.900	83.600	-1.53%
H	5600	HEAD	01/27/2015	23.3	21.6	0.100	1120	3920	8.430	82.200	84.300	2.55%
D	750	BODY	01/29/2015	24.0	22.0	0.100	1054	3263	0.867	8.640	8.670	0.35%
K	835	BODY	01/28/2015	22.6	21.5	0.100	4d133	3288	0.997	9.350	9.970	6.63%
K	1750	BODY	01/28/2015	23.9	22.1	0.100	1008	3288	3.640	37.600	36.400	-3.19%
G	1900	BODY	01/29/2015	24.0	22.9	0.100	5d141	3258	4.080	40.600	40.800	0.49%
I	2450	BODY	01/26/2015	22.5	23.5	0.100	719	3209	5.470	51.800	54.700	5.60%
H	5300	BODY	01/30/2015	22.5	20.8	0.100	1120	3920	7.990	75.800	79.900	5.41%
H	5500	BODY	01/30/2015	22.8	20.8	0.100	1120	3920	8.160	79.200	81.600	3.03%
H	5600	BODY	01/30/2015	23.0	20.8	0.100	1120	3920	8.120	79.400	81.200	2.27%
H	5800	BODY	01/30/2015	23.8	20.8	0.100	1120	3920	7.490	74.400	74.900	0.67%

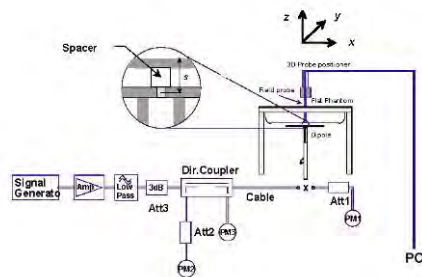


Figure 10-1
System Verification Setup Diagram



Figure 10-2
System Verification Setup Photo

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 62 of 87

11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
GSM 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Serial Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.5	32.20	0.06	Right	Cheek	11520	1:8.3	0.086	1.349	0.116	A1
836.60	190	GSM 850	GSM	33.5	32.20	0.01	Right	Tilt	11520	1:8.3	0.051	1.349	0.069	
836.60	190	GSM 850	GSM	33.5	32.20	0.01	Left	Cheek	11520	1:8.3	0.059	1.349	0.080	
836.60	190	GSM 850	GSM	33.5	32.20	0.00	Left	Tilt	11520	1:8.3	0.050	1.349	0.067	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram						

Table 11-2
UMTS 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	24.5	23.78	0.13	Right	Cheek	11518	1:1	0.105	1.180	0.124	A2
836.60	4183	UMTS 850	RMC	24.5	23.78	0.06	Right	Tilt	11518	1:1	0.064	1.180	0.076	
836.60	4183	UMTS 850	RMC	24.5	23.78	0.12	Left	Cheek	11518	1:1	0.092	1.180	0.109	
836.60	4183	UMTS 850	RMC	24.5	23.78	0.08	Left	Tilt	11518	1:1	0.061	1.180	0.072	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram						

Table 11-3
UMTS 1750 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1732.40	1412	UMTS 1750	RMC	24.5	23.64	0.02	Right	Cheek	11518	1:1	0.214	1.219	0.261	
1732.40	1412	UMTS 1750	RMC	24.5	23.64	0.09	Right	Tilt	11518	1:1	0.165	1.219	0.201	
1732.40	1412	UMTS 1750	RMC	24.5	23.64	0.03	Left	Cheek	11518	1:1	0.323	1.219	0.394	A3
1732.40	1412	UMTS 1750	RMC	24.5	23.64	0.01	Left	Tilt	11518	1:1	0.182	1.219	0.222	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 63 of 87

Table 11-4
GSM 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	30.8	29.36	0.05	Right	Cheek	11520	1:8.3	0.104	1.393	0.145	
1880.00	661	GSM 1900	GSM	30.8	29.36	0.02	Right	Tilt	11520	1:8.3	0.066	1.393	0.092	
1880.00	661	GSM 1900	GSM	30.8	29.36	-0.07	Left	Cheek	11520	1:8.3	0.181	1.393	0.252	A4
1880.00	661	GSM 1900	GSM	30.8	29.36	0.10	Left	Tilt	11520	1:8.3	0.055	1.393	0.077	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-5
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	24.0	23.07	-0.01	Right	Cheek	11520	1:1	0.215	1.239	0.266	
1880.00	9400	UMTS 1900	RMC	24.0	23.07	0.01	Right	Tilt	11520	1:1	0.125	1.239	0.155	
1880.00	9400	UMTS 1900	RMC	24.0	23.07	-0.03	Left	Cheek	11520	1:1	0.325	1.239	0.403	A5
1880.00	9400	UMTS 1900	RMC	24.0	23.07	-0.01	Left	Tilt	11520	1:1	0.105	1.239	0.130	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-6
LTE Band 12 Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
707.50	23095	Mid	LTE Band 12	10	24.8	24.80	0.03	0	Right	Cheek	QPSK	1	25	11518	1:1	0.220	1.000	0.220	A6
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.12	1	Right	Cheek	QPSK	25	12	11518	1:1	0.152	1.042	0.158	
707.50	23095	Mid	LTE Band 12	10	24.8	24.80	0.04	0	Right	Tilt	QPSK	1	25	11518	1:1	0.112	1.000	0.112	
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.19	1	Right	Tilt	QPSK	25	12	11518	1:1	0.070	1.042	0.073	
707.50	23095	Mid	LTE Band 12	10	24.8	24.80	0.06	0	Left	Cheek	QPSK	1	25	11518	1:1	0.202	1.000	0.202	
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.13	1	Left	Cheek	QPSK	25	12	11518	1:1	0.148	1.042	0.154	
707.50	23095	Mid	LTE Band 12	10	24.8	24.80	-0.06	0	Left	Tilt	QPSK	1	25	11518	1:1	0.119	1.000	0.119	
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.03	1	Left	Tilt	QPSK	25	12	11518	1:1	0.084	1.042	0.088	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 64 of 87

Table 11-7
LTE Band 5 (Cell) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Md	LTE Band 5 (Cell)	10	24.0	23.91	0.00	0	Right	Cheek	QPSK	1	0	11518	1:1	0.101	1.021	0.103	A7
836.50	20525	Md	LTE Band 5 (Cell)	10	23.0	22.62	0.07	1	Right	Cheek	QPSK	25	0	11518	1:1	0.073	1.091	0.080	
836.50	20525	Md	LTE Band 5 (Cell)	10	24.0	23.91	0.01	0	Right	Tilt	QPSK	1	0	11518	1:1	0.052	1.021	0.053	
836.50	20525	Md	LTE Band 5 (Cell)	10	23.0	22.62	0.03	1	Right	Tilt	QPSK	25	0	11518	1:1	0.038	1.091	0.041	
836.50	20525	Md	LTE Band 5 (Cell)	10	24.0	23.91	-0.02	0	Left	Cheek	QPSK	1	0	11518	1:1	0.079	1.021	0.081	
836.50	20525	Md	LTE Band 5 (Cell)	10	23.0	22.62	0.09	1	Left	Cheek	QPSK	25	0	11518	1:1	0.062	1.091	0.068	
836.50	20525	Md	LTE Band 5 (Cell)	10	24.0	23.91	0.13	0	Left	Tilt	QPSK	1	0	11518	1:1	0.062	1.021	0.063	
836.50	20525	Md	LTE Band 5 (Cell)	10	23.0	22.62	0.02	1	Left	Tilt	QPSK	25	0	11518	1:1	0.043	1.091	0.047	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram									

Table 11-8
LTE Band 4 (AWS) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.5	23.50	-0.05	0	Right	Cheek	QPSK	1	99	11525	1:1	0.188	1.259	0.237	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	22.33	-0.18	1	Right	Cheek	QPSK	50	0	11525	1:1	0.150	1.309	0.196	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.5	23.50	-0.07	0	Right	Tilt	QPSK	1	99	11525	1:1	0.164	1.259	0.206	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	22.33	-0.08	1	Right	Tilt	QPSK	50	0	11525	1:1	0.116	1.309	0.152	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.5	23.50	0.09	0	Left	Cheek	QPSK	1	99	11525	1:1	0.375	1.259	0.472	A8
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	22.33	0.08	1	Left	Cheek	QPSK	50	0	11525	1:1	0.275	1.309	0.360	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.5	23.50	-0.09	0	Left	Tilt	QPSK	1	99	11525	1:1	0.168	1.259	0.212	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	22.33	0.13	1	Left	Tilt	QPSK	50	0	11525	1:1	0.136	1.309	0.178	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram									

Table 11-9
LTE Band 2 (PCS) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.0	23.39	0.00	0	Right	Cheek	QPSK	1	0	11520	1:1	0.232	1.151	0.267	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.30	0.00	1	Right	Cheek	QPSK	50	0	11520	1:1	0.181	1.175	0.213	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.0	23.39	-0.04	0	Right	Tilt	QPSK	1	0	11520	1:1	0.171	1.151	0.197	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.30	0.02	1	Right	Tilt	QPSK	50	0	11520	1:1	0.125	1.175	0.147	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.0	23.39	0.02	0	Left	Cheek	QPSK	1	0	11520	1:1	0.359	1.151	0.413	A9
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.30	-0.06	1	Left	Cheek	QPSK	50	0	11520	1:1	0.279	1.175	0.328	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.0	23.39	0.08	0	Left	Tilt	QPSK	1	0	11520	1:1	0.158	1.151	0.182	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.30	0.06	1	Left	Tilt	QPSK	50	0	11520	1:1	0.104	1.175	0.122	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram									

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 65 of 87

**Table 11-10
DTS Head SAR**

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2462	11	802.11b	DSSS	22	14.5	14.30	0.06	Right	Cheek	1	119C8	1	99.31	0.334	0.247	1.047	1.007	0.261	
2462	11	802.11b	DSSS	22	14.5	14.30	0.05	Right	Tilt	1	119C8	1	99.31	0.577	0.407	1.047	1.007	0.429	
2462	11	802.11b	DSSS	22	14.5	14.30	-	Left	Cheek	1	119C8	1	99.31	0.246	-	1.047	1.007	-	
2462	11	802.11b	DSSS	22	14.5	14.30	-	Left	Tilt	1	119C8	1	99.31	0.299	-	1.047	1.007	-	
2462	11	802.11b	DSSS	22	14.5	14.21	-	Right	Cheek	2	119C8	1	99.46	0.249	-	1.069	1.005	-	
2462	11	802.11b	DSSS	22	14.5	14.21	-	Right	Tilt	2	119C8	1	99.46	0.150	-	1.069	1.005	-	
2462	11	802.11b	DSSS	22	14.5	14.21	0.07	Left	Cheek	2	119C8	1	99.46	0.806	0.596	1.069	1.005	0.640	A10
2462	11	802.11b	DSSS	22	14.5	14.21	0.20	Left	Tilt	2	119C8	1	99.46	0.603	0.451	1.069	1.005	0.484	
2462	11	802.11n	OFDM	20	12.5	12.35	-	Right	Cheek	MIMO	119C8	13	98.41	0.455	-	1.035	1.016	-	
2462	11	802.11n	OFDM	20	12.5	12.35	0.11	Right	Tilt	MIMO	119C8	13	98.41	0.512	0.380	1.035	1.016	0.399	
2462	11	802.11n	OFDM	20	12.5	12.35	-	Left	Cheek	MIMO	119C8	13	98.41	0.463	-	1.035	1.016	-	
2462	11	802.11n	OFDM	20	12.5	12.35	-	Left	Tilt	MIMO	119C8	13	98.41	0.307	-	1.035	1.016	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

**Table 11-11
NII Head SAR**

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor Duty Cycle	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5260	52	802.11ac	OFDM	20	12.5	12.40	0.06	Right	Cheek	1	11656	6.5	98.39	0.479	0.182	1.023	1.016	0.189	
5260	52	802.11ac	OFDM	20	12.5	12.40	-	Right	Tilt	1	11656	6.5	98.39	0.455	-	1.023	1.016	-	
5260	52	802.11ac	OFDM	20	12.5	12.40	-	Left	Cheek	1	11656	6.5	98.39	0.284	-	1.023	1.016	-	
5260	52	802.11ac	OFDM	20	12.5	12.40	-	Left	Tilt	1	11656	6.5	98.39	0.190	-	1.023	1.016	-	
5320	64	802.11a	OFDM	20	12.5	11.94	-	Right	Cheek	2	11656	6	99.24	0.076	-	1.138	1.008	-	
5320	64	802.11a	OFDM	20	12.5	11.94	-	Right	Tilt	2	11656	6	99.24	0.079	-	1.138	1.008	-	
5320	64	802.11a	OFDM	20	12.5	11.94	0.12	Left	Cheek	2	11656	6	99.24	0.170	0.076	1.138	1.008	0.087	
5320	64	802.11a	OFDM	20	12.5	11.94	-	Left	Tilt	2	11656	6	99.24	0.154	-	1.138	1.008	-	
5500	100	802.11n	OFDM	20	12.5	12.49	0.11	Right	Cheek	1	11656	6.5	98.89	0.610	0.203	1.002	1.011	0.205	
5500	100	802.11n	OFDM	20	12.5	12.49	-	Right	Tilt	1	11656	6.5	98.89	0.576	-	1.002	1.011	-	
5500	100	802.11n	OFDM	20	12.5	12.49	-	Left	Cheek	1	11656	6.5	98.89	0.337	-	1.002	1.011	-	
5500	100	802.11n	OFDM	20	12.5	12.49	-	Left	Tilt	1	11656	6.5	98.89	0.223	-	1.002	1.011	-	
5580	116	802.11n	OFDM	20	12.5	11.99	-	Right	Cheek	2	11656	6.5	99.32	0.058	-	1.125	1.007	-	
5580	116	802.11n	OFDM	20	12.5	11.99	-	Right	Tilt	2	11656	6.5	99.32	0.053	-	1.125	1.007	-	
5580	116	802.11n	OFDM	20	12.5	11.99	0.12	Left	Cheek	2	11656	6.5	99.32	0.119	0.055	1.125	1.007	0.062	
5580	116	802.11n	OFDM	20	12.5	11.99	-	Left	Tilt	2	11656	6.5	99.32	0.087	-	1.125	1.007	-	
5660	132	802.11a	OFDM	20	12.5	12.36	0.05	Right	Cheek	1	11656	6	98.96	0.600	0.214	1.033	1.011	0.223	A11
5660	132	802.11a	OFDM	20	12.5	12.36	-	Right	Tilt	1	11656	6	98.96	0.588	-	1.033	1.011	-	
5660	132	802.11a	OFDM	20	12.5	12.36	-	Left	Cheek	1	11656	6	98.96	0.333	-	1.033	1.011	-	
5660	132	802.11a	OFDM	20	12.5	12.36	-	Left	Tilt	1	11656	6	98.96	0.260	-	1.033	1.011	-	
5660	132	802.11a	OFDM	20	12.5	12.23	-	Right	Cheek	2	11656	6	99.24	0.055	-	1.064	1.008	-	
5660	132	802.11a	OFDM	20	12.5	12.23	-	Right	Tilt	2	11656	6	99.24	0.046	-	1.064	1.008	-	
5660	132	802.11a	OFDM	20	12.5	12.23	0.08	Left	Cheek	2	11656	6	99.24	0.089	0.044	1.064	1.008	0.047	
5660	132	802.11a	OFDM	20	12.5	12.23	-	Left	Tilt	2	11656	6	99.24	0.077	-	1.064	1.008	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT									Head										
Spatial Peak									1.6 W/kg (mW/g)										
Uncontrolled Exposure/General Population									averaged over 1 gram										

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 66 of 87

11.2 Standalone Body-Worn SAR Data

Table 11-12
GSM/UMTS Body-Worn SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.5	32.20	-0.01	10 mm	11520	1	1:8.3	back	0.188	1.349	0.254	A12
836.60	4183	UMTS 850	RMC	24.5	23.78	-0.05	10 mm	11518	N/A	1:1	back	0.220	1.180	0.260	A14
1732.40	1412	UMTS 1750	RMC	24.5	23.64	0.01	15 mm	11520	N/A	1:1	back	0.643	1.219	0.784	A16
1880.00	661	GSM 1900	GSM	30.8	29.36	0.05	10 mm	11518	1	1:8.3	back	0.571	1.393	0.795	A18
1880.00	9400	UMTS 1900	RMC	24.0	23.07	0.03	15 mm	11518	N/A	1:1	back	0.317	1.239	0.393	A20
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Table 11-13
LTE Body-Worn 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	24.8	24.80	0.01	0	11518	QPSK	1	25	10 mm	back	1:1	0.582	1.000	0.582	A22
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.04	1	11518	QPSK	25	12	10 mm	back	1:1	0.441	1.042	0.460	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.91	0.03	0	11518	QPSK	1	0	10 mm	back	1:1	0.213	1.021	0.217	A23
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.62	-0.03	1	11518	QPSK	25	0	10 mm	back	1:1	0.158	1.091	0.172	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.5	23.50	0.03	0	11520	QPSK	1	99	15 mm	back	1:1	0.847	1.259	1.066	A25
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	22.33	0.03	1	11520	QPSK	50	0	15 mm	back	1:1	0.665	1.309	0.870	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	22.17	0.04	1	11520	QPSK	100	0	15 mm	back	1:1	0.651	1.358	0.884	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.0	23.39	-0.01	0	11525	QPSK	1	0	15 mm	back	1:1	0.542	1.151	0.624	A27
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.30	0.02	1	11525	QPSK	50	0	15 mm	back	1:1	0.406	1.175	0.477	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak									Body 1.6 W/kg (mW/g) averaged over 1 gram										
Uncontrolled Exposure/General Population																			

Table 11-14
DTS Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)	(W/kg)			
2462	11	802.11b	DSSS	22	15.5	15.42	0.03	10 mm	1	1164B	1	back	99.31	0.051	0.041	1.019	1.007	0.042	
2462	11	802.11b	DSSS	22	15.5	15.41	-0.05	10 mm	2	1164B	1	back	99.46	0.097	0.075	1.021	1.005	0.077	A29
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

Table 11-15
NII Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5260	52	802.11ac	OFDM	20	12.5	12.40	0.12	10 mm	1	11656	6.5	back	98.39	0.031	0.011	1.023	1.016	0.011	
5320	64	802.11a	OFDM	20	12.5	11.94	0.05	10 mm	2	11656	6	back	99.24	0.083	0.032	1.138	1.008	0.036	A31
5500	100	802.11n	OFDM	20	12.5	12.49	0.05	10 mm	1	11656	6.5	back	98.89	0.052	0.019	1.002	1.011	0.019	
5580	116	802.11n	OFDM	20	12.5	11.99	0.04	10 mm	2	11656	6.5	back	99.32	0.029	0.003	1.125	1.007	0.003	
5660	132	802.11a	OFDM	20	12.5	12.36	0.04	10 mm	1	11656	6	back	98.96	0.023	0.008	1.033	1.011	0.008	
5660	132	802.11a	OFDM	20	12.5	12.23	0.05	10 mm	2	11656	6	back	99.24	0.047	0.015	1.064	1.008	0.016	
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: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 67 of 87

11.3 Standalone Wireless Router SAR Data

Table 11-16
GPRS/UMTS Hotspot SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GPRS	28.0	27.79	0.18	10 mm	11520	4	1:2.076	back	0.258	1.050	0.271	
836.60	190	GSM 850	GPRS	28.0	27.79	-0.14	10 mm	11520	4	1:2.076	front	0.204	1.050	0.214	
836.60	190	GSM 850	GPRS	28.0	27.79	0.02	10 mm	11520	4	1:2.076	bottom	0.110	1.050	0.116	
836.60	190	GSM 850	GPRS	28.0	27.79	0.00	10 mm	11520	4	1:2.076	right	0.331	1.050	0.348	A13
836.60	190	GSM 850	GPRS	28.0	27.79	0.04	10 mm	11520	4	1:2.076	left	0.189	1.050	0.198	
836.60	4183	UMTS 850	RMC	24.5	23.78	-0.05	10 mm	11518	N/A	1:1	back	0.220	1.180	0.260	
836.60	4183	UMTS 850	RMC	24.5	23.78	0.01	10 mm	11518	N/A	1:1	front	0.176	1.180	0.208	
836.60	4183	UMTS 850	RMC	24.5	23.78	-0.01	10 mm	11518	N/A	1:1	bottom	0.092	1.180	0.109	
836.60	4183	UMTS 850	RMC	24.5	23.78	0.02	10 mm	11518	N/A	1:1	right	0.249	1.180	0.294	A15
836.60	4183	UMTS 850	RMC	24.5	23.78	-0.01	10 mm	11518	N/A	1:1	left	0.153	1.180	0.181	
1732.40	1412	UMTS 1750	RMC	21.5	21.45	-0.04	10 mm	11521	N/A	1:1	back	0.775	1.012	0.784	
1732.40	1412	UMTS 1750	RMC	21.5	21.45	-0.06	10 mm	11521	N/A	1:1	front	0.724	1.012	0.733	
1712.40	1312	UMTS 1750	RMC	21.5	21.36	-0.11	10 mm	11521	N/A	1:1	bottom	0.989	1.033	1.022	
1732.40	1412	UMTS 1750	RMC	21.5	21.45	-0.15	10 mm	11521	N/A	1:1	bottom	1.060	1.012	1.073	A17
1752.50	1862	UMTS 1750	RMC	21.5	21.49	-0.04	10 mm	11521	N/A	1:1	bottom	0.971	1.002	0.973	
1732.40	1412	UMTS 1750	RMC	21.5	21.45	-0.04	10 mm	11521	N/A	1:1	right	0.057	1.012	0.058	
1732.40	1412	UMTS 1750	RMC	21.5	21.45	-0.04	10 mm	11521	N/A	1:1	left	0.224	1.012	0.227	
1850.20	512	GSM 1900	GPRS	26.0	25.30	-0.10	10 mm	11518	4	1:2.076	back	0.931	1.175	1.094	A19
1880.00	661	GSM 1900	GPRS	26.0	25.04	-0.04	10 mm	11518	4	1:2.076	back	0.735	1.247	0.917	
1909.80	810	GSM 1900	GPRS	26.0	25.03	0.19	10 mm	11518	4	1:2.076	back	0.840	1.250	1.050	
1850.20	512	GSM 1900	GPRS	26.0	25.30	0.03	10 mm	11518	4	1:2.076	front	0.775	1.175	0.911	
1880.00	661	GSM 1900	GPRS	26.0	25.04	0.04	10 mm	11518	4	1:2.076	front	0.779	1.247	0.971	
1909.80	810	GSM 1900	GPRS	26.0	25.03	-0.01	10 mm	11518	4	1:2.076	front	0.647	1.250	0.809	
1850.20	512	GSM 1900	GPRS	26.0	25.30	0.02	10 mm	11518	4	1:2.076	bottom	0.757	1.175	0.889	
1880.00	661	GSM 1900	GPRS	26.0	25.04	0.01	10 mm	11518	4	1:2.076	bottom	0.670	1.247	0.835	
1909.80	810	GSM 1900	GPRS	26.0	25.03	0.02	10 mm	11518	4	1:2.076	bottom	0.591	1.250	0.739	
1880.00	661	GSM 1900	GPRS	26.0	25.04	0.05	10 mm	11518	4	1:2.076	right	0.026	1.247	0.032	
1880.00	661	GSM 1900	GPRS	26.0	25.04	-0.12	10 mm	11518	4	1:2.076	left	0.236	1.247	0.294	
1850.20	512	GSM 1900	GPRS	26.0	25.30	-0.03	10 mm	11518	4	1:2.076	back	0.854	1.175	1.003	
1880.00	9400	UMTS 1900	RMC	22.0	21.21	-0.02	10 mm	11521	N/A	1:1	back	0.544	1.199	0.652	
1880.00	9400	UMTS 1900	RMC	22.0	21.21	-0.02	10 mm	11521	N/A	1:1	front	0.650	1.199	0.779	A21
1880.00	9400	UMTS 1900	RMC	22.0	21.21	-0.02	10 mm	11521	N/A	1:1	bottom	0.587	1.199	0.704	
1880.00	9400	UMTS 1900	RMC	22.0	21.21	0.06	10 mm	11521	N/A	1:1	right	0.028	1.199	0.034	
1880.00	9400	UMTS 1900	RMC	22.0	21.21	0.01	10 mm	11521	N/A	1:1	left	0.216	1.199	0.259	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

Blue entry represents variability measurement.

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Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 68 of 87

Table 11-17
LTE Band 12 Hotspot 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	24.8	24.80	0.01	0	11518	QPSK	1	25	10 mm	back	1:1	0.582	1.000	0.582	A22
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.04	1	11518	QPSK	25	12	10 mm	back	1:1	0.441	1.042	0.460	
707.50	23095	Mid	LTE Band 12	10	24.8	24.80	-0.06	0	11518	QPSK	1	25	10 mm	front	1:1	0.543	1.000	0.543	
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.03	1	11518	QPSK	25	12	10 mm	front	1:1	0.401	1.042	0.418	
707.50	23095	Mid	LTE Band 12	10	24.8	24.80	-0.05	0	11518	QPSK	1	25	10 mm	bottom	1:1	0.208	1.000	0.208	
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.00	1	11518	QPSK	25	12	10 mm	bottom	1:1	0.153	1.042	0.159	
707.50	23095	Mid	LTE Band 12	10	24.8	24.80	0.03	0	11518	QPSK	1	25	10 mm	right	1:1	0.270	1.000	0.270	
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.04	1	11518	QPSK	25	12	10 mm	right	1:1	0.209	1.042	0.218	
707.50	23095	Mid	LTE Band 12	10	24.8	24.80	0.00	0	11518	QPSK	1	25	10 mm	left	1:1	0.226	1.000	0.226	
707.50	23095	Mid	LTE Band 12	10	23.8	23.62	0.07	1	11518	QPSK	25	12	10 mm	left	1:1	0.177	1.042	0.184	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak								Body 1.6 W/kg (mW/g) averaged over 1 gram											
Uncontrolled Exposure/General Population																			

Table 11-18
LTE Band 5 (Cell) Hotspot 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	24.0	23.91	0.03	0	11518	QPSK	1	0	10 mm	back	1:1	0.213	1.021	0.217	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.62	-0.03	1	11518	QPSK	25	0	10 mm	back	1:1	0.158	1.091	0.172	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.91	-0.01	0	11518	QPSK	1	0	10 mm	front	1:1	0.195	1.021	0.199	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.62	0.03	1	11518	QPSK	25	0	10 mm	front	1:1	0.142	1.091	0.155	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.91	0.07	0	11518	QPSK	1	0	10 mm	bottom	1:1	0.122	1.021	0.125	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.62	0.06	1	11518	QPSK	25	0	10 mm	bottom	1:1	0.089	1.091	0.097	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.91	0.09	0	11518	QPSK	1	0	10 mm	right	1:1	0.268	1.021	0.274	A24
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.62	-0.03	1	11518	QPSK	25	0	10 mm	right	1:1	0.204	1.091	0.223	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.91	-0.01	0	11518	QPSK	1	0	10 mm	left	1:1	0.167	1.021	0.171	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	22.62	-0.04	1	11518	QPSK	25	0	10 mm	left	1:1	0.120	1.091	0.131	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

Table 11-19
LTE Band 4 (AWS) Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.96	0.19	0	11521	QPSK	1	0	10 mm	back	1:1	0.808	1.009	0.815	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.89	-0.03	0	11521	QPSK	50	25	10 mm	back	1:1	0.794	1.026	0.815	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.83	-0.03	0	11521	QPSK	100	0	10 mm	back	1:1	0.776	1.040	0.807	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.96	0.03	0	11521	QPSK	1	0	10 mm	front	1:1	0.817	1.009	0.824	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.89	0.04	0	11521	QPSK	50	25	10 mm	front	1:1	0.814	1.026	0.835	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.83	0.11	0	11521	QPSK	100	0	10 mm	front	1:1	0.806	1.040	0.838	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.96	0.00	0	11521	QPSK	1	0	10 mm	bottom	1:1	1.070	1.009	1.080	A26
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.89	-0.02	0	11521	QPSK	50	25	10 mm	bottom	1:1	1.030	1.026	1.057	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.83	-0.01	0	11521	QPSK	100	0	10 mm	bottom	1:1	1.030	1.040	1.071	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.96	0.04	0	11521	QPSK	1	0	10 mm	right	1:1	0.082	1.009	0.083	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.89	0.17	0	11521	QPSK	50	25	10 mm	right	1:1	0.072	1.026	0.074	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.96	0.03	0	11521	QPSK	1	0	10 mm	left	1:1	0.260	1.009	0.262	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.89	0.06	0	11521	QPSK	50	25	10 mm	left	1:1	0.245	1.026	0.251	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.0	21.96	-0.02	0	11521	QPSK	1	0	10 mm	bottom	1:1	1.010	1.009	1.019	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

Blue entry represents variability measurement.

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Table 11-20
LTE Band 2 (PCS) Hotspot 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)			
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.99	-0.02	0	11521	QPSK	1	50	10 mm	back	1:1	0.677	1.002	0.678	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	21.84	-0.10	0	11521	QPSK	50	0	10 mm	back	1:1	0.651	1.038	0.676	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.99	-0.04	0	11521	QPSK	1	50	10 mm	front	1:1	0.670	1.002	0.671	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	21.84	0.01	0	11521	QPSK	50	0	10 mm	front	1:1	0.667	1.038	0.692	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	21.93	-0.06	0	11521	QPSK	1	50	10 mm	bottom	1:1	0.787	1.016	0.800	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.99	-0.03	0	11521	QPSK	1	50	10 mm	bottom	1:1	0.803	1.002	0.805	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.0	21.85	-0.15	0	11521	QPSK	1	50	10 mm	bottom	1:1	0.902	1.035	0.934	A28
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	21.84	-0.05	0	11521	QPSK	50	0	10 mm	bottom	1:1	0.723	1.038	0.750	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.77	-0.06	0	11521	QPSK	100	0	10 mm	bottom	1:1	0.699	1.054	0.737	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.99	0.06	0	11521	QPSK	1	50	10 mm	right	1:1	0.038	1.002	0.038	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	21.84	0.05	0	11521	QPSK	50	0	10 mm	right	1:1	0.034	1.038	0.035	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.0	21.99	-0.06	0	11521	QPSK	1	50	10 mm	left	1:1	0.274	1.002	0.275	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	21.84	-0.01	0	11521	QPSK	50	0	10 mm	left	1:1	0.260	1.038	0.270	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

Table 11-21
WLAN Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2462	11	802.11b	DSSS	22	15.5	15.42	-	10 mm	1	1164B	1	back	99.31	0.051	-	1.019	1.007	-	
2462	11	802.11b	DSSS	22	15.5	15.42	-	10 mm	1	1164B	1	front	99.31	0.078	-	1.019	1.007	-	
2462	11	802.11b	DSSS	22	15.5	15.42	-0.07	10 mm	1	1164B	1	top	99.31	0.145	0.114	1.019	1.007	0.117	A30
2462	11	802.11b	DSSS	22	15.5	15.42	-	10 mm	1	1164B	1	left	99.31	0.059	-	1.019	1.007	-	
2462	11	802.11b	DSSS	22	15.5	15.41	-	10 mm	2	1164B	1	back	99.46	0.097	-	1.021	1.005	-	
2462	11	802.11b	DSSS	22	15.5	15.41	0.17	10 mm	2	1164B	1	front	99.46	0.124	0.093	1.021	1.005	0.095	
2462	11	802.11b	DSSS	22	15.5	15.41	-	10 mm	2	1164B	1	top	99.46	0.026	-	1.021	1.005	-	
2462	11	802.11b	DSSS	22	15.5	15.41	-	10 mm	2	1164B	1	right	99.46	0.029	-	1.021	1.005	-	
5825	165	802.11a	OFDM	20	12.5	11.94	-	10 mm	1	11656	6	back	98.96	0.115	-	1.138	1.011	-	
5825	165	802.11a	OFDM	20	12.5	11.94	-0.07	10 mm	1	11656	6	front	98.96	0.132	0.053	1.138	1.011	0.061	A32
5825	165	802.11a	OFDM	20	12.5	11.94	-	10 mm	1	11656	6	top	98.96	0.019	-	1.138	1.011	-	
5825	165	802.11a	OFDM	20	12.5	11.94	-	10 mm	1	11656	6	left	98.96	0.026	-	1.138	1.011	-	
5745	149	802.11a	OFDM	20	12.5	12.16	0.05	10 mm	2	11656	6	back	99.24	0.043	0.012	1.081	1.008	0.013	
5745	149	802.11a	OFDM	20	12.5	12.16	-	10 mm	2	11656	6	front	99.24	0.015	-	1.081	1.008	-	
5745	149	802.11a	OFDM	20	12.5	12.16	-	10 mm	2	11656	6	top	99.24	0.009	-	1.081	1.008	-	
5745	149	802.11a	OFDM	20	12.5	12.16	-	10 mm	2	11656	6	right	99.24	0.011	-	1.081	1.008	-	
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: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 70 of 87

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, 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. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 15 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance. A test separation distance of 10 mm for body-worn SAR was also used for GSM 850/1900, UMTS 850, LTE Bands 12/5, and 2.4/5 GHz WLAN as it is more conservative.
7. Per FCC KDB Publication 648474 D04v01, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. 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 13 for variability analysis.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.6 for more details).
10. This device utilizes power reduction for UMTS 1750/ 1900, LTE Band 4, and LTE Band 2 under some portable hotspot conditions for SAR compliance. Therefore, these wireless router configurations were tested at reduced output power levels.

GSM Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. Justification for reduced test configurations per KDB Publication 941225 D03v01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
3. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel was used.

UMTS Notes:

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

FCC ID: A3LSMG920T	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset
		Page 71 of 87

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 8.5.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).
4. Per KDB Publication 941225 D05Av01r01, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

WLAN Notes:

1. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 8.7.5 for more information.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 8.7.6 for more information.
4. Head SAR for 2.4 GHz MIMO was measured with both antennas transmitting simultaneously at the specified maximum output power in MIMO mode following the initial test configuration procedures. Head SAR for 5 GHz MIMO, and body-worn/hotspot MIMO SAR measurements were excluded per KDB 248227 D01 DR02-41929 since the sum of the 1g single transmission chain SAR measurements (at a equal or higher power level) is <1.6 W/kg.
5. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
6. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.
7. Only channels in the U-NII-2C >5.65 GHz and UNII 3 aggregate band that support wireless router were considered for hotspot SAR tests.
8. For SAR compliance, this device always uses power reduction when the device is in a held-to-ear RF exposure condition with 2.4 GHz WIFI data modes. Therefore, 2.4 GHz WIFI Head SAR was evaluated at reduced power levels.

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 72 of 87

12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

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

12.2 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. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1-g or 10-g SAR.

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 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	11.50	15	0.196

Note:

- Held-to-ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
- Head SAR for 2.4 GHz MIMO was measured with both antennas transmitting simultaneously at the specified maximum output power in MIMO mode following the initial test configuration procedures.
- Head SAR for 5 GHz MIMO, and body-worn/hotspot MIMO SAR measurements were excluded per KDB 248227 D01 DR02-41929 and were determined by the sum of 1g SISO SAR values.
- The highest reported SAR for each exposure condition is used for SAR summation purpose.

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 73 of 87

12.3 Head SAR Simultaneous Transmission Analysis

Table 12-2

Simultaneous Transmission Scenario with 2.4 GHz WLAN – Ant 1 (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	GSM 850	0.116	0.429	0.545
	UMTS 850	0.124	0.429	0.553
	UMTS 1750	0.394	0.429	0.823
	GSM 1900	0.252	0.429	0.681
	UMTS 1900	0.403	0.429	0.832
	LTE Band 12	0.220	0.429	0.649
	LTE Band 5 (Cell)	0.103	0.429	0.532
	LTE Band 4 (AWS)	0.472	0.429	0.901
	LTE Band 2 (PCS)	0.413	0.429	0.842

Table 12-3

Simultaneous Transmission Scenario with 2.4 GHz WLAN – Ant 2 (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	GSM 850	0.116	0.640	0.756
	UMTS 850	0.124	0.640	0.764
	UMTS 1750	0.394	0.640	1.034
	GSM 1900	0.252	0.640	0.892
	UMTS 1900	0.403	0.640	1.043
	LTE Band 12	0.220	0.640	0.860
	LTE Band 5 (Cell)	0.103	0.640	0.743
	LTE Band 4 (AWS)	0.472	0.640	1.112
	LTE Band 2 (PCS)	0.413	0.640	1.053

Table 12-4

Simultaneous Transmission Scenario with 2.4 GHz WLAN – MIMO (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	GSM 850	0.116	0.399	0.515
	UMTS 850	0.124	0.399	0.523
	UMTS 1750	0.394	0.399	0.793
	GSM 1900	0.252	0.399	0.651
	UMTS 1900	0.403	0.399	0.802
	LTE Band 12	0.220	0.399	0.619
	LTE Band 5 (Cell)	0.103	0.399	0.502
	LTE Band 4 (AWS)	0.472	0.399	0.871
	LTE Band 2 (PCS)	0.413	0.399	0.812

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 74 of 87

Table 12-5
Simultaneous Transmission Scenario with 5 GHz WLAN – Ant 1 (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	GSM 850	0.116	0.223	0.339
	UMTS 850	0.124	0.223	0.347
	UMTS 1750	0.394	0.223	0.617
	GSM 1900	0.252	0.223	0.475
	UMTS 1900	0.403	0.223	0.626
	LTE Band 12	0.220	0.223	0.443
	LTE Band 5 (Cell)	0.103	0.223	0.326
	LTE Band 4 (AWS)	0.472	0.223	0.695
	LTE Band 2 (PCS)	0.413	0.223	0.636

Table 12-6
Simultaneous Transmission Scenario with 5 GHz WLAN – Ant 2 (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	GSM 850	0.116	0.087	0.203
	UMTS 850	0.124	0.087	0.211
	UMTS 1750	0.394	0.087	0.481
	GSM 1900	0.252	0.087	0.339
	UMTS 1900	0.403	0.087	0.490
	LTE Band 12	0.220	0.087	0.307
	LTE Band 5 (Cell)	0.103	0.087	0.190
	LTE Band 4 (AWS)	0.472	0.087	0.559
	LTE Band 2 (PCS)	0.413	0.087	0.500

Table 12-7
Simultaneous Transmission Scenario with 5 GHz WLAN – MIMO (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	GSM 850	0.116	0.223	0.087	0.426
	UMTS 850	0.124	0.223	0.087	0.434
	UMTS 1750	0.394	0.223	0.087	0.704
	GSM 1900	0.252	0.223	0.087	0.562
	UMTS 1900	0.403	0.223	0.087	0.713
	LTE Band 12	0.220	0.223	0.087	0.530
	LTE Band 5 (Cell)	0.103	0.223	0.087	0.413
	LTE Band 4 (AWS)	0.472	0.223	0.087	0.782
	LTE Band 2 (PCS)	0.413	0.223	0.087	0.723

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 75 of 87

12.4 Body-Worn Simultaneous Transmission Analysis

1. For SAR summation for body-worn back side at 15mm, the SAR values at 10mm for some transmission modes were used since the 10mm test distance was more conservative. "<" denotes that the 10mm SAR values were used for summation purposes.
2. Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used for SAR summation for body-worn back side at 15mm to determine simultaneous transmission SAR test exclusion.

Table 12-8

Simultaneous Transmission Scenario with 2.4 GHz WLAN - Ant 1 (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn	GSM 850	<0.254	<0.042	<0.296
	UMTS 850	<0.260	<0.042	<0.302
	UMTS 1750	0.784	<0.042	<0.826
	GSM 1900	<0.795	<0.042	<0.837
	UMTS 1900	0.393	<0.042	<0.435
	LTE Band 12	<0.582	<0.042	<0.624
	LTE Band 5 (Cell)	<0.217	<0.042	<0.259
	LTE Band 4 (AWS)	1.066	<0.042	<1.108
	LTE Band 2 (PCS)	0.624	<0.042	<0.666

Table 12-9

Simultaneous Transmission Scenario with 2.4 GHz WLAN - Ant 2 (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn	GSM 850	<0.254	<0.077	<0.331
	UMTS 850	<0.260	<0.077	<0.337
	UMTS 1750	0.784	<0.077	<0.861
	GSM 1900	<0.795	<0.077	<0.872
	UMTS 1900	0.393	<0.077	<0.470
	LTE Band 12	<0.582	<0.077	<0.659
	LTE Band 5 (Cell)	<0.217	<0.077	<0.294
	LTE Band 4 (AWS)	1.066	<0.077	<1.143
	LTE Band 2 (PCS)	0.624	<0.077	<0.701

Table 12-10

Simultaneous Transmission Scenario with 2.4 GHz WLAN - MIMO (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body-Worn	GSM 850	<0.254	<0.042	<0.077	<0.373
	UMTS 850	<0.260	<0.042	<0.077	<0.379
	UMTS 1750	0.784	<0.042	<0.077	<0.903
	GSM 1900	<0.795	<0.042	<0.077	<0.914
	UMTS 1900	0.393	<0.042	<0.077	<0.512
	LTE Band 12	<0.582	<0.042	<0.077	<0.701
	LTE Band 5 (Cell)	<0.217	<0.042	<0.077	<0.336
	LTE Band 4 (AWS)	1.066	<0.042	<0.077	<1.185
	LTE Band 2 (PCS)	0.624	<0.042	<0.077	<0.743

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 76 of 87

Table 12-11
Simultaneous Transmission Scenario with 5 GHz WLAN - Ant 1 (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn	GSM 850	<0.254	<0.019	<0.273
	UMTS 850	<0.260	<0.019	<0.279
	UMTS 1750	0.784	<0.019	<0.803
	GSM 1900	<0.795	<0.019	<0.814
	UMTS 1900	0.393	<0.019	<0.412
	LTE Band 12	<0.582	<0.019	<0.601
	LTE Band 5 (Cell)	<0.217	<0.019	<0.236
	LTE Band 4 (AWS)	1.066	<0.019	<1.085
	LTE Band 2 (PCS)	0.624	<0.019	<0.643

Table 12-12
Simultaneous Transmission Scenario with 5 GHz WLAN - Ant 2 (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn	GSM 850	<0.254	<0.036	<0.290
	UMTS 850	<0.260	<0.036	<0.296
	UMTS 1750	0.784	<0.036	<0.820
	GSM 1900	<0.795	<0.036	<0.831
	UMTS 1900	0.393	<0.036	<0.429
	LTE Band 12	<0.582	<0.036	<0.618
	LTE Band 5 (Cell)	<0.217	<0.036	<0.253
	LTE Band 4 (AWS)	1.066	<0.036	<1.102
	LTE Band 2 (PCS)	0.624	<0.036	<0.660

Table 12-13
Simultaneous Transmission Scenario with 5 GHz WLAN - MIMO (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body-Worn	GSM 850	<0.254	<0.019	<0.036	<0.309
	UMTS 850	<0.260	<0.019	<0.036	<0.315
	UMTS 1750	0.784	<0.019	<0.036	<0.839
	GSM 1900	<0.795	<0.019	<0.036	<0.850
	UMTS 1900	0.393	<0.019	<0.036	<0.448
	LTE Band 12	<0.582	<0.019	<0.036	<0.637
	LTE Band 5 (Cell)	<0.217	<0.019	<0.036	<0.272
	LTE Band 4 (AWS)	1.066	<0.019	<0.036	<1.121
	LTE Band 2 (PCS)	0.624	<0.019	<0.036	<0.679

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset			Page 77 of 87

Table 12-14
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn	GSM 850	<0.254	0.196	<0.450
	UMTS 850	<0.260	0.196	<0.456
	UMTS 1750	0.784	0.196	0.980
	GSM 1900	<0.795	0.196	<0.991
	UMTS 1900	0.393	0.196	0.589
	LTE Band 12	<0.582	0.196	<0.778
	LTE Band 5 (Cell)	<0.217	0.196	<0.413
	LTE Band 4 (AWS)	1.066	0.196	1.262
	LTE Band 2 (PCS)	0.624	0.196	0.820

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 78 of 87

12.5 Hotspot SAR Simultaneous Transmission Analysis

Table 12-15
Simultaneous Transmission Scenario 2.4 GHz WLAN – Ant 1 (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	GPRS 850	0.348	0.117	0.465
	UMTS 850	0.294	0.117	0.411
	UMTS 1750	1.073	0.117	1.190
	GPRS 1900	1.094	0.117	1.211
	UMTS 1900	0.779	0.117	0.896
	LTE Band 12	0.582	0.117	0.699
	LTE Band 5 (Cell)	0.274	0.117	0.391
	LTE Band 4 (AWS)	1.080	0.117	1.197
	LTE Band 2 (PCS)	0.934	0.117	1.051

Table 12-16
Simultaneous Transmission Scenario 2.4 GHz WLAN – Ant 2 (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	GPRS 850	0.348	0.095	0.443
	UMTS 850	0.294	0.095	0.389
	UMTS 1750	1.073	0.095	1.168
	GPRS 1900	1.094	0.095	1.189
	UMTS 1900	0.779	0.095	0.874
	LTE Band 12	0.582	0.095	0.677
	LTE Band 5 (Cell)	0.274	0.095	0.369
	LTE Band 4 (AWS)	1.080	0.095	1.175
	LTE Band 2 (PCS)	0.934	0.095	1.029

Table 12-17
Simultaneous Transmission Scenario 2.4 GHz WLAN – MIMO (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Hotspot SAR	GPRS 850	0.348	0.117	0.095	0.560
	UMTS 850	0.294	0.117	0.095	0.506
	UMTS 1750	1.073	0.117	0.095	1.285
	GPRS 1900	1.094	0.117	0.095	1.306
	UMTS 1900	0.779	0.117	0.095	0.991
	LTE Band 12	0.582	0.117	0.095	0.794
	LTE Band 5 (Cell)	0.274	0.117	0.095	0.486
	LTE Band 4 (AWS)	1.080	0.117	0.095	1.292
	LTE Band 2 (PCS)	0.934	0.117	0.095	1.146

Table 12-18
Simultaneous Transmission Scenario 5 GHz WLAN – Ant 1 (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	GPRS 850	0.348	0.061	0.409
	UMTS 850	0.294	0.061	0.355
	UMTS 1750	1.073	0.061	1.134
	GPRS 1900	1.094	0.061	1.155
	UMTS 1900	0.779	0.061	0.840
	LTE Band 12	0.582	0.061	0.643
	LTE Band 5 (Cell)	0.274	0.061	0.335
	LTE Band 4 (AWS)	1.080	0.061	1.141
	LTE Band 2 (PCS)	0.934	0.061	0.995

Table 12-19
Simultaneous Transmission Scenario 5 GHz WLAN – Ant 2 (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	GPRS 850	0.348	0.013	0.361
	UMTS 850	0.294	0.013	0.307
	UMTS 1750	1.073	0.013	1.086
	GPRS 1900	1.094	0.013	1.107
	UMTS 1900	0.779	0.013	0.792
	LTE Band 12	0.582	0.013	0.595
	LTE Band 5 (Cell)	0.274	0.013	0.287
	LTE Band 4 (AWS)	1.080	0.013	1.093
	LTE Band 2 (PCS)	0.934	0.013	0.947

Table 12-20
Simultaneous Transmission Scenario 5 GHz WLAN – MIMO (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Hotspot SAR	GPRS 850	0.348	0.061	0.013	0.422
	UMTS 850	0.294	0.061	0.013	0.368
	UMTS 1750	1.073	0.061	0.013	1.147
	GPRS 1900	1.094	0.061	0.013	1.168
	UMTS 1900	0.779	0.061	0.013	0.853
	LTE Band 12	0.582	0.061	0.013	0.656
	LTE Band 5 (Cell)	0.274	0.061	0.013	0.348
	LTE Band 4 (AWS)	1.080	0.061	0.013	1.154
	LTE Band 2 (PCS)	0.934	0.061	0.013	1.008

12.6 Simultaneous Transmission Conclusion

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

FCC ID: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT			Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset			Page 80 of 87

13 SAR MEASUREMENT VARIABILITY

13.1 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 13-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS														
Band	FREQUENCY		Mode	Service	# of Time Slots	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)	
1900	1850.20	512	GSM 1900	GPRS	4	back	10 mm	0.931	0.854	1.09	N/A	N/A	N/A	N/A
1750	1732.50	20175	LTE Band 4 (AWS)	QPSK, 1 RB, 0 RB Offset	N/A	bottom	10 mm	1.070	1.010	1.06	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram							

13.2 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: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 81 of 87

14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/30/2014	Annual	10/30/2015	1833460
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	12/30/2014	Annual	12/30/2015	JP38020182
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/15/2014	Annual	4/15/2015	3629U00687
SPEAG	D1765V2	1765 MHz SAR Dipole	5/7/2014	Annual	5/7/2015	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	4/9/2014	Annual	4/9/2015	5d141
SPEAG	D1900V2	1900 MHz SAR Dipole	7/23/2014	Annual	7/23/2015	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	8/11/2014	Annual	8/11/2015	719
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
SPEAG	D5GHzV2	5 GHz SAR Dipole	2/26/2014	Annual	2/26/2015	1120
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
SPEAG	D750V3	750 MHz Dipole	3/17/2014	Annual	3/17/2015	1054
SPEAG	D835V2	835 MHz SAR Dipole	7/24/2014	Annual	7/24/2015	4d133
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433972
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/17/2014	Annual	3/17/2015	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/11/2014	Annual	4/11/2015	1368
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/14/2014	Annual	5/14/2015	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/12/2014	Annual	8/12/2015	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/18/2014	Annual	9/18/2015	1364
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/6/2014	Annual	5/6/2015	1070
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264165
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764551
Agilent	E4438C	ESG Vector Signal Generator	3/31/2014	Annual	3/31/2015	MY42082659
Control Company	4052	Long Stem Thermometer	9/27/2013	Biennial	9/27/2015	130567447
Control Company	61220-416	Long-Stem Thermometer	4/29/2014	Biennial	4/29/2016	11131323
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Agilent	N9020A	MXA Signal Analyzer	10/27/2014	Annual	10/27/2015	US46470561
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420800
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Anritsu	ML2469A	Power Meter	3/14/2014	Annual	3/14/2015	1306009
Anritsu	ML2495A	Power Meter	10/31/2013	Biennial	10/31/2015	0941001
Anritsu	MA2411B	Pulse Power Sensor	3/25/2014	Annual	3/25/2015	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/13/2014	Annual	11/13/2015	1339018
Anritsu	MT8820C	Radio Communication Analyzer	8/28/2014	Annual	8/28/2015	6201240328
Anritsu	MT8820C	Radio Communication Analyzer	5/6/2014	Annual	5/6/2015	6201144419
Rohde & Schwarz	CMW500	Radio Communication Tester	2/20/2014	Annual	2/20/2015	128633
Rohde & Schwarz	CMW500	Radio Communication Tester	4/17/2014	Annual	4/17/2015	101699
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/16/2014	Annual	4/16/2015	B010177
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258
SPEAG	ES3DV3	SAR Probe	3/19/2014	Annual	3/19/2015	3209
SPEAG	ES3DV3	SAR Probe	5/15/2014	Annual	5/15/2015	3263
SPEAG	ES3DV2	SAR Probe	8/19/2014	Annual	8/19/2015	3022
SPEAG	ES3DV3	SAR Probe	9/24/2014	Annual	9/24/2015	3288
SPEAG	EX3DV4	SAR Probe	12/12/2014	Annual	12/12/2015	3920
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Agilent	8753E5	S-Parameter Network Analyzer	5/22/2014	Annual	5/22/2015	US39170118
Fisher Scientific	S97611	Thermometer	4/12/2013	Biennial	4/12/2015	130219303
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
Gigatronics	8651A	Universal Power Meter	10/30/2014	Annual	10/30/2015	8650319
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1231538
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1231535
VWR	36934-158	Wall-Mounted Thermometer	8/8/2013	Biennial	8/8/2015	130477877
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: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 82 of 87

15 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	E.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)							RSS	12.1	11.7
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.2	23.5

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

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 83 of 87

Applicable for frequencies up to 6 GHz:

a	b	c	d	e= f(d,k)	f	g	h = c x i/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 E 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 E lectronics	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: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 84 of 87

16 CONCLUSION

16.1 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: A3LSMG920T	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 85 of 87

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FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 86 of 87

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- [29] Anexo à Resolução No. 533, de 10 de Setembro de 2009.
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FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Document S/N: 0Y1501300306.A3L	Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset		Page 87 of 87

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11520

Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

Medium: 835 Head, Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.899 \text{ S/m}$; $\epsilon_r = 42.087$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-28-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: SAM Front; Type: SAM; Serial: 1686

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

Mode: GSM 850, Right Head, Cheek, Mid.ch

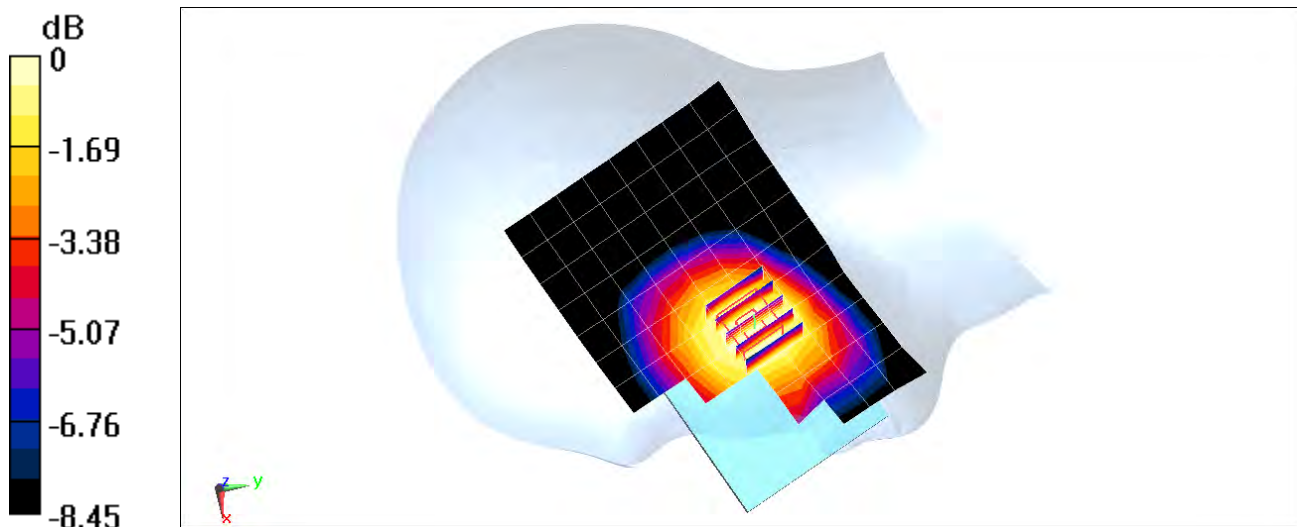
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 10.35 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.105 W/kg

SAR(1 g) = 0.086 W/kg



0 dB = 0.0919 W/kg = -10.37 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium: 835 Head, Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.899 \text{ S/m}$; $\epsilon_r = 42.087$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-28-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: SAM Front; Type: SAM; Serial: 1686

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

Mode: UMTS 850, Right Head, Cheek, Mid.ch

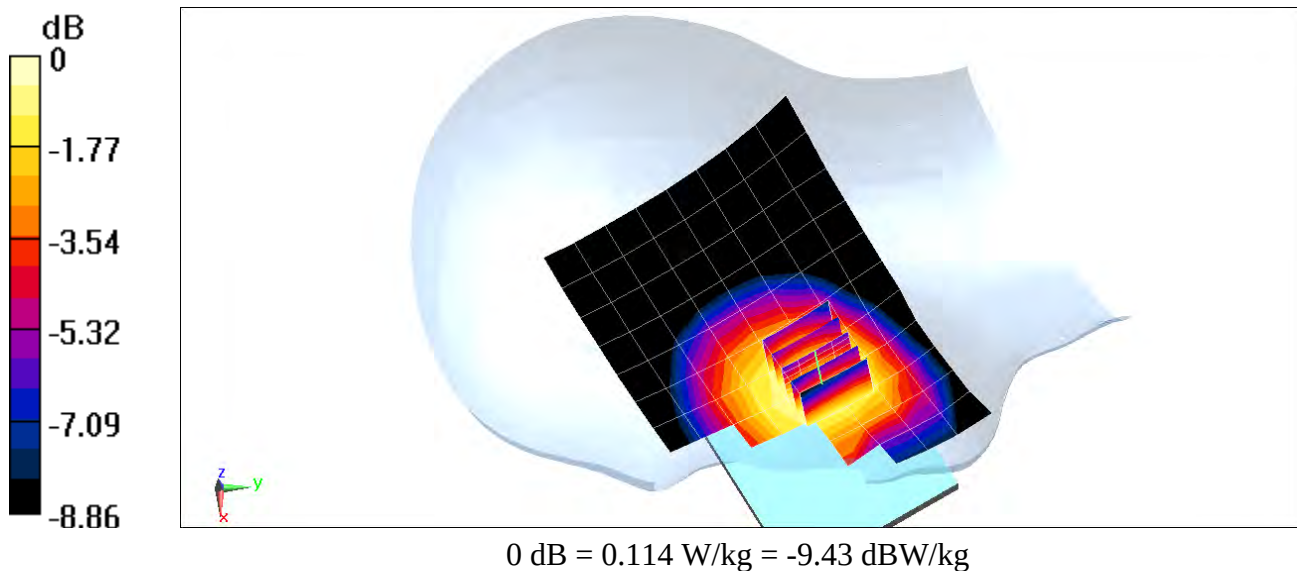
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 11.75 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 0.128 W/kg

SAR(1 g) = 0.105 W/kg.



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1

Medium: 1750 Head, Medium parameters used (interpolated):

$f = 1732.4 \text{ MHz}$; $\sigma = 1.373 \text{ S/m}$; $\epsilon_r = 39.316$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-26-2015; Ambient Temp: 22.9°C; Tissue Temp: 21.7°C

Probe: ES3DV2 - SN3022; ConvF(5.04, 5.04, 5.04); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800

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

Mode: AWS UMTS, Left Head, Cheek, Mid.ch

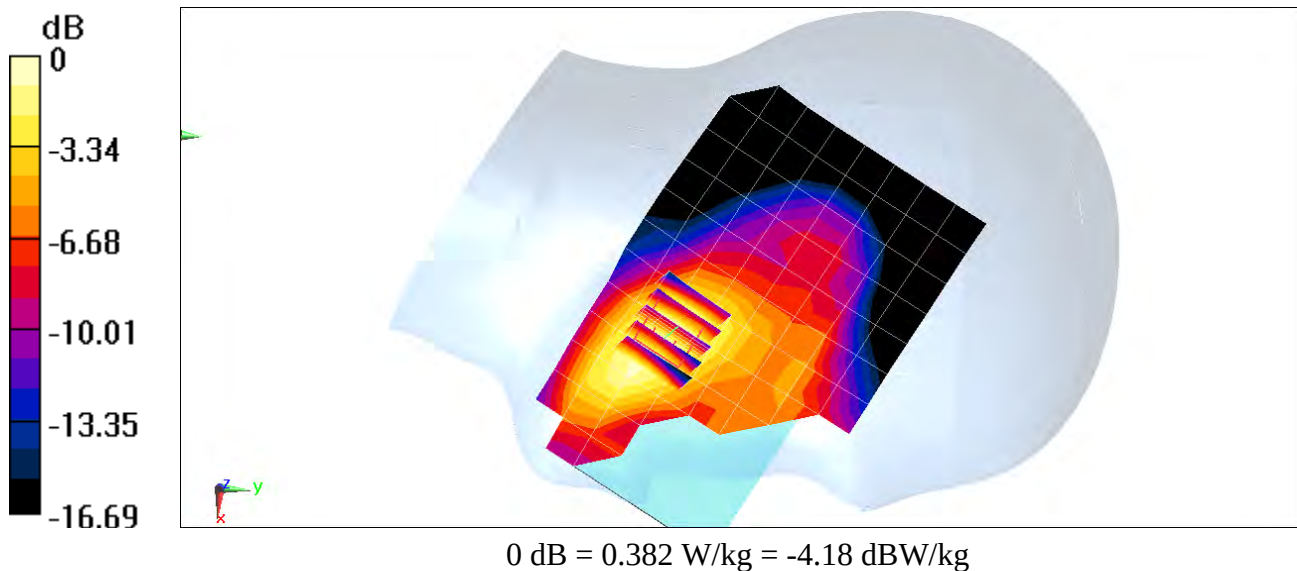
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 15.72 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.491 W/kg

SAR(1 g) = 0.323 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11520

Communication System: UID 0, GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium: 1900 Head, Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.391 \text{ S/m}$; $\epsilon_r = 38.258$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/14/2014

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

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

Mode: GSM 1900, Left Head, Cheek, Mid.ch

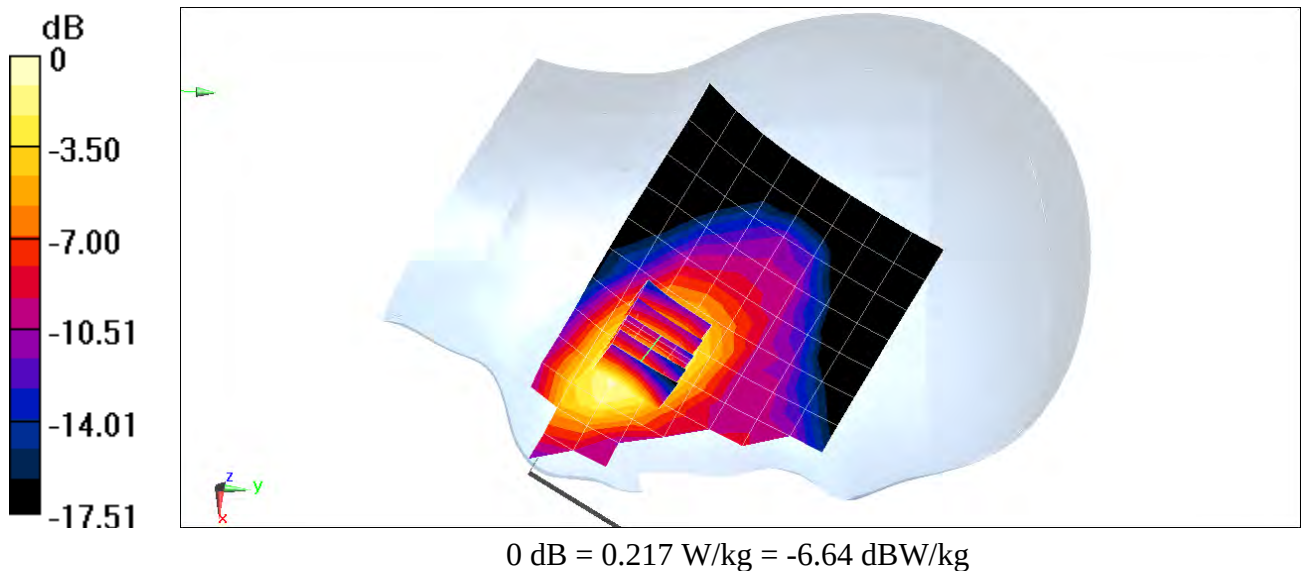
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 11.62 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 0.286 W/kg

SAR(1 g) = 0.181 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11520

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

Medium: 1900 Head, Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.391 \text{ S/m}$; $\epsilon_r = 38.258$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/14/2014

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

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

Mode: UMTS 1900, Left Head, Cheek, Mid.ch

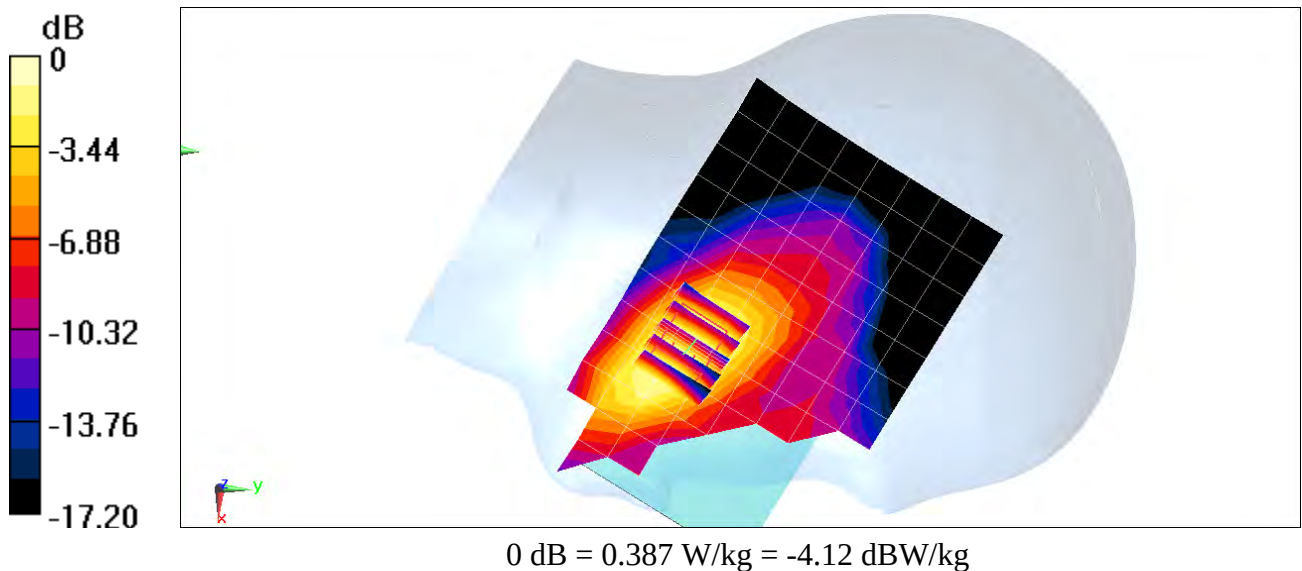
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 15.69 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.515 W/kg

SAR(1 g) = 0.325 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

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

Medium: 750 Head, Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.879 \text{ S/m}$; $\epsilon_r = 42.081$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 02-03-2015; Ambient Temp: 24.5°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3288; ConvF(6.81, 6.81, 6.81); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

**Mode: LTE Band 12, Right Head, Cheek, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

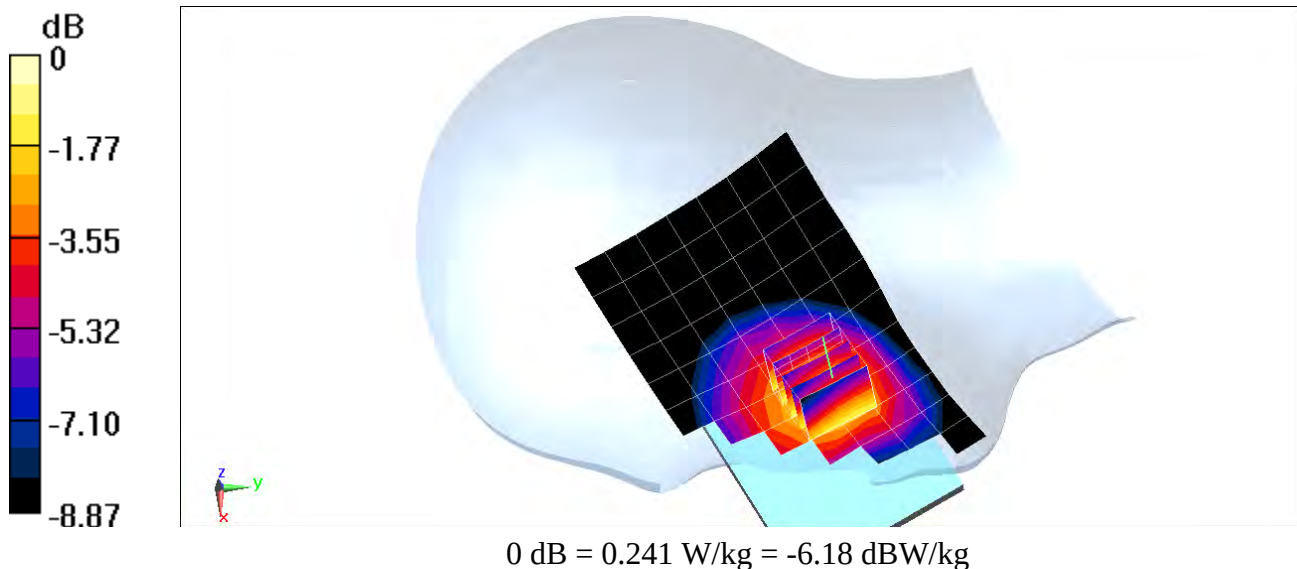
Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 16.63 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.276 W/kg

SAR(1 g) = 0.220 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

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

Medium: 835 Head, Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 0.899 \text{ S/m}$; $\epsilon_r = 42.088$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-28-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: SAM Front; Type: SAM; Serial: 1686

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

**Mode: LTE Band 5 (Cell.), Right Head, Cheek, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

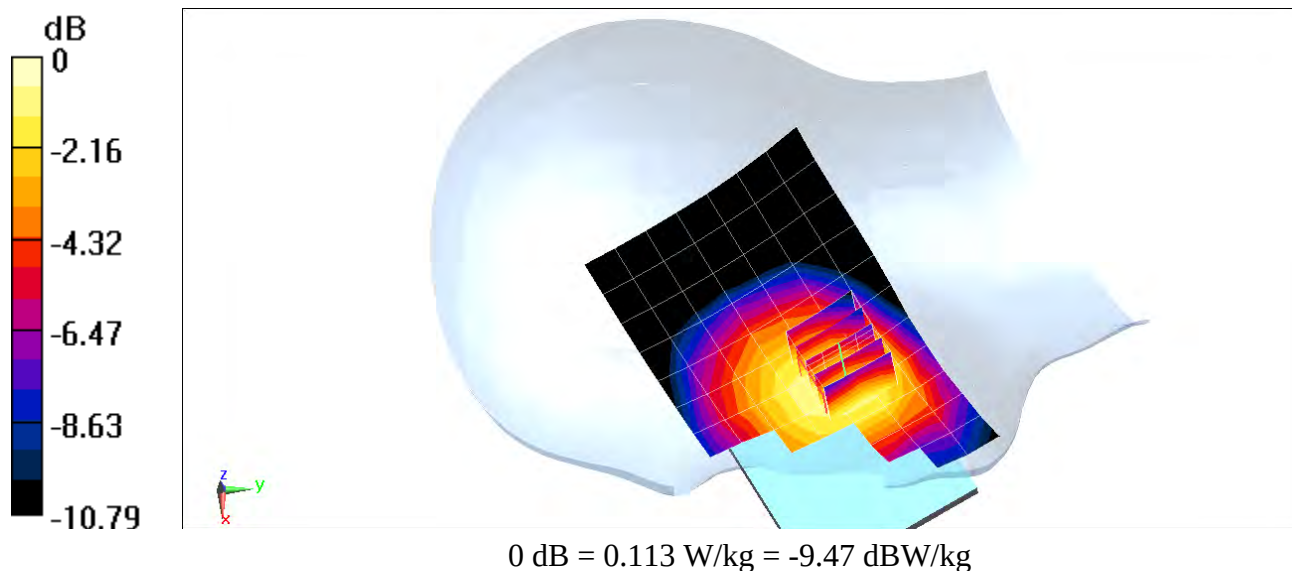
Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 11.25 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.129 W/kg

SAR(1 g) = 0.101 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11525

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

Medium: 1750 Head, Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.373 \text{ S/m}$; $\epsilon_r = 39.316$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-26-2015; Ambient Temp: 22.9°C; Tissue Temp: 21.7°C

Probe: ES3DV2 - SN3022; ConvF(5.04, 5.04, 5.04); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800

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

**Mode: LTE Band 4 (AWS), Left Head, Cheek, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset**

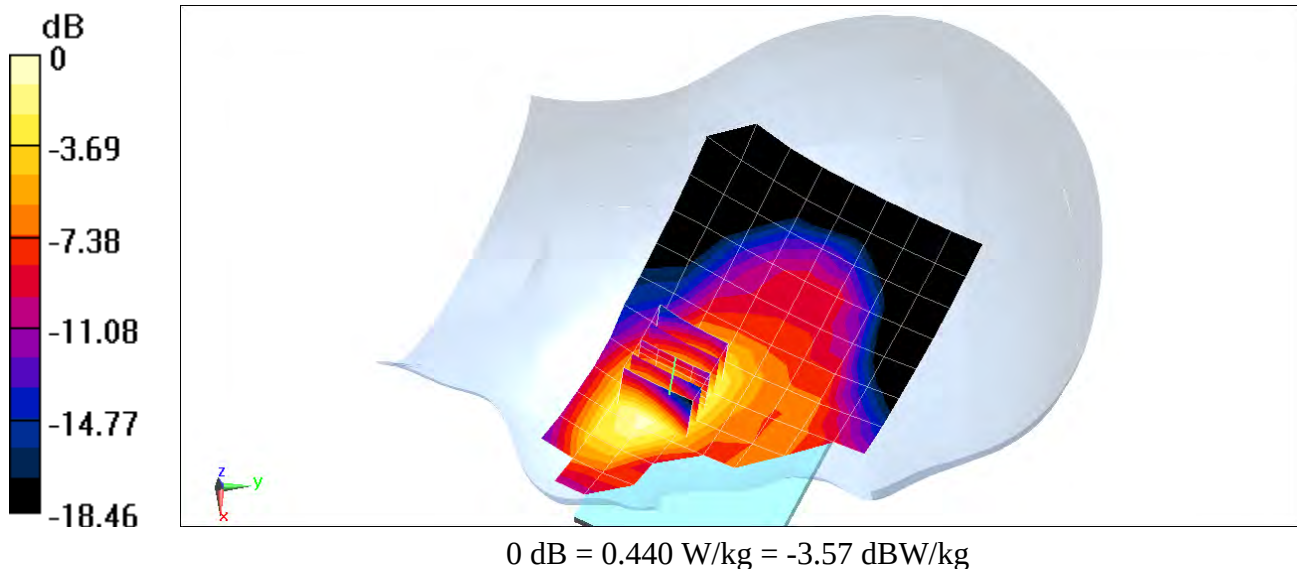
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 18.65 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 0.573 W/kg

SAR(1 g) = 0.375 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11520

Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1860 MHz; Duty Cycle: 1:1

Medium: 1900 Head, Medium parameters used (interpolated):

$f = 1860 \text{ MHz}$; $\sigma = 1.371 \text{ S/m}$; $\epsilon_r = 38.327$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/14/2014

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

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

**Mode: LTE Band 2 (PCS), Left Head, Cheek, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

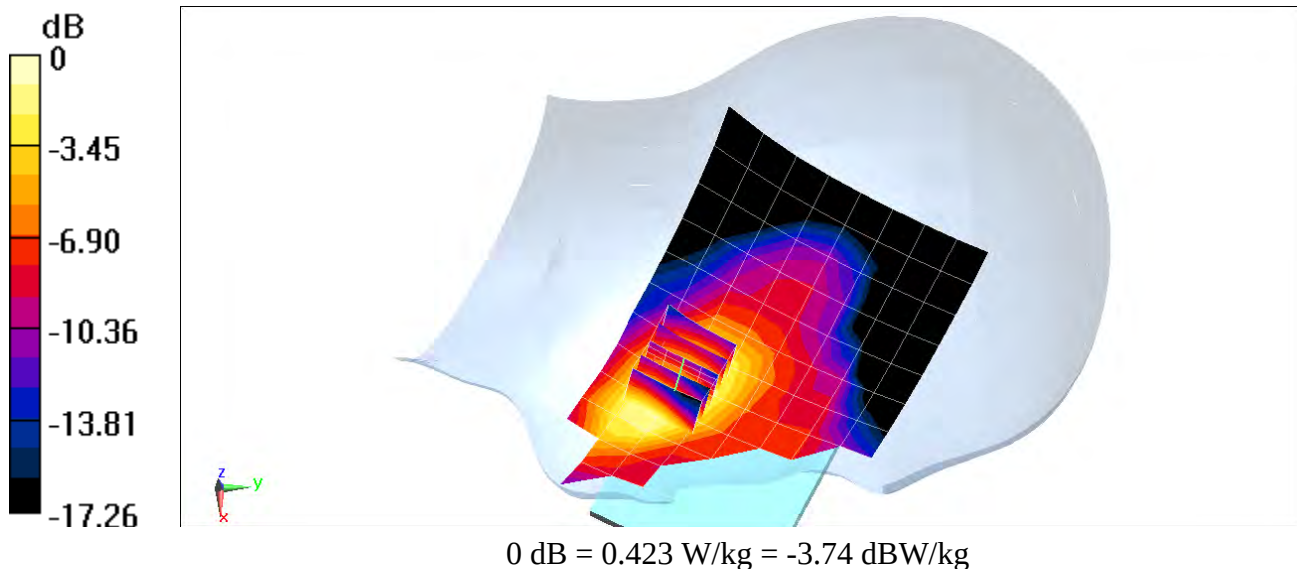
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 18.14 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.548 W/kg

SAR(1 g) = 0.359 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 119C8

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

Medium: 2450 Head, Medium parameters used (interpolated):

$f = 2462 \text{ MHz}$; $\sigma = 1.811 \text{ S/m}$; $\epsilon_r = 37.915$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 02-02-2015; Ambient Temp: 24.1°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(4.52, 4.52, 4.52); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: SAM Front; Type: SAM; Serial: 1686

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

Mode: IEEE 802.11b, Left Head, Cheek, Ch 11, 1 Mbps, Antenna 2

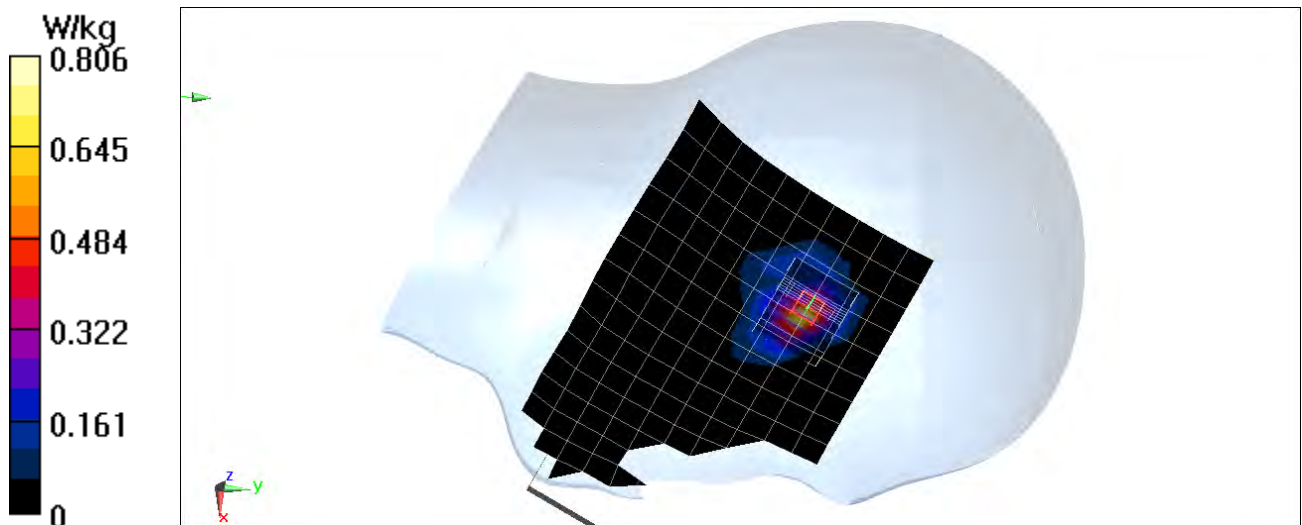
Area Scan (11x18x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 17.61 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 1.25 W/kg

SAR(1 g) = 0.596 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11656

Communication System: UID 0, IEEE 802.11a 5.2-5.8 GHz Band, Frequency: 5660 MHz; Duty Cycle: 1:1

Medium: 5 GHz Head, Medium parameters used:

$f = 5660 \text{ MHz}$; $\sigma = 5.022 \text{ S/m}$; $\epsilon_r = 36.602$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-27-2015; Ambient Temp: 23.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3920; ConvF(4.35, 4.35, 4.35); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

**Mode: IEEE 802.11a, U-NII-2C, 20 MHz Bandwidth,
Right Head, Cheek, Ch 132, 6 Mbps, Antenna 1**

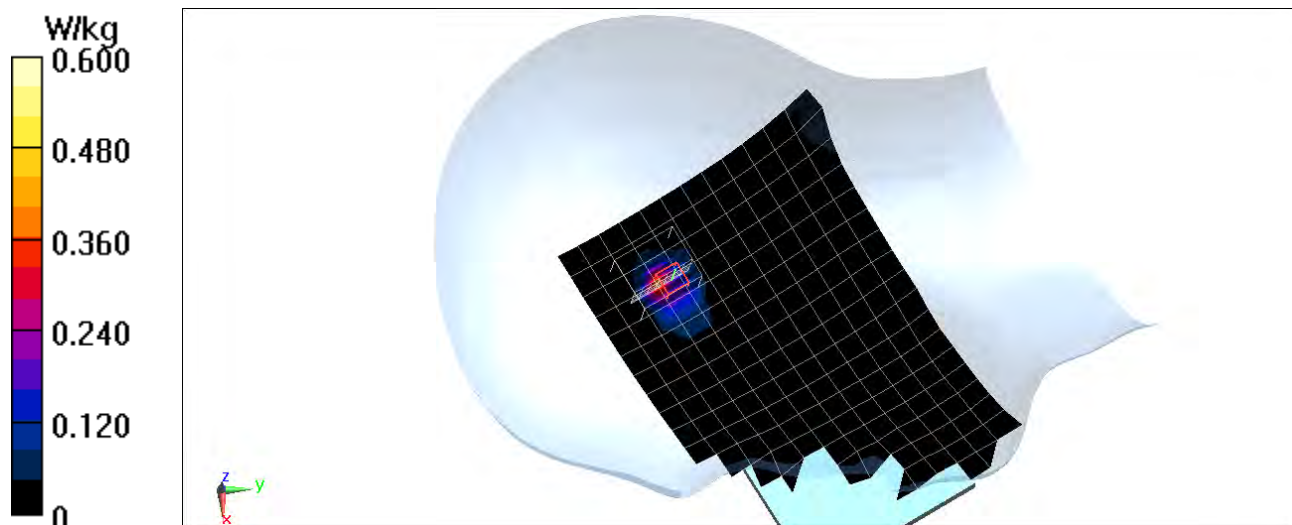
Area Scan (13x20x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Reference Value = 5.786 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 1.93 W/kg

SAR(1 g) = 0.214 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11520

Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3

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

$f = 836.6 \text{ MHz}$; $\sigma = 1.004 \text{ S/m}$; $\epsilon_r = 53.832$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 22.6°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

Mode: GSM 850, Body SAR, Back Side, Mid.ch

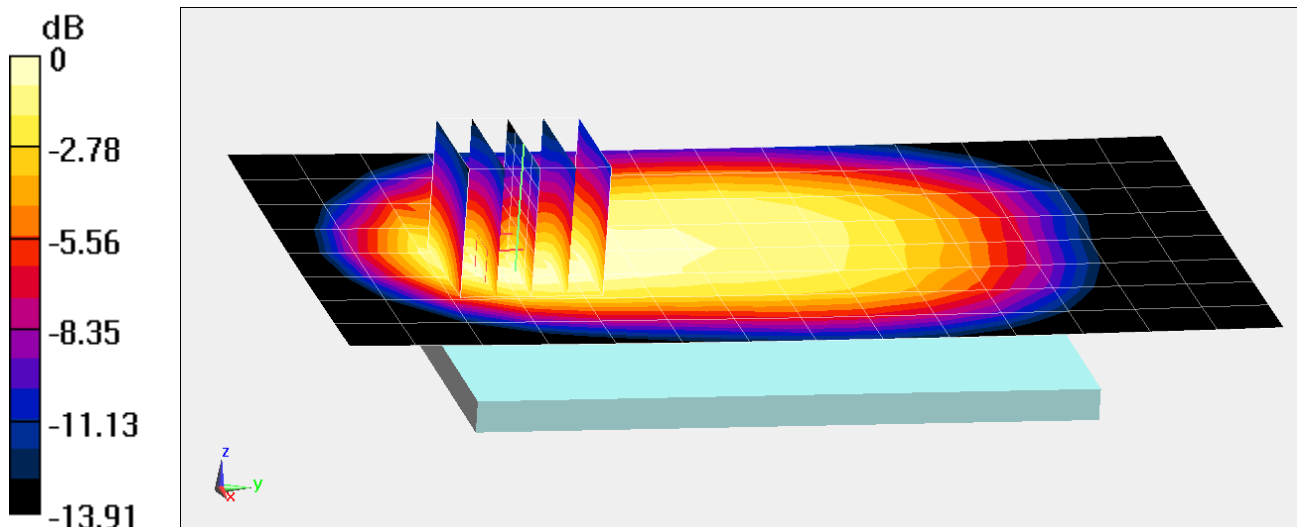
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 14.50 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.332 W/kg

SAR(1 g) = 0.188 W/kg



0 dB = 0.227 W/kg = -6.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11520

Communication System: UID 0, GSM850 GPRS; 4 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:2.076

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

$f = 836.6 \text{ MHz}$; $\sigma = 1.004 \text{ S/m}$; $\epsilon_r = 53.832$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 22.6°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

Mode: GPRS 850, Body SAR, Right Edge, Mid.ch, 4 Tx Slots

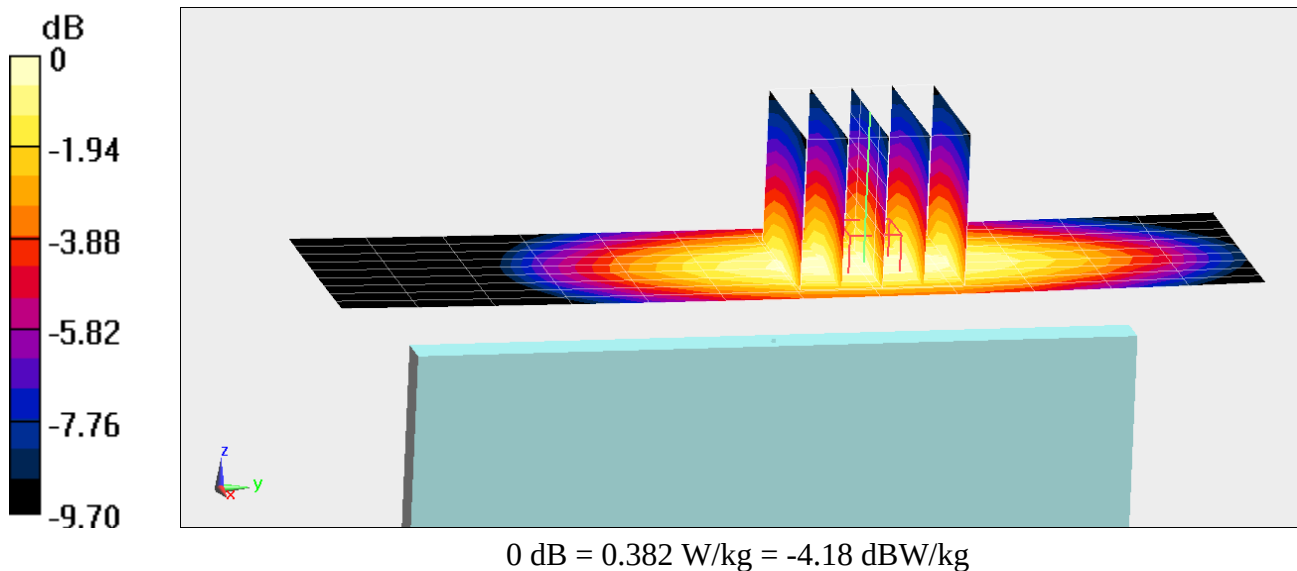
Area Scan (10x13x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 18.86 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.474 W/kg

SAR(1 g) = 0.331 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

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

$f = 836.6 \text{ MHz}$; $\sigma = 1.004 \text{ S/m}$; $\epsilon_r = 53.832$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 22.6°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

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

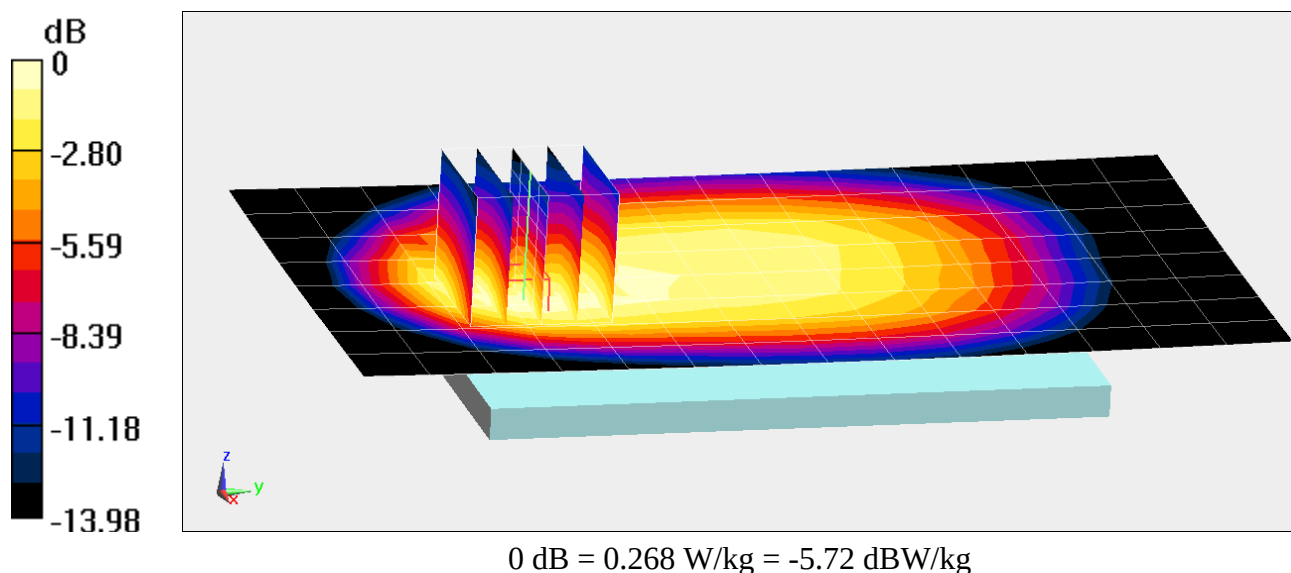
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 15.65 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.390 W/kg

SAR(1 g) = 0.220 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1

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

$f = 836.6 \text{ MHz}$; $\sigma = 1.004 \text{ S/m}$; $\epsilon_r = 53.832$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 22.6°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

Mode: UMTS 850, Body SAR, Right Edge, Mid.ch

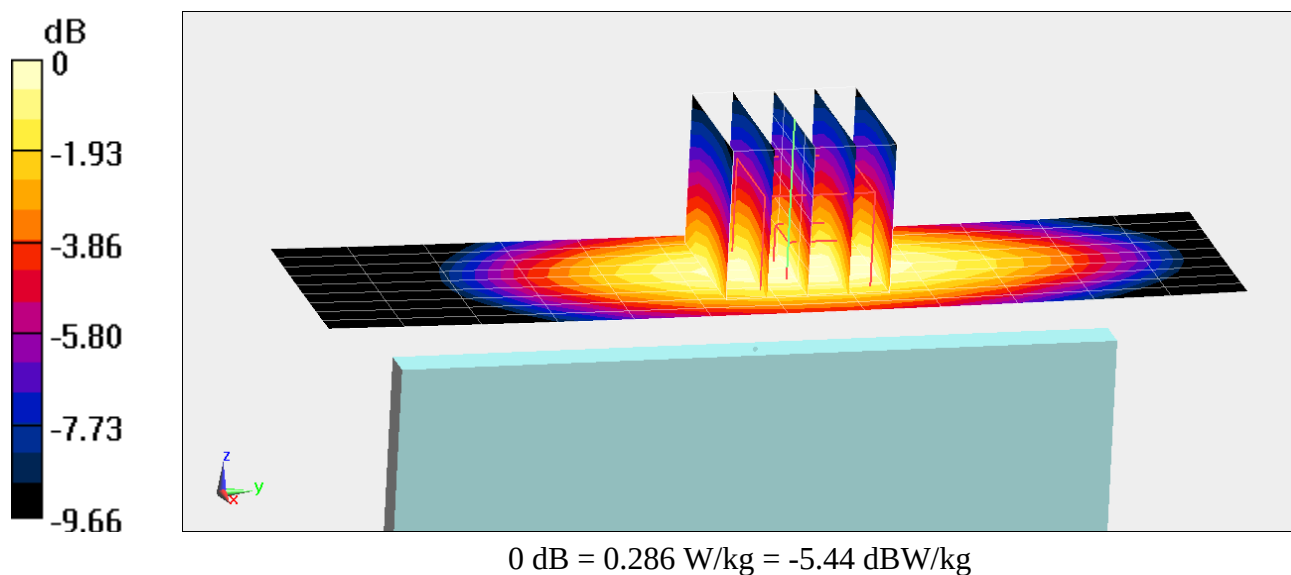
Area Scan (10x13x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 16.42 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.356 W/kg

SAR(1 g) = 0.249 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11520

Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1

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

$f = 1732.4 \text{ MHz}$; $\sigma = 1.434 \text{ S/m}$; $\epsilon_r = 51.921$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-28-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3288; ConvF(5.03, 5.03, 5.03); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

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

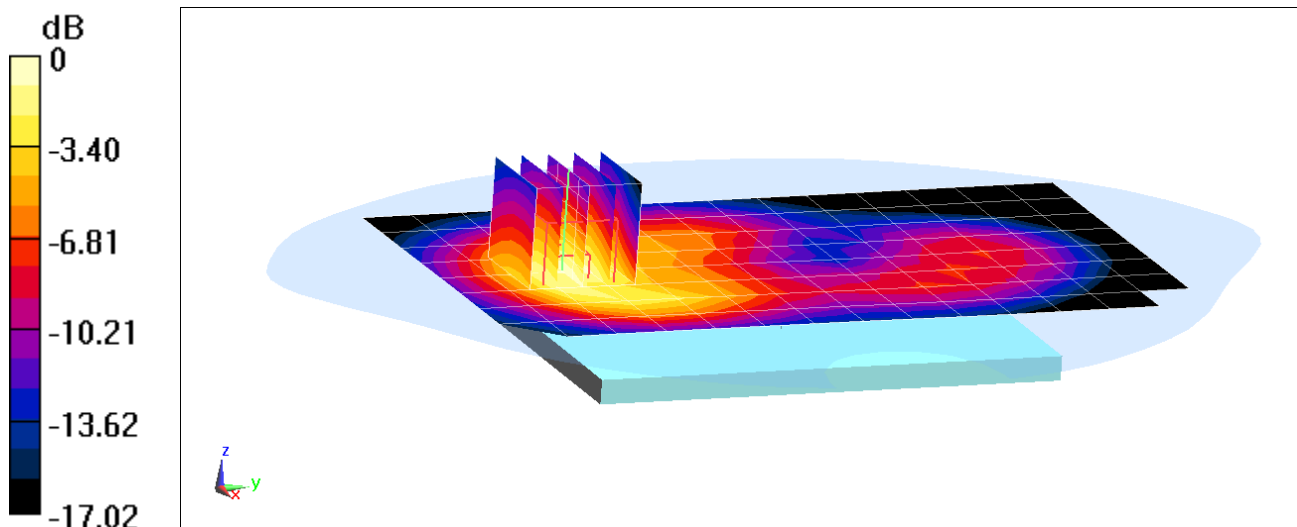
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 20.69 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.02 W/kg

SAR(1 g) = 0.643 W/kg



0 dB = 0.767 W/kg = -1.15 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11521

Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1

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

$f = 1732.4 \text{ MHz}$; $\sigma = 1.434 \text{ S/m}$; $\epsilon_r = 51.921$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3288; ConvF(5.03, 5.03, 5.03); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

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

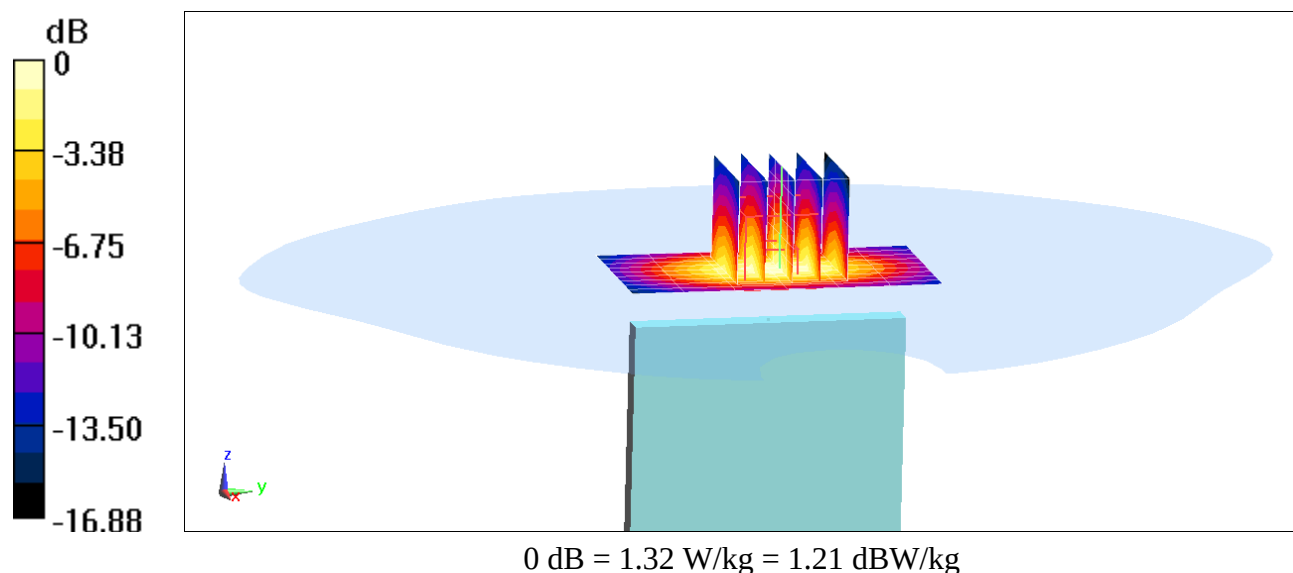
Area Scan (10x7x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 29.06 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 1.78 W/kg

SAR(1 g) = 1.06 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

Communication System: UID 0, GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium: 1900 Body, Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.527 \text{ S/m}$; $\epsilon_r = 52.312$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

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

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

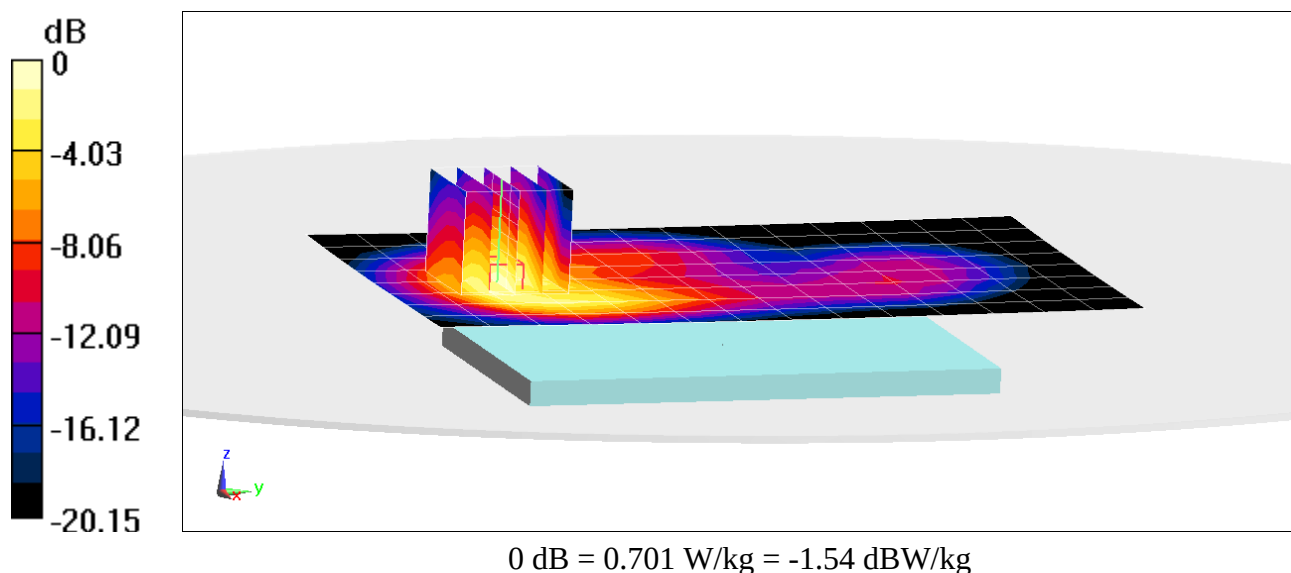
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 18.50 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.959 W/kg

SAR(1 g) = 0.571 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

Communication System: UID 0, GSM GPRS; 4 Tx slots; Frequency: 1850.2 MHz; Duty Cycle: 1:2.076

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

$f = 1850.2 \text{ MHz}$; $\sigma = 1.494 \text{ S/m}$; $\epsilon_r = 52.411$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

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

Mode: GPRS 1900, Body SAR, Back side, Low.ch, 4 Tx Slots

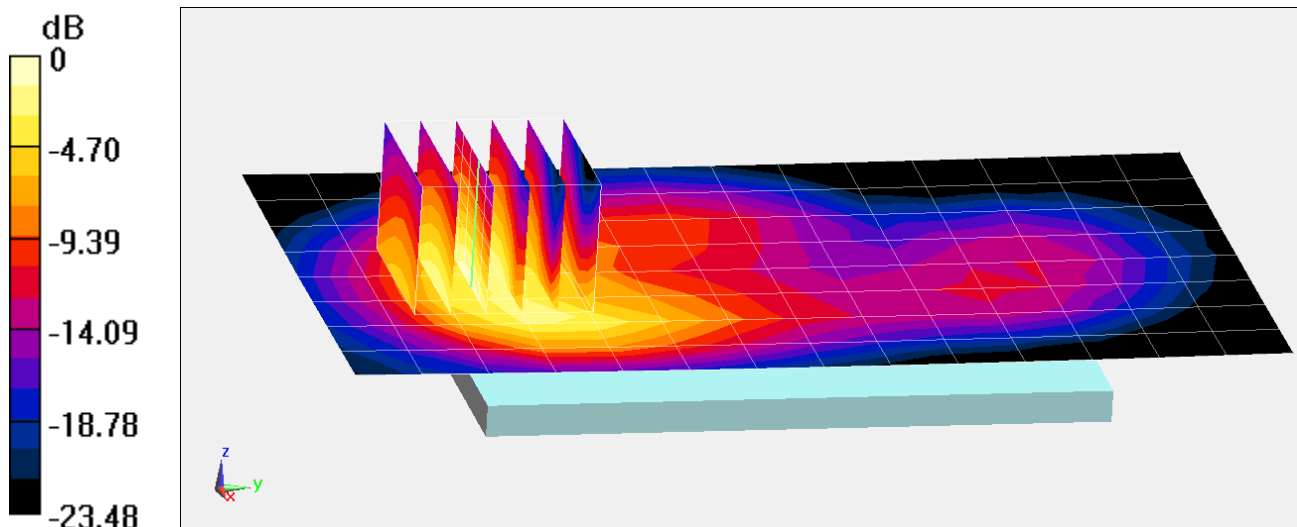
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 22.35 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 1.58 W/kg

SAR(1 g) = 0.931 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

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

Medium: 1900 Body, Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.527 \text{ S/m}$; $\epsilon_r = 52.312$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

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

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

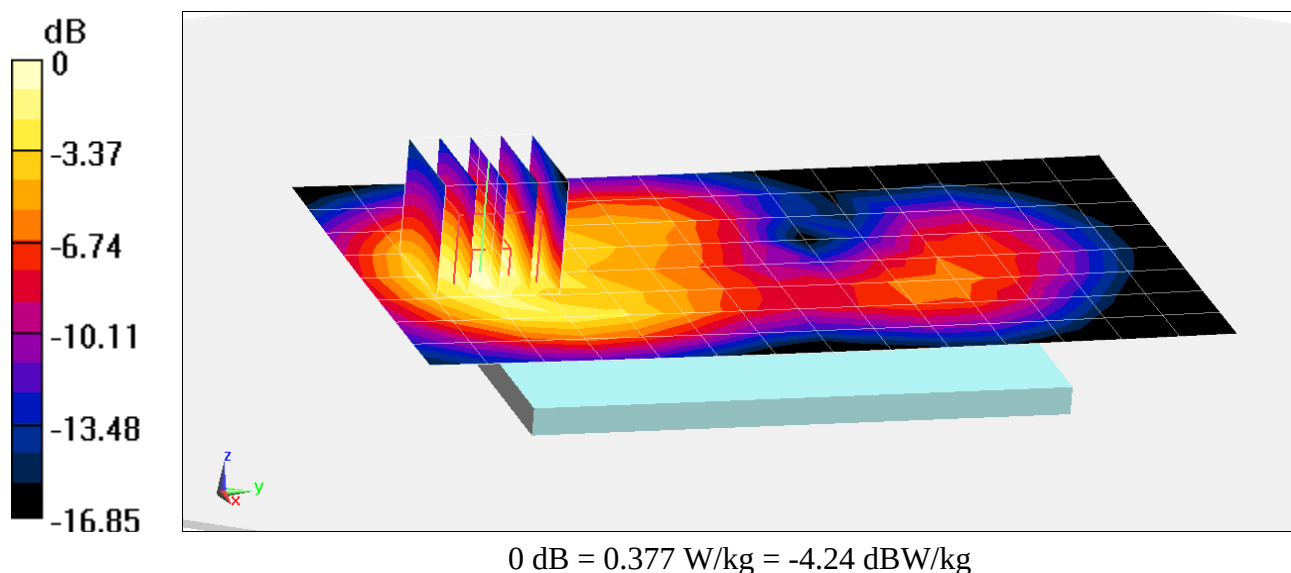
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 15.17 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.498 W/kg

SAR(1 g) = 0.317 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11521

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

Medium: 1900 Body, Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.527 \text{ S/m}$; $\epsilon_r = 52.312$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

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

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

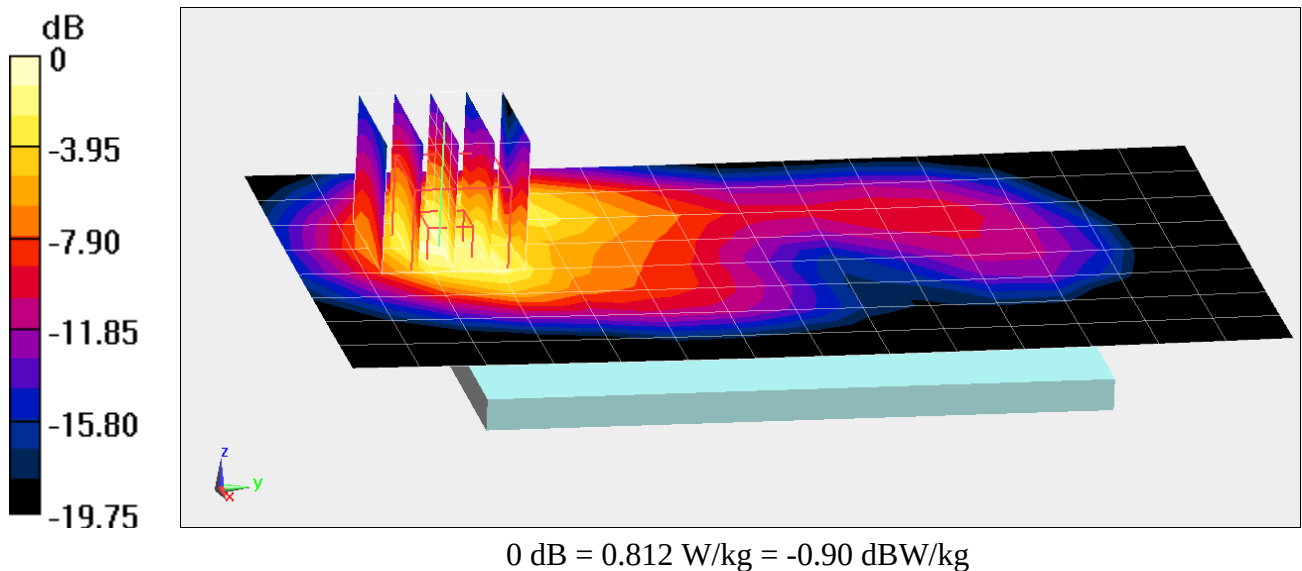
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 20.70 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.09 W/kg

SAR(1 g) = 0.650 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

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

Medium: 740 Body, Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.932 \text{ S/m}$; $\epsilon_r = 54.235$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(6.19, 6.19, 6.19); Calibrated: 5/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/14/2014

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

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

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

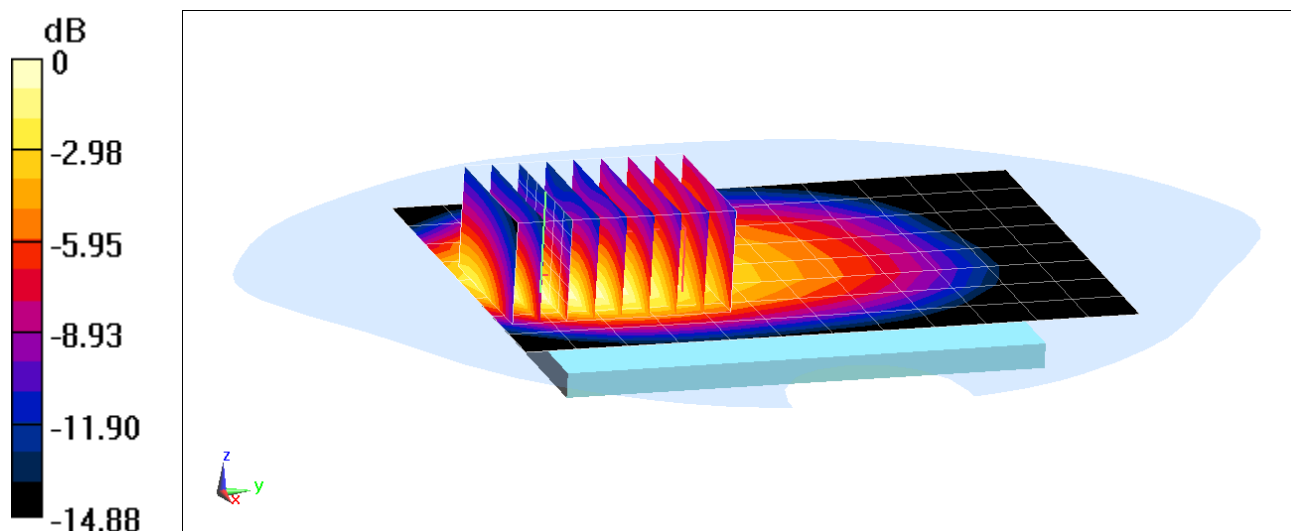
Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm

Zoom Scan (7x9x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 26.18 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.05 W/kg

SAR(1 g) = 0.582 W/kg



0 dB = 0.723 W/kg = -1.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

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

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

$f = 836.5 \text{ MHz}$; $\sigma = 1.004 \text{ S/m}$; $\epsilon_r = 53.833$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 22.6°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

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

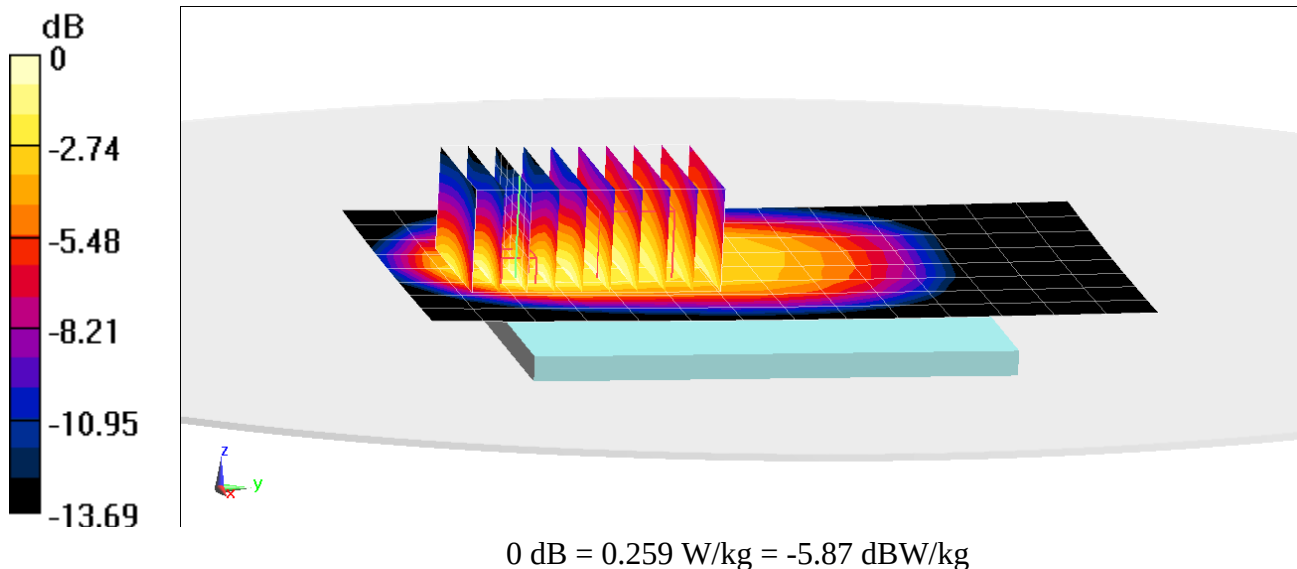
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (7x10x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 15.40 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.368 W/kg

SAR(1 g) = 0.213 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11518

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

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

$f = 836.5 \text{ MHz}$; $\sigma = 1.004 \text{ S/m}$; $\epsilon_r = 53.833$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 22.6°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

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

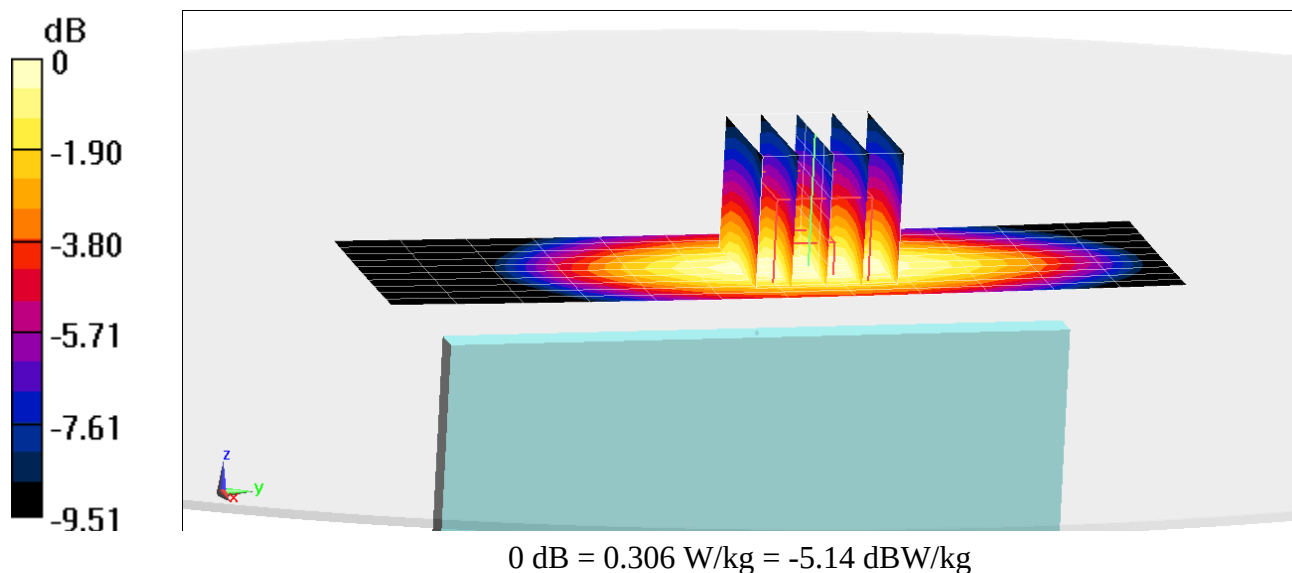
Area Scan (11x13x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 17.09 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 0.380 W/kg

SAR(1 g) = 0.268 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11520

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

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

$f = 1732.5 \text{ MHz}$; $\sigma = 1.434 \text{ S/m}$; $\epsilon_r = 51.921$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-28-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3288; ConvF(5.03, 5.03, 5.03); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

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

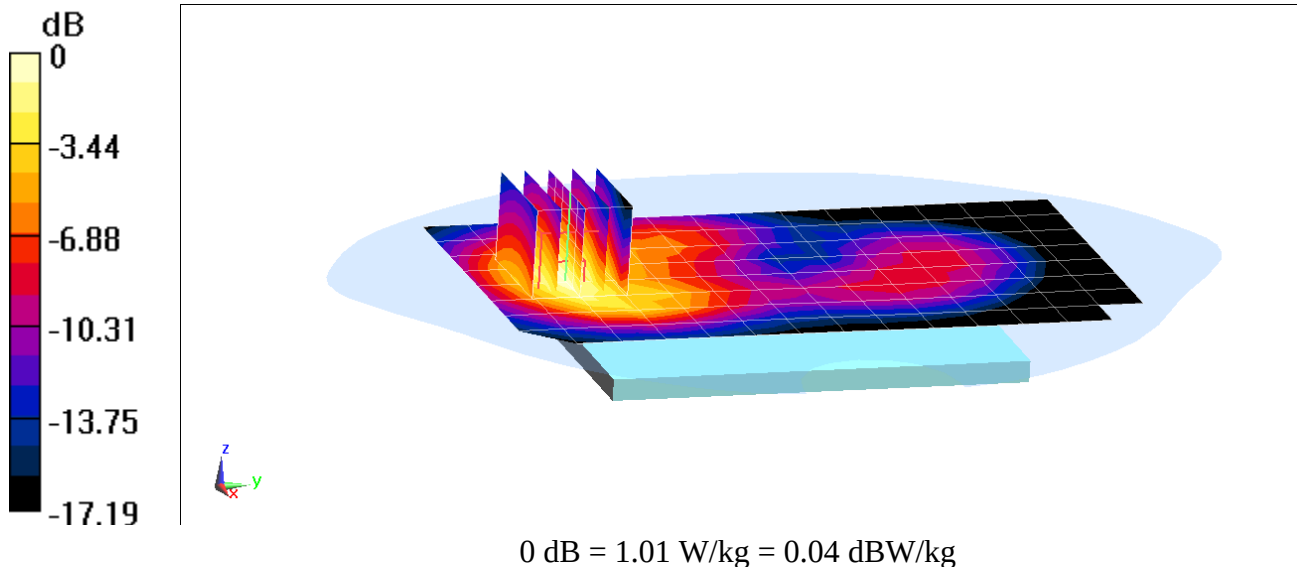
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Zoom Scan (6x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 25.85 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.35 W/kg

SAR(1 g) = 0.847 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11521

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

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

$f = 1732.5$ MHz; $\sigma = 1.434$ S/m; $\epsilon_r = 51.921$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3288; ConvF(5.03, 5.03, 5.03); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

**Mode: LTE Band 4 (AWS), Body SAR, Bottom Edge, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

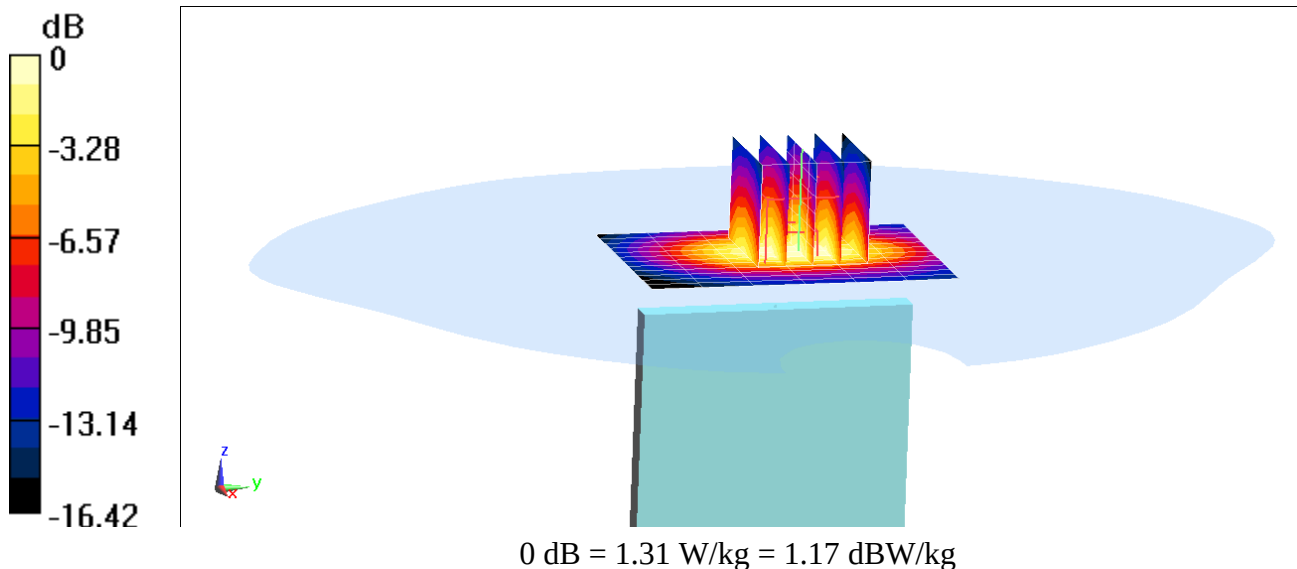
Area Scan (13x7x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 30.44 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 1.75 W/kg

SAR(1 g) = 1.07 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11525

Communication System: UID 0, LTE Band 2 (PCS) Frequency: 1860 MHz; Duty Cycle: 1:1

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

$f = 1860 \text{ MHz}$; $\sigma = 1.505 \text{ S/m}$; $\epsilon_r = 52.379$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

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

**Mode: LTE Band 2 (PCS), Body SAR, Back side, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

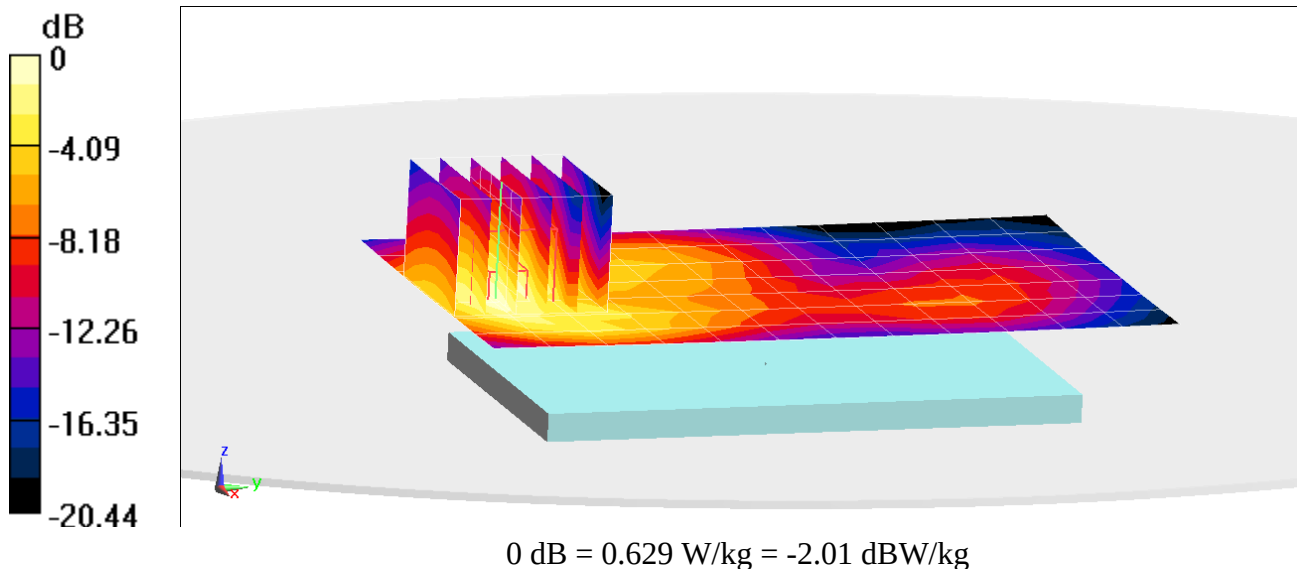
Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 19.55 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.862 W/kg

SAR(1 g) = 0.542 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11521

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

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

$f = 1900 \text{ MHz}$; $\sigma = 1.551 \text{ S/m}$; $\epsilon_r = 52.251$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

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

**Mode: LTE Band 2 (PCS), Body SAR, Bottom Edge, High.ch,
20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset**

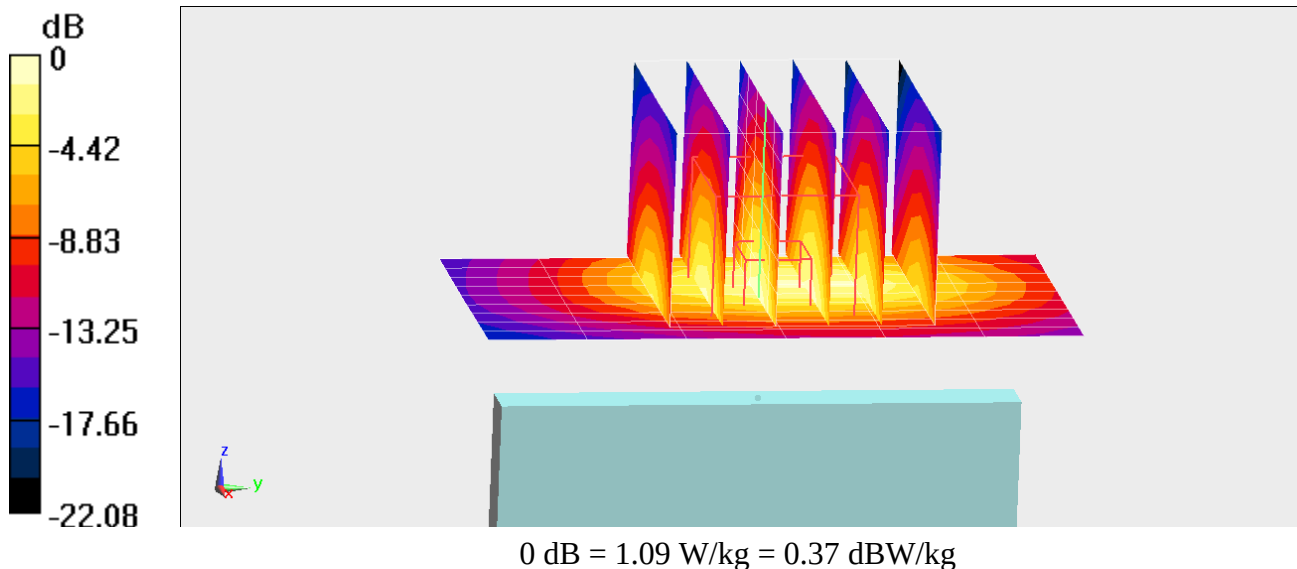
Area Scan (10x7x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 22.09 V/m; Power Drift = -0.15 dB

Peak SAR (extrapolated) = 1.50 W/kg

SAR(1 g) = 0.902 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 1164B

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

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

$f = 2462 \text{ MHz}$; $\sigma = 2.013 \text{ S/m}$; $\epsilon_r = 51.688$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 22.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/17/2014

Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715

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

Mode: IEEE 802.11b, Body SAR, Ch 11, 1 Mbps, Back Side, Antenna 2

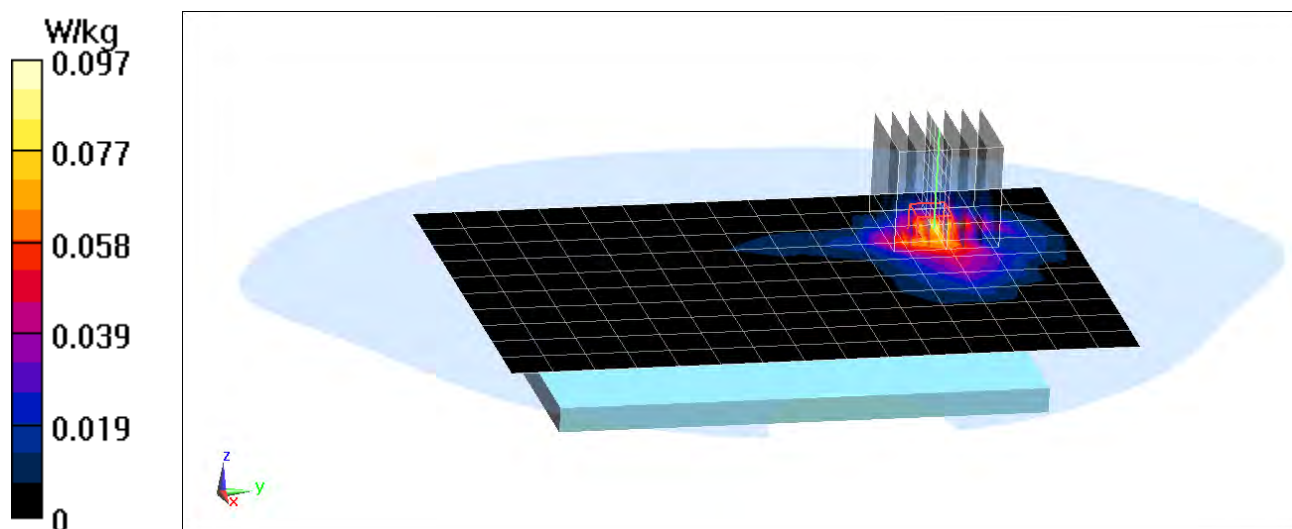
Area Scan (11x16x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 6.107 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.164 W/kg

SAR(1 g) = 0.075 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 1164B

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

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

$f = 2462 \text{ MHz}$; $\sigma = 2.013 \text{ S/m}$; $\epsilon_r = 51.688$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 22.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/17/2014

Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715

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

Mode: IEEE 802.11b, Body SAR, Ch 11, 1 Mbps, Top Edge, Antenna 1

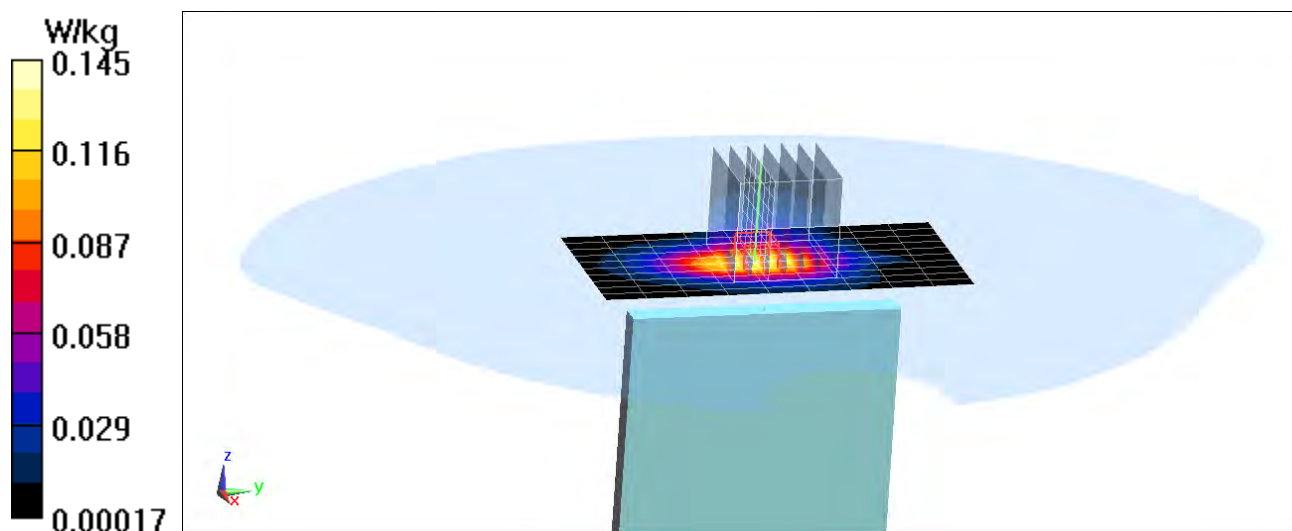
Area Scan (11x10x1): Measurement grid: $dx=5\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 7.768 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 0.228 W/kg

SAR(1 g) = 0.114 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11656

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band, Frequency: 5320 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body, Medium parameters used:

$f = 5320 \text{ MHz}$; $\sigma = 5.601 \text{ S/m}$; $\epsilon_r = 47.596$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-30-2015; Ambient Temp: 22.5°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN3920; ConvF(4.16, 4.16, 4.16); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

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

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

**Mode: IEEE 802.11a, U-NII-2A, 20 MHz Bandwidth, Body SAR,
Ch 64, 6 Mbps, Back Side, Antenna 2**

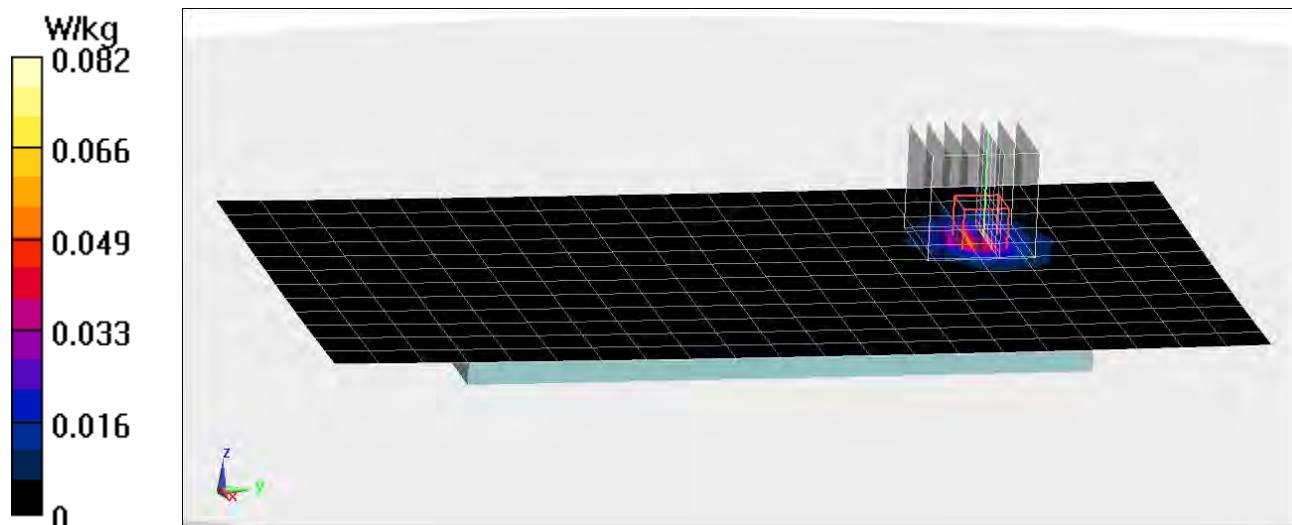
Area Scan (13x22x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

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 = 2.534 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.171 W/kg

SAR(1 g) = 0.032 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG920T; Type: Portable Handset; Serial: 11656

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5825 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body, Medium parameters used:

$f = 5825 \text{ MHz}$; $\sigma = 6.302 \text{ S/m}$; $\epsilon_r = 46.809$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-30-2015; Ambient Temp: 23.8°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN3920; ConvF(3.93, 3.93, 3.93); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

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

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

**Mode: IEEE 802.11a, U-NII-3, 20 MHz Bandwidth, Body SAR,
Ch 165, 6 Mbps, Front Side, Antenna 1**

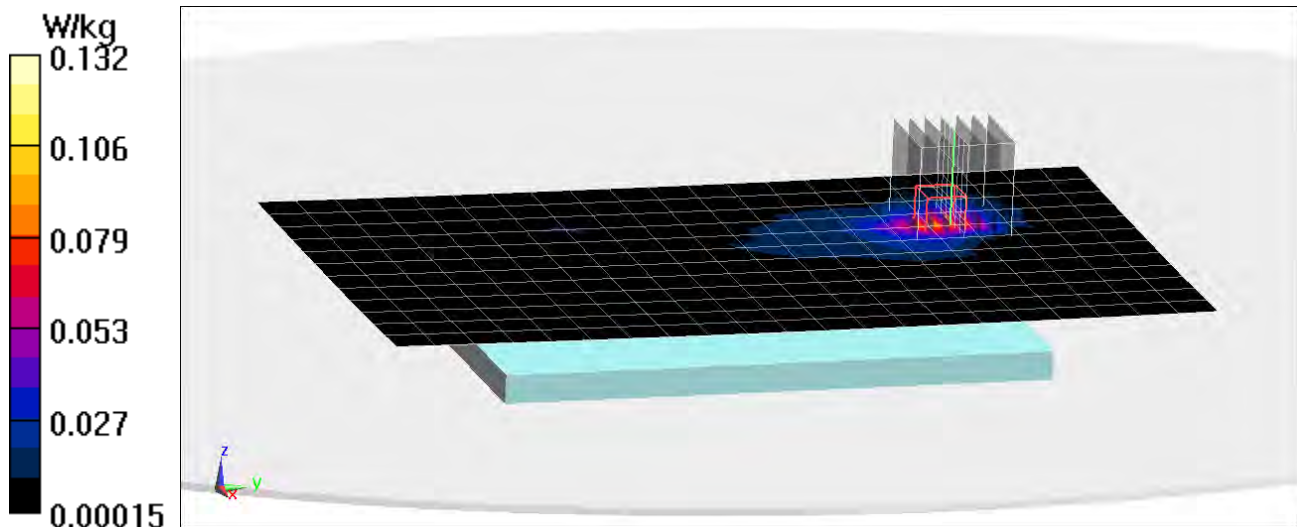
Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm

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

Reference Value = 2.745 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 0.264 W/kg

SAR(1 g) = 0.053 W/kg



APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1054

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

Medium: 750 Head, Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.919 \text{ S/m}$; $\epsilon_r = 41.523$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 02-03-2015; Ambient Temp: 24.5°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3288; ConvF(6.81, 6.81, 6.81); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

750 MHz System Verification

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

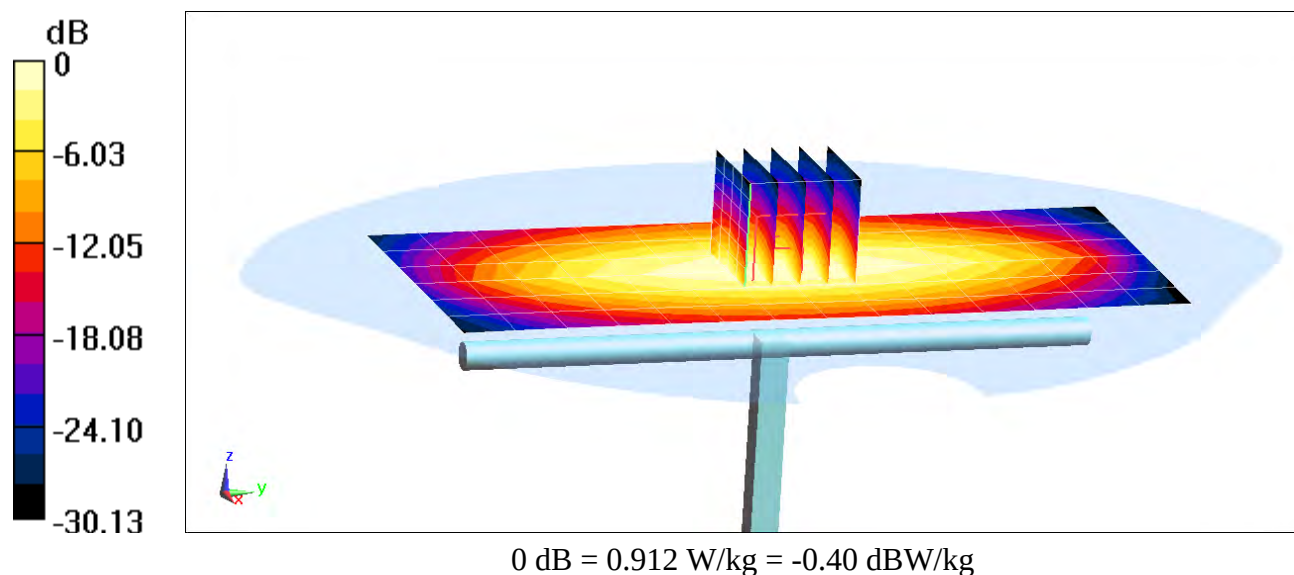
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.21 W/kg

SAR(1 g) = 0.800 W/kg

Deviation = -3.96%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d133

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

Medium: 835 Head, Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.897 \text{ S/m}$; $\epsilon_r = 42.105$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-28-2015; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(6.27, 6.27, 6.27); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: SAM Front; Type: SAM; Serial: 1686

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

835 MHz System Validation

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

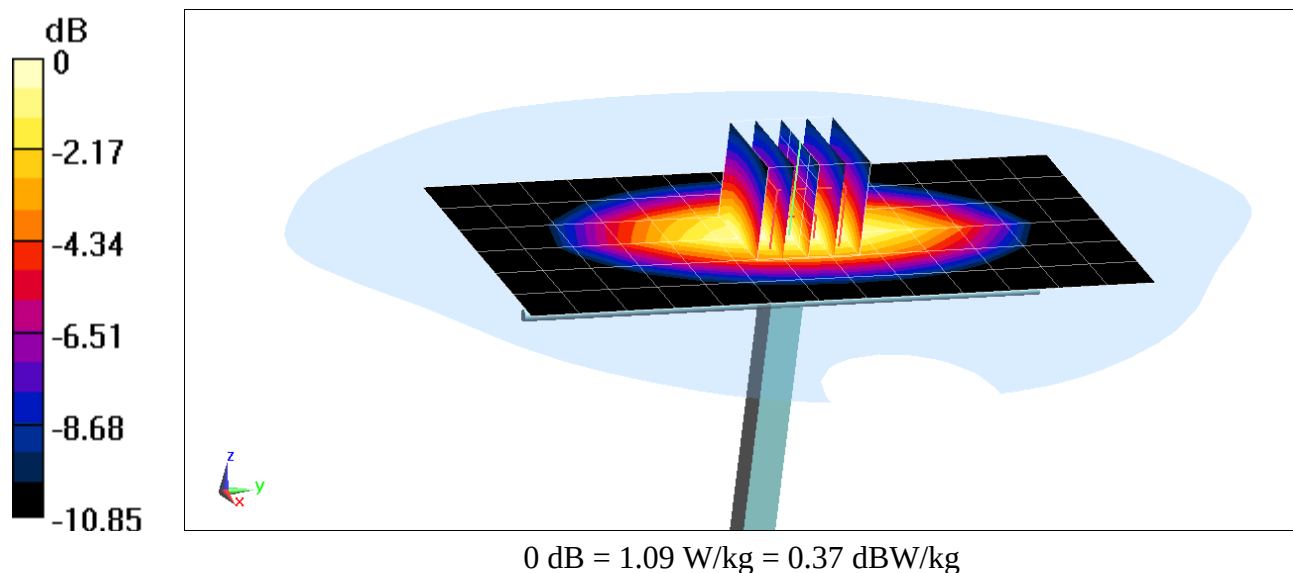
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.41 W/kg

SAR(1 g) = 0.949 W/kg

Deviation = 3.15%



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 Head, Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.392 \text{ S/m}$; $\epsilon_r = 39.242$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 22.9°C; Tissue Temp: 21.7°C

Probe: ES3DV2 - SN3022; ConvF(5.04, 5.04, 5.04); Calibrated: 8/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/12/2014

Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800

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

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm

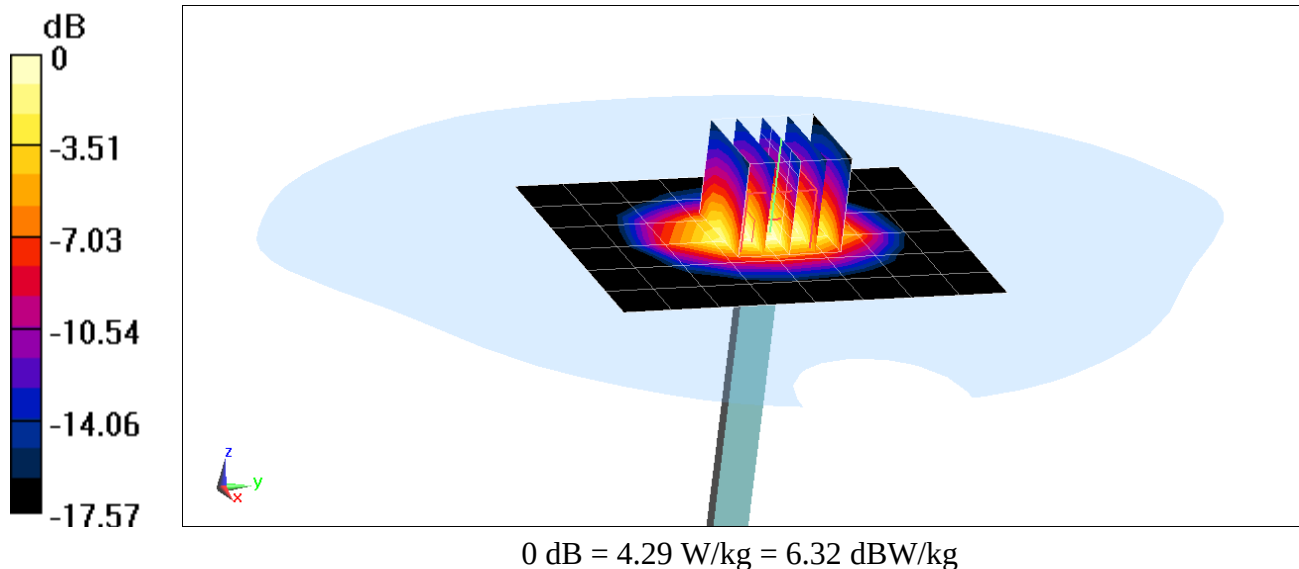
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.20 W/kg

SAR(1 g) = 3.45 W/kg

Deviation = -6.50%



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 Head, Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.411 \text{ S/m}$; $\epsilon_r = 38.163$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 23.5°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/14/2014

Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687

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

1900 MHz System Verification

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

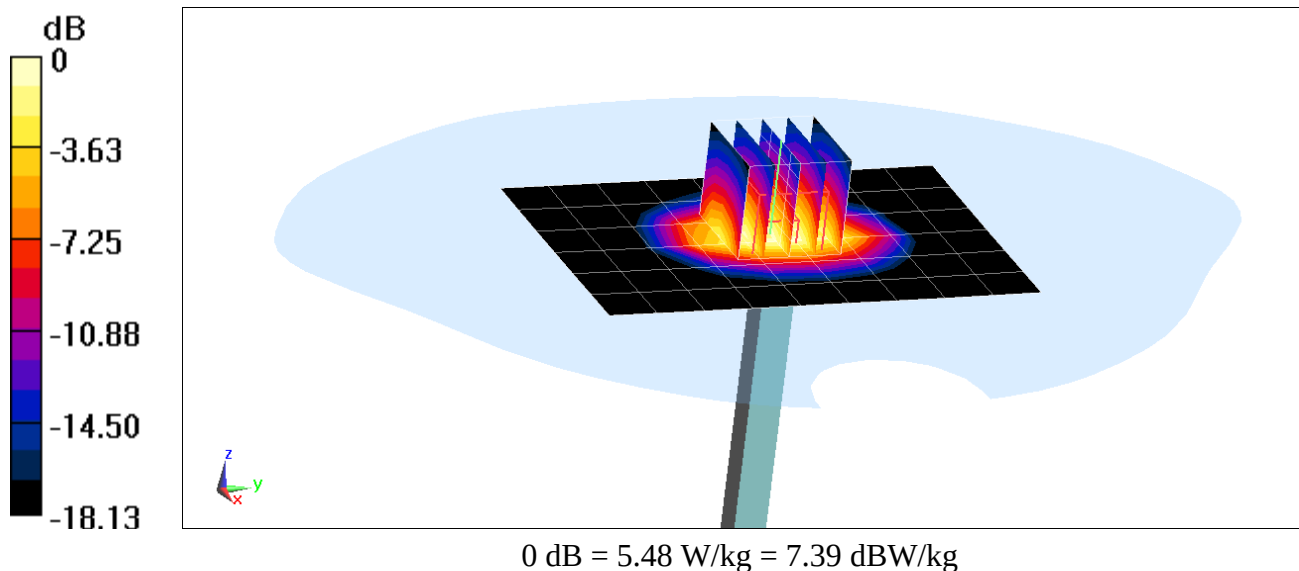
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.98 W/kg

SAR(1 g) = 4.32 W/kg

Deviation = 7.46%



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 Head, Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.797 \text{ S/m}$; $\epsilon_r = 37.953$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 02-02-2015; Ambient Temp: 24.1°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(4.52, 4.52, 4.52); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: SAM Front; Type: SAM; Serial: 1686

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

2450 MHz System Verification

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

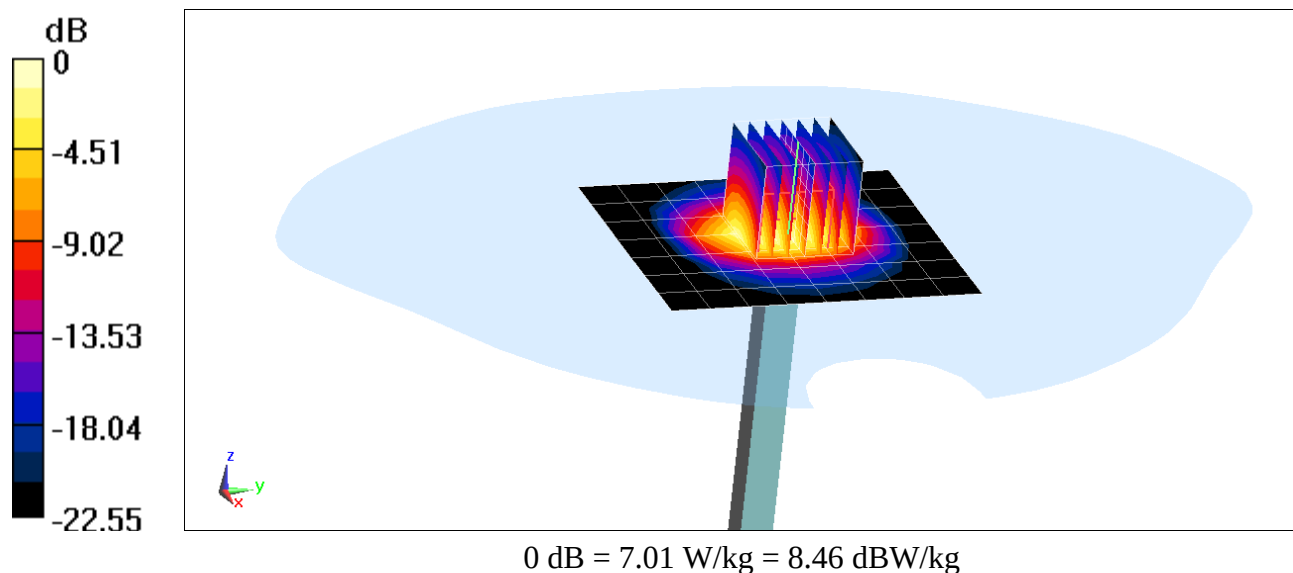
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 10.6 W/kg

SAR(1 g) = 5.07 W/kg

Deviation = -2.69%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Head, Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 4.627 \text{ S/m}$; $\epsilon_r = 37.125$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-27-2015; Ambient Temp: 24.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3920; ConvF(4.69, 4.69, 4.69); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

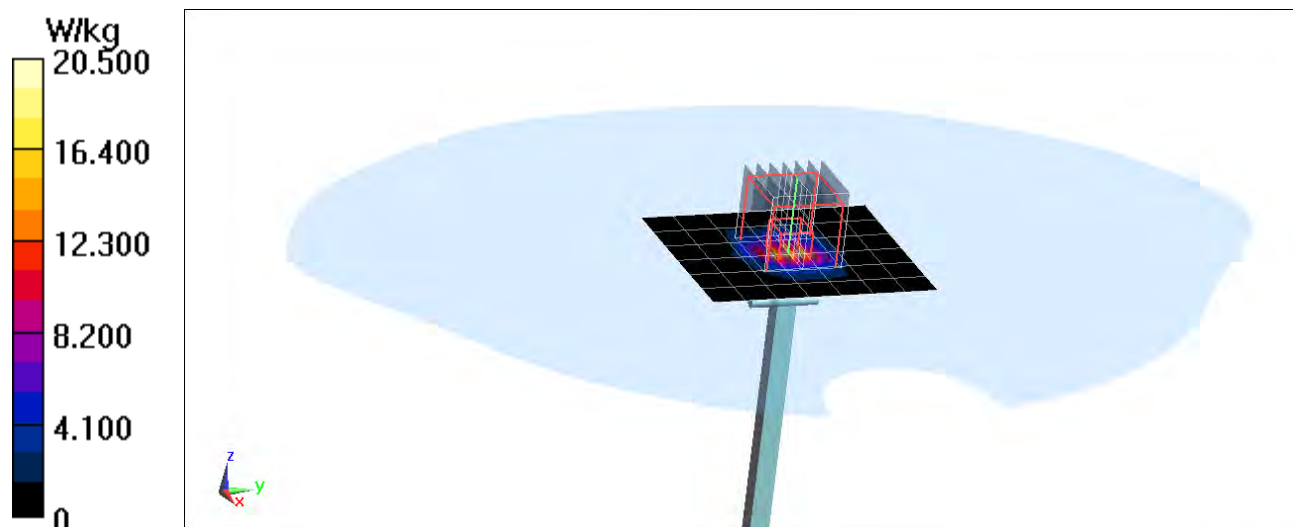
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 33.0 W/kg

SAR(1 g) = 8.17 W/kg

Deviation = -2.04%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Head, Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 4.847 \text{ S/m}$; $\epsilon_r = 36.818$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-27-2015; Ambient Temp: 24.0°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3920; ConvF(4.44, 4.44, 4.44); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

5500 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm

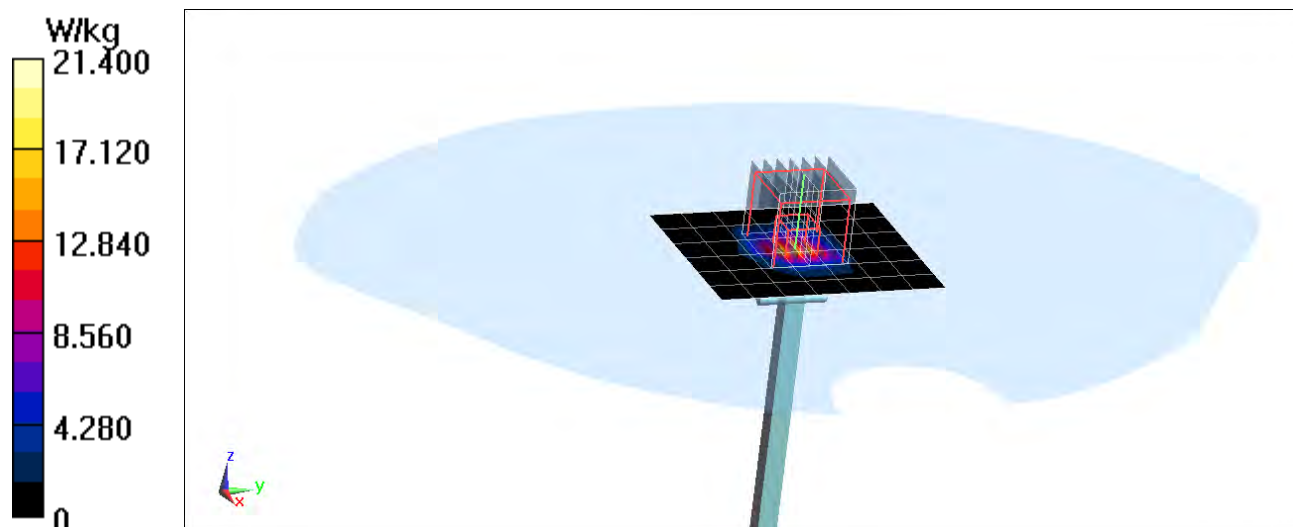
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 33.8 W/kg

SAR(1 g) = 8.36 W/kg

Deviation = -1.53%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Head, Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 4.951 \text{ S/m}$; $\epsilon_r = 36.628$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-27-2015; Ambient Temp: 23.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3920; ConvF(4.35, 4.35, 4.35); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: SAM, Left; Type: QD000P40CD; Serial: TP:1759

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

5600 MHz System Verification

Area Scan (7x7x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

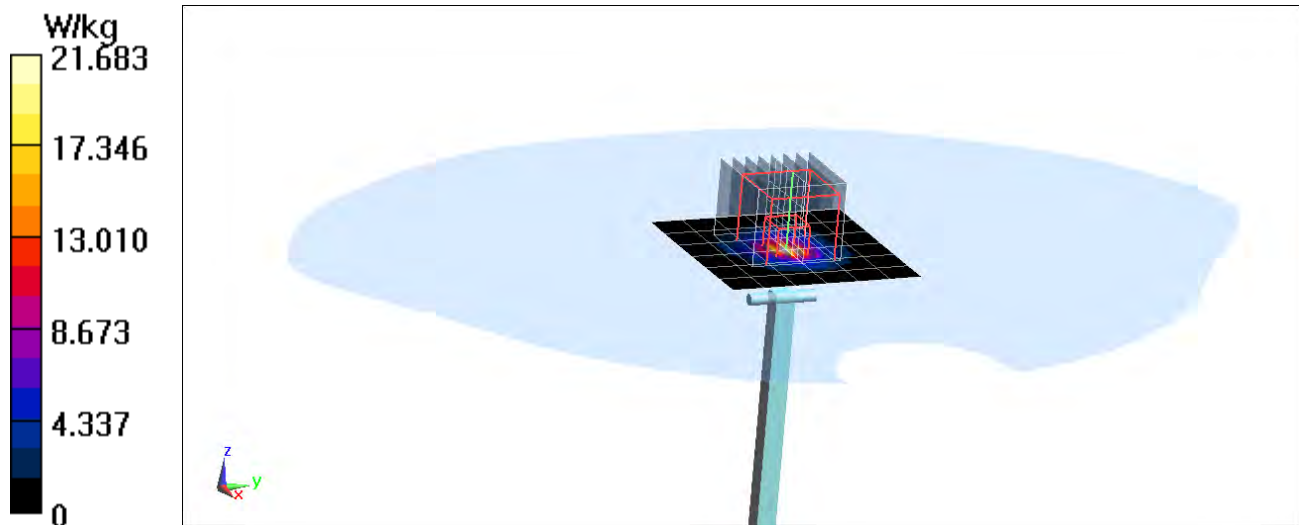
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 36.8 W/kg

SAR(1 g) = 8.43 W/kg

Deviation = 2.55%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1054

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

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

$f = 750 \text{ MHz}$; $\sigma = 0.97 \text{ S/m}$; $\epsilon_r = 53.792$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(6.19, 6.19, 6.19); Calibrated: 5/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/14/2014

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

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

750 MHz System Verification

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

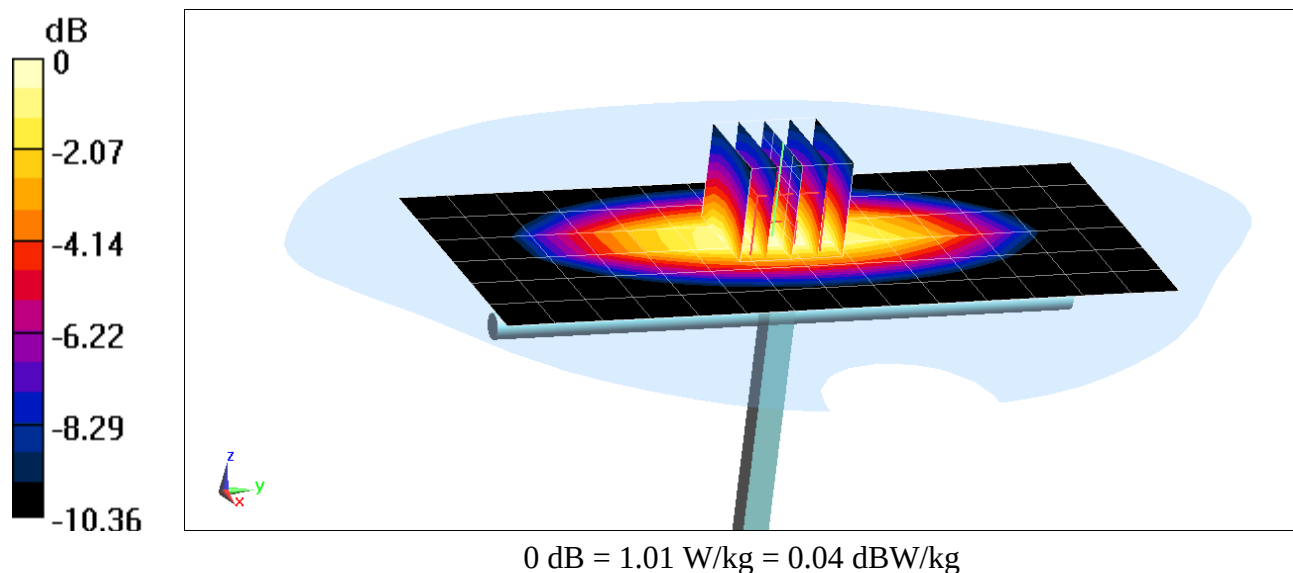
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.27 W/kg

SAR(1 g) = 0.867 W/kg

Deviation = 0.35%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d133

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

Medium: 835 Body, Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 1.002 \text{ S/m}$; $\epsilon_r = 53.848$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-28-2015; Ambient Temp: 22.6°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

835 MHz System Verification

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

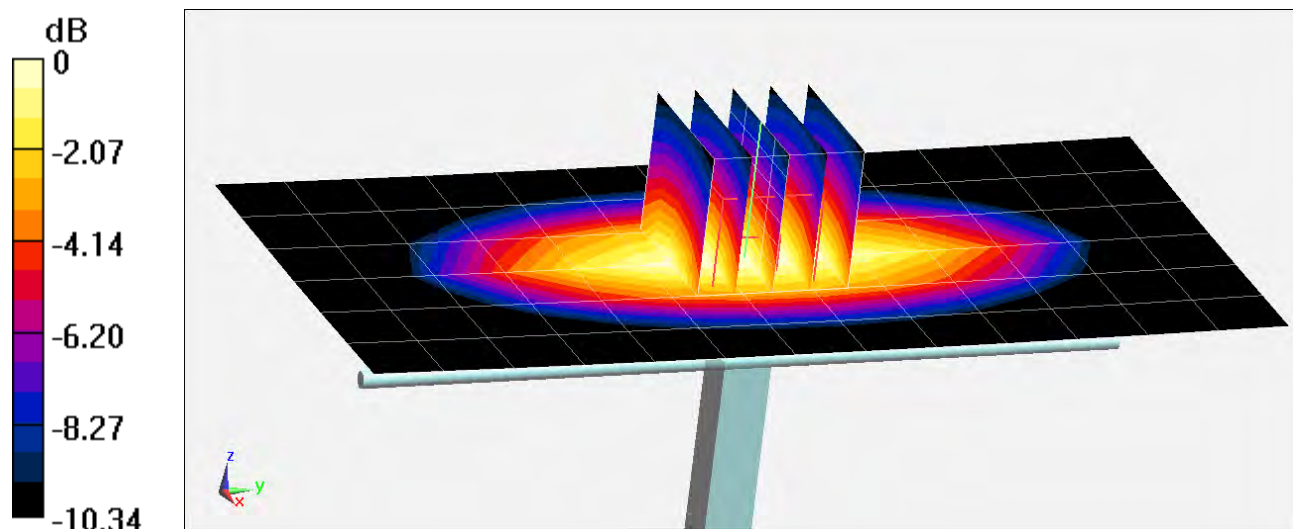
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 1.47 W/kg

SAR(1 g) = 0.997 W/kg

Deviation = 6.63%



0 dB = 1.16 W/kg = 0.64 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:

$f = 1750 \text{ MHz}$; $\sigma = 1.454 \text{ S/m}$; $\epsilon_r = 51.87$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-28-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.1°C

Probe: ES3DV3 - SN3288; ConvF(5.03, 5.03, 5.03); Calibrated: 9/24/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 9/18/2014

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

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

1750 MHz System Verification

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

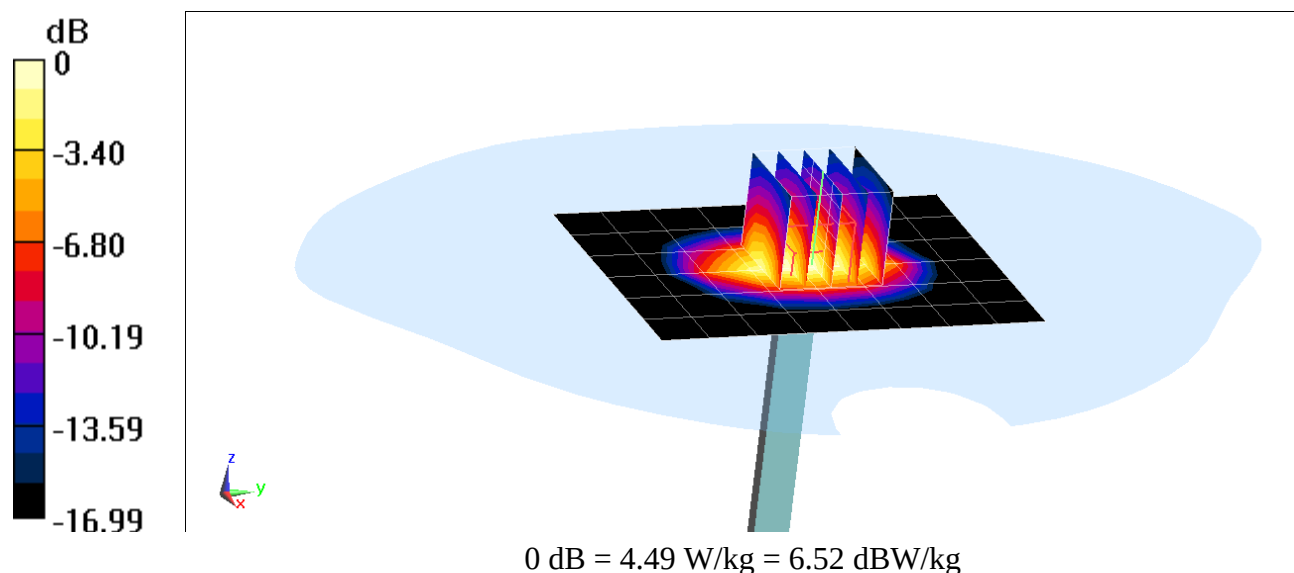
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.39 W/kg

SAR(1 g) = 3.64 W/kg

Deviation = -3.19%



PCTEST ENGINEERING LABORATORY, INC.

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

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

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

$f = 1900 \text{ MHz}$; $\sigma = 1.551 \text{ S/m}$; $\epsilon_r = 52.251$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-29-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.9°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

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

1900 MHz System Verification

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

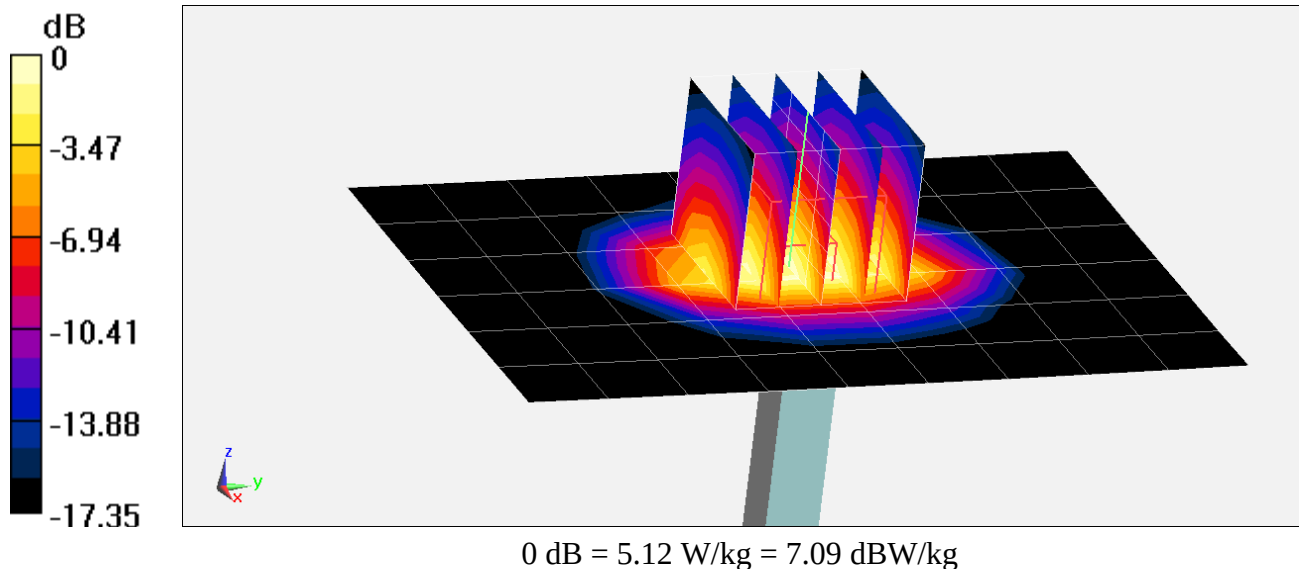
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.05 W/kg

SAR(1 g) = 4.08 W/kg

Deviation = 0.49%



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:

$f = 2450 \text{ MHz}$; $\sigma = 1.997 \text{ S/m}$; $\epsilon_r = 51.723$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-26-2015; Ambient Temp: 22.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(4.2, 4.2, 4.2); Calibrated: 3/19/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1334; Calibrated: 3/17/2014

Phantom: SAM left; Type: QD000P40CD; Serial: TP:1715

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

2450 MHz System Verification

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

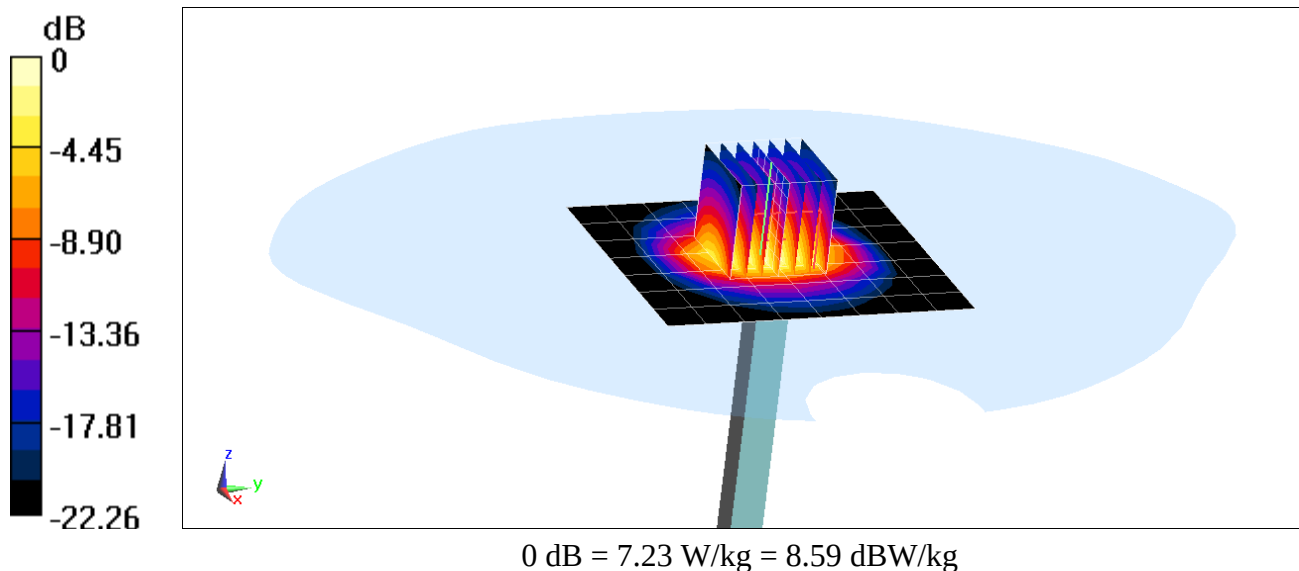
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 11.9 W/kg

SAR(1 g) = 5.47 W/kg

Deviation = 5.60%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Body, Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 5.592 \text{ S/m}$; $\epsilon_r = 47.736$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-30-2015; Ambient Temp: 22.5°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN3920; ConvF(4.16, 4.16, 4.16); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

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

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

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

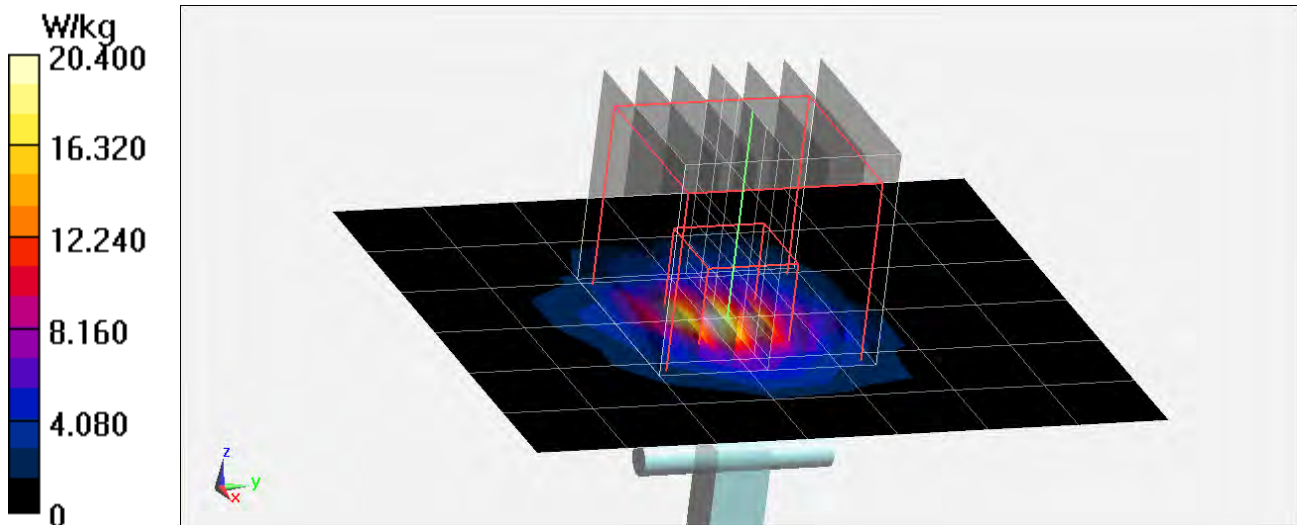
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 32.8 W/kg

SAR(1 g) = 7.99 W/kg

Deviation = 5.41%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Body, Medium parameters used:

$f = 5500 \text{ MHz}$; $\sigma = 5.863 \text{ S/m}$; $\epsilon_r = 47.307$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-30-2015; Ambient Temp: 22.8°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN3920; ConvF(3.79, 3.79, 3.79); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

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

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

5500 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

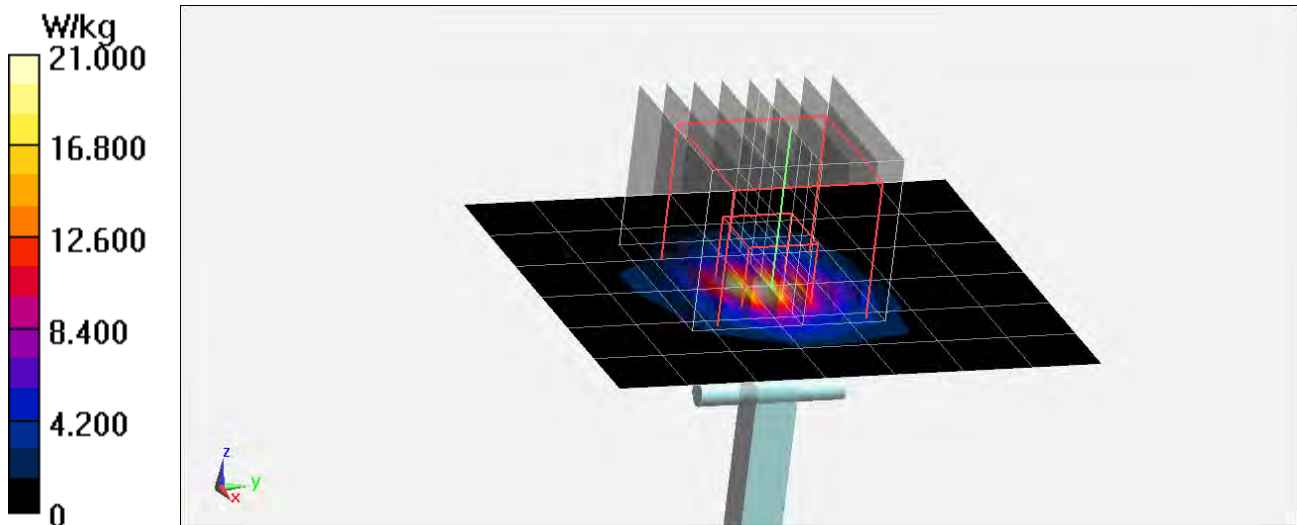
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 34.3 W/kg

SAR(1 g) = 8.16 W/kg

Deviation = 3.03%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Body, Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.989 \text{ S/m}$; $\epsilon_r = 47.154$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-30-2015; Ambient Temp: 23.0°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN3920; ConvF(3.66, 3.66, 3.66); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

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

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

5600 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

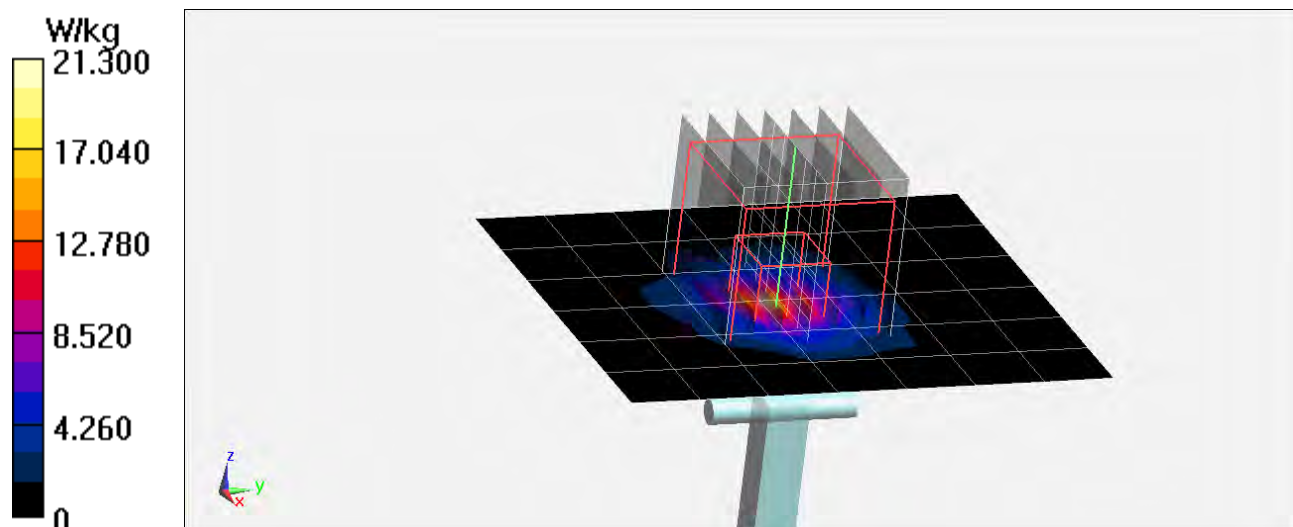
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 34.8 W/kg

SAR(1 g) = 8.12 W/kg

Deviation = 2.27%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1120

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

Medium: 5 GHz Body, Medium parameters used:

$f = 5800 \text{ MHz}$; $\sigma = 6.257 \text{ S/m}$; $\epsilon_r = 46.878$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-30-2015; Ambient Temp: 23.8°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN3920; ConvF(3.93, 3.93, 3.93); Calibrated: 12/12/2014;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

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

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

5800 MHz System Verification

Area Scan (7x8x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

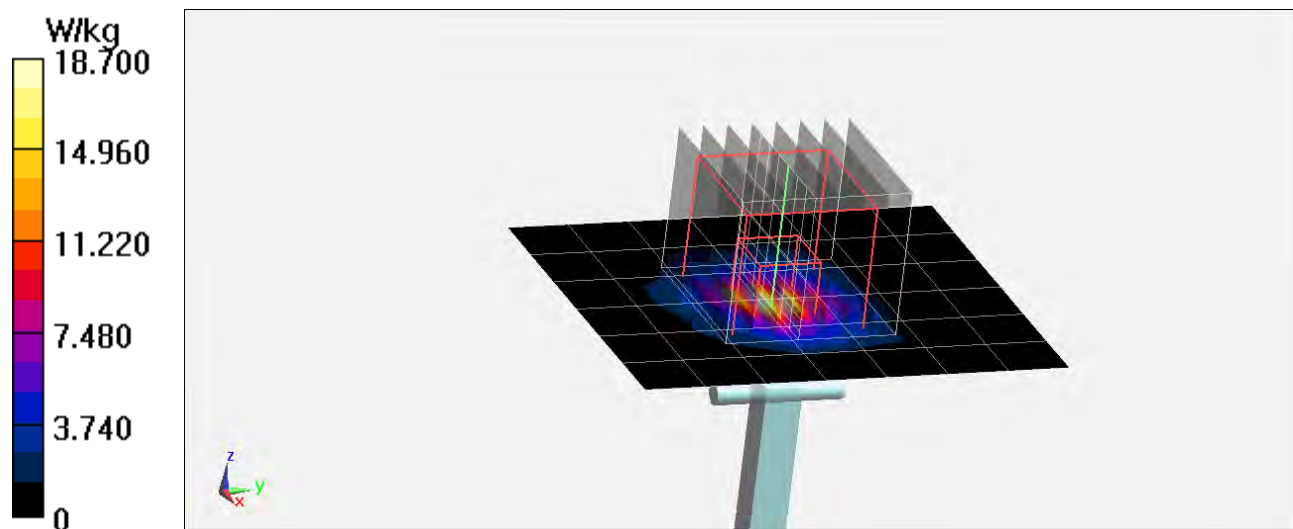
Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 34.1 W/kg

SAR(1 g) = 7.49 W/kg

Deviation = 0.67%



APPENDIX C: PROBE CALIBRATION



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Client **PC Test**

Certificate No: **D750V3-1054_Mar14**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1054**

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

Calibration date: **March 17, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	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** Function: **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** Technical Manager

Issued: March 17, 2014

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

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

Calibration is Performed According to the Following Standards:

- 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	40.6 $\pm$ 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	2.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.33 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	1.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.42 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	55.2 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.64 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	1.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.69 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$55.1 \Omega + 0.7 j\Omega$
Return Loss	- 26.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.5 \Omega - 2.8 j\Omega$
Return Loss	- 29.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.035 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 08, 2011

DASY5 Validation Report for Head TSL

Date: 17.03.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1054

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

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.92 \text{ S/m}$; $\epsilon_r = 40.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.37, 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:

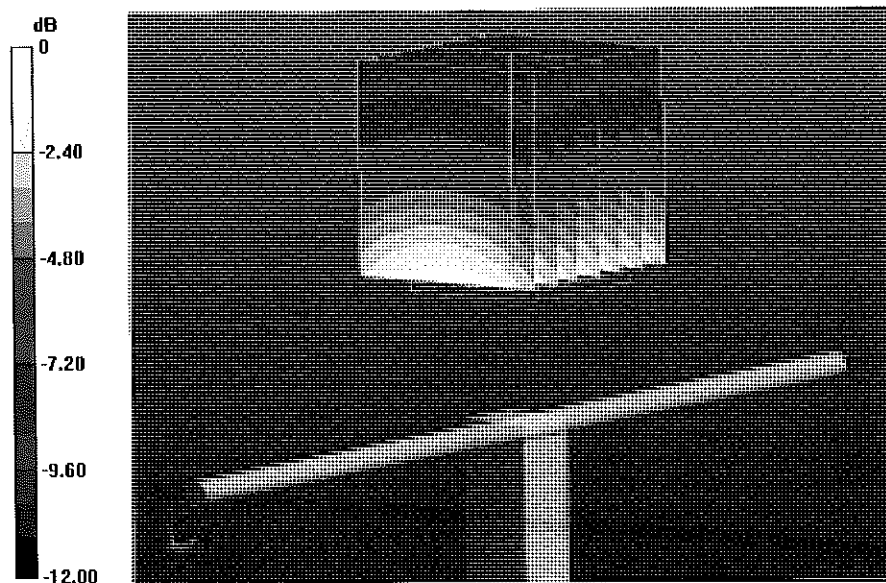
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.851 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.25 W/kg

SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.39 W/kg

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

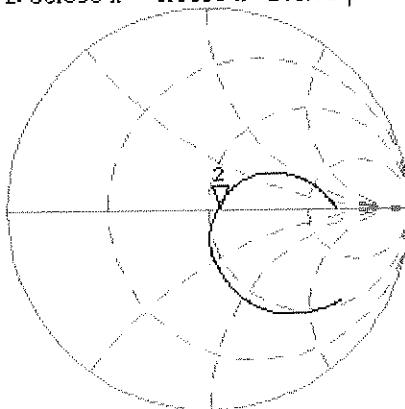


0 dB = 2.51 W/kg = 4.00 dBW/kg

Impedance Measurement Plot for Head TSL

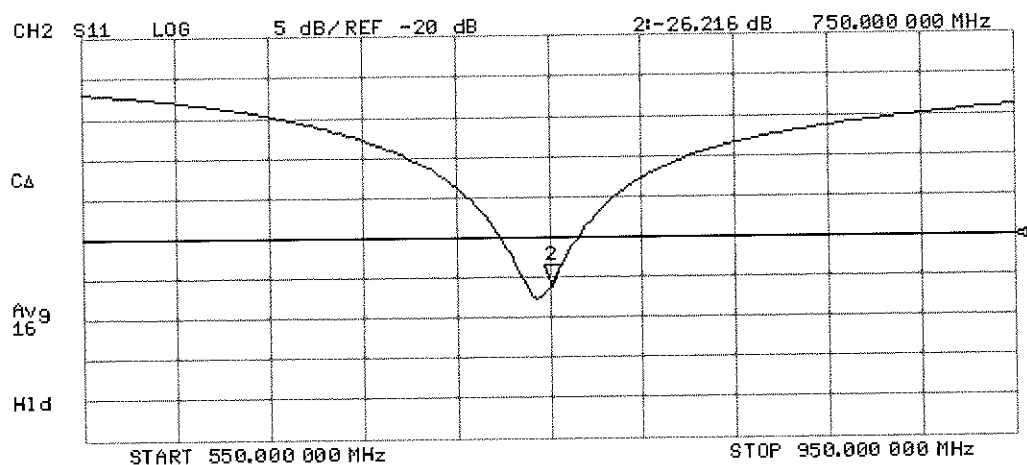
17 Mar 2014 15:32:32
[CH1] S11 1 U FS 2: 55.090 Ω 0.6895 Ω 146.31 pF 750.000 000 MHz

*
De1
CA



Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 14.03.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1054

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

Medium parameters used: $f = 750$ MHz; $\sigma = 1$ S/m; $\epsilon_r = 55.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.13, 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:

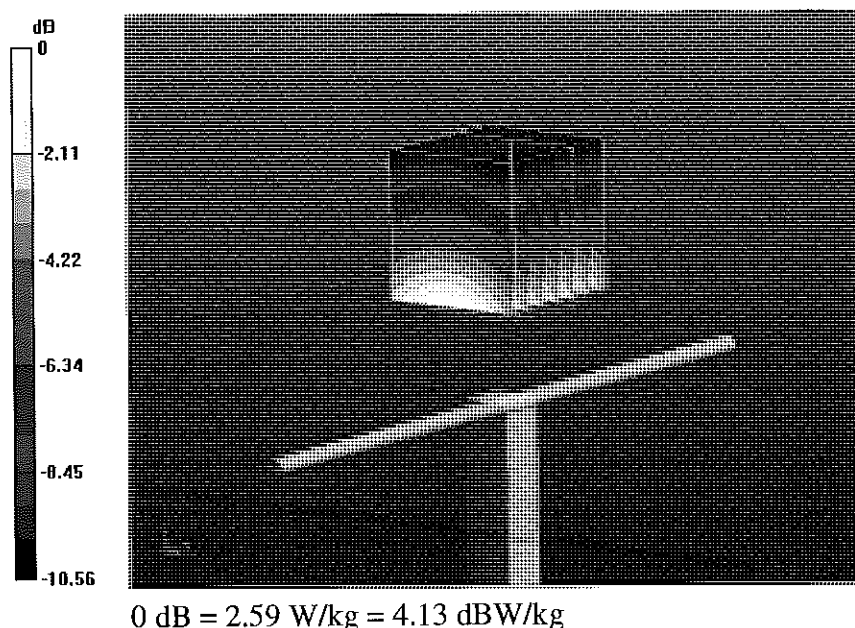
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 52.788 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 3.27 W/kg

SAR(1 g) = 2.23 W/kg; SAR(10 g) = 1.46 W/kg

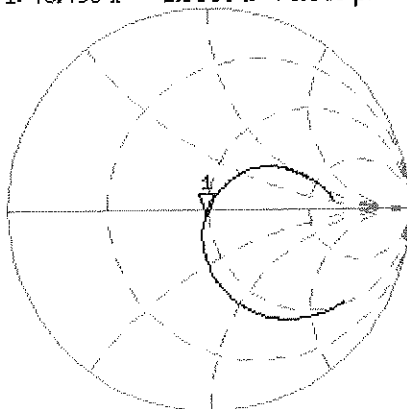
Maximum value of SAR (measured) = 2.59 W/kg



Impedance Measurement Plot for Body TSL

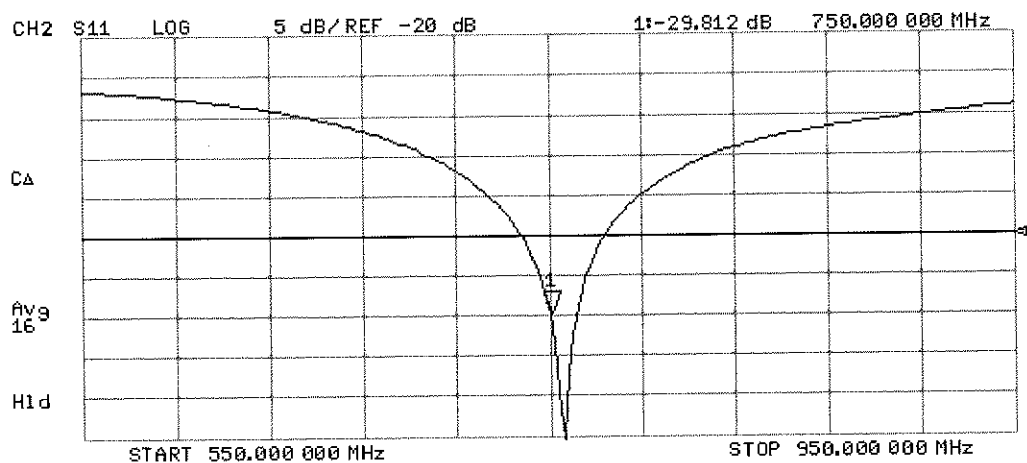
14 Mar 2014 17:44:13
CH1 S11 1 U FS 1: 48.496 Ω -2.8066 Ω 75.609 pF 750.000 000 MHz

*
De1
CA



AVG
16

H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d133_Jul14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d133**

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

CC
W/CM

Calibration date: **July 24, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8763E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Name** **Function**
Jeton Kastrali **Laboratory Technician**

Signature

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

Issued: July 24, 2014

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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 1528-2013, "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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.1 $\pm$ 6 %	0.94 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	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.20 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	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.96 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	53.8 $\pm$ 6 %	1.02 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	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.35 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	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.15 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.6 Ω - 1.0 j Ω
Return Loss	- 34.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8 Ω - 3.3 j Ω
Return Loss	- 27.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.395 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 24.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d133

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

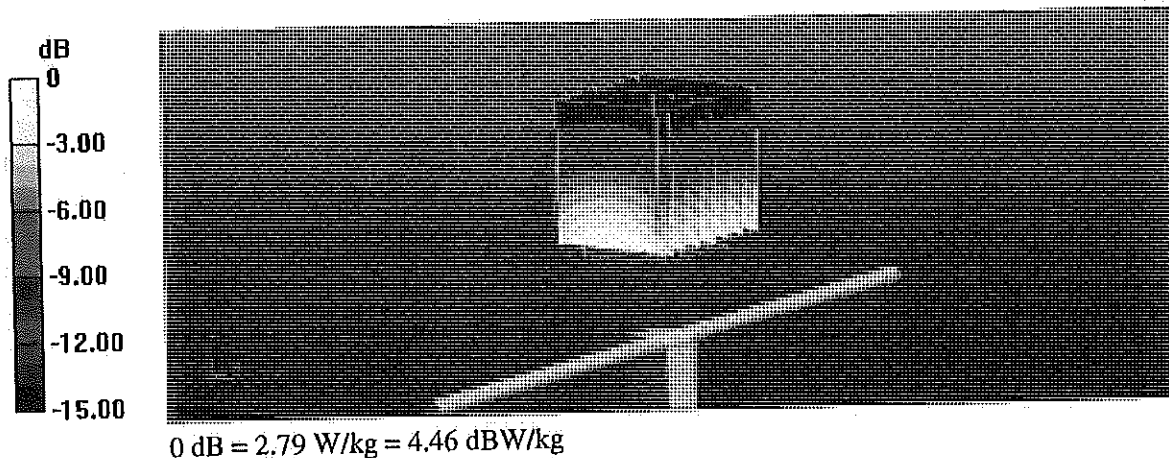
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.07 V/m; Power Drift = 0.03 dB

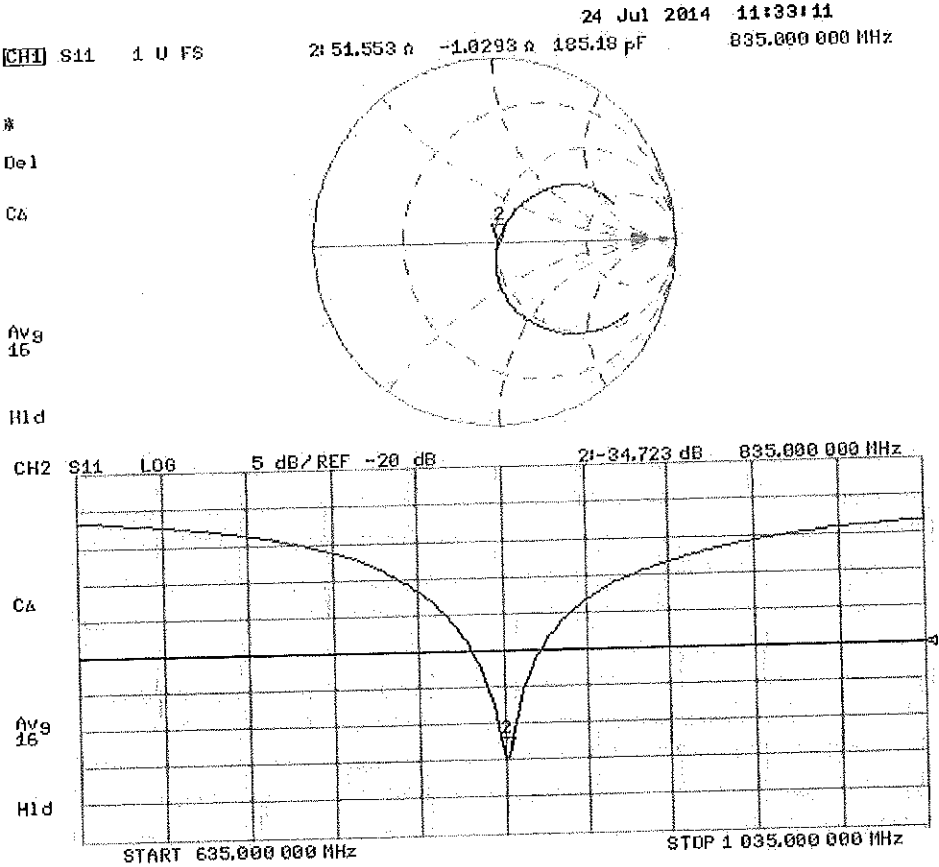
Peak SAR (extrapolated) = 3.58 W/kg

SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.53 W/kg

Maximum value of SAR (measured) = 2.79 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 17.07.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d133

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

Medium parameters used: $f = 835$ MHz; $\sigma = 1.02$ S/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

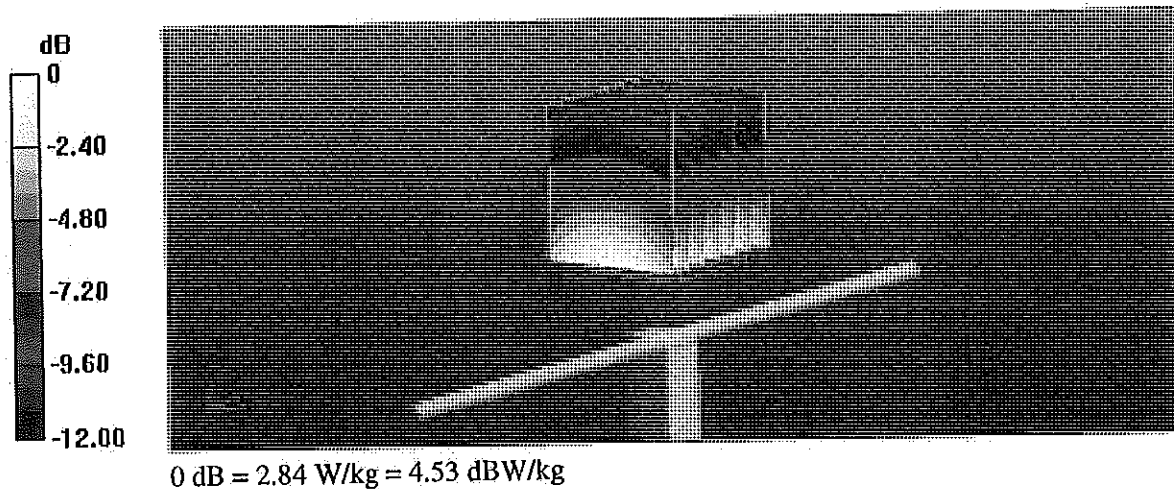
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.61 V/m; Power Drift = -0.01 dB

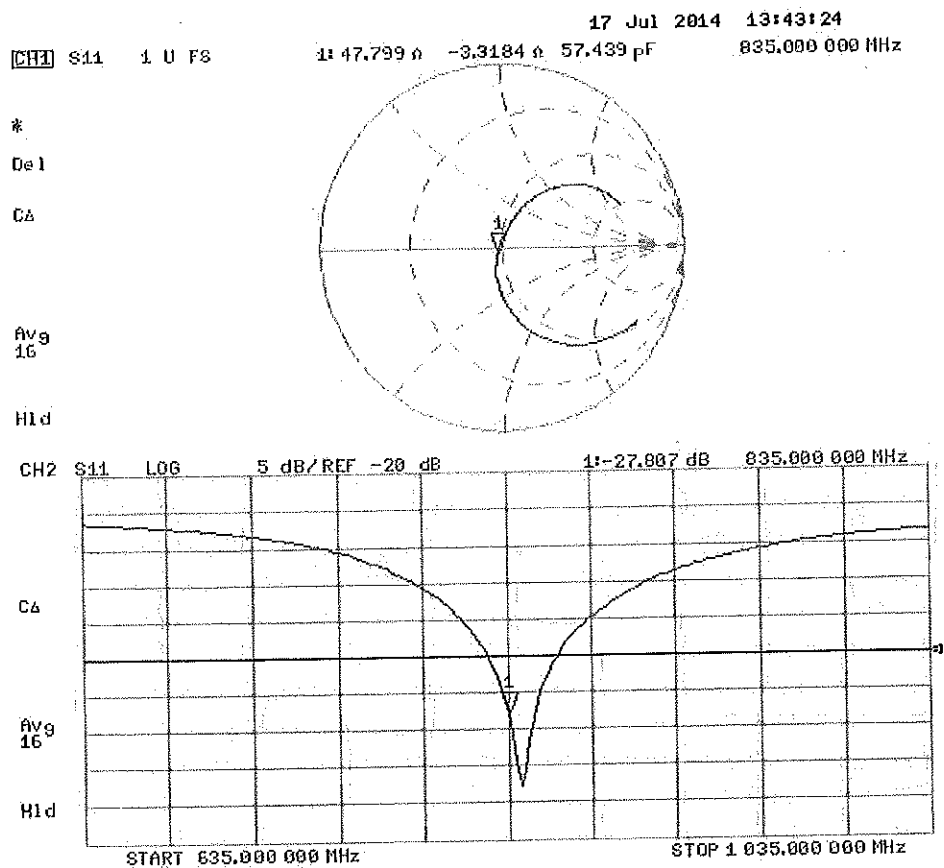
Peak SAR (extrapolated) = 3.59 W/kg

SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.84 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: **D1765V2-1008_May14**

CALIBRATION CERTIFICATE

Object **D1765V2 - SN: 1008**

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

CCV
6/2/14

Calibration date: **May 07, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: May 12, 2014

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 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	39.0 $\pm$ 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	9.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.9 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.5 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.2 $\pm$ 6 %	1.48 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.1 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.7 Ω - 6.1 j Ω
Return Loss	- 23.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.7 Ω - 6.4 j Ω
Return Loss	- 20.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.211 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	October 06, 2005

DASY5 Validation Report for Head TSL

Date: 07.05.2014

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; $\sigma = 1.36$ S/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.23, 5.23, 5.23); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

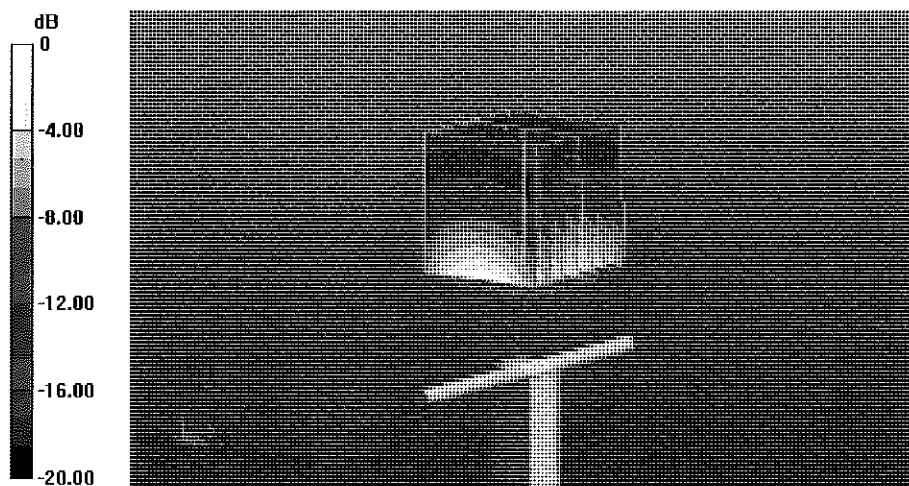
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.06 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 9.23 W/kg; SAR(10 g) = 4.87 W/kg

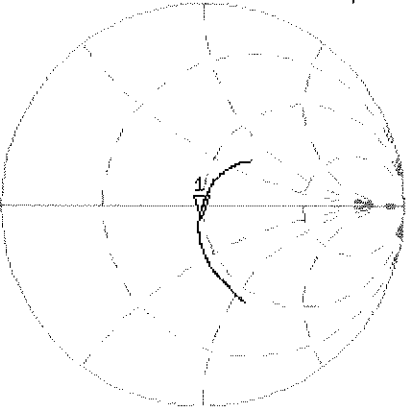
Maximum value of SAR (measured) = 11.7 W/kg



Impedance Measurement Plot for Head TSL

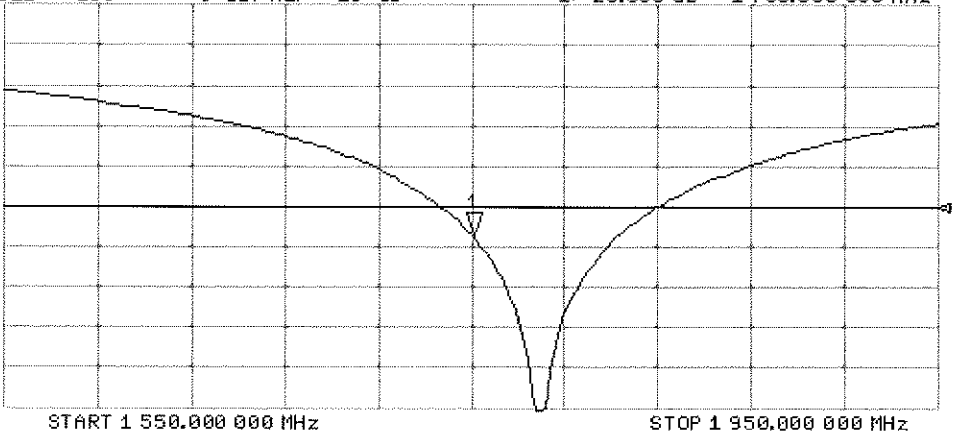
7 May 2014 09:22:36
[CH1] S11 1 U FS 1: 47.709 Ω -6.0566 Ω 15.016 pF 1 750.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-23.588 dB 1 750.000 000 MHz

CA
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 07.05.2014

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; $\sigma = 1.48$ S/m; $\epsilon_r = 52.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.89, 4.89, 4.89); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

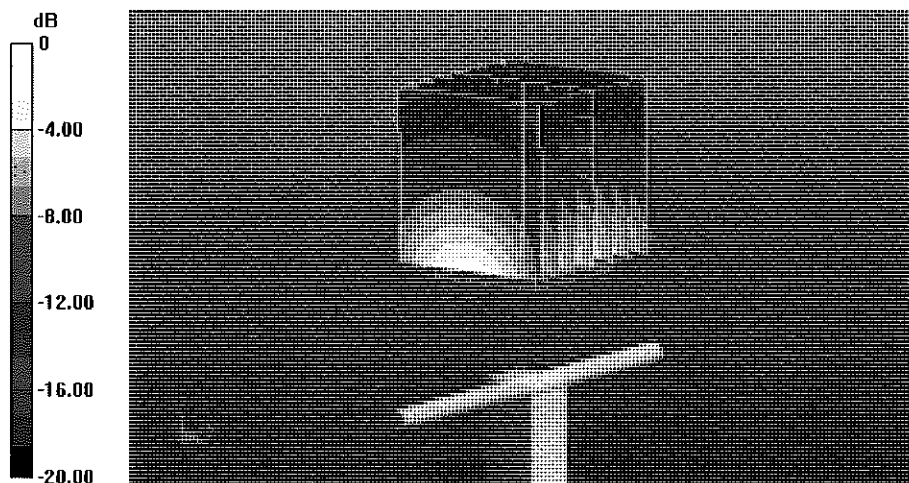
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.01 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 16.3 W/kg

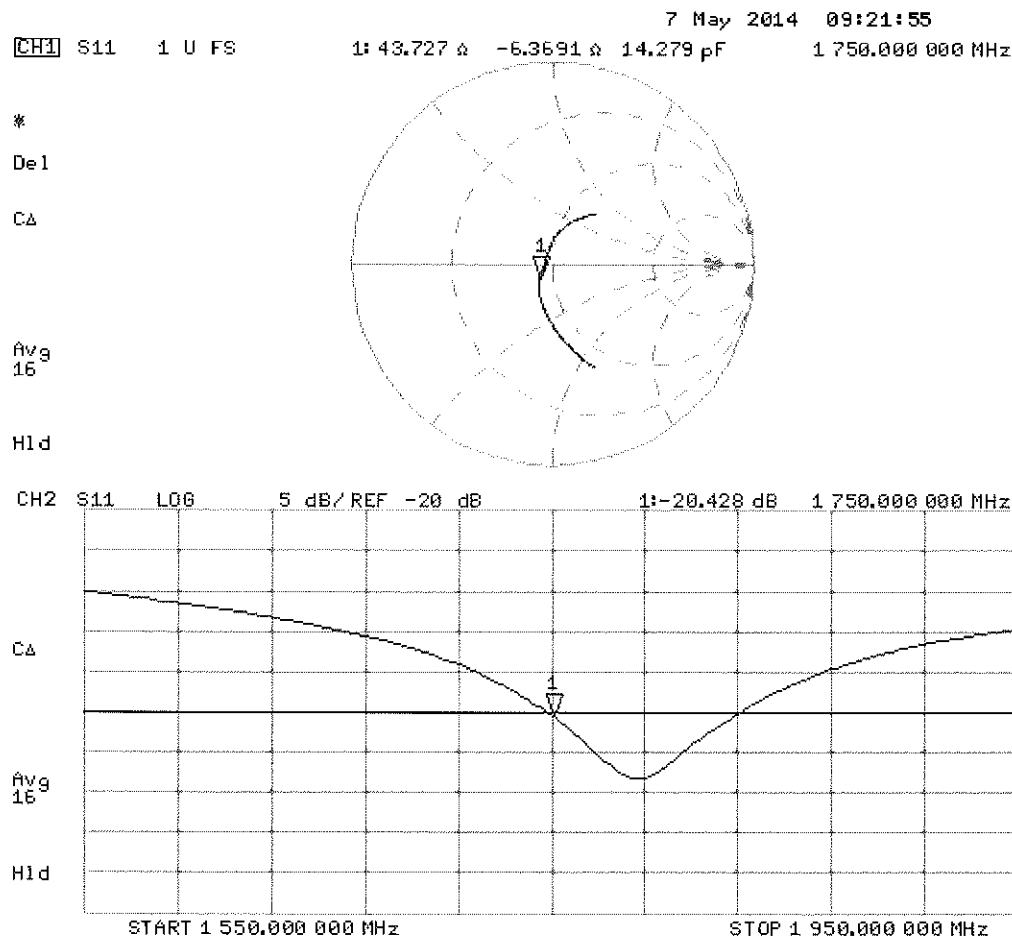
SAR(1 g) = 9.41 W/kg; SAR(10 g) = 5.02 W/kg

Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 11.8 W/kg = 10.72 dBW/kg

Impedance Measurement Plot for Body TSL





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d149_Jul14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d149**

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

CC
11/5/14

Calibration date: **July 23, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (In house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (In house check Oct-13)	In house check: Oct-14

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

Issued: July 23, 2014

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
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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 1528-2013, "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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.5 $\pm$ 6 %	1.38 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.2 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	5.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.0 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	52.5 $\pm$ 6 %	1.51 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.4 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	5.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.6 \Omega + 5.5 j\Omega$
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.8 \Omega + 6.1 j\Omega$
Return Loss	- 24.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 23.07.2014

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: $f = 1900 \text{ MHz}$; $\sigma = 1.38 \text{ S/m}$; $\epsilon_r = 39.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

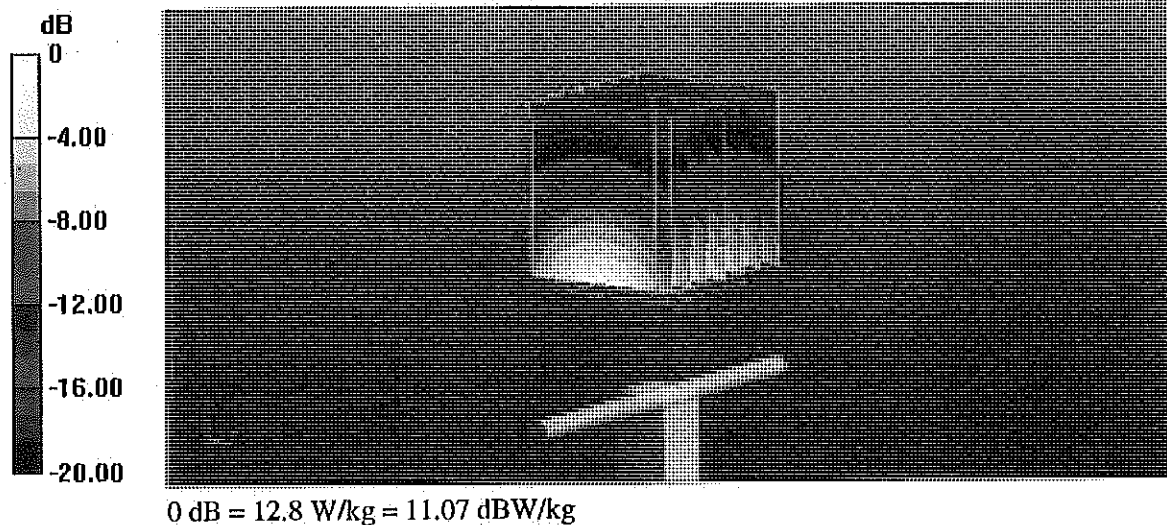
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 98.92 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 18.4 W/kg

SAR(1 g) = 10 W/kg; SAR(10 g) = 5.24 W/kg

Maximum value of SAR (measured) = 12.8 W/kg



Impedance Measurement Plot for Head TSL

23 Jul 2014 10:46:05

CH1 S11 1 U FS

1: 52.600 Ω 5.4570 Ω 457.11 pH

1 900.000 000 MHz

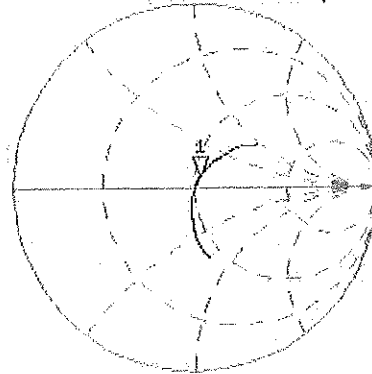
#

De1

Cor

Avg
16

H1d

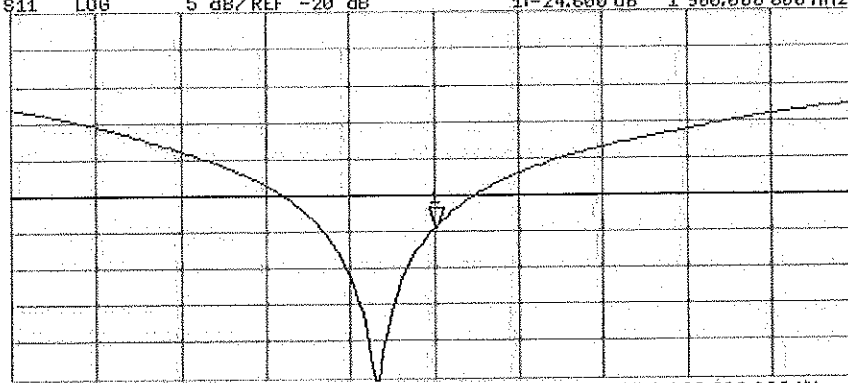


CH2 S11 LOG 5 dB/REF -20 dB 1: -24.600 dB 1 900.000 000 MHz

Cor

Avg
16

H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 23.07.2014

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; $\sigma = 1.51$ S/m; $\epsilon_r = 52.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

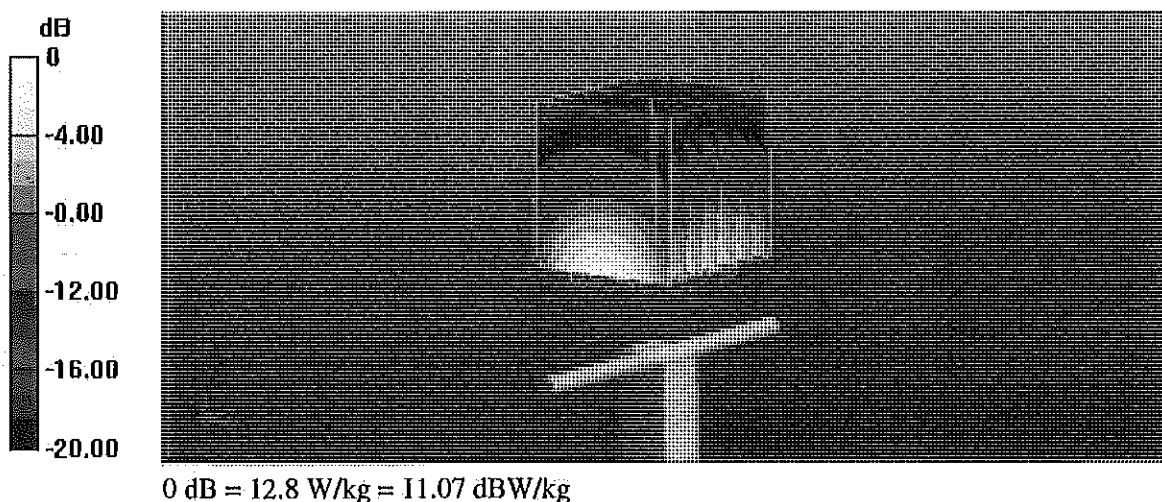
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.83 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.33 W/kg

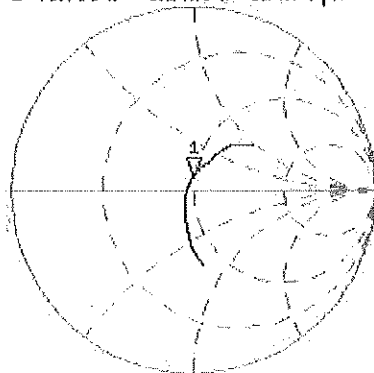
Maximum value of SAR (measured) = 12.8 W/kg



Impedance Measurement Plot for Body TSL

23 Jul 2014 10:45:45
 CH1 S11 1 U FS 1: 48.789 Ω 6.1426 Ω 514.54 μH 1 900.000 000 MHz

*
 Del
 Cor



Avg
 16

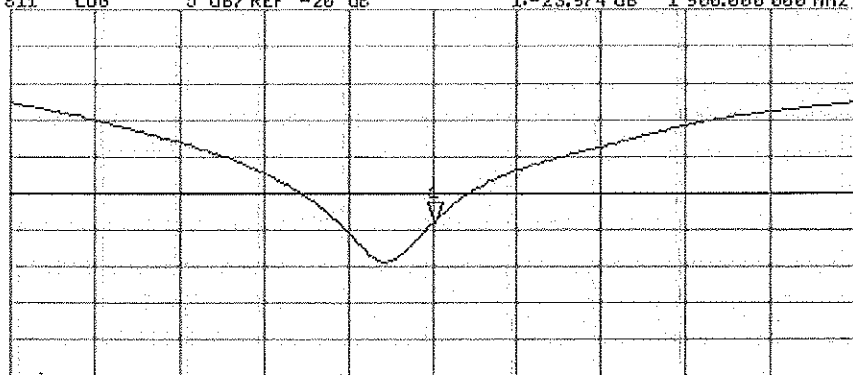
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -23.974 dB 1 900.000 000 MHz

Cor

Avg
 16

H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D2450V2-719_Aug14**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 719**

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

Calibration date: **August 11, 2014**

✓ KOK
9/8/14

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)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Michael Weber** Function: **Laboratory Technician**

Signature

M. Weber

Approved by: **Katja Pokovic** Technical Manager

Katja Pokovic

Issued: August 12, 2014

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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 1528-2013, "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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 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	38.0 $\pm$ 6 %	1.82 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	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.1 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	6.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	50.5 $\pm$ 6 %	2.02 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	51.8 W/kg $\pm$ 17.0 % (k=2)

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

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.9 \Omega + 3.0 j\Omega$
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.9 \Omega + 5.8 j\Omega$
Return Loss	- 24.7 dB

General Antenna Parameters and Design

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

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.82$ S/m; $\epsilon_r = 38$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

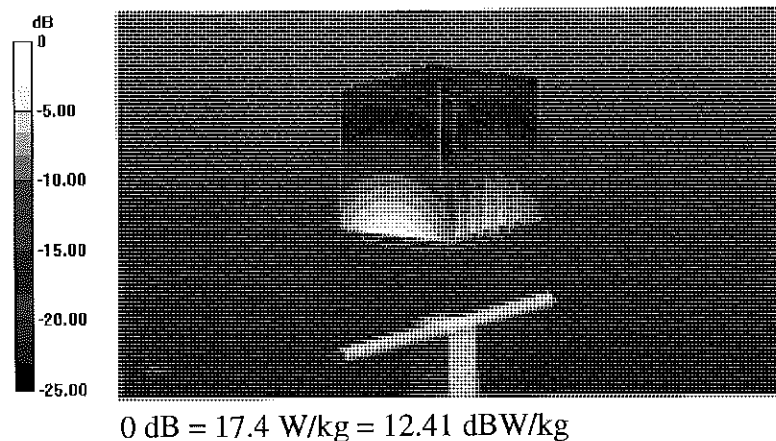
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.6 V/m; Power Drift = 0.03 dB

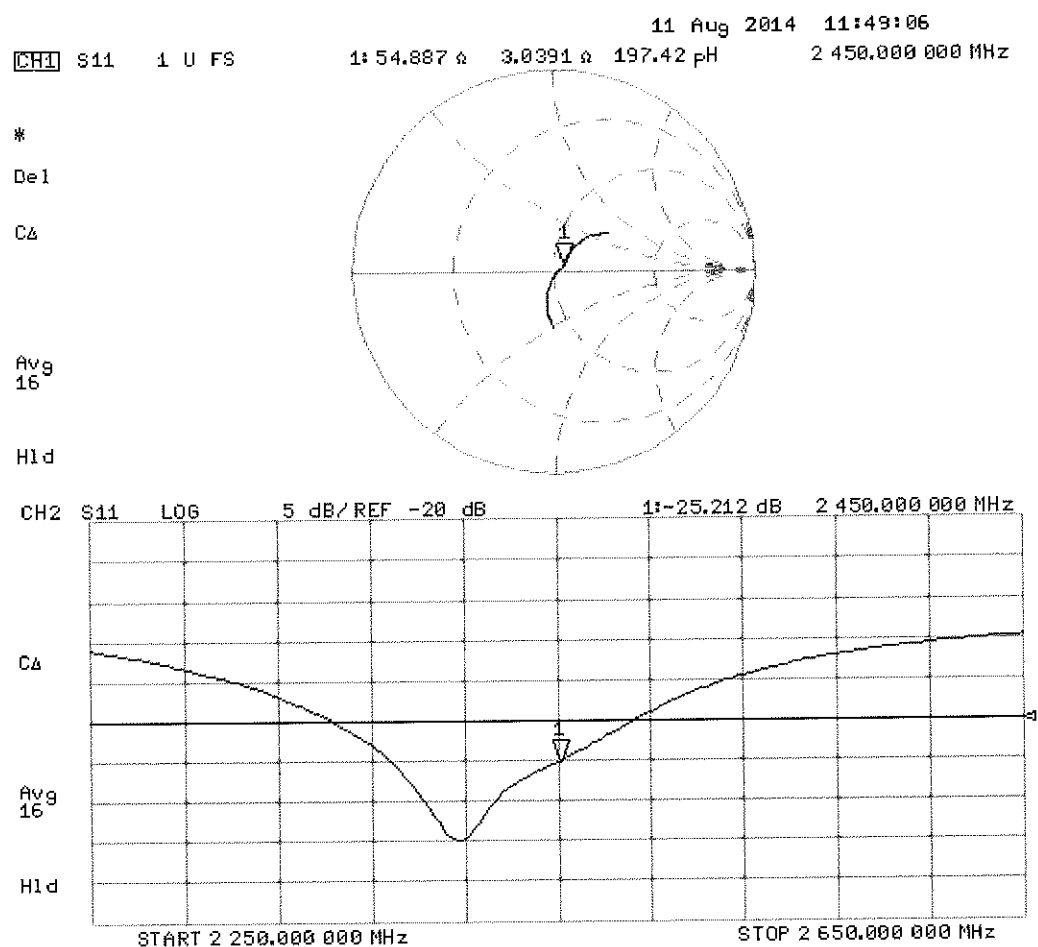
Peak SAR (extrapolated) = 27.5 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kg

Maximum value of SAR (measured) = 17.4 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 50.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

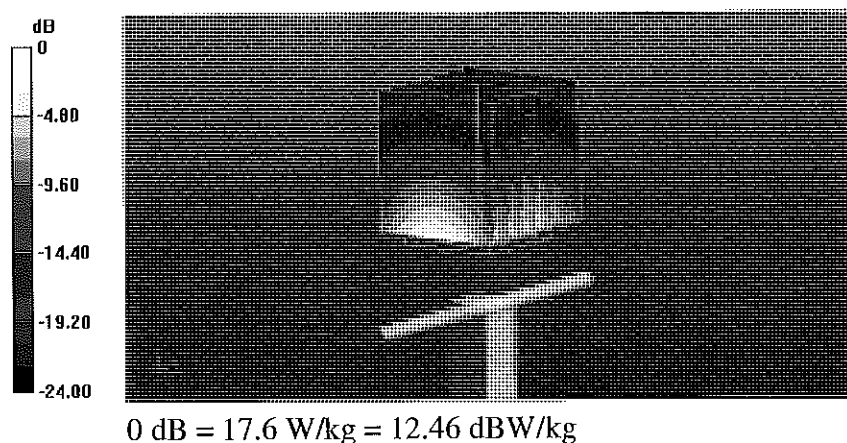
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.08 V/m; Power Drift = -0.01 dB

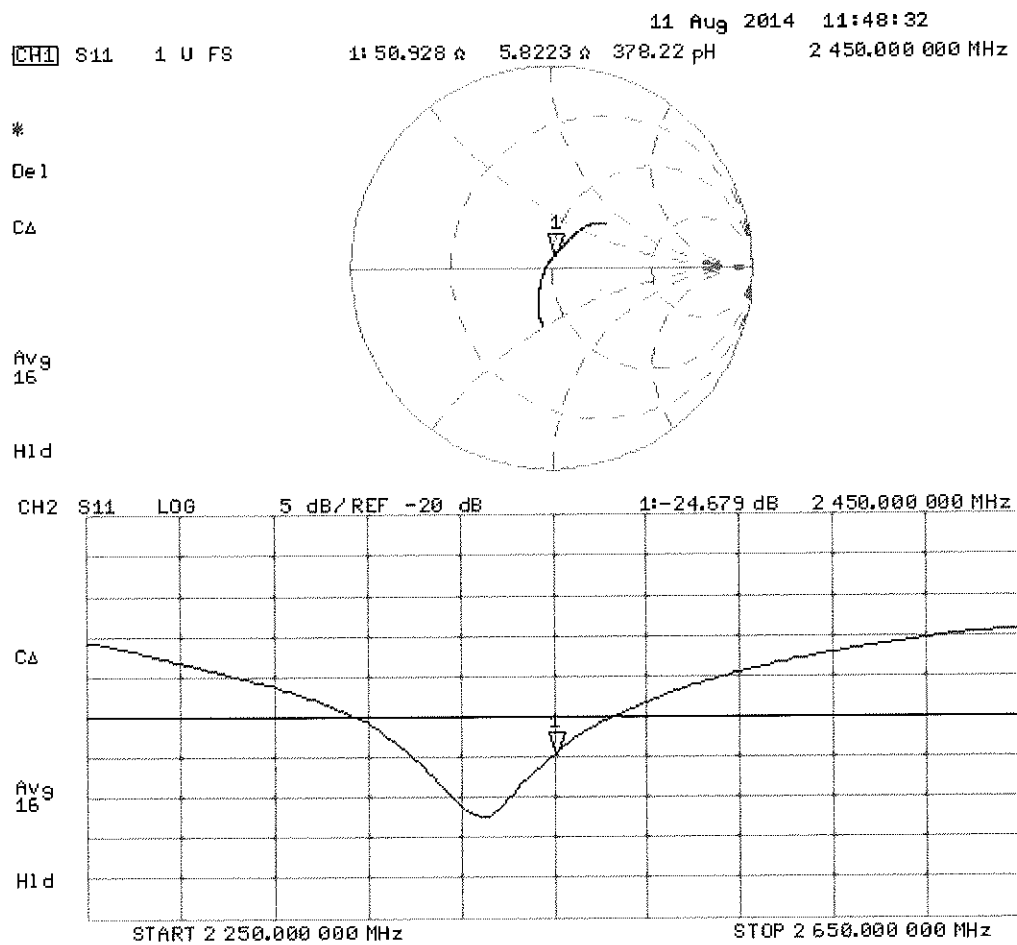
Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.1 W/kg

Maximum value of SAR (measured) = 17.6 W/kg



Impedance Measurement Plot for Body TSL





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Client **PC Test**

Certificate No: **D5GHzV2-1120_Feb14**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1120**

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

Calibration date: **February 26, 2014**

CC✓
3/16/14

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	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	30-Dec-13 (No. EX3-3503_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: **Claudio Leubler** Function: **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: February 27, 2014

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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:

- 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	37.1 $\pm$ 6 %	4.52 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	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.1 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 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	36.9 ± 6 %	4.63 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	8.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.4 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 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	36.7 ± 6 %	4.84 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	8.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.1 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	36.6 ± 6 %	4.95 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 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	36.3 ± 6 %	5.16 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.8 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 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	47.6 ± 6 %	5.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.80 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.96 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.0 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	47.1 ± 6 %	5.94 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.98 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.6 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	$54.0\ \Omega - 5.6\ j\Omega$
Return Loss	- 23.6 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	$51.1\ \Omega + 1.6\ j\Omega$
Return Loss	- 34.6 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	$51.1\ \Omega - 2.3\ j\Omega$
Return Loss	- 31.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	$58.4\ \Omega - 0.2\ j\Omega$
Return Loss	- 22.2 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	$52.9\ \Omega + 2.8\ j\Omega$
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	$52.3\ \Omega - 5.9\ j\Omega$
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	$51.1\ \Omega + 1.2\ j\Omega$
Return Loss	- 35.8 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	$50.5\ \Omega - 2.6\ j\Omega$
Return Loss	- 31.6 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	59.5 Ω - 2.9 j Ω
Return Loss	- 20.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	54.2 Ω + 1.1 j Ω
Return Loss	- 27.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.206 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 26.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1120

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; $\sigma = 4.52$ S/m; $\epsilon_r = 37.1$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5300$ MHz; $\sigma = 4.63$ S/m; $\epsilon_r = 36.9$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5500$ MHz; $\sigma = 4.84$ S/m; $\epsilon_r = 36.7$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5600$ MHz; $\sigma = 4.95$ S/m; $\epsilon_r = 36.6$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5800$ MHz; $\sigma = 5.16$ S/m; $\epsilon_r = 36.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.52, 5.52, 5.52); Calibrated: 30.12.2013, ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2013, ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.86, 4.86, 4.86); Calibrated: 30.12.2013, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 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 = 62.794 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 28.6 W/kg

SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.24 W/kg

Maximum value of SAR (measured) = 18.0 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 = 63.390 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 8.3 W/kg; SAR(10 g) = 2.37 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.321 V/m; Power Drift = 0.08 dB

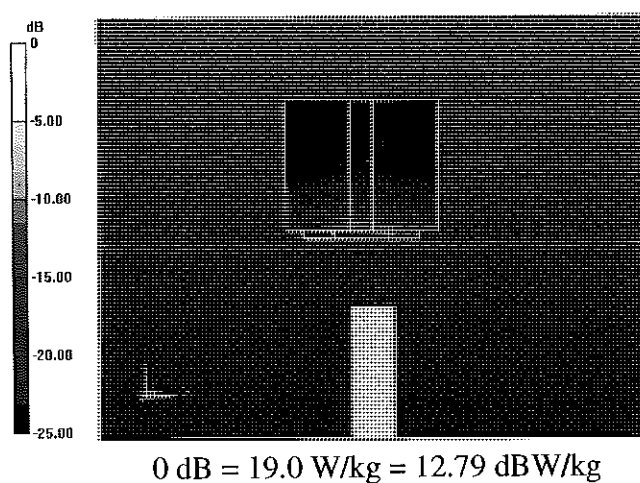
Peak SAR (extrapolated) = 33.6 W/kg

SAR(1 g) = 8.45 W/kg; SAR(10 g) = 2.4 W/kg

Maximum value of SAR (measured) = 20.0 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 = 62.007 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 32.7 W/kg
SAR(1 g) = 8.18 W/kg; SAR(10 g) = 2.33 W/kg
Maximum value of SAR (measured) = 19.4 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 = 59.638 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 33.0 W/kg
SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.23 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

26 Feb 2014 10:12:36

[CH1] S11 1 U FS 1: 53.980 Ω -5.5879 Ω 5.4773 pF 5 200.000 000 MHz

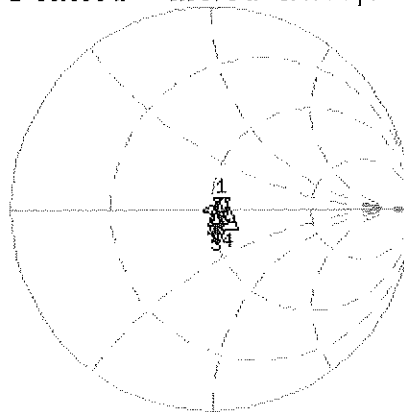
*

Del

Cor

Avg
16

H1d



CH1 Markers

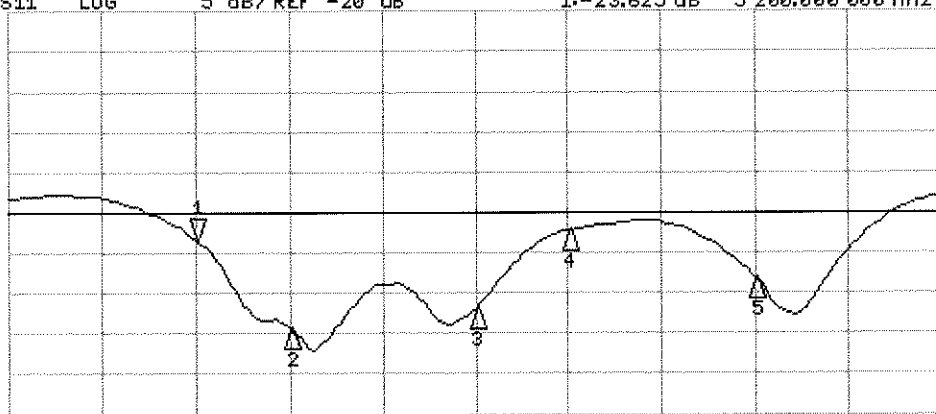
2: 51.086 Ω
1.5508 Ω
5.30000 GHz
3: 51.148 Ω
-2.3066 Ω
5.50000 GHz
4: 50.436 Ω
-158.20 m Ω
5.60000 GHz
5: 52.877 Ω
2.8086 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -23.625 dB 5 200.000 000 MHz

Cor

Avg
16

H1d



CH2 Markers

2: -34.550 dB
5.30000 GHz
3: -31.869 dB
5.50000 GHz
4: -22.182 dB
5.60000 GHz
5: -28.164 dB
5.80000 GHz

START 5 000.000 000 MHz

STOP 5 800.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 25.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1120

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; $\sigma = 5.4$ S/m; $\epsilon_r = 47.8$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5300$ MHz; $\sigma = 5.53$ S/m; $\epsilon_r = 47.6$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5500$ MHz; $\sigma = 5.8$ S/m; $\epsilon_r = 47.3$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.94$ S/m; $\epsilon_r = 47.1$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5800$ MHz; $\sigma = 6.21$ S/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013, ConvF(4.52, 4.52, 4.52); Calibrated: 30.12.2013, ConvF(4.3, 4.3, 4.3); Calibrated: 30.12.2013, ConvF(4.47, 4.47, 4.47); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 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 = 59.562 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 29.5 W/kg

SAR(1 g) = 7.43 W/kg; SAR(10 g) = 2.08 W/kg

Maximum value of SAR (measured) = 17.7 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 = 58.903 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 18.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.015 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 34.5 W/kg

SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 19.5 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 = 58.626 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 35.6 W/kg

SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 19.8 W/kg

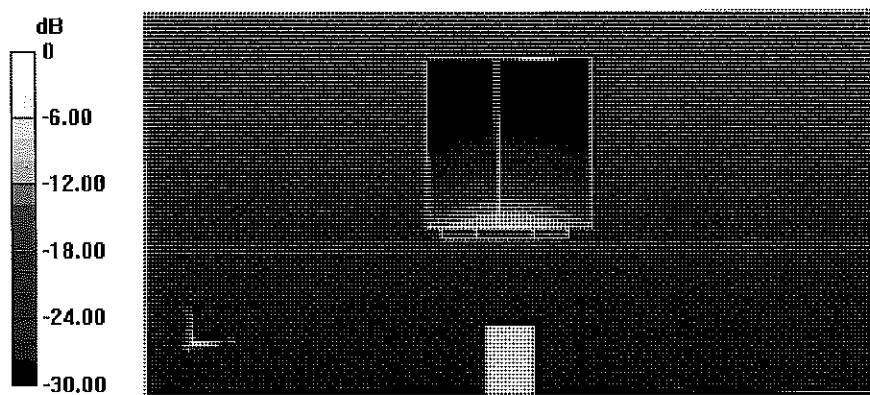
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.428 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 34.9 W/kg

SAR(1 g) = 7.47 W/kg; SAR(10 g) = 2.07 W/kg

Maximum value of SAR (measured) = 18.8 W/kg

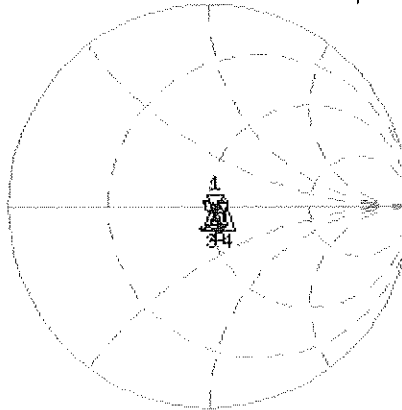


0 dB = 18.8 W/kg = 12.74 dBW/kg

Impedance Measurement Plot for Body TSL

25 Feb 2014 15:49:48
 [CH1] S11 1 U FS 1: 52.344 Ω -5.8965 Ω 5.1907 pF 5 200.000 000 MHz

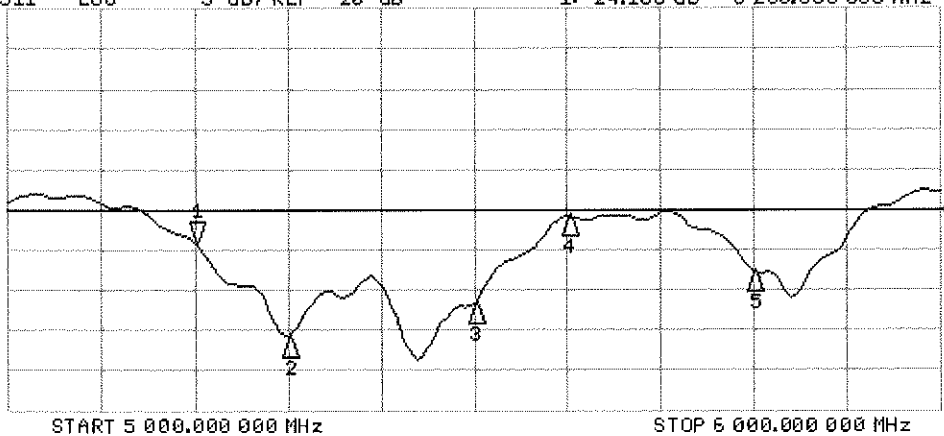
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 51.105 Ω
 1.1973 Ω
 5.30000 GHz
 3: 50.543 Ω
 -2.5781 Ω
 5.50000 GHz
 4: 59.457 Ω
 -2.9082 Ω
 5.60000 GHz
 5: 54.162 Ω
 1.1016 Ω
 5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -24.165 dB 5 200.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -35.830 dB
 5.30000 GHz
 3: -31.626 dB
 5.50000 GHz
 4: -20.878 dB
 5.60000 GHz
 5: -27.672 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: **D1900V2-5d141_Apr14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d141**

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

Calibration date: **April 09, 2014**

✓
Kok
5/7/14

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292763	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 801	25-Apr-13 (No. DAE4-801_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: **Claudio Leubler** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: April 9, 2014

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



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

Accreditation No.: **SCS 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 1528-2013, "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	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 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 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.1 W/kg $\pm$ 17.0 % (k=2)

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

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.4 $\pm$ 6 %	1.52 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.41 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	$52.8 \Omega + 5.5 j\Omega$
Return Loss	- 24.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.8 \Omega + 6.3 j\Omega$
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 09.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.36$ 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(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- 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/ $P_{in}=250$ mW, $d=10$ mm/Zoom Scan (7x7x7)/Cube 0:

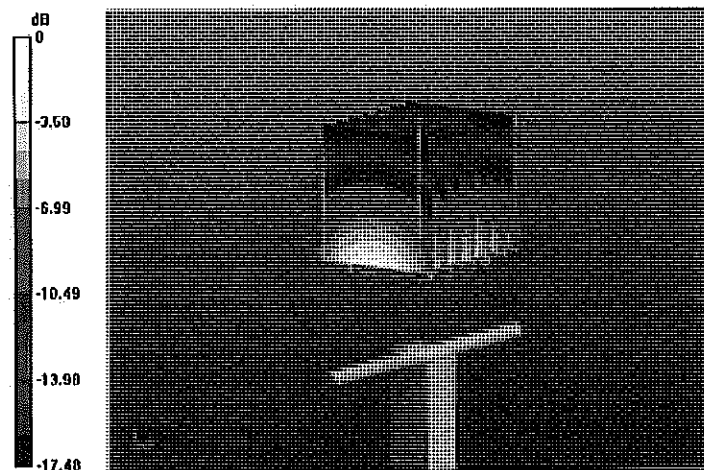
Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 99.080 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.2 W/kg

SAR(1 g) = 9.91 W/kg; SAR(10 g) = 5.17 W/kg

Maximum value of SAR (measured) = 12.5 W/kg

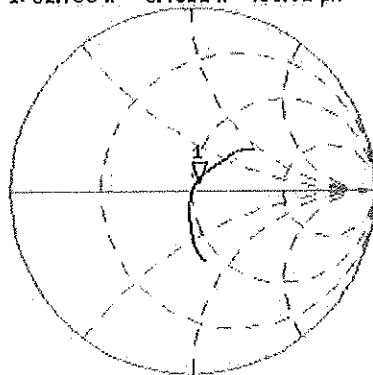


0 dB = 12.5 W/kg = 10.97 dBW/kg

Impedance Measurement Plot for Head TSL

9 Apr 2014 11:03:32
 CH1 S11 1 U FS 1 52.760 n 5.4512 n 456.62 pF 1 900.000 000 MHz

*
 Del
 CA



AVG
 16

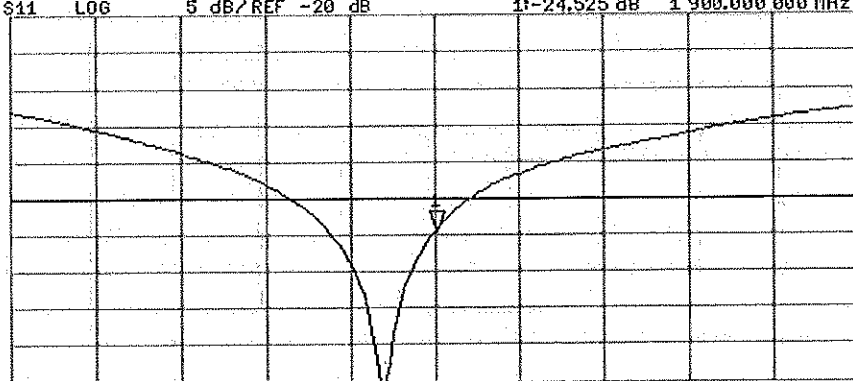
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1 24.525 dB 1 900.000 000 MHz

CA

AVG
 16

H1d



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 09.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ S/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- 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:

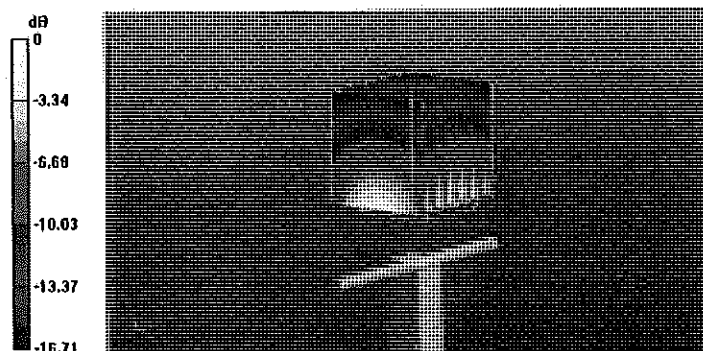
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.820 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 17.9 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.41 W/kg

Maximum value of SAR (measured) = 12.9 W/kg



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

Impedance Measurement Plot for Body TSL

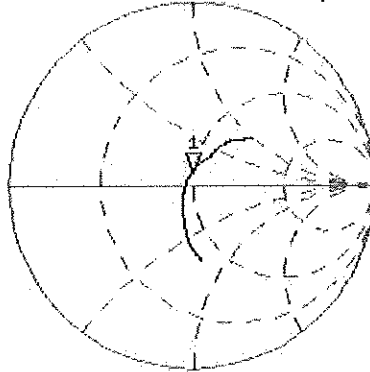
9 Apr 2014 11:02:32
[CH1] S11 1 U FS 1: 48.752 Ω 6.3320 Ω 530.41 μ H 1 900.000 000 MHz

*
Del

CA

Avg
16

↑

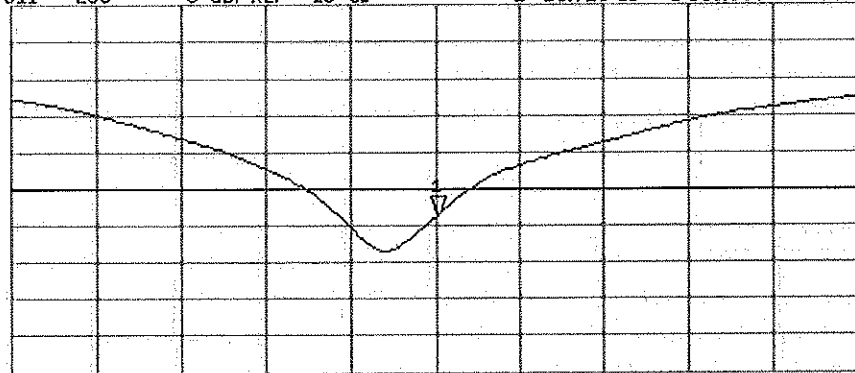


CH2 S11 LOG 5 dB/REF -20 dB 1: -23.715 dB 1 900.000 000 MHz

CA

Avg
16

↑



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3288_Sep14/2**

CALIBRATION CERTIFICATE (Replacement of No:ES3-3288_Sep14)

Object **ES3DV3 - SN:3288**

Calibration procedure(s)

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

CC
10/12/14

Calibration date:

September 24, 2014

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: November 3, 2014			
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
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 E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3288

Manufactured:	July 6, 2010
Repaired:	September 18, 2014
Calibrated:	September 24, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	1.05	1.16	0.92	$\pm 10.1 \%$
DCP (mV) ^B	105.1	104.6	106.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	195.8	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		175.9	
		Z	0.0	0.0	1.0		177.1	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	2.71	61.9	11.4	10.00	40.3	$\pm 2.2 \%$
		Y	2.37	60.2	11.2		42.6	
		Z	1.54	56.6	8.9		41.2	
10011- CAB	UMTS-FDD (WCDMA)	X	3.29	67.1	18.4	2.91	133.8	$\pm 0.5 \%$
		Y	3.43	67.9	18.9		139.5	
		Z	3.45	68.1	18.9		141.3	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.99	68.9	18.6	1.87	135.1	$\pm 0.7 \%$
		Y	3.59	72.4	20.4		140.7	
		Z	3.54	72.4	20.3		143.0	
10013- CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.15	70.8	23.3	9.46	132.3	$\pm 3.5 \%$
		Y	11.29	70.8	23.2		141.1	
		Z	11.07	70.7	23.2		139.2	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	14.71	90.5	24.5	9.39	149.0	$\pm 1.9 \%$
		Y	16.40	92.8	26.0		131.3	
		Z	11.34	87.2	23.6		126.1	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	15.91	92.2	25.3	9.57	138.9	$\pm 2.5 \%$
		Y	21.25	96.9	27.2		142.0	
		Z	11.68	87.2	23.5		145.9	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	38.62	99.8	24.7	6.56	123.8	$\pm 2.2 \%$
		Y	36.71	99.7	25.2		128.1	
		Z	36.56	99.4	24.5		129.5	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	56.60	99.6	22.6	4.80	138.8	$\pm 1.9 \%$
		Y	46.94	99.9	23.7		149.9	
		Z	51.17	99.8	22.9		144.9	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	70.88	100.0	21.6	3.55	147.5	$\pm 1.9 \%$
		Y	52.58	99.8	22.6		129.4	
		Z	76.98	99.8	21.2		128.7	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	98.89	99.5	18.9	1.16	135.8	$\pm 1.4 \%$
		Y	78.39	99.6	19.5		141.7	
		Z	95.21	95.5	17.1		143.4	
10039- CAB	CDMA2000 (1xRTT, RC1)	X	4.72	66.7	18.9	4.57	133.7	$\pm 0.9 \%$
		Y	4.85	67.1	19.1		137.7	
		Z	4.81	67.4	19.2		141.9	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.91	66.3	18.6	3.97	129.5	±0.7 %
		Y	4.00	66.6	18.7		133.7	
		Z	3.99	66.8	18.8		137.5	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.63	66.9	18.7	3.98	141.4	±0.7 %
		Y	4.78	67.5	19.0		147.7	
		Z	4.57	66.8	18.6		127.8	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.59	68.2	20.1	5.67	149.2	±1.4 %
		Y	6.36	67.3	19.6		130.7	
		Z	6.36	67.5	19.6		133.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.44	67.8	20.0	5.80	146.6	±1.4 %
		Y	6.23	66.8	19.4		128.8	
		Z	6.24	67.1	19.6		131.4	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.08	67.1	19.6	5.75	143.2	±1.4 %
		Y	6.20	67.4	19.8		148.0	
		Z	5.92	66.6	19.3		128.5	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.32	69.3	21.5	8.10	137.0	±2.2 %
		Y	10.31	69.1	21.4		143.5	
		Z	10.37	69.5	21.6		146.1	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.35	69.4	21.6	8.07	138.3	±2.2 %
		Y	10.36	69.3	21.4		146.4	
		Z	10.42	69.6	21.6		149.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.95	75.7	26.2	9.28	134.9	±3.3 %
		Y	10.37	76.0	26.1		146.6	
		Z	9.77	75.4	26.0		142.5	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.12	67.2	19.7	5.75	144.9	±1.4 %
		Y	6.21	67.4	19.8		148.8	
		Z	5.91	66.5	19.3		128.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.28	66.7	19.4	5.82	125.5	±1.2 %
		Y	6.37	66.8	19.4		129.7	
		Z	6.36	67.1	19.6		132.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.08	67.6	20.2	5.73	147.0	±1.2 %
		Y	4.95	66.6	19.6		128.6	
		Z	4.91	66.9	19.8		131.2	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.18	77.2	27.2	9.21	123.4	±2.7 %
		Y	8.37	76.6	26.6		129.5	
		Z	7.97	76.7	26.9		128.7	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.05	67.4	20.1	5.72	146.2	±1.4 %
		Y	5.10	67.3	20.0		142.8	
		Z	4.87	66.7	19.6		129.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.04	67.4	20.0	5.72	145.5	±1.2 %
		Y	5.12	67.4	20.0		143.4	
		Z	4.87	66.7	19.6		129.9	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.92	68.9	21.4	8.09	131.0	±2.2 %
		Y	9.84	68.5	21.1		130.0	
		Z	9.94	69.0	21.4		138.6	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.90	68.9	21.4	8.10	130.8	±2.2 %
		Y	9.81	68.4	21.0		131.4	
		Z	9.95	69.1	21.5		140.5	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.81	68.8	21.3	8.03	130.0	±2.2 %
		Y	9.89	68.9	21.3		138.1	
		Z	9.89	69.1	21.5		140.5	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.25	69.2	21.4	8.06	137.1	±2.2 %
		Y	10.30	69.2	21.4		144.4	
		Z	10.38	69.6	21.6		148.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.90	66.8	19.3	5.97	132.8	±1.4 %
		Y	7.09	67.3	19.6		142.0	
		Z	7.04	67.4	19.6		143.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	9.61	81.9	29.6	9.21	149.3	±2.7 %
		Y	8.66	77.6	27.1		133.7	
		Z	8.20	77.5	27.3		132.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.16	74.5	25.8	9.24	126.3	±3.0 %
		Y	9.62	75.0	25.8		137.4	
		Z	9.16	74.8	25.9		135.2	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.97	75.7	26.3	9.30	133.7	±3.3 %
		Y	10.38	75.9	26.1		146.1	
		Z	9.91	75.7	26.3		143.8	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.86	66.6	18.7	4.87	129.9	±0.9 %
		Y	6.01	67.1	19.0		135.7	
		Z	5.95	67.1	19.0		139.4	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.40	66.7	18.6	3.96	136.4	±0.7 %
		Y	4.55	67.3	19.0		138.3	
		Z	4.56	67.6	19.1		144.3	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.64	66.9	18.7	3.46	127.4	±0.5 %
		Y	3.77	67.6	19.1		130.2	
		Z	3.72	67.5	19.0		134.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.58	67.0	18.7	3.39	128.4	±0.5 %
		Y	3.73	67.7	19.1		132.7	
		Z	3.69	67.8	19.1		136.1	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.43	67.7	19.9	5.81	145.5	±1.4 %
		Y	6.49	67.7	19.9		149.5	
		Z	6.23	67.0	19.6		129.5	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.74	67.3	19.8	6.06	126.7	±1.4 %
		Y	6.83	67.5	19.8		132.9	
		Z	6.81	67.6	19.9		135.8	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.00	69.9	19.4	1.71	133.9	±0.5 %
		Y	3.30	71.5	20.1		141.0	
		Z	3.22	71.4	20.0		142.9	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.17	69.2	21.8	8.36	130.5	±2.5 %
		Y	10.20	69.1	21.6		138.4	
		Z	10.20	69.4	21.8		140.7	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.75	68.3	18.8	3.76	138.5	±0.7 %
		Y	5.00	69.1	19.2		146.7	
		Z	4.92	69.2	19.1		148.5	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.73	68.6	18.9	3.77	136.3	±0.7 %
		Y	4.97	69.4	19.4		143.7	
		Z	4.91	69.6	19.3		146.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.65	68.1	18.5	1.54	135.2	±0.5 %
		Y	3.05	70.8	19.9		140.7	
		Z	2.87	69.8	19.3		144.8	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	10.00	69.0	21.5	8.23	130.8	±2.2 %
		Y	10.06	68.9	21.4		138.6	
		Z	10.08	69.3	21.7		141.6	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.81	6.81	6.81	0.37	1.70	± 12.0 %
835	41.5	0.90	6.51	6.51	6.51	0.45	1.52	± 12.0 %
1750	40.1	1.37	5.38	5.38	5.38	0.44	1.58	± 12.0 %
1900	40.0	1.40	5.17	5.17	5.17	0.80	1.18	± 12.0 %
2450	39.2	1.80	4.56	4.56	4.56	0.80	1.21	± 12.0 %
2600	39.0	1.96	4.44	4.44	4.44	0.80	1.22	± 12.0 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.38	6.38	6.38	0.31	1.89	± 12.0 %
835	55.2	0.97	6.32	6.32	6.32	0.55	1.39	± 12.0 %
1750	53.4	1.49	5.03	5.03	5.03	0.57	1.44	± 12.0 %
1900	53.3	1.52	4.82	4.82	4.82	0.51	1.54	± 12.0 %
2450	52.7	1.95	4.36	4.36	4.36	0.71	1.07	± 12.0 %
2600	52.5	2.16	4.22	4.22	4.22	0.80	1.07	± 12.0 %

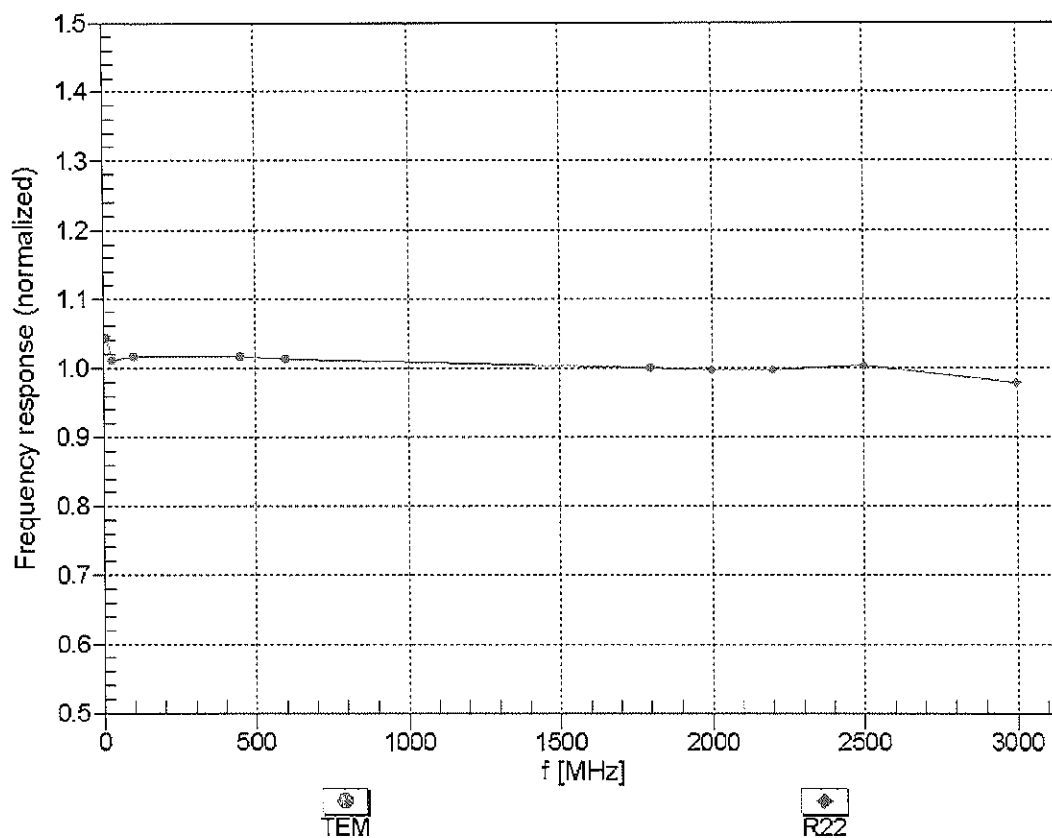
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Frequency Response of E-Field

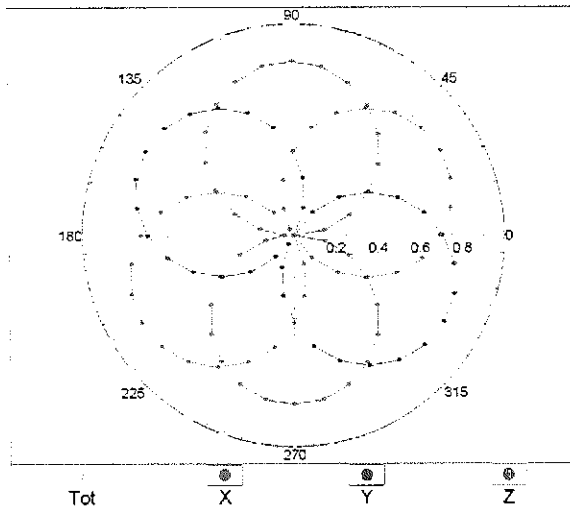
(TEM-Cell:ifi110 EXX, Waveguide: R22)



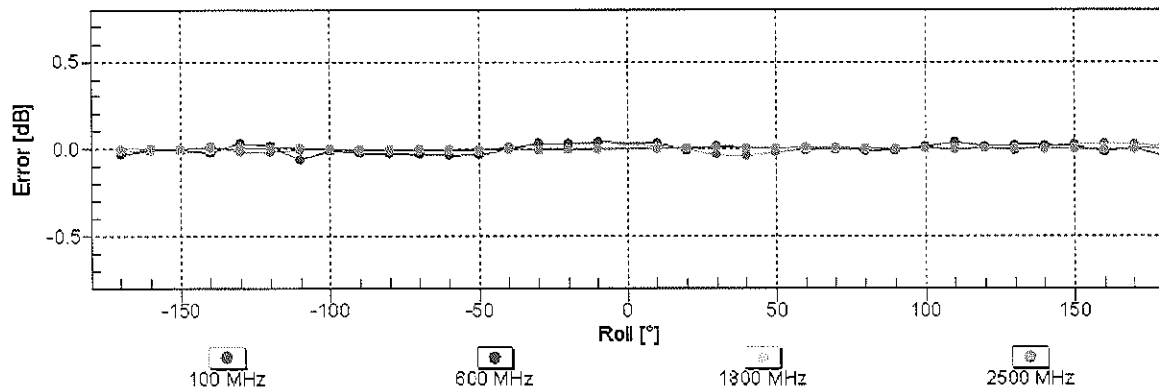
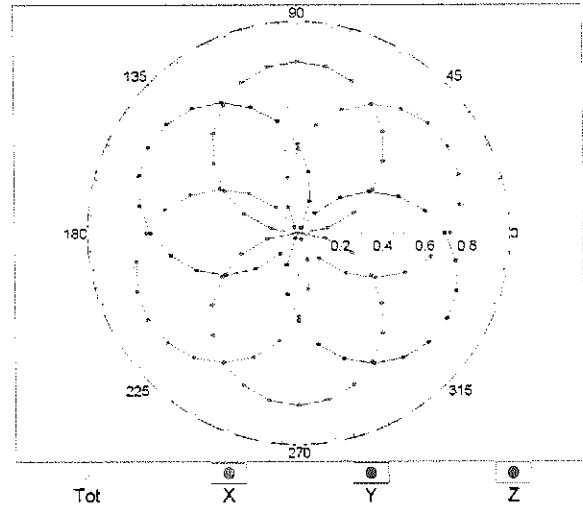
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

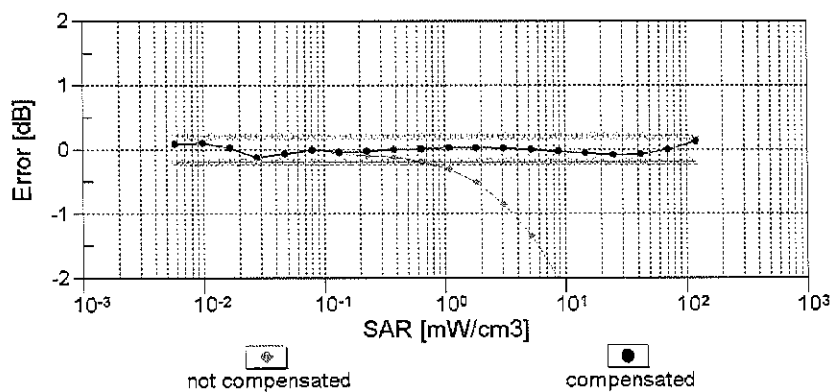
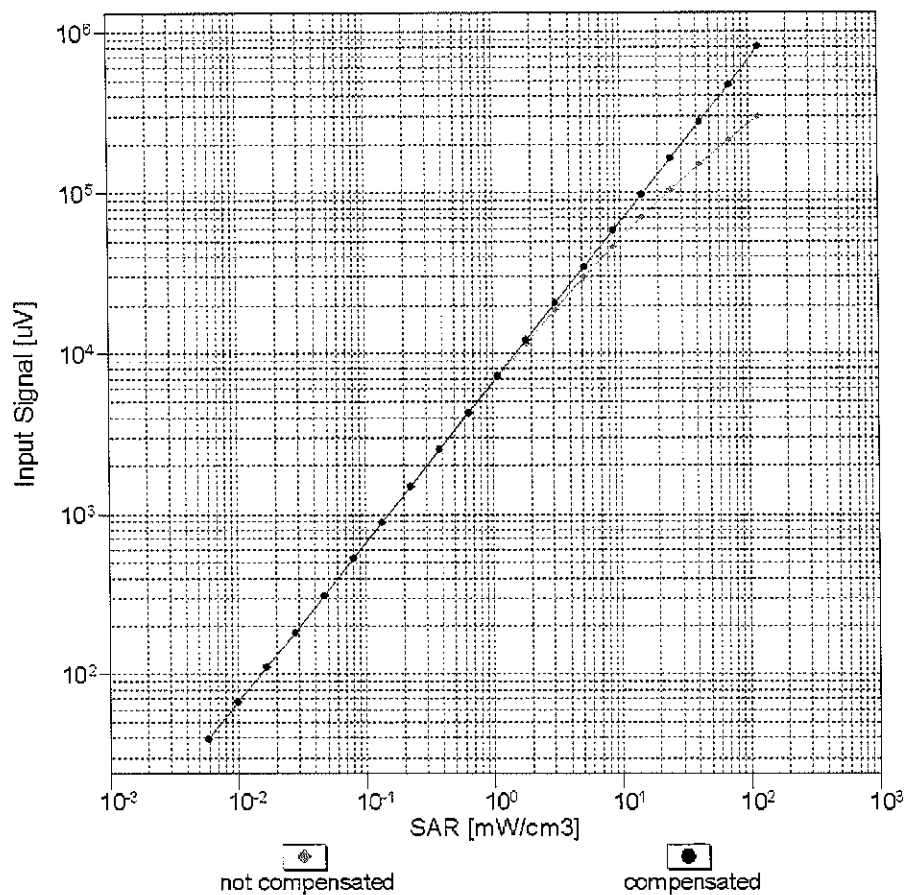


f=1800 MHz,R22



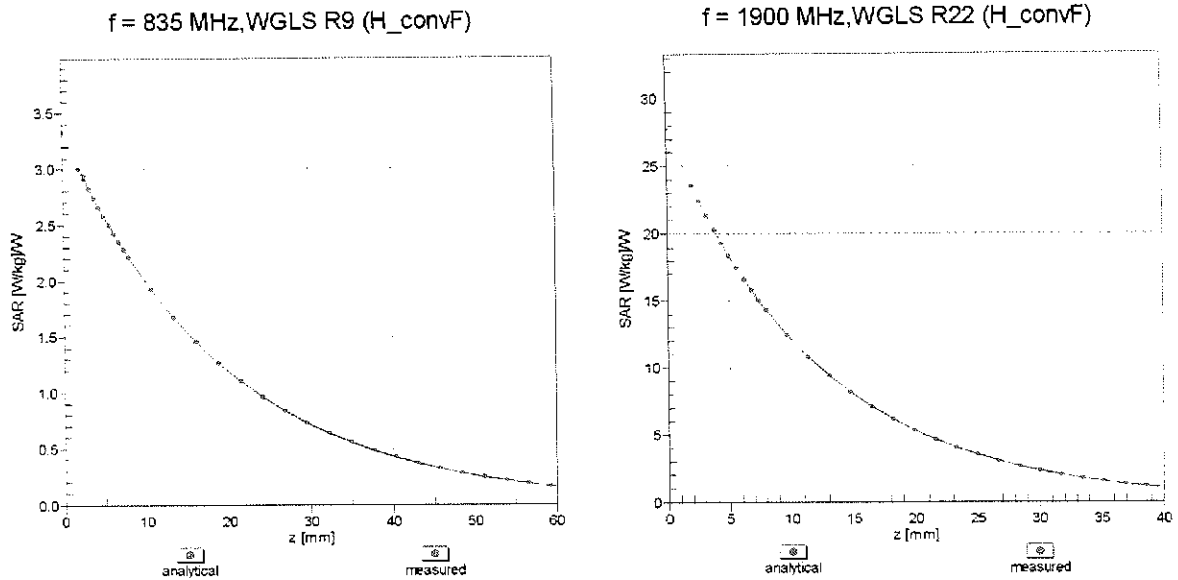
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



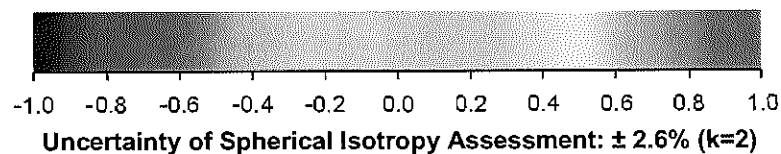
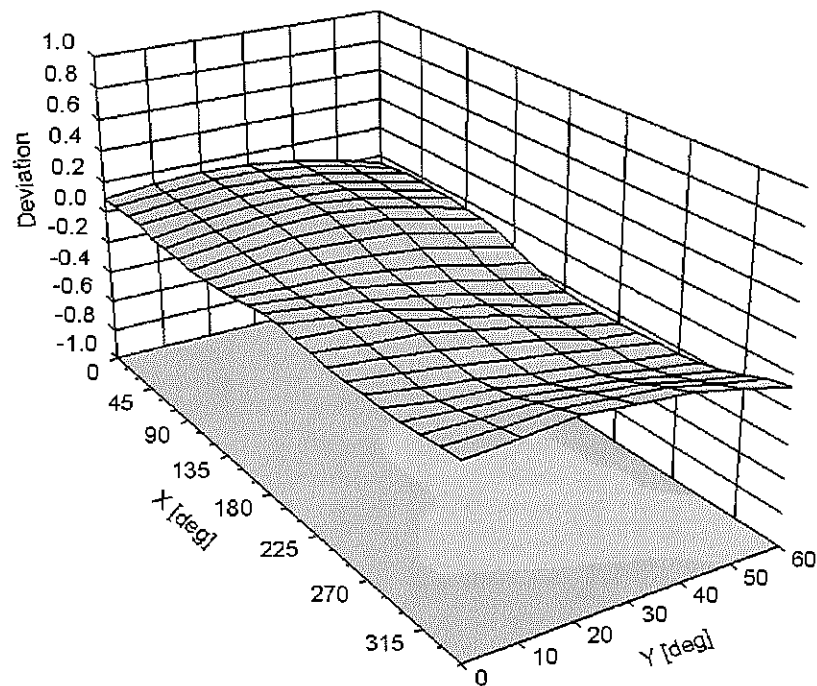
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-110
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3258_Feb14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3258**

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

CCV
 3/6/14

Calibration date: **February 25, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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 Israe El-Naouq	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 27, 2014

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



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Accreditation No.: **SCS 108**

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
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 E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3258

Manufactured: January 25, 2010
Calibrated: February 25, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.29	1.19	1.23	$\pm 10.1 \%$
DCP (mV) ^B	104.5	107.0	103.0	

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	222.4	$\pm 3.8 \%$
		Y	0.0	0.0	1.0		202.2	
		Z	0.0	0.0	1.0		207.1	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	5.09	65.6	14.1	10.00	44.8	$\pm 1.9 \%$
		Y	1.68	57.4	9.3		40.7	
		Z	4.01	62.4	13.0		51.1	
10011- CAB	UMTS-FDD (WCDMA)	X	3.34	67.5	18.9	2.91	131.2	$\pm 0.5 \%$
		Y	3.43	67.9	18.7		137.1	
		Z	3.42	67.8	19.0		146.0	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.40	70.9	19.8	1.87	134.2	$\pm 0.7 \%$
		Y	3.19	70.2	19.2		137.9	
		Z	3.46	70.8	19.6		149.6	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	30.24	99.7	28.7	9.39	131.2	$\pm 1.4 \%$
		Y	12.91	88.5	23.9		147.5	
		Z	30.37	99.5	28.9		128.0	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	29.88	100.0	29.0	9.57	123.0	$\pm 1.9 \%$
		Y	16.02	92.5	25.4		140.7	
		Z	30.01	100.0	29.4		125.8	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	44.57	99.7	25.9	6.56	119.6	$\pm 1.7 \%$
		Y	28.97	95.3	23.2		127.6	
		Z	43.72	99.8	26.3		120.1	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	53.52	99.7	24.4	4.80	129.4	$\pm 2.2 \%$
		Y	54.55	99.9	22.9		143.3	
		Z	51.63	99.7	24.8		127.5	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	58.93	99.8	23.4	3.55	133.4	$\pm 2.2 \%$
		Y	77.54	99.7	21.3		125.3	
		Z	56.64	99.8	23.8		130.8	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	47.03	99.5	21.3	1.16	136.3	$\pm 1.7 \%$
		Y	95.86	95.2	17.1		138.2	
		Z	39.68	100.0	22.2		132.3	
10039- CAB	CDMA2000 (1xRTT, RC1)	X	4.84	66.8	19.1	4.57	131.3	$\pm 0.9 \%$
		Y	4.75	67.0	18.9		135.2	
		Z	4.86	66.7	19.0		127.2	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	4.06	66.8	19.0	3.97	148.4	±0.7 %
		Y	3.96	66.6	18.6		134.7	
		Z	4.13	66.9	19.1		143.4	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.63	66.8	18.7	3.98	137.3	±0.7 %
		Y	4.75	67.5	18.8		148.4	
		Z	4.65	66.7	18.7		133.2	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.66	68.5	20.3	5.67	144.0	±1.2 %
		Y	6.27	67.1	19.3		130.6	
		Z	6.62	68.2	20.1		140.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.53	68.0	20.2	5.80	142.6	±1.4 %
		Y	6.17	66.8	19.3		129.2	
		Z	6.52	67.8	20.1		139.0	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.19	67.3	19.9	5.75	137.9	±1.4 %
		Y	6.12	67.3	19.6		149.5	
		Z	6.19	67.1	19.8		136.1	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.49	69.5	21.7	8.10	132.4	±2.5 %
		Y	10.23	69.1	21.3		144.3	
		Z	10.45	69.3	21.6		129.5	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.46	69.5	21.7	8.07	133.9	±2.5 %
		Y	10.26	69.2	21.3		147.4	
		Z	10.47	69.4	21.7		130.5	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	11.61	77.4	26.8	9.28	118.8	±3.0 %
		Y	9.89	75.2	25.7		144.9	
		Z	12.01	77.8	26.9		119.6	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.20	67.3	19.9	5.75	139.2	±1.2 %
		Y	5.86	66.2	19.0		128.5	
		Z	6.22	67.3	19.9		136.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.63	67.8	20.1	5.82	144.1	±1.4 %
		Y	6.31	66.8	19.3		133.1	
		Z	6.66	67.7	20.0		140.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.25	67.5	20.2	5.73	143.6	±1.2 %
		Y	4.92	66.7	19.5		131.0	
		Z	5.29	67.4	20.2		140.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	13.49	87.5	31.6	9.21	139.0	±2.7 %
		Y	7.83	75.5	26.0		124.9	
		Z	13.47	86.5	31.1		137.8	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.22	67.4	20.1	5.72	144.3	±1.4 %
		Y	5.08	67.5	19.9		147.9	
		Z	5.26	67.2	20.0		139.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.24	67.5	20.1	5.72	144.5	±1.2 %
		Y	5.06	67.4	19.8		147.0	
		Z	5.29	67.3	20.1		139.2	

10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	10.12	69.1	21.6	8.09	128.8	±2.2 %
		Y	9.76	68.4	21.0		132.8	
		Z	10.08	68.9	21.5		123.4	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.15	69.2	21.7	8.10	130.2	±2.2 %
		Y	9.77	68.5	21.0		134.1	
		Z	10.10	69.0	21.5		124.0	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	10.02	69.0	21.5	8.03	128.7	±2.2 %
		Y	9.67	68.5	21.0		133.3	
		Z	10.02	68.9	21.5		123.9	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.46	69.6	21.7	8.06	134.0	±2.2 %
		Y	10.09	68.8	21.1		139.7	
		Z	10.40	69.3	21.6		128.7	
10225-CAB	UMTS-FDD (HSPA+)	X	7.09	67.1	19.6	5.97	131.2	±1.4 %
		Y	6.98	67.2	19.4		138.0	
		Z	7.06	66.8	19.4		127.2	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	13.63	87.8	31.7	9.21	141.6	±3.0 %
		Y	7.85	75.5	26.0		126.5	
		Z	13.99	87.7	31.6		141.4	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	12.86	81.4	28.9	9.24	142.1	±3.0 %
		Y	8.91	73.4	24.8		129.9	
		Z	13.15	81.4	28.8		142.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	11.63	77.5	26.8	9.30	118.7	±3.0 %
		Y	9.62	74.3	25.2		138.4	
		Z	11.96	77.7	26.9		119.3	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.14	67.4	19.3	4.87	149.9	±0.9 %
		Y	5.90	66.9	18.7		132.8	
		Z	6.20	67.5	19.3		146.6	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.45	66.9	18.9	3.96	130.1	±0.7 %
		Y	4.50	67.2	18.8		137.9	
		Z	4.64	67.6	19.3		149.2	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.79	67.5	19.2	3.46	145.3	±0.7 %
		Y	3.74	67.5	18.9		128.2	
		Z	3.78	67.3	19.1		139.1	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.77	67.8	19.3	3.39	147.0	±0.5 %
		Y	3.69	67.7	18.9		130.1	
		Z	3.73	67.3	19.0		141.3	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.52	67.9	20.1	5.81	141.4	±1.4 %
		Y	6.41	67.6	19.7		147.4	
		Z	6.51	67.7	20.1		135.4	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.17	68.7	20.7	6.06	147.7	±1.4 %
		Y	6.69	67.2	19.6		128.6	
		Z	7.12	68.4	20.5		142.0	

10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.04	70.0	19.6	1.71	129.8	±0.5 %
		Y	3.25	71.3	19.7		136.9	
		Z	3.09	69.9	19.5		148.7	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.73	67.3	18.6	3.76	135.7	±0.5 %
		Y	4.93	69.1	19.0		141.5	
		Z	4.73	67.1	18.4		132.7	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.67	67.5	18.6	3.77	134.0	±0.5 %
		Y	4.92	69.4	19.1		139.8	
		Z	4.65	67.1	18.5		130.7	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.53	6.53	6.53	0.40	1.60	± 12.0 %
835	41.5	0.90	6.27	6.27	6.27	0.80	1.17	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.80	1.10	± 12.0 %
1900	40.0	1.40	5.04	5.04	5.04	0.68	1.27	± 12.0 %
2450	39.2	1.80	4.52	4.52	4.52	0.78	1.23	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.76	1.33	± 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:3258

Calibration Parameter Determined in Body Tissue Simulating Media

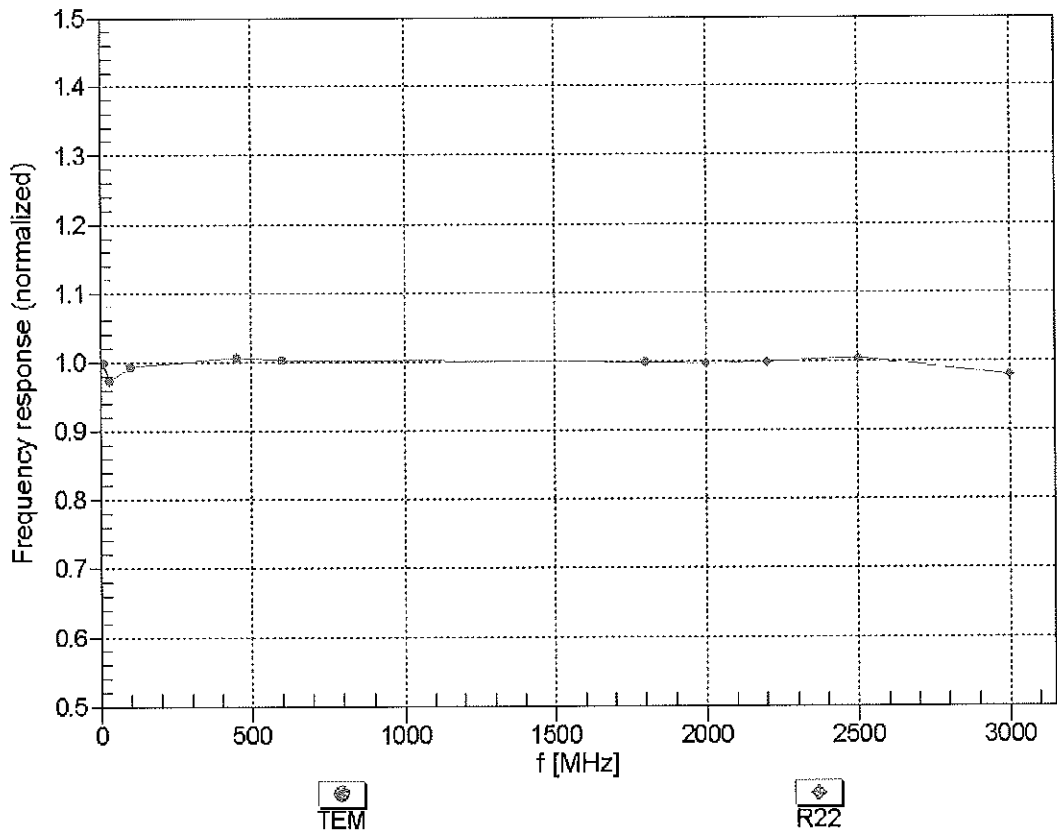
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.15	6.15	6.15	0.61	1.32	± 12.0 %
835	55.2	0.97	6.11	6.11	6.11	0.80	1.15	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.47	1.74	± 12.0 %
1900	53.3	1.52	4.61	4.61	4.61	0.55	1.59	± 12.0 %
2450	52.7	1.95	4.14	4.14	4.14	0.80	1.11	± 12.0 %
2600	52.5	2.16	3.91	3.91	3.91	0.80	1.00	± 12.0 %

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

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

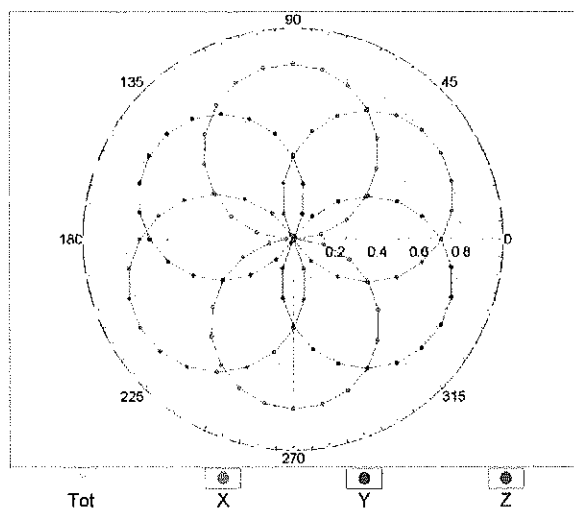
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



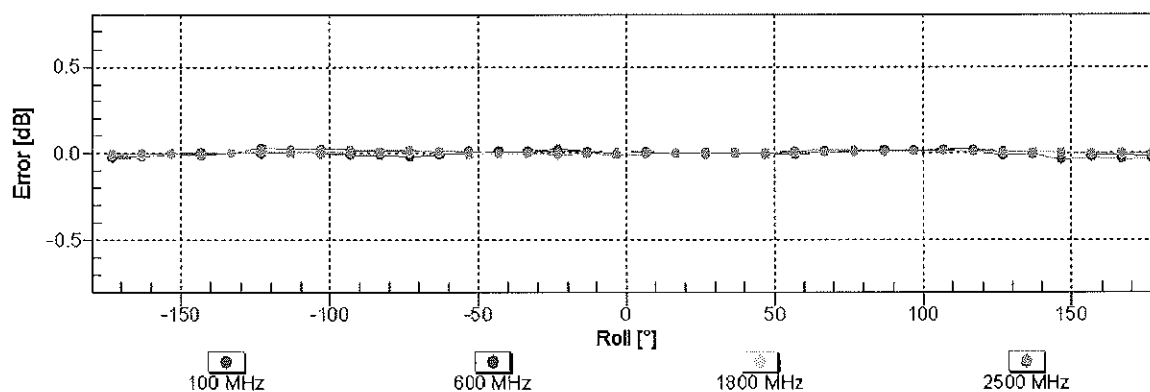
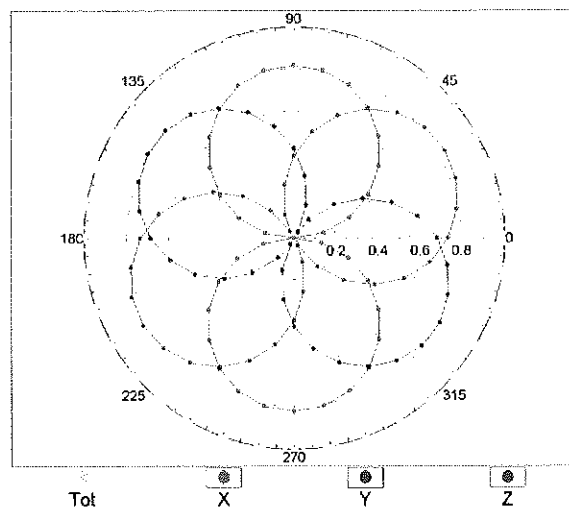
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM



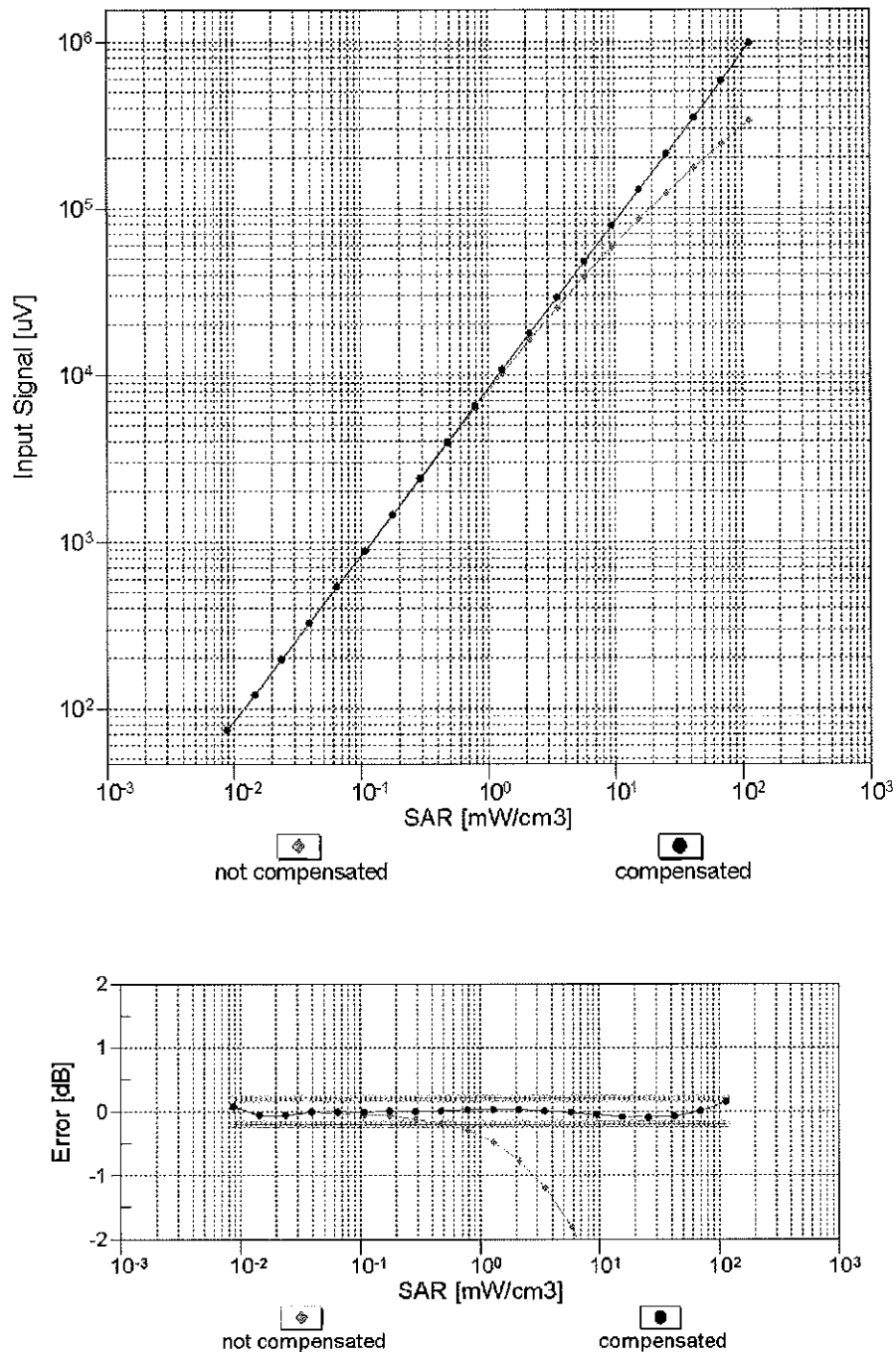
f=1800 MHz,R22



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

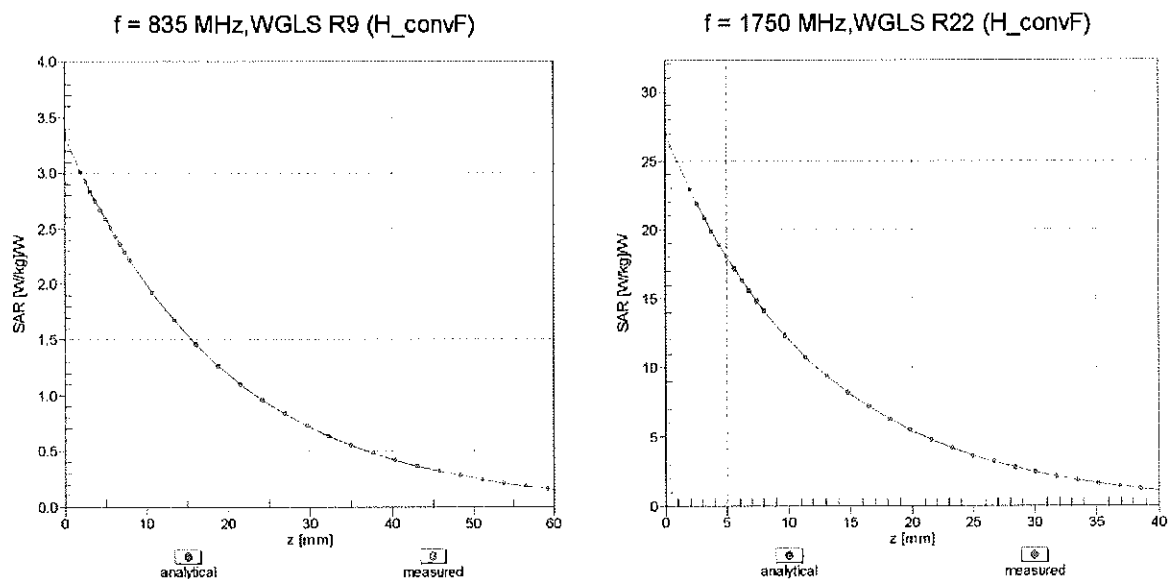
Dynamic Range f(SAR_{head})

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



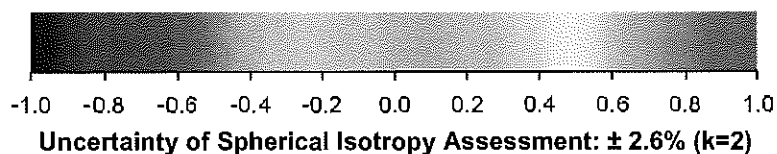
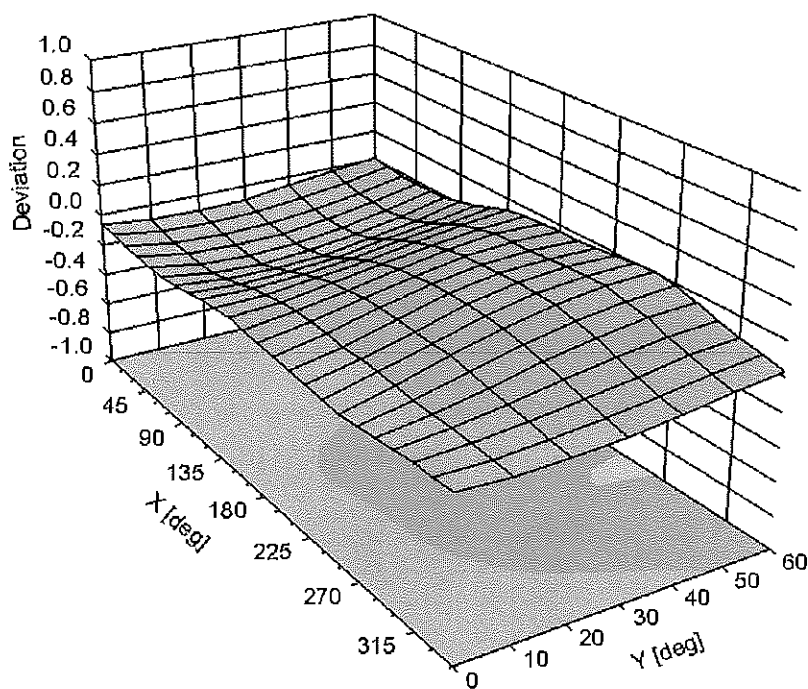
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-123.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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



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

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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3022_Aug14/2**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3022_Aug14)

Object **ES3DV2 - SN:3022**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6**
Calibration procedure for dosimetric E-field probes

CC
D/M/Y

Calibration date: **August 19, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	
Issued: November 3, 2014 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
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 E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}:** DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR:** PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}:** A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters:** Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy):** In a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset:** The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle:** The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 19, 2014

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 ($\mu V/(V/m)^2$) ^A	1.00	1.04	0.96	$\pm 10.1 \%$
DCP (mV) ^B	103.0	96.3	101.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	181.8	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		183.0	
		Z	0.0	0.0	1.0		192.3	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	2.51	63.1	12.7	10.00	42.6	$\pm 1.9 \%$
		Y	2.62	63.1	12.9		42.7	
		Z	3.12	65.7	13.6		40.4	
10011- CAB	UMTS-FDD (WCDMA)	X	3.33	67.8	19.2	2.91	145.9	$\pm 0.9 \%$
		Y	3.13	64.9	16.9		147.4	
		Z	3.20	66.4	18.2		139.6	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.05	70.1	19.8	1.87	147.2	$\pm 0.9 \%$
		Y	2.62	65.1	16.2		147.4	
		Z	2.85	68.2	18.4		141.7	
10013- CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.10	70.9	23.6	9.46	143.9	$\pm 3.0 \%$
		Y	11.04	70.2	22.9		144.2	
		Z	10.77	70.2	23.1		134.7	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	19.66	99.7	28.6	9.39	126.0	$\pm 1.9 \%$
		Y	11.04	89.6	25.5		138.9	
		Z	10.45	88.8	24.9		137.5	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	20.19	99.6	28.5	9.57	142.0	$\pm 2.5 \%$
		Y	10.53	88.4	25.0		145.5	
		Z	15.52	96.5	27.8		147.6	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	31.93	99.6	25.2	6.56	149.5	$\pm 1.9 \%$
		Y	12.70	87.9	22.2		148.0	
		Z	27.00	99.8	25.7		135.3	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	38.32	99.8	23.8	4.80	148.1	$\pm 2.2 \%$
		Y	9.80	83.2	19.3		138.8	
		Z	31.96	99.9	24.2		128.9	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	40.03	99.5	22.8	3.55	130.5	$\pm 2.2 \%$
		Y	40.27	99.6	23.0		148.1	
		Z	43.09	99.7	22.5		140.1	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	38.93	99.4	20.4	1.16	146.7	$\pm 1.9 \%$
		Y	32.83	92.5	17.9		139.2	
		Z	31.94	99.5	20.8		133.1	
10039- CAB	CDMA2000 (1xRTT, RC1)	X	4.66	66.8	19.3	4.57	144.5	$\pm 1.2 \%$
		Y	4.56	65.3	17.9		137.2	
		Z	4.52	66.1	18.7		131.7	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.82	66.0	18.7	3.97	140.3	±0.9 %
		Y	3.77	64.5	17.3		133.6	
		Z	3.79	65.7	18.4		128.2	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.40	66.2	18.5	3.98	130.9	±1.2 %
		Y	4.39	65.0	17.4		131.1	
		Z	4.47	66.3	18.4		140.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.30	67.3	19.8	5.67	137.4	±1.7 %
		Y	6.25	66.3	18.9		135.9	
		Z	6.36	67.4	19.7		147.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.14	66.8	19.6	5.80	134.6	±1.7 %
		Y	6.17	66.1	18.9		133.9	
		Z	6.24	67.0	19.7		144.5	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.82	66.3	19.4	5.75	131.2	±1.7 %
		Y	5.82	65.4	18.6		130.3	
		Z	5.91	66.5	19.4		140.4	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.00	68.5	21.2	8.10	124.3	±2.5 %
		Y	9.89	67.9	20.6		124.0	
		Z	10.05	68.6	21.2		133.2	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.01	68.6	21.2	8.07	125.8	±2.5 %
		Y	9.91	67.9	20.7		125.8	
		Z	10.09	68.8	21.3		134.7	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.69	75.5	26.4	9.28	144.7	±3.3 %
		Y	9.09	72.7	24.6		143.2	
		Z	8.54	72.0	24.5		124.8	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.82	66.2	19.4	5.75	131.3	±1.9 %
		Y	6.06	66.3	19.1		149.2	
		Z	5.91	66.5	19.4		140.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.27	66.9	19.7	5.82	136.5	±1.4 %
		Y	6.19	65.8	18.7		128.4	
		Z	6.33	67.0	19.6		145.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.81	66.4	19.7	5.73	134.8	±1.7 %
		Y	4.92	66.1	19.1		149.9	
		Z	4.78	66.4	19.6		141.2	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.83	76.6	27.2	9.21	131.4	±3.5 %
		Y	7.54	74.5	25.8		147.8	
		Z	7.71	76.7	27.4		145.3	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.90	66.9	20.0	5.72	147.6	±1.4 %
		Y	4.90	66.0	19.1		148.0	
		Z	4.78	66.4	19.6		141.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.90	66.9	20.0	5.72	148.1	±1.4 %
		Y	4.89	65.9	19.0		146.9	
		Z	4.80	66.5	19.7		142.1	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.80	68.7	21.4	8.09	135.1	±2.7 %
		Y	9.78	68.2	20.9		135.5	
		Z	9.70	68.5	21.2		130.2	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.79	68.7	21.4	8.10	136.4	±2.7 %
		Y	9.81	68.3	20.9		138.0	
		Z	9.72	68.6	21.3		132.8	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.68	68.6	21.3	8.03	136.0	±2.7 %
		Y	9.74	68.3	21.0		137.4	
		Z	9.62	68.5	21.2		132.6	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.20	69.1	21.5	8.06	143.4	±2.5 %
		Y	9.91	60.0	20.7		125.8	
		Z	10.27	69.4	21.6		148.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.87	66.9	19.6	5.97	139.5	±1.9 %
		Y	7.04	66.9	19.3		149.3	
		Z	6.89	67.0	19.5		143.5	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	7.66	75.9	26.9	9.21	126.1	±3.0 %
		Y	7.17	73.1	25.1		132.1	
		Z	7.18	74.6	26.3		128.0	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.58	73.1	25.3	9.24	127.6	±3.3 %
		Y	8.22	71.0	23.7		126.9	
		Z	8.83	74.3	26.0		149.8	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.69	75.5	26.5	9.30	143.8	±3.3 %
		Y	8.88	72.0	24.2		135.2	
		Z	8.83	72.9	25.1		131.3	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.87	67.0	19.2	4.87	141.2	±1.4 %
		Y	5.77	65.8	18.1		136.0	
		Z	5.71	66.3	18.6		132.7	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.44	67.2	19.2	3.96	147.3	±0.9 %
		Y	4.29	65.3	17.6		139.2	
		Z	4.31	66.3	18.5		139.6	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.60	67.1	19.1	3.46	137.8	±0.7 %
		Y	3.44	64.8	17.2		129.6	
		Z	3.48	66.2	18.4		130.5	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.50	66.9	18.9	3.39	139.5	±0.7 %
		Y	3.38	64.8	17.2		132.0	
		Z	3.48	66.5	18.5		133.1	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.12	66.7	19.6	5.81	133.3	±1.9 %
		Y	6.35	66.7	19.3		149.3	
		Z	6.17	66.8	19.5		132.7	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.72	67.4	20.0	6.06	138.7	±1.7 %
		Y	6.63	66.3	19.1		131.4	
		Z	6.72	67.3	19.9		138.7	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.90	69.9	19.8	1.71	146.4	±0.5 %
		Y	2.54	65.2	16.5		139.3	
		Z	2.75	68.1	18.5		146.4	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.12	69.3	21.9	8.36	142.9	±3.0 %
		Y	10.01	68.5	21.3		135.2	
		Z	10.11	69.3	21.9		141.7	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.59	68.2	19.0	3.76	126.7	±0.7 %
		Y	4.59	67.2	18.0		142.4	
		Z	4.64	68.5	19.0		143.0	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.64	68.8	19.3	3.77	147.1	±0.9 %
		Y	4.47	67.1	17.9		139.6	
		Z	4.54	68.4	18.9		147.2	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.66	69.0	19.4	1.54	145.8	±0.5 %
		Y	2.40	64.8	16.2		140.0	
		Z	2.62	67.8	18.4		147.2	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.97	69.1	21.7	8.23	142.0	±3.0 %
		Y	10.08	68.9	21.4		145.8	
		Z	10.01	69.2	21.8		143.3	

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%.

[^] The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

[^] Numerical linearization parameter: uncertainty not required.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unct. (k=2)
750	41.9	0.89	6.39	6.39	6.39	0.20	2.24	± 12.0 %
835	41.5	0.90	6.18	6.18	6.18	0.23	1.98	± 12.0 %
1750	40.1	1.37	5.04	5.04	5.04	0.51	1.35	± 12.0 %
1900	40.0	1.40	4.85	4.85	4.85	0.38	1.66	± 12.0 %
2450	39.2	1.80	4.31	4.31	4.31	0.66	1.28	± 12.0 %
2600	39.0	1.96	4.13	4.13	4.13	0.76	1.28	± 12.0 %

^c Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^g (mm)	Unct. (k=2)
450	56.7	0.94	6.78	6.78	6.78	0.12	1.30	± 13.3 %
600	56.1	0.95	6.72	6.72	6.72	0.05	1.20	± 13.3 %
750	55.5	0.96	6.02	6.02	6.02	0.23	2.05	± 12.0 %
835	55.2	0.97	5.98	5.98	5.98	0.29	1.85	± 12.0 %
1750	53.4	1.49	4.70	4.70	4.70	0.66	1.25	± 12.0 %
1900	53.3	1.52	4.49	4.49	4.49	0.33	2.02	± 12.0 %
2450	52.7	1.95	4.05	4.05	4.05	0.80	1.01	± 12.0 %
2600	52.5	2.16	3.94	3.94	3.94	0.68	1.03	± 12.0 %

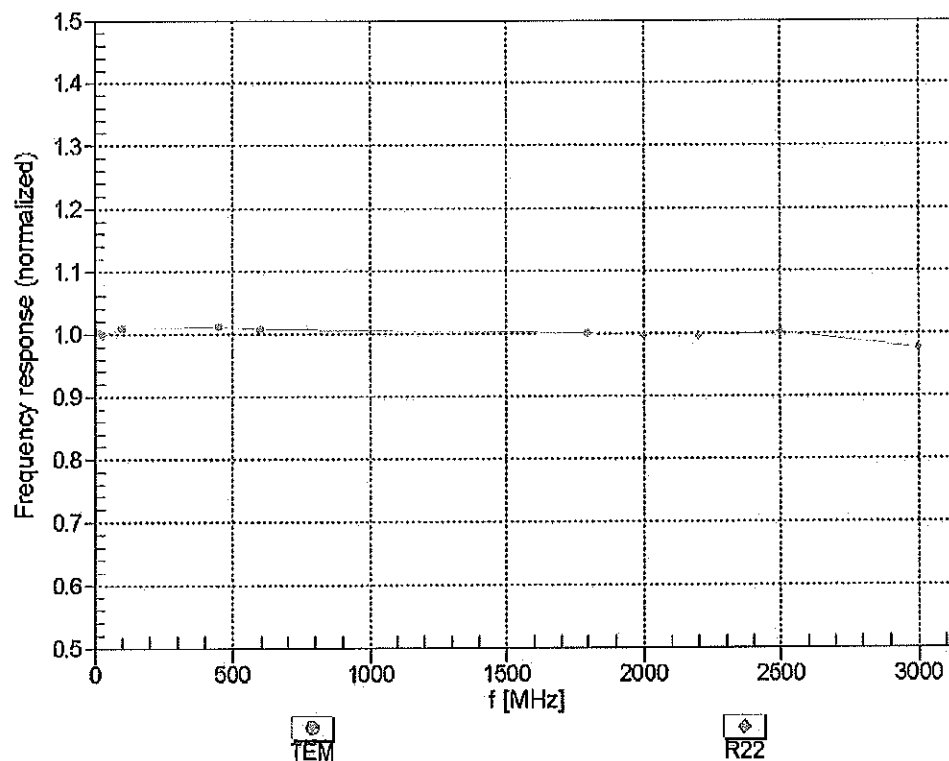
^c Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^f At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Frequency Response of E-Field

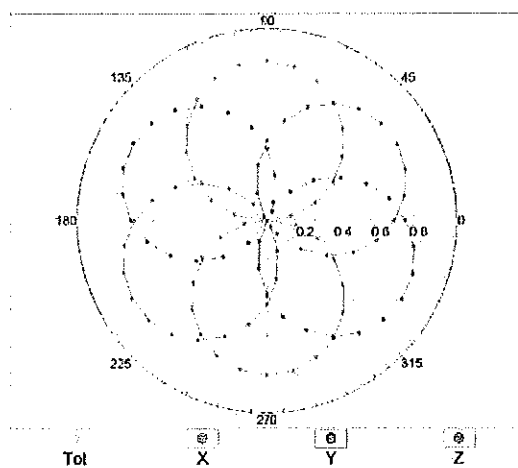
(TEM-Cell:ifi110 EXX, Waveguide: R22)



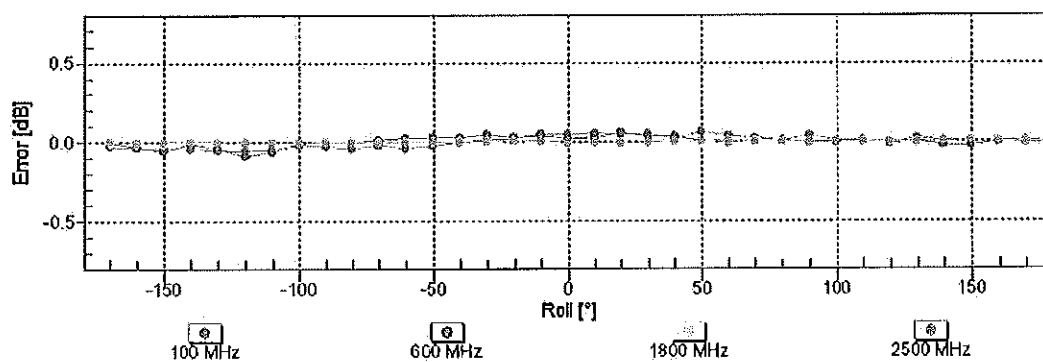
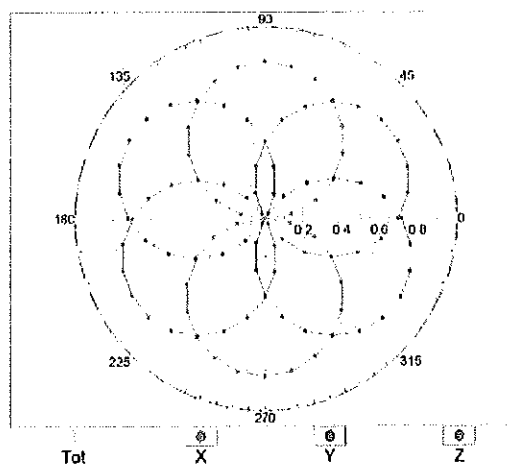
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

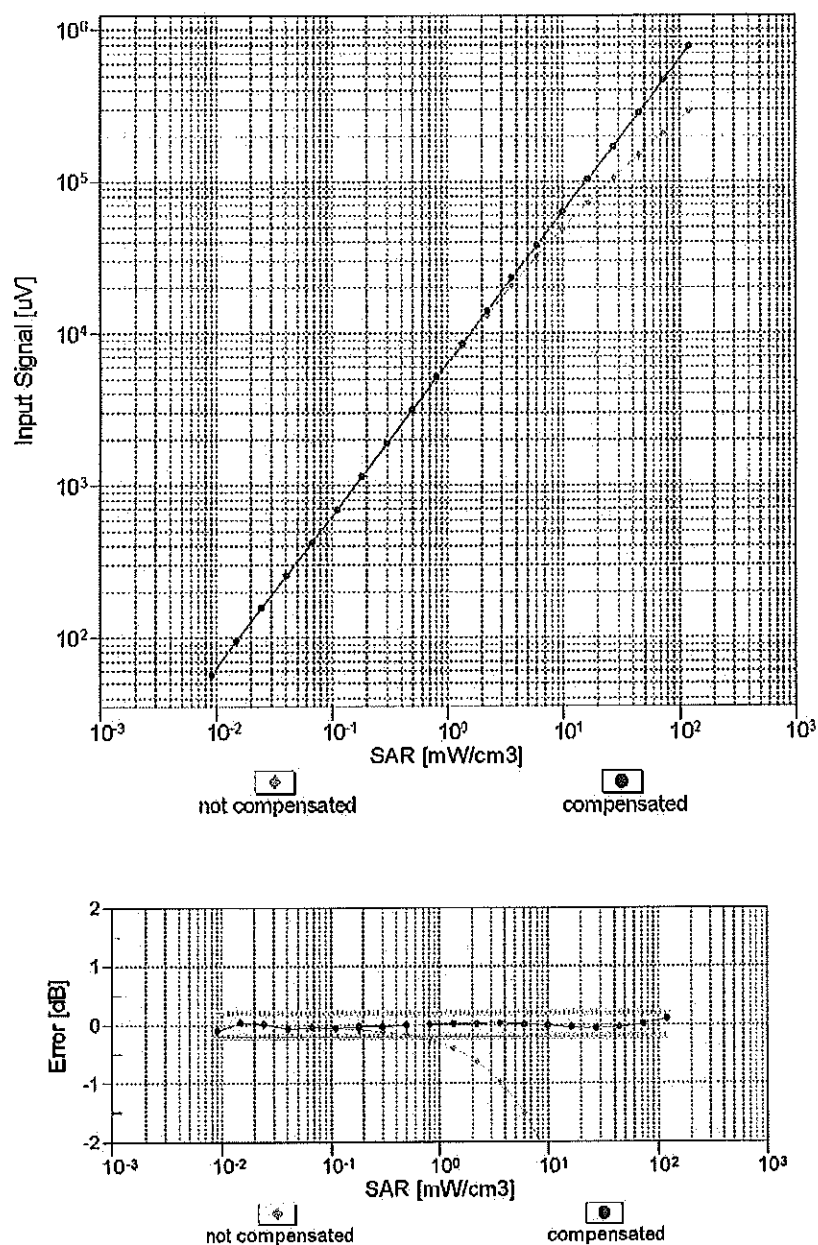


f=1800 MHz,R22



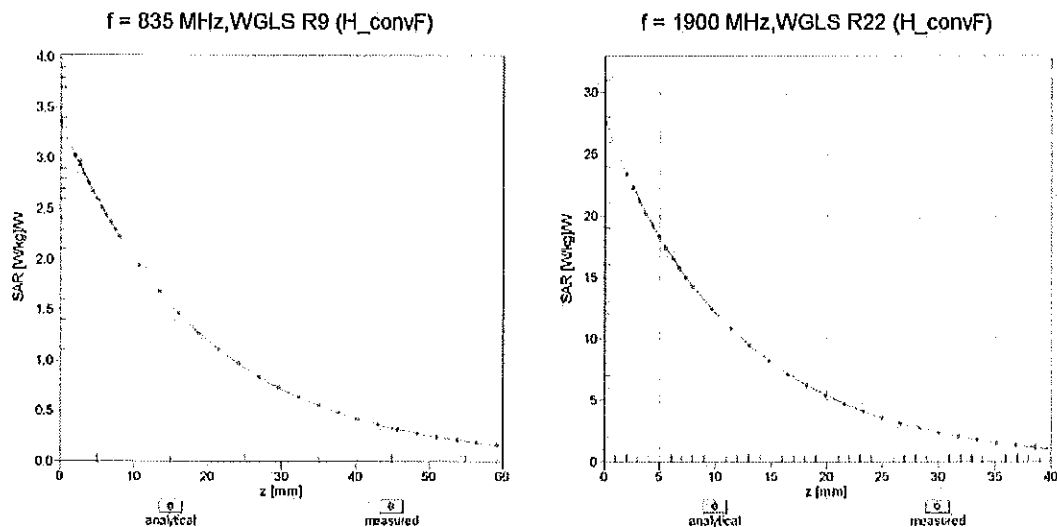
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



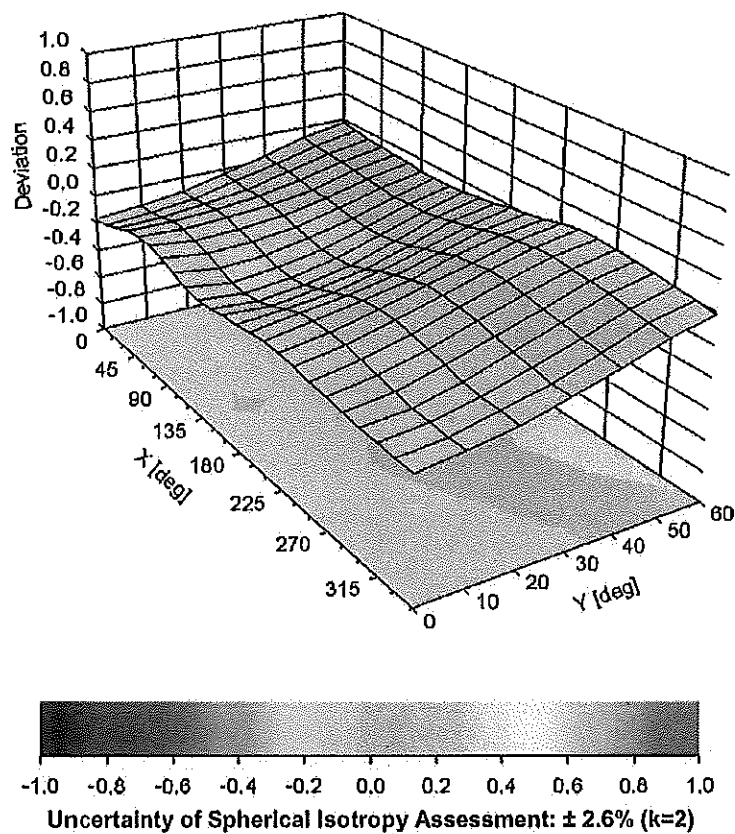
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

Sensor Arrangement	Triangular
Connector Angle (°)	-80.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Client **PC Test**

Certificate No: **ES3-3263_May14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3263**

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

CCV
 7/17/14

Calibration date: **May 15, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: May 15, 2014			
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
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 E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3263

Manufactured: January 25, 2010
Calibrated: May 15, 2014

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	1.24	1.13	$\pm 10.1 \%$
DCP (mV) ^B	103.8	102.3	104.7	

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	156.3	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		203.1	
		Z	0.0	0.0	1.0		197.2	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.33	59.4	10.8	10.00	46.4	$\pm 1.4 \%$
		Y	4.39	63.4	13.6		50.8	
		Z	1.35	55.5	7.8		39.6	
10011-CAB	UMTS-FDD (WCDMA)	X	3.49	68.2	19.1	2.91	126.7	$\pm 0.7 \%$
		Y	3.28	66.9	18.5		120.7	
		Z	2.74	63.1	15.1		113.5	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.51	72.0	20.3	1.87	127.9	$\pm 0.7 \%$
		Y	3.21	69.4	18.8		124.1	
		Z	1.93	60.6	12.6		113.3	
10013-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	11.30	70.8	23.3	9.46	125.2	$\pm 2.5 \%$
		Y	12.42	72.7	24.4		129.4	
		Z	10.03	67.8	21.1		105.5	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	24.45	99.1	27.6	9.39	141.4	$\pm 1.4 \%$
		Y	29.93	99.5	29.0		124.5	
		Z	4.53	73.0	18.1		111.6	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	25.10	99.7	27.9	9.57	134.2	$\pm 1.9 \%$
		Y	24.85	96.1	28.0		120.2	
		Z	5.99	76.5	19.1		142.5	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	24.34	93.0	23.0	6.56	117.1	$\pm 1.4 \%$
		Y	26.49	92.6	24.2		148.7	
		Z	4.00	69.6	13.8		136.6	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	51.24	99.9	23.5	4.80	131.1	$\pm 1.9 \%$
		Y	56.83	99.5	24.3		101.8	
		Z	1.70	61.4	9.1		107.7	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	60.12	99.6	22.2	3.55	138.7	$\pm 1.9 \%$
		Y	64.73	99.9	23.4		105.5	
		Z	1.13	58.4	6.0		116.0	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	77.27	99.6	19.6	1.16	149.5	$\pm 2.5 \%$
		Y	60.44	99.7	21.0		109.4	
		Z	0.34	55.9	2.9		131.4	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.79	66.8	19.0	4.57	124.5	$\pm 0.9 \%$
		Y	4.85	66.4	18.8		125.6	
		Z	4.06	63.4	16.1		108.1	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.93	66.1	18.5	3.97	119.8	±0.7 %
		Y	3.90	65.5	18.2		120.1	
		Z	3.29	62.4	15.3		108.5	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.68	66.9	18.7	3.98	131.2	±0.7 %
		Y	4.64	66.6	18.6		130.5	
		Z	4.15	64.5	16.5		118.8	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.61	68.1	20.0	5.67	137.5	±1.7 %
		Y	6.70	68.4	20.2		137.7	
		Z	5.90	65.6	17.9		124.0	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.44	67.5	19.8	5.80	135.1	±1.7 %
		Y	6.60	68.0	20.1		135.4	
		Z	5.75	64.9	17.6		121.8	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.14	67.1	19.7	5.75	131.6	±1.2 %
		Y	6.28	67.4	19.9		132.7	
		Z	5.62	65.5	18.2		118.4	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.18	68.8	21.2	8.10	124.3	±1.9 %
		Y	10.60	69.7	21.8		126.2	
		Z	9.38	67.0	19.8		108.4	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.23	68.9	21.3	8.07	125.0	±1.9 %
		Y	10.56	69.6	21.7		127.1	
		Z	9.37	67.1	19.8		109.1	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	10.23	75.7	26.0	9.28	125.0	±2.7 %
		Y	14.60	83.3	29.5		147.3	
		Z	8.05	69.7	22.3		106.3	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.12	67.0	19.6	5.75	131.6	±1.4 %
		Y	6.28	67.4	19.9		132.4	
		Z	5.49	64.7	17.4		117.9	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.57	67.5	19.8	5.82	136.0	±1.4 %
		Y	6.71	67.9	20.1		137.1	
		Z	5.89	65.2	17.8		122.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.82	66.0	19.3	5.73	113.5	±1.4 %
		Y	5.12	66.3	19.4		116.6	
		Z	4.75	65.9	18.3		142.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	9.53	80.6	28.6	9.21	136.5	±2.2 %
		Y	11.32	81.6	28.8		109.2	
		Z	6.84	72.0	23.8		117.3	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.86	66.2	19.4	5.72	112.9	±1.2 %
		Y	5.10	66.2	19.4		115.9	
		Z	4.55	64.9	17.8		137.7	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.81	66.0	19.2	5.72	111.6	±1.2 %
		Y	5.13	66.4	19.5		116.1	
		Z	4.70	65.7	18.3		137.1	
10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.80	68.3	21.0	8.09	117.2	±2.2 %
		Y	10.23	69.1	21.6		121.5	
		Z	9.85	68.9	20.8		148.4	

10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.81	68.4	21.1	8.10	117.7	±2.2 %
		Y	10.23	69.2	21.6		121.7	
		Z	9.87	69.0	20.9		149.9	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.71	68.3	21.0	8.03	117.8	±2.2 %
		Y	10.12	69.1	21.6		121.0	
		Z	8.90	66.6	19.6		104.1	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.14	68.7	21.2	8.06	122.3	±1.9 %
		Y	10.52	69.5	21.7		125.4	
		Z	9.28	66.8	19.6		108.5	
10225-CAB	UMTS-FDD (HSPA+)	X	7.25	67.8	19.9	5.97	146.3	±1.7 %
		Y	7.32	67.5	19.8		149.3	
		Z	6.52	65.7	18.0		130.7	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	9.55	80.7	28.7	9.21	137.2	±2.5 %
		Y	11.34	81.7	28.9		109.9	
		Z	6.98	72.5	24.0		119.5	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.26	74.1	25.3	9.24	115.6	±3.3 %
		Y	13.72	82.5	29.3		137.9	
		Z	8.83	73.3	24.4		144.1	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	10.06	75.2	25.8	9.30	122.9	±2.7 %
		Y	14.69	83.4	29.6		147.6	
		Z	8.02	69.6	22.3		103.4	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.08	67.2	19.0	4.87	140.2	±1.2 %
		Y	6.23	67.5	19.2		143.5	
		Z	5.52	65.4	17.4		125.1	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.44	66.7	18.7	3.96	122.1	±0.7 %
		Y	4.39	66.3	18.5		124.4	
		Z	3.83	63.7	16.0		114.0	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.64	66.7	18.6	3.46	115.7	±0.7 %
		Y	3.60	66.0	18.2		118.0	
		Z	3.17	64.2	16.3		108.4	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.62	67.0	18.8	3.39	116.9	±0.9 %
		Y	3.54	66.1	18.2		119.1	
		Z	3.24	64.2	15.8		145.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.43	67.5	19.8	5.81	132.0	±1.4 %
		Y	6.60	68.0	20.1		134.9	
		Z	5.81	65.4	18.0		115.0	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.04	68.1	20.2	6.06	137.5	±1.4 %
		Y	7.19	68.6	20.5		140.3	
		Z	6.26	65.7	18.2		119.6	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.05	70.0	19.4	1.71	121.7	±0.7 %
		Y	2.91	68.7	18.7		123.4	
		Z	1.83	60.2	12.3		108.4	
10316-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	10.05	68.7	21.4	8.36	117.3	±1.9 %
		Y	10.57	69.7	22.0		122.8	
		Z	9.11	66.5	19.7		103.1	

10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.81	68.3	18.8	3.76	125.8	±0.7 %
		Y	4.65	66.5	18.1		130.8	
		Z	3.98	64.7	16.0		114.7	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.91	69.1	19.2	3.77	123.3	±0.7 %
		Y	4.60	66.6	18.1		128.5	
		Z	3.73	64.0	15.4		112.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.78	69.0	19.0	1.54	121.9	±0.7 %
		Y	2.46	66.8	17.9		122.5	
		Z	1.83	60.9	13.0		112.4	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.88	68.4	21.2	8.23	116.6	±1.7 %
		Y	10.29	69.2	21.7		121.5	
		Z	9.25	67.3	20.2		103.4	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN: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 ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.42	6.42	6.42	0.72	1.18	± 12.0 %
835	41.5	0.90	6.23	6.23	6.23	0.27	2.02	± 12.0 %
1750	40.1	1.37	5.41	5.41	5.41	0.74	1.23	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.80	1.16	± 12.0 %
2450	39.2	1.80	4.47	4.47	4.47	0.80	1.22	± 12.0 %
2600	39.0	1.96	4.33	4.33	4.33	0.66	1.41	± 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: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 ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.19	6.19	6.19	0.52	1.41	± 12.0 %
835	55.2	0.97	6.16	6.16	6.16	0.68	1.28	± 12.0 %
1750	53.4	1.49	4.98	4.98	4.98	0.38	1.91	± 12.0 %
1900	53.3	1.52	4.78	4.78	4.78	0.66	1.35	± 12.0 %
2450	52.7	1.95	4.27	4.27	4.27	0.72	1.13	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.74	1.07	± 12.0 %

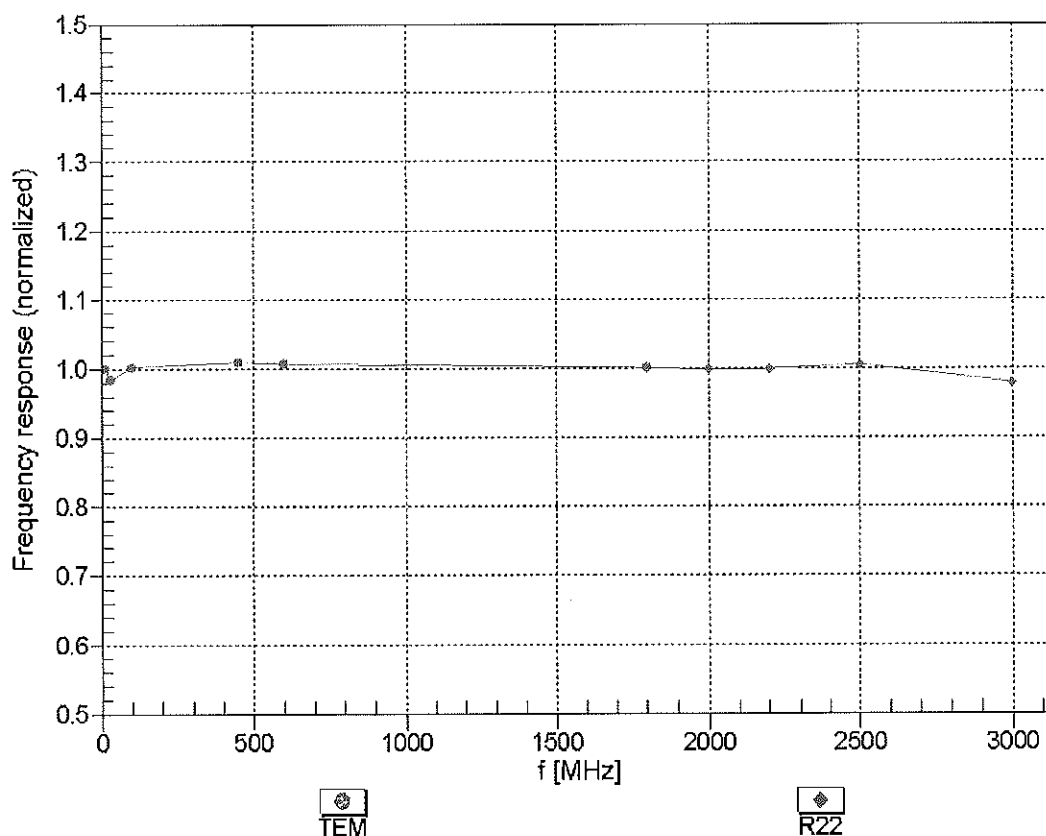
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^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

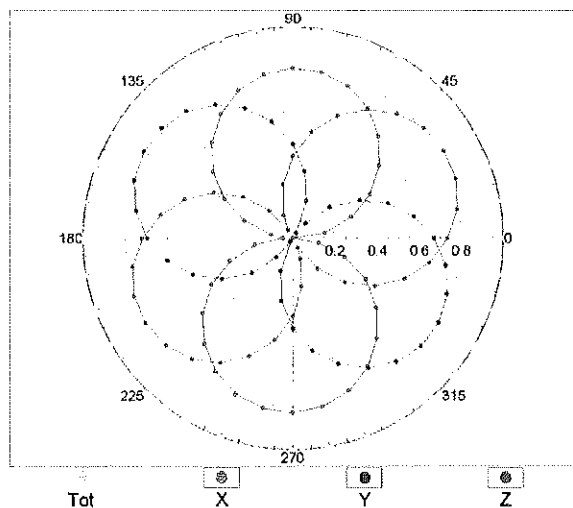
(TEM-Cell:ifi110 EXX, Waveguide: R22)



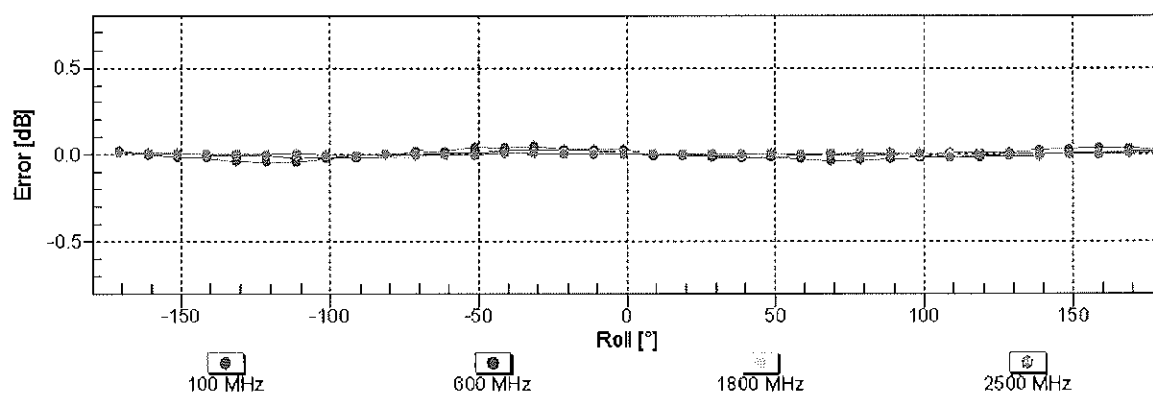
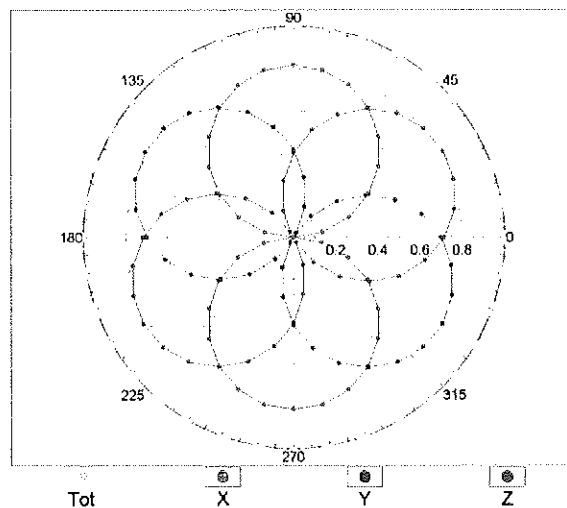
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

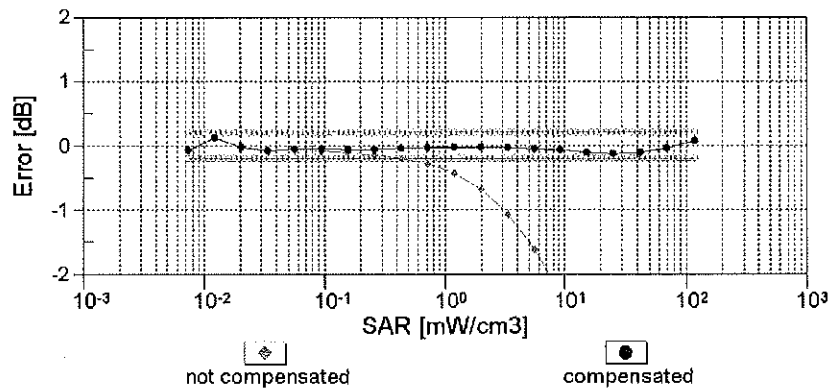
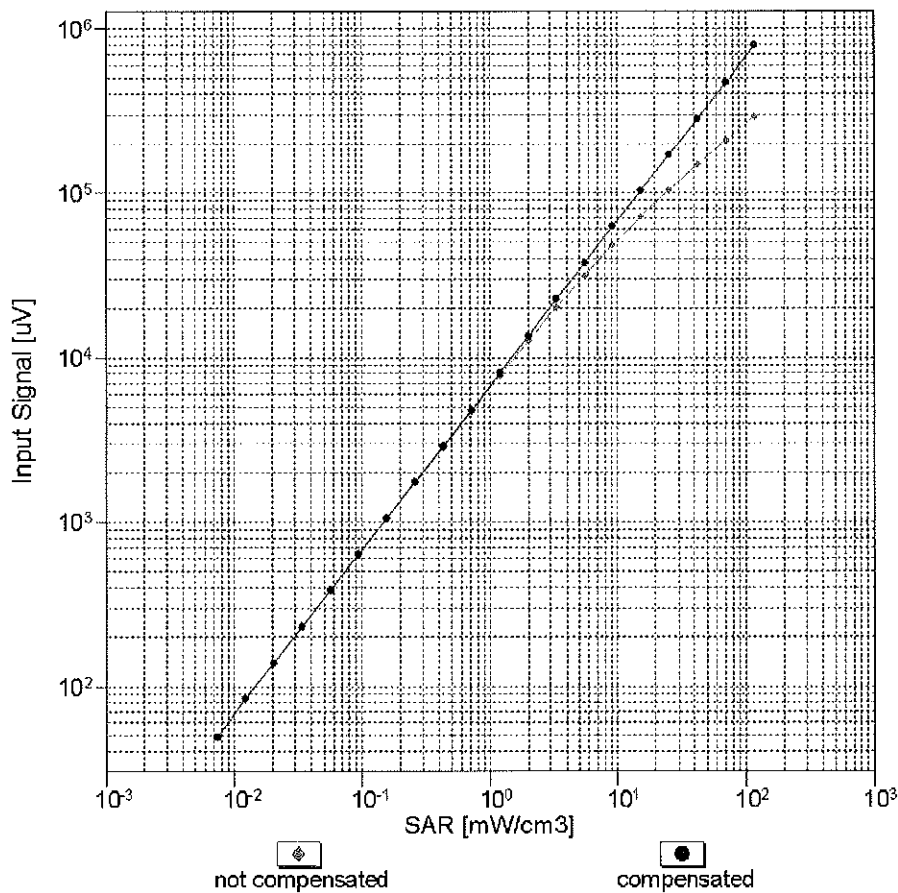


f=1800 MHz,R22



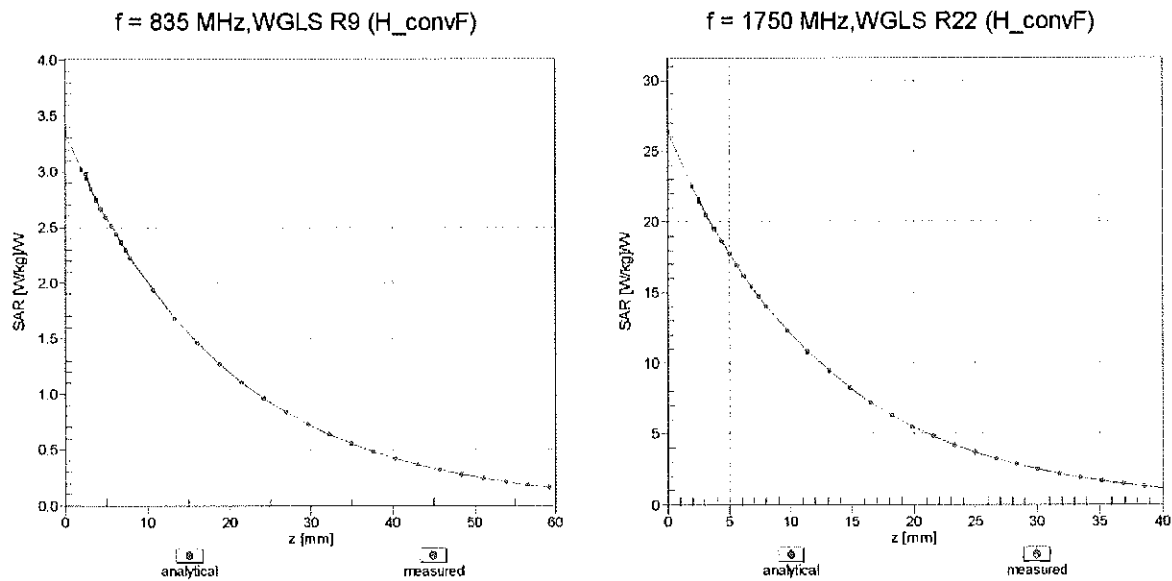
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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

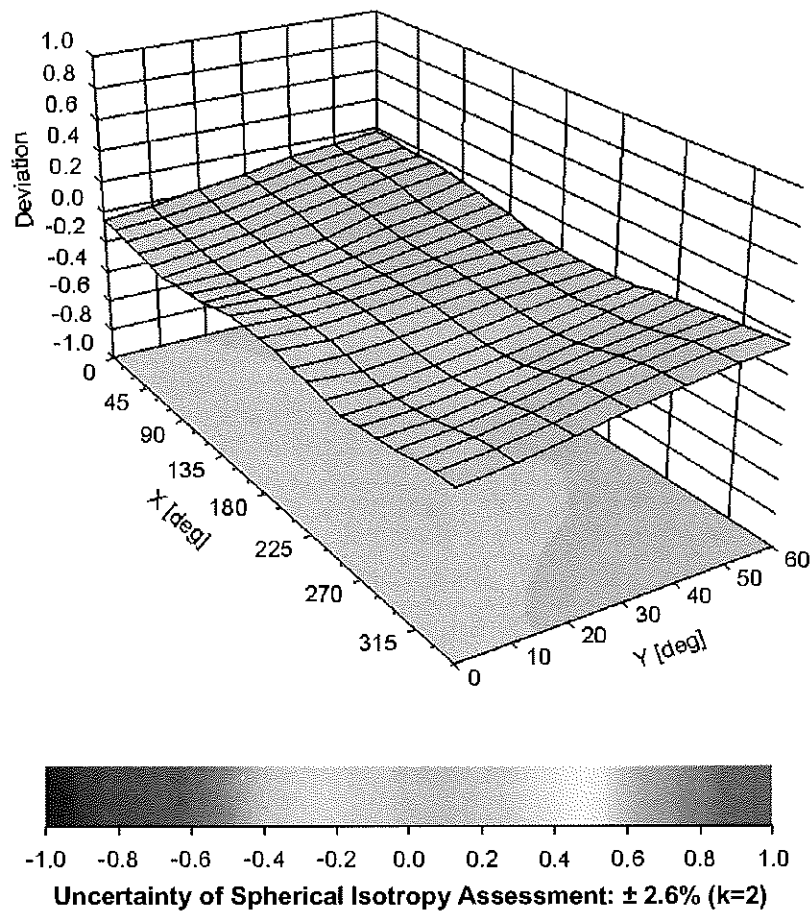


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, ϑ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-111.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm



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: **EX3-3920_Dec14**

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

CC
 12/30/14

Calibration date: **December 12, 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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 13, 2014

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



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Accreditation No.: **SCS 108**

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

Probe EX3DV4

SN:3920

Manufactured: December 18, 2012
Calibrated: December 12, 2014

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 ($\mu V/(V/m)^2$) ^A	0.35	0.50	0.50	$\pm 10.1 \%$
DCP (mV) ^B	104.2	98.5	97.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	131.7	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		140.3	
		Z	0.0	0.0	1.0		136.8	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	0.94	56.5	8.3	10.00	38.1	$\pm 0.7 \%$
		Y	2.14	63.7	12.2		41.6	
		Z	3.89	70.9	15.1		40.9	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.91	68.2	18.0	1.87	142.7	$\pm 0.7 \%$
		Y	2.48	64.3	15.8		132.6	
		Z	2.61	65.8	16.8		129.2	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.41	69.4	22.2	9.46	149.3	$\pm 3.5 \%$
		Y	10.78	69.4	22.2		146.4	
		Z	10.76	69.7	22.6		141.9	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.29	58.3	5.2	1.16	136.2	$\pm 0.7 \%$
		Y	0.52	61.5	7.4		149.5	
		Z	0.99	66.7	9.6		146.5	
10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	9.78	68.2	21.1	8.68	126.2	$\pm 3.3 \%$
		Y	10.40	68.9	21.4		145.8	
		Z	10.43	69.3	21.9		146.6	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	7.49	68.0	21.7	9.29	145.0	$\pm 2.2 \%$
		Y	7.76	68.0	21.7		137.3	
		Z	8.12	69.7	22.9		139.5	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.08	68.6	20.8	8.07	140.7	$\pm 3.0 \%$
		Y	10.01	67.8	20.3		129.1	
		Z	10.13	68.3	20.8		130.9	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.12	67.7	21.7	9.28	140.0	$\pm 2.2 \%$
		Y	7.42	67.6	21.5		133.0	
		Z	7.70	69.2	22.8		135.2	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.55	68.8	22.5	9.21	129.9	$\pm 2.7 \%$
		Y	6.01	69.1	22.6		144.5	
		Z	6.16	70.6	23.9		146.7	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.56	68.2	20.7	8.10	132.3	$\pm 3.0 \%$
		Y	10.09	68.7	20.9		149.9	
		Z	10.08	69.0	21.3		147.9	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.60	69.2	22.8	9.21	133.6	$\pm 2.7 \%$
		Y	6.05	69.3	22.7		145.6	
		Z	6.15	70.5	23.9		147.8	

10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.68	67.3	21.6	9.24	133.4	±2.7 %
		Y	7.19	68.0	21.9		147.8	
		Z	7.38	69.3	23.0		147.7	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.14	67.7	21.8	9.30	139.9	±2.2 %
		Y	7.44	67.6	21.5		133.0	
		Z	7.68	69.1	22.7		131.5	
10317-AAB	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	9.72	68.3	21.0	8.36	132.1	±3.3 %
		Y	10.25	68.8	21.2		148.1	
		Z	10.27	69.2	21.6		148.7	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	9.78	68.3	20.9	8.37	131.9	±3.3 %
		Y	9.97	67.9	20.7		125.1	
		Z	10.36	69.3	21.7		148.4	
10401-AAB	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	10.63	68.9	21.2	8.60	142.5	±3.0 %
		Y	10.72	68.6	21.0		133.5	
		Z	10.74	68.8	21.4		133.0	
10402-AAB	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.89	69.3	21.2	8.53	145.0	±3.3 %
		Y	10.70	68.4	20.8		133.2	
		Z	10.95	69.2	21.4		134.0	
10415-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 99pc duty cycle)	X	2.84	68.2	17.9	1.54	141.1	±0.5 %
		Y	2.39	64.2	15.6		130.2	
		Z	2.63	66.6	17.2		128.6	
10416-AAA	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 99pc duty cycle)	X	9.67	68.3	20.9	8.23	131.6	±3.3 %
		Y	10.14	68.6	21.0		147.9	
		Z	10.17	69.1	21.5		148.5	
10417-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 99pc duty cycle)	X	9.67	68.3	20.9	8.23	133.0	±3.3 %
		Y	9.78	67.7	20.5		124.4	
		Z	10.21	69.1	21.5		149.4	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 6 and 7).

^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)
2450	39.2	1.80	7.12	7.12	7.12	0.62	0.65	± 12.0 %
2600	39.0	1.96	6.85	6.85	6.85	0.36	0.86	± 12.0 %
5200	36.0	4.66	4.87	4.87	4.87	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.69	4.69	4.69	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.44	4.44	4.44	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.35	4.35	4.35	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.27	4.27	4.27	0.40	1.80	± 13.1 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN: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)	Uct. (k=2)
2450	52.7	1.95	7.02	7.02	7.02	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.78	6.78	6.78	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.33	4.33	4.33	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.16	4.16	4.16	0.45	1.90	± 13.1 %
5500	48.6	5.65	3.79	3.79	3.79	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.66	3.66	3.66	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.93	3.93	3.93	0.50	1.90	± 13.1 %

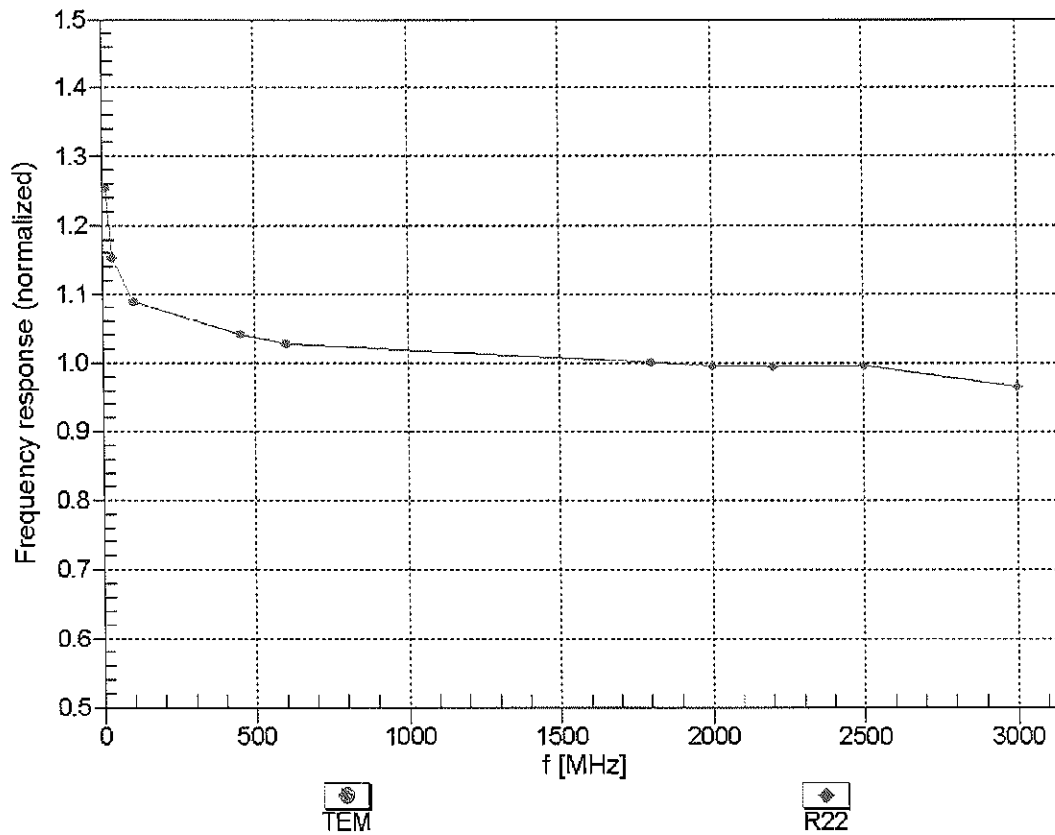
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

Frequency Response of E-Field

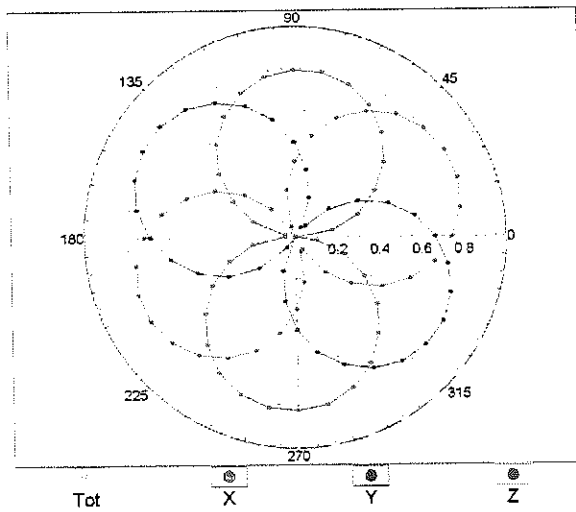
(TEM-Cell:ifi110 EXX, Waveguide: R22)



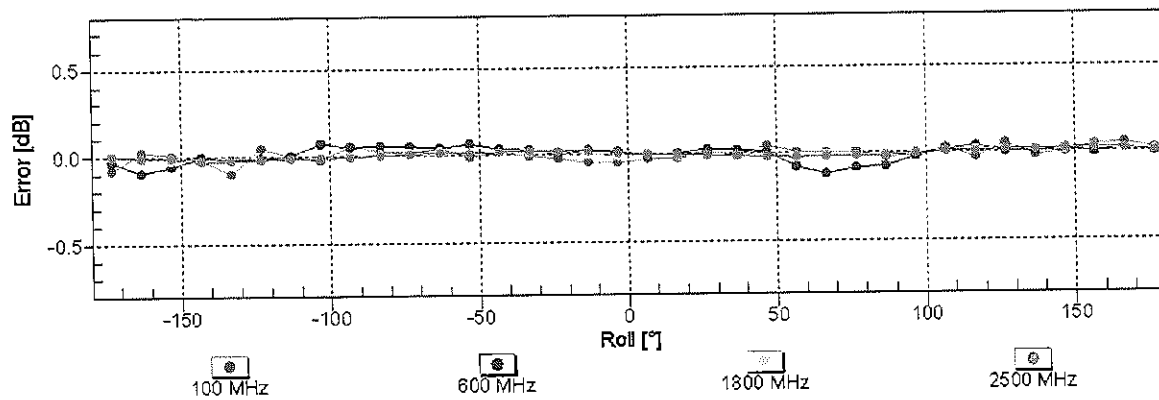
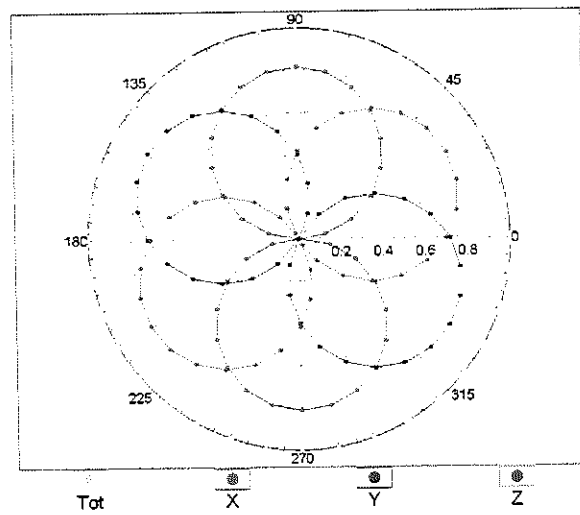
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

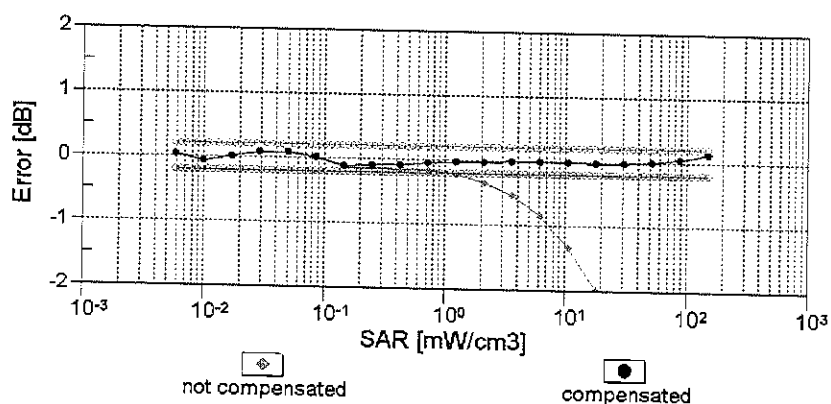
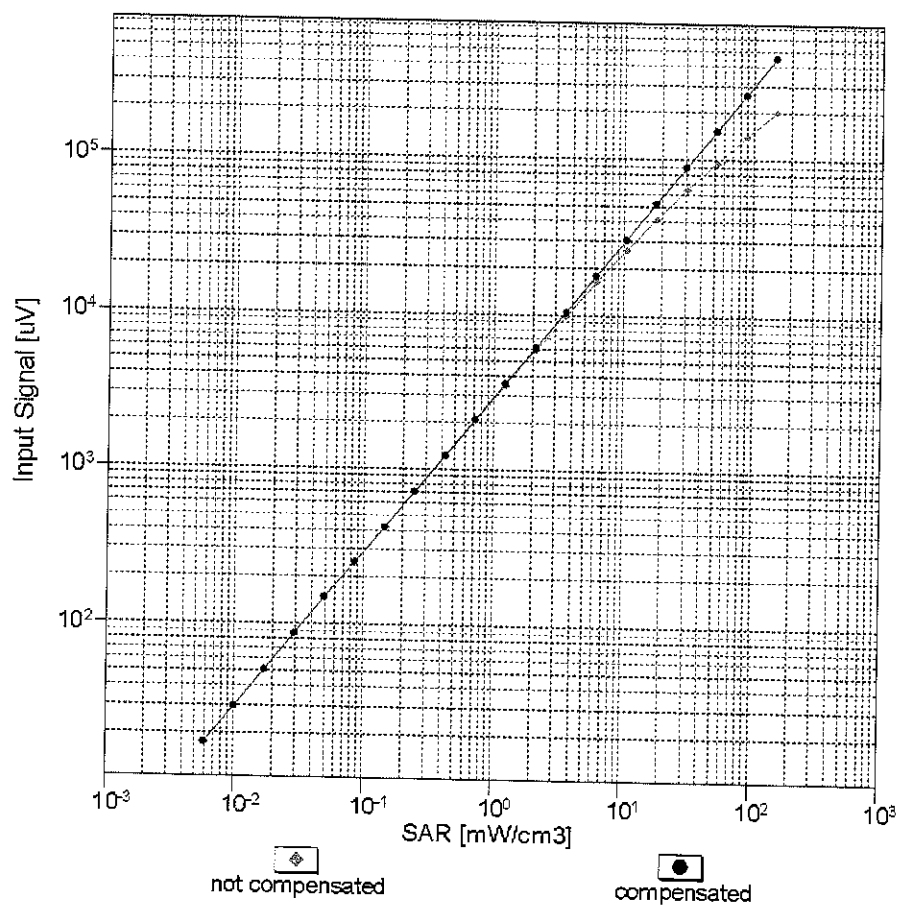


f=1800 MHz,R22



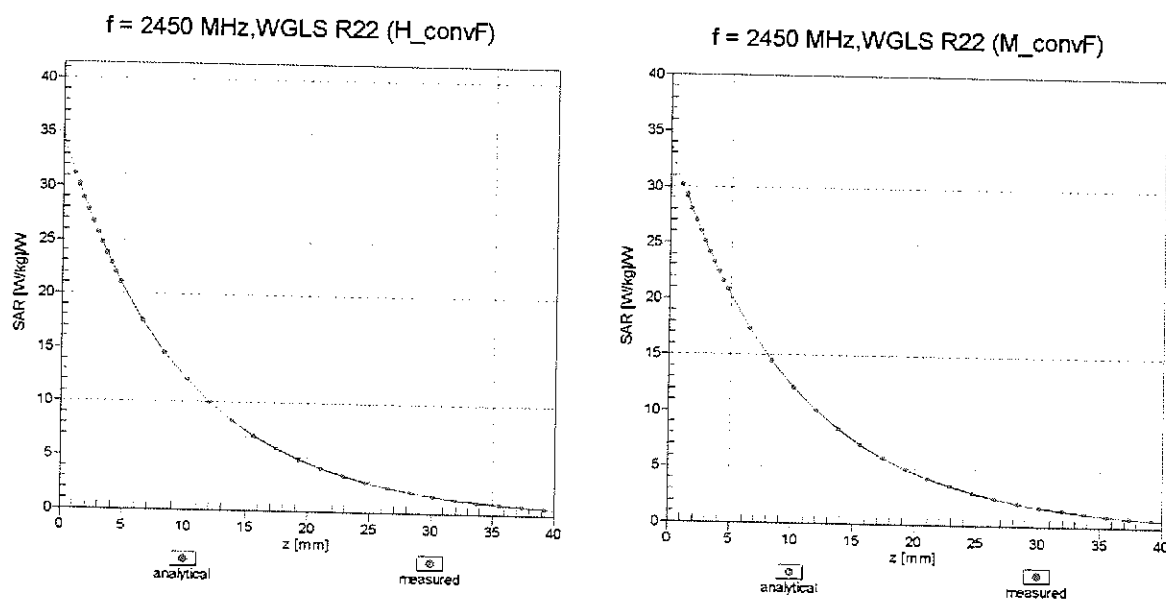
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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



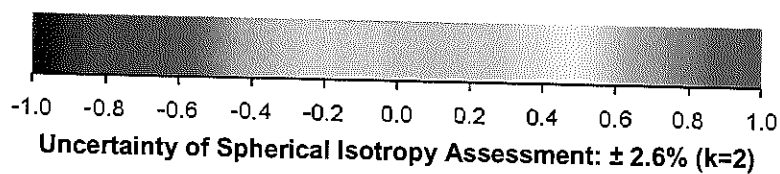
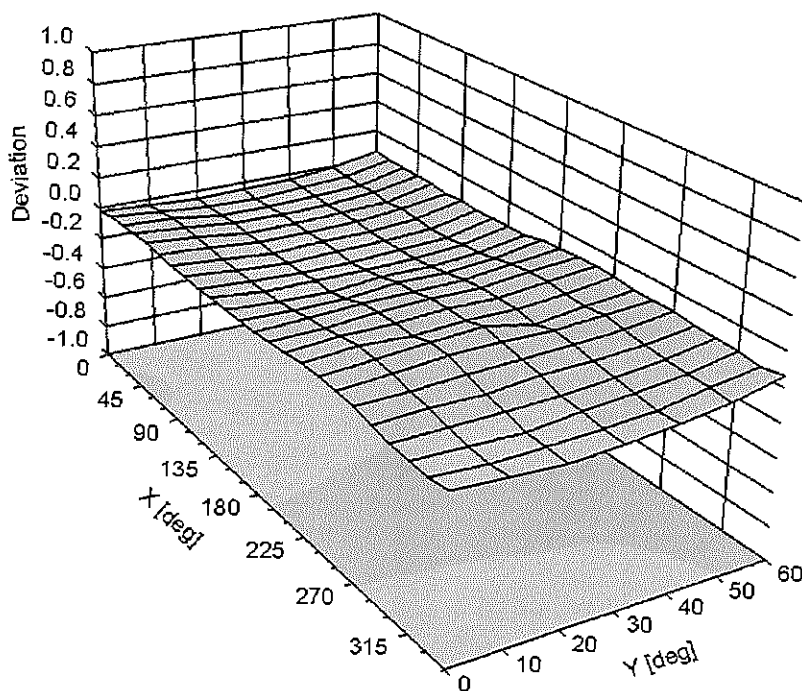
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-23.3
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	1.4 mm



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Client **PC Test**

Certificate No: **ES3-3209_Mar14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3209**

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

CCV
 3/27/14

Calibration date: **March 19, 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 $(22 \pm 3)^{\circ}\text{C}$ 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	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:	Katja Pokovic	Technical Manager	

Issued: March 20, 2014

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



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Accreditation No.: **SCS 108**

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
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:3209

Manufactured: October 14, 2008
Calibrated: March 19, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	1.35	1.32	1.13	$\pm 10.1 \%$
DCP (mV) ^B	101.5	101.0	102.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^F (k=2)
0	CW	X	0.0	0.0	1.0	0.00	188.4	$\pm 3.8 \%$
		Y	0.0	0.0	1.0		180.7	
		Z	0.0	0.0	1.0		200.1	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.80	64.7	12.3	10.00	43.2	$\pm 1.4 \%$
		Y	3.12	65.6	13.1		41.9	
		Z	2.67	64.0	11.7		39.4	
10011-CAB	UMTS-FDD (WCDMA)	X	3.39	67.7	19.0	2.91	149.2	$\pm 0.5 \%$
		Y	3.38	67.7	19.0		146.1	
		Z	3.35	67.6	18.7		136.1	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.01	69.8	19.4	1.87	149.4	$\pm 0.7 \%$
		Y	3.06	70.1	19.6		147.1	
		Z	2.98	69.7	19.2		136.4	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	5.47	79.6	20.4	9.39	146.9	$\pm 1.7 \%$
		Y	7.76	84.9	22.9		134.2	
		Z	4.34	75.3	18.5		134.2	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	6.66	82.9	21.6	9.57	139.8	$\pm 2.5 \%$
		Y	9.36	88.2	24.2		131.5	
		Z	4.67	76.1	18.8		144.8	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	5.89	79.1	17.9	6.56	141.2	$\pm 1.9 \%$
		Y	27.58	99.6	24.8		145.8	
		Z	5.42	77.8	17.4		129.3	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	9.68	85.3	19.0	4.80	136.9	$\pm 2.2 \%$
		Y	36.47	100.0	23.3		139.2	
		Z	31.63	96.5	21.4		149.2	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	40.09	99.7	21.7	3.55	125.9	$\pm 1.9 \%$
		Y	47.92	99.6	21.7		127.6	
		Z	61.98	99.9	20.8		136.2	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	99.32	95.7	16.5	1.16	145.1	$\pm 1.7 \%$
		Y	55.30	99.5	19.3		145.6	
		Z	0.54	60.4	5.7		132.7	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.77	67.1	19.2	4.57	145.6	$\pm 0.9 \%$
		Y	4.85	67.5	19.5		147.8	
		Z	4.67	66.7	18.9		133.4	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.93	66.4	18.8	3.97	140.9	±0.7 %
		Y	4.02	66.9	19.1		146.0	
		Z	3.86	66.1	18.5		129.1	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.56	66.6	18.6	3.98	132.8	±0.7 %
		Y	4.58	66.7	18.7		135.9	
		Z	4.63	67.0	18.7		143.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.42	67.5	19.8	5.67	139.3	±1.4 %
		Y	6.49	67.9	20.1		143.0	
		Z	6.18	66.7	19.3		126.9	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.28	67.1	19.7	5.80	136.9	±1.4 %
		Y	6.35	67.5	20.0		140.4	
		Z	6.36	67.5	19.8		147.1	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.94	66.5	19.4	5.75	134.0	±1.4 %
		Y	6.01	66.9	19.8		136.4	
		Z	5.99	66.8	19.5		143.6	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.02	68.5	21.1	8.10	127.2	±2.2 %
		Y	10.31	69.3	21.8		130.2	
		Z	10.12	68.8	21.2		139.0	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.03	68.5	21.1	8.07	129.2	±2.2 %
		Y	10.31	69.3	21.7		131.2	
		Z	10.15	68.9	21.3		141.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.54	72.4	24.8	9.28	139.6	±3.0 %
		Y	9.29	75.2	26.7		144.1	
		Z	8.55	72.5	24.7		149.7	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.94	66.5	19.4	5.75	134.7	±1.4 %
		Y	6.00	66.9	19.7		136.7	
		Z	6.01	66.9	19.5		143.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.40	67.1	19.7	5.82	139.9	±1.7 %
		Y	6.48	67.5	20.0		142.9	
		Z	6.43	67.3	19.7		148.7	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.90	66.8	19.8	5.73	136.1	±1.4 %
		Y	5.03	67.2	20.2		141.1	
		Z	5.08	67.3	20.0		148.1	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.56	72.5	25.2	9.21	125.7	±2.5 %
		Y	7.28	75.4	27.1		128.8	
		Z	6.78	73.0	25.2		138.3	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.86	66.6	19.7	5.72	133.7	±1.4 %
		Y	4.97	66.9	20.0		136.3	
		Z	5.04	67.2	19.9		145.7	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.88	66.7	19.7	5.72	133.3	±1.4 %
		Y	4.99	67.0	20.0		136.5	
		Z	5.06	67.3	19.9		145.7	

10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	10.05	69.2	21.7	8.09	146.7	±2.5 %
		Y	10.20	69.8	22.1		146.9	
		Z	9.76	68.5	21.1		132.1	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.05	69.2	21.7	8.10	148.5	±2.2 %
		Y	10.21	69.9	22.2		148.0	
		Z	9.75	68.5	21.2		133.6	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.96	69.2	21.6	8.03	148.9	±2.5 %
		Y	10.09	69.7	22.1		147.4	
		Z	9.67	68.5	21.1		133.4	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.00	68.5	21.1	8.06	127.8	±2.2 %
		Y	10.21	69.1	21.6		127.3	
		Z	10.11	68.9	21.2		140.4	
10225-CAB	UMTS-FDD (HSPA+)	X	6.81	66.5	19.3	5.97	125.8	±1.4 %
		Y	7.07	67.5	19.9		149.0	
		Z	6.92	67.0	19.4		136.8	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	6.62	72.8	25.3	9.21	128.5	±2.2 %
		Y	7.33	75.7	27.2		129.5	
		Z	6.87	73.4	25.5		141.8	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	7.92	71.5	24.4	9.24	131.3	±3.0 %
		Y	8.35	73.3	25.7		131.3	
		Z	7.94	71.6	24.3		140.2	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	8.52	72.3	24.8	9.30	138.8	±3.0 %
		Y	9.10	74.5	26.3		139.5	
		Z	8.53	72.3	24.6		149.4	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.98	67.1	19.1	4.87	144.4	±0.9 %
		Y	5.99	67.3	19.2		144.0	
		Z	5.80	66.6	18.7		131.0	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.51	67.2	19.0	3.96	148.6	±0.7 %
		Y	4.30	66.3	18.6		127.3	
		Z	4.40	66.9	18.7		135.9	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.61	66.9	18.8	3.46	138.3	±0.7 %
		Y	3.67	67.2	19.0		140.5	
		Z	3.62	67.0	18.7		128.8	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.59	67.1	18.9	3.39	141.5	±0.7 %
		Y	3.59	67.1	18.9		142.0	
		Z	3.59	67.2	18.8		130.8	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.27	67.0	19.7	5.81	135.3	±1.7 %
		Y	6.31	67.3	19.9		136.0	
		Z	6.36	67.4	19.8		147.2	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.91	67.9	20.2	6.06	141.9	±1.7 %
		Y	6.94	68.1	20.4		142.7	
		Z	6.68	67.1	19.7		130.3	

10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.94	69.9	19.6	1.71	148.6	±0.5 %
		Y	2.81	68.8	19.0		148.8	
		Z	2.92	69.7	19.2		138.1	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.76	68.7	19.1	3.76	128.0	±0.5 %
		Y	4.71	68.2	18.9		129.2	
		Z	4.85	68.8	19.0		141.9	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.64	68.5	19.0	3.77	126.3	±0.7 %
		Y	4.60	68.2	18.9		127.9	
		Z	4.74	68.8	19.0		140.6	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.43	6.43	6.43	0.29	2.01	± 12.0 %
835	41.5	0.90	6.23	6.23	6.23	0.34	1.70	± 12.0 %
1750	40.1	1.37	5.24	5.24	5.24	0.80	1.13	± 12.0 %
1900	40.0	1.40	5.13	5.13	5.13	0.46	1.49	± 12.0 %
2450	39.2	1.80	4.54	4.54	4.54	0.63	1.38	± 12.0 %
2600	39.0	1.96	4.38	4.38	4.38	0.76	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.

^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:3209

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.16	6.16	6.16	0.26	2.23	± 12.0 %
835	55.2	0.97	6.14	6.14	6.14	0.80	1.13	± 12.0 %
1750	53.4	1.49	4.85	4.85	4.85	0.59	1.42	± 12.0 %
1900	53.3	1.52	4.68	4.68	4.68	0.52	1.59	± 12.0 %
2450	52.7	1.95	4.20	4.20	4.20	0.73	1.08	± 12.0 %
2600	52.5	2.16	4.04	4.04	4.04	0.80	1.00	± 12.0 %

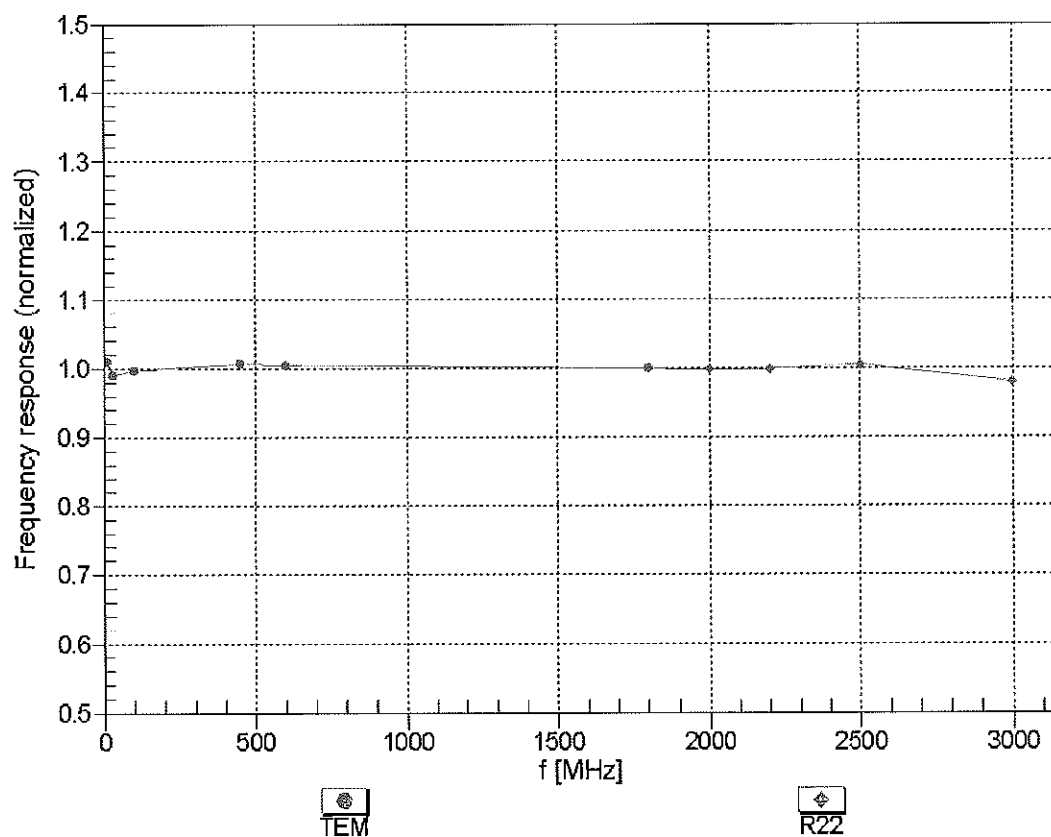
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^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

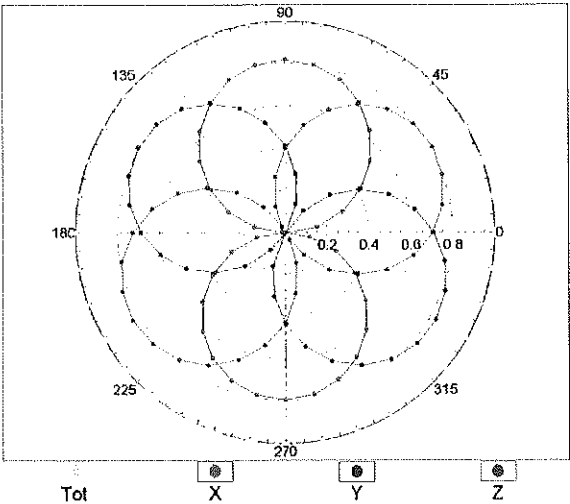
(TEM-Cell:ifi110 EXX, Waveguide: R22)



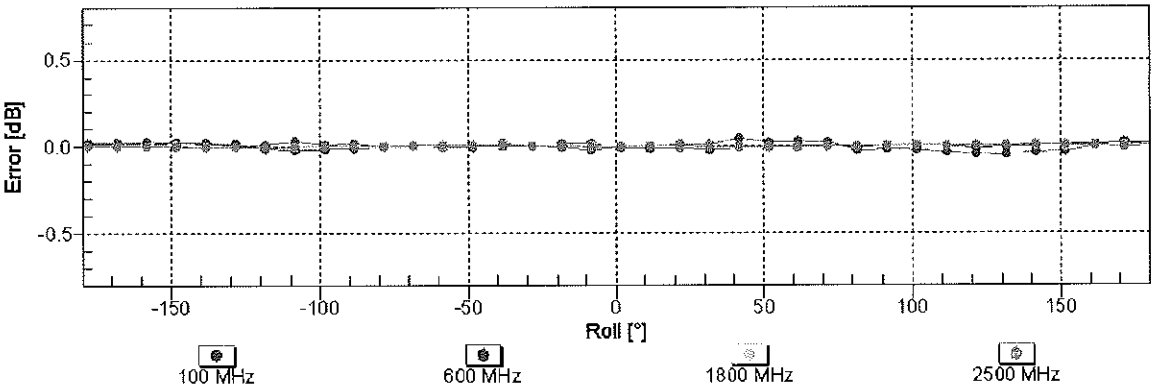
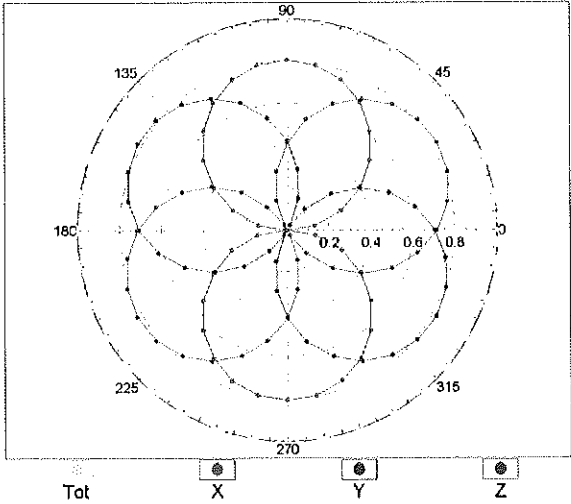
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

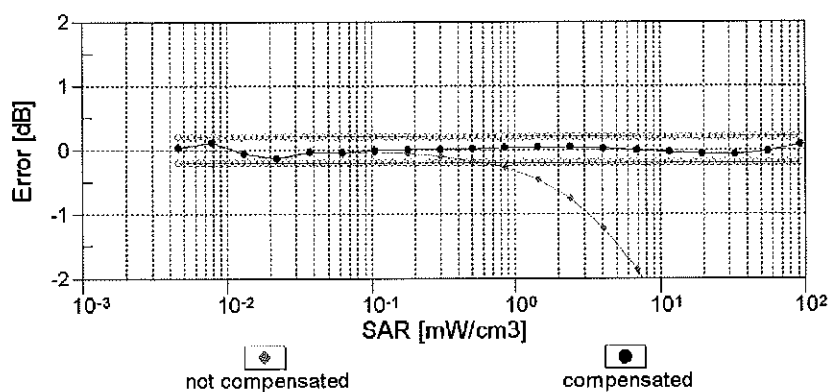
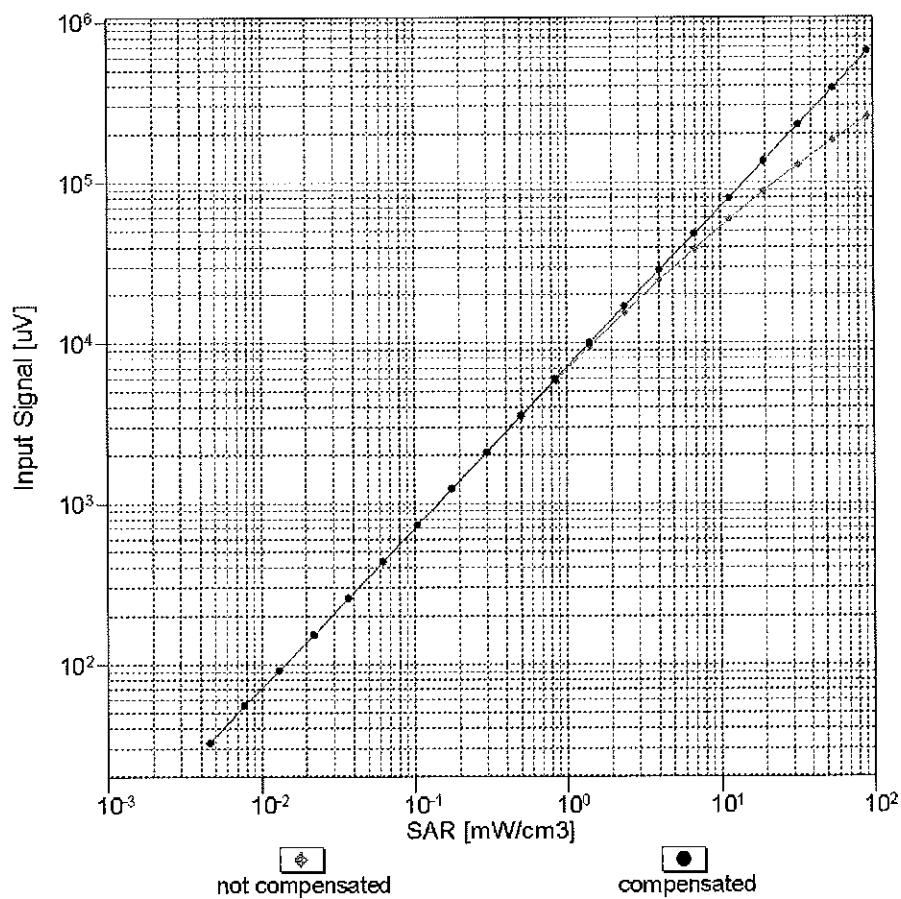


f=1800 MHz,R22



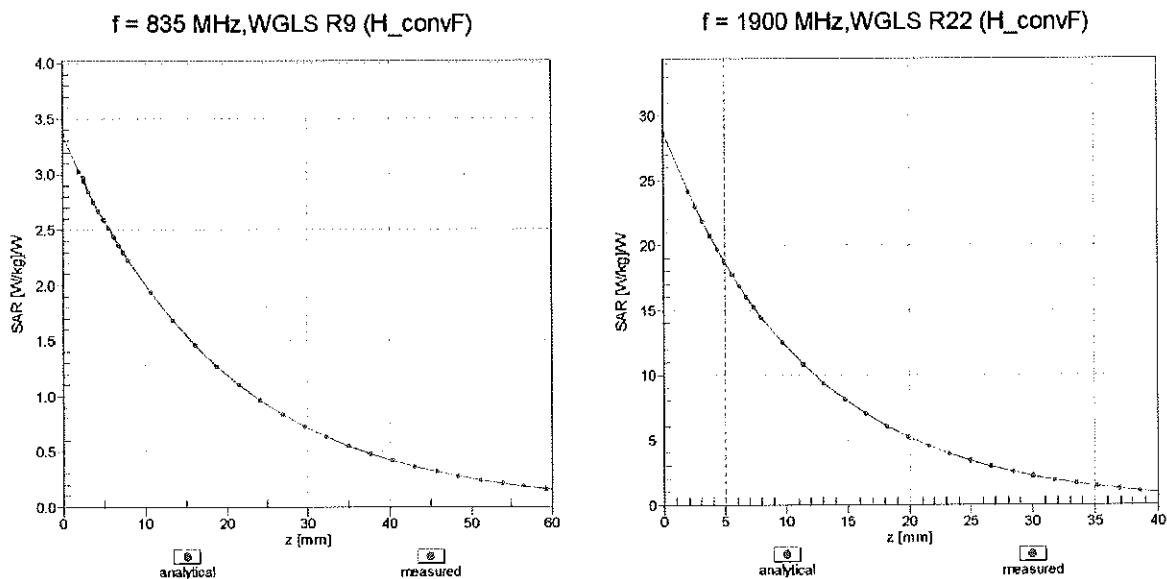
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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



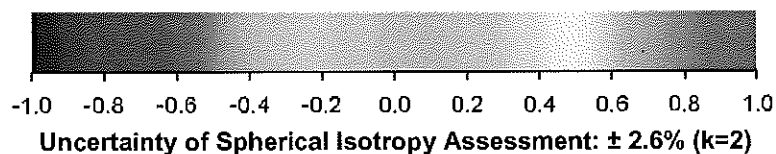
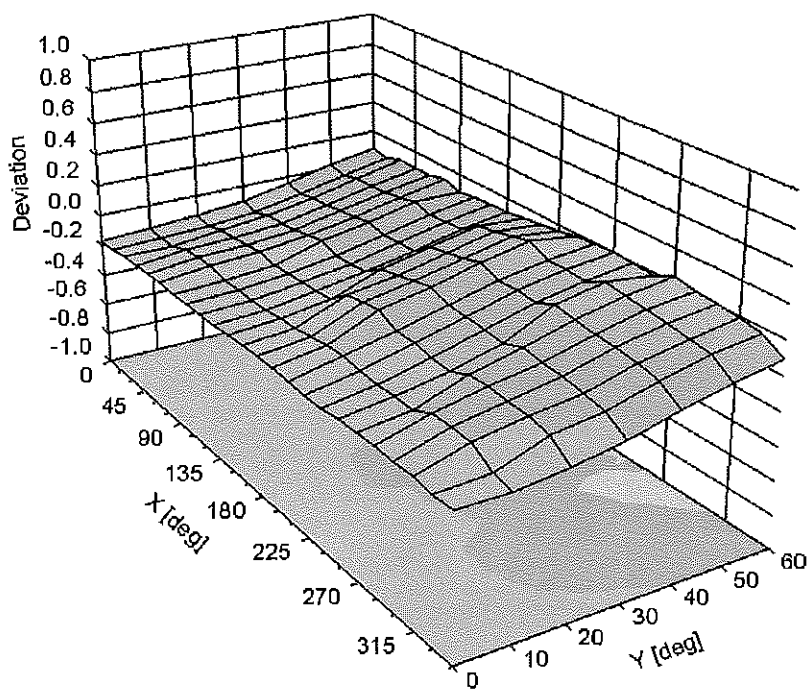
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-38.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue Verification:

- 3) The network analyzer and probe system was configured and calibrated.
- 4) 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.
- 5) The complex admittance with respect to the probe aperture was measured
- 6) 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	750	835	835	1750	1750	1900	1900	2450	2450	5200-5800	5200-5800
Tissue	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)												
Bactericide			0.1	0.1								
DGBE					47	31	44.92	29.44		26.7		
HEC			1	1								
NaCl			1.45	0.94	0.4	0.2	0.18	0.39		0.1		
Sucrose			57	44.9								
Polysorbate (Tween) 80												20
Water			40.45	53.06	52.6	68.8	54.9	70.17		73.2		80

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset			APPENDIX D: Page 1 of 5

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 Head and 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 temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	13-Mar-13
Operator	IEH

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	22.36	1.04	55.2	0.98	-0.3	5.9
875	54.9	22.28	1.05	55.2	0.99	-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
1000	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

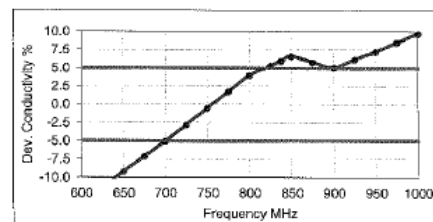
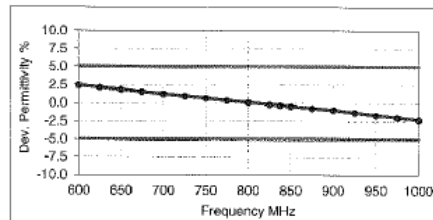


Figure D-2

750MHz Body Tissue Equivalent Matter

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset			APPENDIX D: Page 2 of 5

Measurement Certificate / Material Test

Item Name **Head Tissue Simulating Liquid (HSL750V2)**
 Product No. SL AAH 075 AA (Charge: 130312-4)
 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 temperatur (22 ± 3)°C and humidity < 70%.
 TSL Temperature 22°C
 Test Date 13-Mar-13
 Operator IEN

Additional Information

TSL Density 1.284 g/cm³
 TSL Heat-capacity 2.701 kJ/(kg*K)

f [MHz]	Measured			Target		Diff. to Target [%]	
	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
600	44.6	23.25	0.78	42.7	0.88	4.3	-12.0
625	44.2	23.00	0.80	42.6	0.88	3.8	-9.5
650	43.8	22.76	0.82	42.5	0.89	3.2	-7.1
675	43.4	22.50	0.84	42.3	0.89	2.6	-4.9
700	43.1	22.24	0.87	42.2	0.89	2.1	-2.6
725	42.7	22.06	0.89	42.1	0.89	1.6	-0.2
750	42.4	21.88	0.91	41.9	0.89	1.1	2.2
775	42.1	21.72	0.94	41.8	0.90	0.6	4.6
800	41.7	21.55	0.96	41.7	0.90	0.1	6.9
825	41.4	21.40	0.98	41.6	0.91	-0.4	8.3
850	41.3	21.32	0.99	41.5	0.91	-0.6	9.0
875	41.1	21.24	1.00	41.5	0.92	-0.9	9.6
900	40.8	21.11	1.03	41.5	0.94	-1.6	9.0
925	40.6	20.99	1.05	41.5	0.97	-2.3	8.3
950	40.3	20.87	1.07	41.5	0.98	-2.9	9.4
975	40.0	20.76	1.10	41.4	0.99	-3.5	10.3
1000	39.7	20.66	1.12	41.4	1.00	-4.0	11.5
1000	39.5	20.57	1.14	41.3	1.01	-4.5	12.7

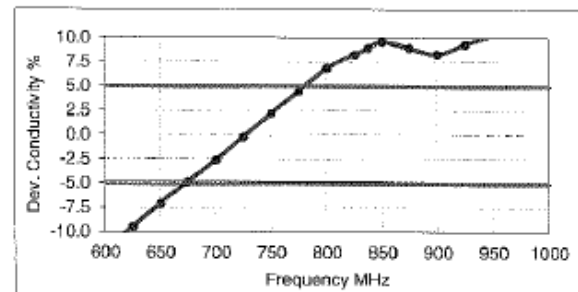
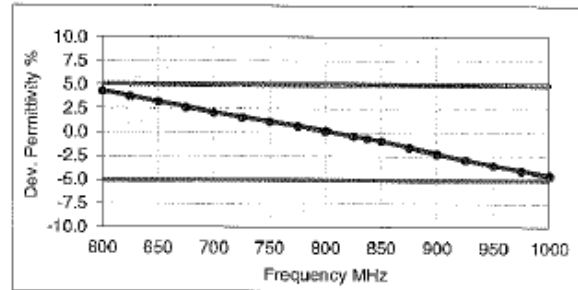


Figure D-3
750MHz Head Tissue Equivalent Matter

FCC ID: A3LSMG920T	 PCTEST Engineering Laboratory, Inc.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset			APPENDIX D: Page 3 of 5

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H ₂ O	Water, 52 – 75%
C ₈ H ₁₈ O ₃	Diethylene glycol monobutyl ether (DGBE), 25 – 48% (CAS-No. 112-34-5, EC-No. 203-961-6, EC-index-No. 603-096-00-8) Relevant for safety; Refer to the respective Safety Data Sheet*.
NaCl	Sodium Chloride, <1.0%

Figure D-4

Composition of 2.4 GHz Head Tissue Equivalent Matter

Note: 2.4 GHz head 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	Head Tissue Simulating Liquid (HSL2450V2)
Product No.	SL AAH 245 BA (Charge: 130926-1)
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 temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	23°C
Test Date	2-Oct-13
Operator	CL

Additional Information

TSL Density	0.988 g/cm ³
TSL Heat-capacity	3.680 kJ/(kg·K)

f (MHz)	HP-e	HP-e ²	sigma	eps	sigma	Δ-eps	Δ-sigma
1900	40.3	11.88	1.26	40.0	1.40	0.9	-10.3
1925	40.3	11.98	1.28	40.0	1.40	0.6	-8.3
1950	40.2	12.08	1.31	40.0	1.40	0.4	-8.4
1975	40.1	12.15	1.34	40.0	1.40	0.2	-4.6
2000	40.0	12.23	1.36	40.0	1.40	-0.1	-2.8
2025	39.9	12.34	1.39	40.0	1.42	-0.2	-2.3
2050	39.8	12.45	1.42	39.9	1.44	-0.3	-1.7
2075	39.7	12.54	1.45	39.9	1.47	-0.4	-1.3
2100	39.6	12.64	1.48	39.8	1.49	-0.5	-0.8
2125	39.5	12.69	1.50	39.8	1.51	-0.7	-0.7
2150	39.4	12.75	1.52	39.7	1.53	-0.8	-0.6
2175	39.3	12.84	1.55	39.7	1.56	-1.0	0.1
2200	39.2	12.94	1.58	39.6	1.58	-1.2	0.4
2225	39.1	13.00	1.61	39.6	1.60	-1.3	0.6
2250	39.0	13.07	1.64	39.6	1.62	-1.4	0.8
2275	38.9	13.15	1.66	39.5	1.64	-1.5	1.2
2300	38.8	13.22	1.69	39.5	1.67	-1.7	1.5
2325	38.7	13.32	1.72	39.4	1.69	-1.9	2.0
2350	38.6	13.42	1.75	39.4	1.71	-2.0	2.5
2375	38.5	13.49	1.78	39.3	1.73	-2.1	2.8
2400	38.4	13.56	1.81	39.3	1.75	-2.3	3.1
2425	38.3	13.63	1.84	39.2	1.78	-2.5	3.5
2450	38.2	13.71	1.87	39.2	1.80	-2.6	3.8
2475	38.1	13.79	1.90	39.2	1.83	-2.8	3.9
2500	38.0	13.87	1.93	39.1	1.85	-3.0	4.0
2525	37.9	13.96	1.96	39.1	1.88	-3.1	4.2
2550	37.8	14.05	1.99	39.1	1.91	-3.3	4.4
2575	37.7	14.11	2.02	39.0	1.94	-3.5	4.4
2600	37.5	14.17	2.05	39.0	1.96	-3.8	4.4
2625	37.4	14.23	2.08	39.0	1.99	-4.0	4.4
2650	37.3	14.30	2.11	38.9	2.02	-4.2	4.5
2675	37.2	14.37	2.14	38.9	2.05	-4.4	4.6
2700	37.1	14.45	2.17	38.9	2.07	-4.6	4.7

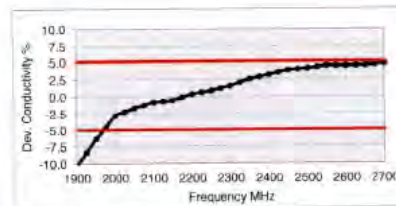
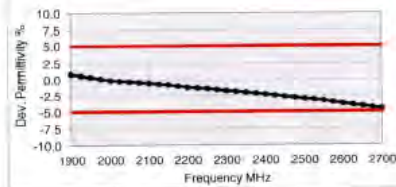


Figure D-5

2.4 GHz Head Tissue Equivalent Matter

FCC ID: A3LSMG920T	 PCTEST Engineering Laboratory, Inc.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset			APPENDIX D: Page 4 of 5

2 Composition / Information on ingredients

The Item is composed of the following ingredients:

Water	50 – 65%
Mineral oil	10 – 30%
Emulsifiers	8 – 25%
Sodium salt	0 – 1.5%

Figure D-6
Composition of 5 GHz Head Tissue Equivalent Matter

Note: 5GHz head 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	Head Tissue Simulating Liquid (HBBL3500-5800V5)
Product No.	SL AAH 502 AC (Charge: 130903-1)
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 temperatur (22 ± 3)°C and humidity < 70%.
TSL Temperature	22°C
Test Date	4-Sep-13
Operator	IEN

Additional information

TSL Density	0.985 g/cm ³
TSL Heat-capacity	3.383 kJ/(kg·K)

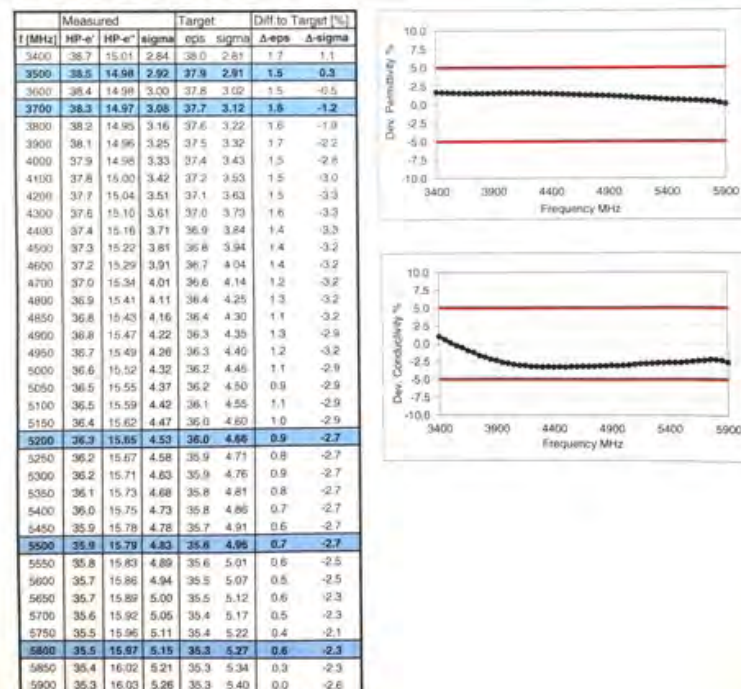


Figure D-7
5GHz Head Tissue Equivalent Matter

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset			APPENDIX D: Page 5 of 5

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
K	750	10/10/2014	3288	ES3DV3	750	Head	0.889	40.21	PASS	PASS	PASS	N/A	N/A	N/A
G	835	6/30/2014	3258	ES3DV3	835	Head	0.907	40.95	PASS	PASS	PASS	GMSK	PASS	N/A
J	1750	9/23/2014	3022	ES3DV2	1750	Head	1.345	39.15	PASS	PASS	PASS	N/A	N/A	N/A
D	1900	9/30/2014	3263	ES3DV3	1900	Head	1.421	39.44	PASS	PASS	PASS	GMSK	PASS	N/A
G	2450	3/6/2014	3258	ES3DV3	2450	Head	1.736	38.36	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
H	5300	1/18/2015	3920	EX3DV4	5300	Head	4.647	35.22	PASS	PASS	PASS	OFDM	N/A	PASS
H	5500	1/18/2015	3920	EX3DV4	5500	Head	4.853	34.92	PASS	PASS	PASS	OFDM	N/A	PASS
H	5600	1/18/2015	3920	EX3DV4	5600	Head	4.960	34.73	PASS	PASS	PASS	OFDM	N/A	PASS
D	750	10/20/2014	3263	ES3DV3	750	Body	0.971	55.55	PASS	PASS	PASS	N/A	N/A	N/A
K	835	10/13/2014	3288	ES3DV3	835	Body	0.998	52.95	PASS	PASS	PASS	GMSK	PASS	N/A
K	1750	10/10/2014	3288	ES3DV3	1750	Body	1.480	50.89	PASS	PASS	PASS	N/A	N/A	N/A
G	1900	6/25/2014	3258	ES3DV3	1900	Body	1.534	51.23	PASS	PASS	PASS	GMSK	PASS	N/A
I	2450	7/14/2014	3209	ES3DV3	2450	Body	1.928	51.04	PASS	PASS	PASS	OFDM/TDD	PASS	PASS
H	5300	12/30/2014	3920	EX3DV4	5300	Body	5.523	47.80	PASS	PASS	PASS	OFDM	N/A	PASS
H	5500	12/30/2014	3920	EX3DV4	5500	Body	5.800	47.43	PASS	PASS	PASS	OFDM	N/A	PASS
H	5600	12/30/2014	3920	EX3DV4	5600	Body	5.932	47.26	PASS	PASS	PASS	OFDM	N/A	PASS
H	5800	12/30/2014	3920	EX3DV4	5800	Body	6.191	46.98	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

FCC ID: A3LSMG920T		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 01/26/15 – 02/03/15	DUT Type: Portable Handset			APPENDIX E: Page 1 of 1