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SAR EVALUATION REPORT

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

Date of Testing:
04/17/17 - 05/08/17
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
1M1704170149-01.A3L

FCC ID: A3LSMG390W

APPLICANT: SAMSUNG ELECTRONICS CO., LTD.

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model: SM-G390W

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	0.38	0.61	0.89
PCE	UMTS 850	826.40 - 846.60 MHz	0.42	0.63	0.63
PCE	UMTS 1750	1712.4 - 1752.6 MHz	0.50	0.60	0.78
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	0.32	0.34	0.43
PCE	UMTS 1900	1852.4 - 1907.6 MHz	0.60	0.35	0.67
PCE	LTE Band 12	699.7 - 715.3 MHz	0.47	0.79	0.79
PCE	LTE Band 17	706.5 - 713.5 MHz	N/A		
PCE	LTE Band 13	779.5 - 784.5 MHz	0.52	0.71	0.71
PCE	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.55	0.77	0.77
PCE	LTE Band 66 (AWS)	1710.7 - 1779.3 MHz	0.44	0.38	0.66
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.71	0.40	0.86
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.70	0.36	0.64
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.61	< 0.1	0.22
NII	U-NII-1	5180 - 5240 MHz	N/A		
NII	U-NII-2A	5260 - 5320 MHz	< 0.1	0.18	N/A
NII	U-NII-2C	5500 - 5720 MHz	0.10	0.37	N/A
NII	U-NII-3	5745 - 5825 MHz	< 0.1	0.23	0.34
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A		
Simultaneous SAR per KDB 690783 D01v01r03:			1.21	1.16	1.23

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

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

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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
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 - 1752.6 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 17	Voice/Data	706.5 - 713.5 MHz
LTE Band 13	Voice/Data	779.5 - 784.5 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Voice/Data	1710.7 - 1779.3 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	Voice/Data	5500 - 5720 MHz
U-NII-3	Voice/Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz

1.2 Power Reduction for SAR

This device utilizes a single step power reduction mechanism for SAR compliance under portable hotspot conditions for some wireless modes and bands. All hotspot SAR evaluations for this device were performed at the maximum allowed output power when hotspot is enabled. Detailed descriptions of the power reduction mechanism are included in the operational description.

This device uses an independent fixed level power reduction mechanism for WLAN operations during voice or VoIP held to ear scenarios. Per FCC Guidance, the held-to-ear exposure conditions were evaluated at reduced power according to the head SAR positions described in IEEE 1528-2013. Detailed descriptions of the power reduction mechanism are included in the operational description.

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1.3 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

1.3.1 Maximum Powers

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slot*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slot*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 850	Maximum	**33.0**	**33.0**	**31.5**	**30.0**	**29.0**	**27.5**	**25.5**	**24.5**	**23.0**
	Nominal	**32.5**	**32.5**	**31.0**	**29.5**	**28.5**	**27.0**	**25.0**	**24.0**	**22.5**
GSM/GPRS/EDGE 1900	Maximum	**30.0**	**30.0**	**27.5**	**25.5**	**24.5**	**25.5**	**23.5**	**22.5**	**20.5**
	Nominal	**29.5**	**29.5**	**27.0**	**25.0**	**24.0**	**25.0**	**23.0**	**22.0**	**20.0**

Mode / Band		Modulated Average (dBm)				
		3GPP RMC	*3GPP AMR*	*3GPP HSDPA*	*3GPP HSUPA*	*3GPP DC-HSDPA*
UMTS Band 5 (850 MHz)	Maximum	**24.0**	**22.0**	**23.0**	**24.0**	**23.0**
	Nominal	**23.5**	**21.5**	**22.5**	**23.5**	**22.5**
UMTS Band 4 (1750 MHz)	Maximum	**24.0**	**22.0**	**23.5**	**22.5**	**23.5**
	Nominal	**23.5**	**21.5**	**23.0**	**22.0**	**23.0**
UMTS Band 2 (1900 MHz)	Maximum	**24.0**	**22.0**	**23.0**	**24.0**	**23.0**
	Nominal	**23.5**	**21.5**	**22.5**	**23.5**	**22.5**

Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 17	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 13	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 5 (Cell)	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 66 (AWS)	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 4 (AWS)	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 2 (PCS)	Maximum	**24.0**
	Nominal	**23.5**

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Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**17.5**
	Nominal	**17.0**
IEEE 802.11g (2.4 GHz)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11n (2.4 GHz)	Maximum	**13.5**
	Nominal	**13.0**
Bluetooth	Maximum	**8.5**
	Nominal	**8.0**
Bluetooth LE	Maximum	**7.0**
	Nominal	**6.5**

Mode / Band		Modulated Average (dBm)	
		20 MHz Bandwidth	40 MHz Bandwidth
IEEE 802.11a (5 GHz)	Maximum	**13.5**	
	Nominal	**13.0**	
IEEE 802.11n (5 GHz)	Maximum	**13.5**	**13.0**
	Nominal	**13.0**	**12.5**

1.3.2 Reduced Powers

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	*3GPP HSDPA*	*3GPP HSUPA*	*3GPP DC-HSDPA*
UMTS Band 2 (1900 MHz)	Maximum	**22.0**	**22.0**	**22.0**	**22.0**
	Nominal	**21.5**	**21.5**	**21.5**	**21.5**

Mode / Band		Modulated Average (dBm)
LTE Band 66 (AWS)	Maximum	**23.0**
	Nominal	**22.5**
LTE Band 2 (PCS)	Maximum	**22.0**
	Nominal	**21.5**

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Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**14.5**
	Nominal	**14.0**
IEEE 802.11g (2.4 GHz)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11n (2.4 GHz)	Maximum	**13.5**
	Nominal	**13.0**

1.4 DUT Antenna Locations

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. A diagram showing the location of the device antennas can be found in Appendix F.

Table 1-1
Device Edges/Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	No	Yes
UMTS 850	Yes	Yes	No	Yes	No	Yes
UMTS 1750	Yes	Yes	No	Yes	No	Yes
GPRS 1900	Yes	Yes	No	Yes	No	Yes
UMTS 1900	Yes	Yes	No	Yes	No	Yes
LTE Band 12	Yes	Yes	No	Yes	No	Yes
LTE Band 13	Yes	Yes	No	Yes	No	Yes
LTE Band 5 (Cell)	Yes	Yes	No	Yes	No	Yes
LTE Band 66 (AWS)	Yes	Yes	No	Yes	No	Yes
LTE Band 4 (AWS)	Yes	Yes	No	Yes	No	Yes
LTE Band 2 (PCS)	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	No	No	Yes
5 GHz WLAN	Yes	Yes	Yes	No	No	Yes

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 D06v02r01 Section III. 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 operations are disabled. Therefore, U-NII-1, U-NII-2A, U-NII-2C operations are not considered in this section.

1.5 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the specialized battery. The SAR tests were performed with the specialized battery (model: EB-BG390BBE).

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1.6 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-1 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

Figure 1-1
Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures.

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
12	GPRS/EDGE + 2.4 GHz Bluetooth	N/A	N/A	N/A

1. 2.4 GHz WLAN, 5 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
2. All licensed modes share the same antenna path and cannot transmit simultaneously.
3. 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.
4. 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. 5 GHz Wireless Router is only supported for U-NII-3 by S/W, therefore U-NII-1, U-NII2A, and U-NII2C were not evaluated for wireless router conditions.
6. This device supports VOLTE and VOWIFI.

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1.7 Miscellaneous SAR Test Considerations

(A) WIFI/BT

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 Publication 248227 D01v02r02.

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 U-NII-3 WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v02r01.

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

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

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; [(7/15)* √2.480] = 0.7< 3.0. Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Licensed Transmitter(s)

GSM/GPRS/EDGE DTM is not supported for US bands. Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS/EDGE 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 D01v03r01.

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r04.

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

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

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1.8 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01, D05v02r04, D05Av01r02, D06v02r01 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)

1.9 Device Serial Numbers

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

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
GSM/GPRS/EDGE 850	08968	08968	08968
UMTS 850	09123	08620	08620
UMTS 1750	09123	09123	09123
GSM/GPRS/EDGE 1900	08968	09123	09123
UMTS 1900	08968	09123	09123
LTE Band 12	08620	09123	09123
LTE Band 13	08620	09123	09123
LTE Band 5 (Cell)	08612	08612	08612
LTE Band 66 (AWS)	08620	09156	09123
LTE Band 4 (AWS)	09024	09156	08620
LTE Band 2 (PCS)	08992	08612	09123
2.4 GHz WLAN	10097	10097	10097
5 GHz WLAN	09917	09917	09917

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2 LTE INFORMATION

LTE Information					
FCC ID	**A3LSMG390W**				
Form Factor	Portable Handset				
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz)				
	LTE Band 17 (706.5 - 713.5 MHz)				
	LTE Band 13 (779.5 - 784.5 MHz)				
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)				
	LTE Band 66 (AWS) (1710.7 - 1779.3 MHz)				
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)				
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)				
Channel Bandwidths	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 17: 5 MHz, 10 MHz				
	LTE Band 13: 5 MHz, 10 MHz				
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 66 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 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	Low-Mid	Mid	Mid-High	High
LTE Band 12: 1.4 MHz	699.7 (23017)	N/A	707.5 (23095)	N/A	715.3 (23173)
LTE Band 12: 3 MHz	700.5 (23025)	N/A	707.5 (23095)	N/A	714.5 (23165)
LTE Band 12: 5 MHz	701.5 (23035)	N/A	707.5 (23095)	N/A	713.5 (23155)
LTE Band 12: 10 MHz	704 (23060)	N/A	707.5 (23095)	N/A	711 (23130)
LTE Band 17: 5 MHz	706.5 (23755)	N/A	710 (23790)	N/A	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	N/A	710 (23790)	N/A	711 (23800)
LTE Band 13: 5 MHz	779.5 (23205)	N/A	782 (23230)	N/A	784.5 (23255)
LTE Band 13: 10 MHz	N/A		782 (23230)	N/A	
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	N/A	836.5 (20525)	N/A	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	N/A	836.5 (20525)	N/A	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	N/A	836.5 (20525)	N/A	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	N/A	836.5 (20525)	N/A	844 (20600)
LTE Band 66 (AWS): 1.4 MHz	1710.7 (131979)	1733.6 (132208)	N/A	1756.4 (132436)	1779.3 (132665)
LTE Band 66 (AWS): 3 MHz	1711.5 (131987)	N/A	1745 (132322)	N/A	1778.5 (132657)
LTE Band 66 (AWS): 5 MHz	1712.5 (131997)	N/A	1745 (132322)	N/A	1777.5 (132647)
LTE Band 66 (AWS): 10 MHz	1715 (132022)	N/A	1745 (132322)	N/A	1775 (132622)
LTE Band 66 (AWS): 15 MHz	1717.5 (132047)	N/A	1745 (132322)	N/A	1772.5 (132597)
LTE Band 66 (AWS): 20 MHz	1720 (132072)	N/A	1745 (132322)	N/A	1770 (132572)
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	N/A	1732.5 (20175)	N/A	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	N/A	1732.5 (20175)	N/A	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	N/A	1732.5 (20175)	N/A	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	N/A	1732.5 (20175)	N/A	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	N/A	1732.5 (20175)	N/A	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	N/A	1732.5 (20175)	N/A	1745 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	N/A	1880 (18900)	N/A	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	N/A	1880 (18900)	N/A	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	N/A	1880 (18900)	N/A	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	N/A	1880 (18900)	N/A	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	N/A	1880 (18900)	N/A	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	N/A	1880 (18900)	N/A	1900 (19100)
UE Category	4				
Modulations Supported in UL	QPSK, 16QAM				
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES				
A-MPR (Additional MPR) disabled for SAR Testing?	YES				
LTE Carrier Aggregation Possible Combinations	The technical description includes all the possible carrier aggregation combinations				
LTE Release 10 Additional Information	This device does not support full CA features on 3GPP Release 10. It supports a maximum of 2 carriers in the downlink. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. The following LTE Release 10 Features are not supported: Relay, HetNet, Enhanced MIMO, eICIC, WIFI Offloading, MDH, eMBMS, Cross-Carrier Scheduling, Enhanced SC-FDMA.				

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3 INTRODUCTION

The FCC and Innovation, Science, and Economic Development 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/m^3)
E = Total RMS electric field strength (V/m)

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

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

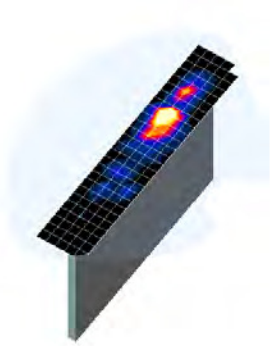

Figure 4-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

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

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

*Also compliant to IEEE 1528-2013 Table 6

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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].

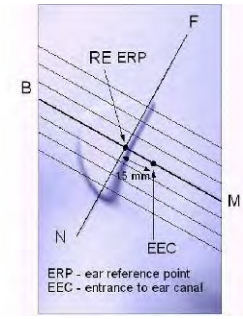

Figure 5-1
Close-Up Side view of ERP

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 than 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

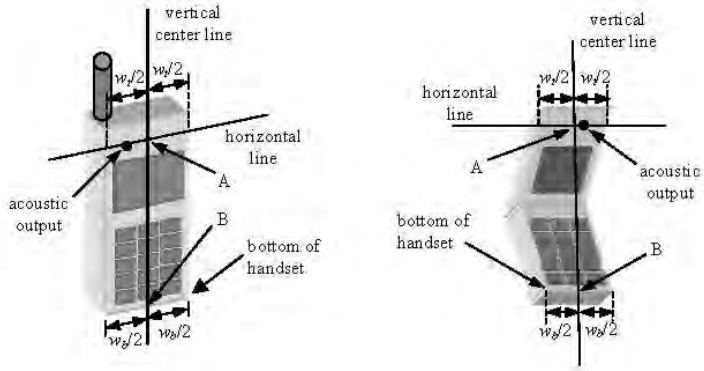

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS

6.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 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 was 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 / 15º 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 15degrees.
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).

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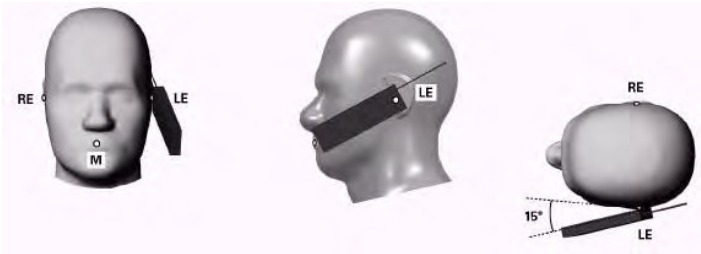

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

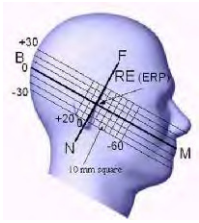

Figure 6-3
Side view w/ relevant markings

6.4 SAR Evaluations near the Mouth/Jaw Regions of the SAM Phantom

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones. Per IEEE 1528-2013, a rotated SAM phantom is necessary to allow probe access to such regions. Both SAM heads of the TwinSAM-Chin20 are rotated 20 degrees around the NF line. Each head can be removed from the table for emptying and cleaning.

Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document FCC KDB Publication 648474 D04v01r03. The SAR required in these regions of SAM should be measured using a flat phantom. The phone should be positioned with a separation distance of 4 mm between the ear reference point (ERP) and the outer surface of the flat phantom shell. While maintaining this distance at the ERP location, the low (bottom) edge of the phone should be lowered from the phantom to establish the same separation distance between the peak SAR location identified by the truncated partial SAR distribution measured with the SAM phantom. The distance from the peak SAR location to the phone is determined by the straight line passing perpendicularly through the phantom surface. When it is not feasible to maintain 4 mm separation at the ERP while also establishing the required separation at the peak SAR location, the top edge of the phone will be allowed to touch the phantom with a separation < 4 mm at the ERP. The phone should not be tilted to the left or right while placed in this inclined position to the flat phantom.

6.5 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 D04v01r03, 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 D01v06 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 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.

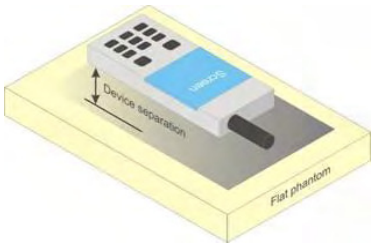

Figure 6-4
Sample Body-Worn Diagram

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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.

6.6 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 447498 D01v06 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v06, 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.

6.7 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 D06v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 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 D01v06 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.

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

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

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8 FCC MEASUREMENT PROCEDURES

Power measurements for licensed transmitters are performed using a base station simulator under digital average power.

8.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

8.2 3G SAR Test Reduction Procedure

In FCC KDB Publication 941225 D01v03r01, certain transmission modes within a frequency band and wireless mode evaluated for SAR are defined as primary modes. The equivalent modes considered for SAR test reduction are denoted as secondary modes. When the maximum output power including tune-up tolerance specified for production units in a secondary mode is ≤ 0.25 dB higher than the primary mode or when the highest reported SAR of the primary mode, scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode, is ≤ 1.2 W/kg, SAR measurements are not required for the secondary mode. These criteria are referred to as the 3G SAR test reduction procedure. When the 3G SAR test reduction procedure is not satisfied, SAR measurements are additionally required for the secondary mode.

8.3 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03r01 “3G SAR Measurement Procedures.”

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

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.

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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 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 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 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 are tested according to FCC KDB 941225 D05v02r04 publication. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 or Anritsu MT8820C simulators are used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

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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.

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 D05v02r04:

a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
   i. The required channel and offset combination with the highest maximum output power is required for SAR.
   ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
   iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to ½ 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 Downlink Only Carrier Aggregation

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

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8.6 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

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 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. 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.

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8.6.5 2.4 GHz SAR Test Requirements

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

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

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

8.6.6 OFDM Transmission Mode and SAR Test Channel Selection

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, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order IEEE 802.11 mode. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

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

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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	32.73	32.74	30.91	28.51	**27.04**	27.46	25.22	23.64	22.19
	190	32.80	32.81	31.10	28.82	**27.30**	27.41	25.32	23.93	22.58
	251	32.92	32.95	31.09	28.86	**27.28**	27.43	25.23	23.87	22.63
GSM 1900	512	29.92	29.96	26.91	25.14	**23.25**	24.35	22.22	20.56	18.94
	661	29.80	29.83	27.13	25.47	**23.51**	24.51	22.15	20.67	18.86
	810	29.53	29.51	27.07	25.48	**23.71**	24.52	22.18	20.53	18.97

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	23.70	23.71	24.89	24.25	**24.03**	18.43	19.20	19.38	19.18
	190	23.77	23.78	25.08	24.56	**24.29**	18.38	19.30	19.67	19.57
	251	23.89	23.92	25.07	24.60	**24.27**	18.40	19.21	19.61	19.62
GSM 1900	512	20.89	20.93	20.89	20.88	**20.24**	15.32	16.20	16.30	15.93
	661	20.77	20.80	21.11	21.21	**20.50**	15.48	16.13	16.41	15.85
	810	20.50	20.48	21.05	21.22	**20.70**	15.49	16.16	16.27	15.96
GSM 850	**Frame Avg.Targets:**	23.47	23.47	24.98	25.24	**25.49**	17.97	18.98	19.74	19.49
GSM 1900		20.47	20.47	20.98	20.74	**20.99**	15.97	16.98	17.74	16.99

Note:

1. 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.
2. GPRS/EDGE (GMSK) output powers were measured with coding scheme setting of 1 (CS1) on the base station simulator. CS1 was configured to measure GPRS output power measurements and SAR to ensure GMSK modulation in the signal. Our Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.
3. 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

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9.2 UMTS Conducted Powers

9.2.1 Maximum Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.60	23.67	23.68	23.73	23.82	23.82	23.71	23.78	23.58	-
99		12.2 kbps AMR	21.31	21.35	21.34	20.93	20.91	20.96	21.65	21.82	21.62	-
6	HSDPA	Subtest 1	22.36	22.35	22.44	23.33	23.34	23.27	22.42	22.62	22.45	0
6		Subtest 2	22.04	21.96	22.05	22.42	22.44	22.29	21.98	22.14	21.95	0
6		Subtest 3	22.49	22.43	22.50	21.43	21.39	21.32	22.41	22.61	22.39	0.5
6		Subtest 4	21.31	21.37	21.40	21.55	21.43	21.36	21.49	21.80	21.54	0.5
6	HSUPA	Subtest 1	21.63	21.58	21.65	20.63	20.51	20.42	21.35	21.62	21.42	0
6		Subtest 2	19.67	19.62	19.67	18.60	18.56	18.46	19.22	19.47	19.26	2
6		Subtest 3	22.45	22.49	22.50	20.51	20.48	20.31	22.41	22.68	22.51	1
6		Subtest 4	19.65	19.59	19.72	18.64	18.51	18.43	19.34	19.59	19.36	2
6		Subtest 5	23.98	23.94	23.96	22.47	22.35	22.21	23.75	23.95	23.71	0
8	DC-HSDPA	Subtest 1	22.55	22.50	22.51	23.00	22.91	22.98	22.49	22.44	22.50	0
8		Subtest 2	22.02	22.03	22.07	22.41	22.20	22.28	22.22	22.12	22.05	0
8		Subtest 3	20.62	20.75	20.71	21.40	21.18	21.36	20.30	20.30	20.34	0.5
8		Subtest 4	21.44	21.48	21.39	21.45	21.21	21.25	21.43	21.39	21.53	0.5

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9.2.2 Reduced Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	PCS Band [dBm]			3GPP MPR [dB]
			9262	9400	9538	
99	WCDMA	12.2 kbps RMC	21.65	21.82	21.67	-
99		12.2 kbps AMR	21.65	21.82	21.62	-
6	HSDPA	Subtest 1	21.79	22.00	21.86	0
6		Subtest 2	21.84	21.98	21.87	0
6		Subtest 3	21.86	21.99	21.93	0.5
6		Subtest 4	21.47	21.72	21.48	0.5
6	HSUPA	Subtest 1	20.62	20.87	20.69	0
6		Subtest 2	19.21	19.39	19.25	2
6		Subtest 3	20.72	20.92	20.67	1
6		Subtest 4	19.29	19.46	19.27	2
6		Subtest 5	21.69	21.95	21.68	0
8	DC-HSDPA	Subtest 1	21.83	21.89	21.78	0
8		Subtest 2	21.80	21.82	21.76	0
8		Subtest 3	20.29	20.22	20.18	0.5
8		Subtest 4	21.42	21.38	21.33	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
- The DUT supports UE category 24 for HSDPA

It is expected by the manufacturer that MPR for some HSPA subtests may be up to 2 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.

Figure 9-2
Power Measurement Setup

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9.3 LTE Conducted Powers

9.3.1 LTE Band 12

Table 9-1
LTE Band 12 Conducted Powers - 10 MHz Bandwidth

LTE Band 12 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23095 (707.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	23.70	0	0
	1	25	23.66		0
	1	49	**23.72**		0
	25	0	**21.80**	0-1	1
	25	12	21.72		1
	25	25	21.73		1
	50	0	21.75		1
16QAM	1	0	21.80	0-1	1
	1	25	21.81		1
	1	49	21.79		1
	25	0	20.77	0-2	2
	25	12	20.72		2
	25	25	20.79		2
	50	0	20.72		2

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

Table 9-2
LTE Band 12 Conducted Powers - 5 MHz Bandwidth

LTE Band 12 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23035 (701.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23155 (713.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.81	23.78	23.33	0	0
	1	12	23.70	23.68	23.55		0
	1	24	23.69	23.73	23.65		0
	12	0	22.80	22.60	22.67	0-1	1
	12	6	22.75	22.60	22.67		1
	12	13	22.71	22.58	22.67		1
	25	0	22.30	22.30	22.30		1
16QAM	1	0	22.17	22.00	22.08	0-1	1
	1	12	22.05	21.96	22.11		1
	1	24	22.03	22.00	22.19		1
	12	0	21.73	21.69	21.63	0-2	2
	12	6	21.73	21.66	21.70		2
	12	13	21.72	21.63	21.70		2
	25	0	21.78	21.79	21.74		2

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

LTE Band 12 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23025 (700.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23165 (714.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.75	23.83	23.71	0	0
	1	7	23.66	23.78	23.54		0
	1	14	23.69	23.77	23.58		0
	8	0	22.77	22.65	22.63	0-1	1
	8	4	22.74	22.66	22.66		1
	8	7	22.72	22.64	22.64		1
	15	0	22.70	22.64	22.65		1
16QAM	1	0	22.30	22.19	21.98	0-1	1
	1	7	22.24	22.15	21.78		1
	1	14	22.29	22.17	22.13		1
	8	0	21.64	21.68	21.64	0-2	2
	8	4	21.62	21.62	21.61		2
	8	7	21.60	21.62	21.60		2
	15	0	21.79	21.67	21.67		2

Table 9-4
LTE Band 12 Conducted Powers - 1.4 MHz Bandwidth

LTE Band 12 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 23017 (699.7 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23173 (715.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.86	23.86	23.83	0	0
	1	2	23.85	23.80	23.85		0
	1	5	23.85	23.82	23.85		0
	3	0	23.74	23.65	23.81		0
	3	2	23.68	23.62	23.77		0
	3	3	23.70	23.66	23.78		0
	6	0	22.70	22.58	22.71	0-1	1
16QAM	1	0	22.47	22.38	22.56	0-1	1
	1	2	22.42	22.20	22.56		1
	1	5	22.43	22.28	22.59		1
	3	0	22.21	22.10	22.30		1
	3	2	22.20	22.10	22.28		1
	3	3	22.25	22.10	22.30		1
	6	0	21.64	21.46	21.74	0-2	2

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9.3.2 LTE Band 13

Table 9-5
LTE Band 13 Conducted Powers - 10 MHz Bandwidth

LTE Band 13 10 MHzBandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23230 (782.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	**23.44**	0	0
	1	25	23.38		0
	1	49	23.40		0
	25	0	21.44	0-1	1
	25	12	**21.47**		1
	25	25	21.44		1
	50	0	21.46		1
16QAM	1	0	21.86	0-1	1
	1	25	21.72		1
	1	49	21.76		1
	25	0	20.47	0-2	2
	25	12	20.55		2
	25	25	20.46		2
	50	0	20.44		2

Table 9-6
LTE Band 13 Conducted Powers - 5 MHz Bandwidth

LTE Band 13 5 MHzBandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23230 (782.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	23.18	0	0
	1	12	23.29		0
	1	24	23.32		0
	12	0	22.41	0-1	1
	12	6	22.36		1
	12	13	22.35		1
	25	0	21.97		1
16QAM	1	0	21.93	0-1	1
	1	12	21.88		1
	1	24	21.90		1
	12	0	21.26	0-2	2
	12	6	21.31		2
	12	13	21.27		2
	25	0	21.00		2

Note: LTE Band 13 at 5 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.

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9.3.3 LTE Band 5 (Cell)

Table 9-7
LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth

LTE Band 5 (Cell) 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20525 (836.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	**23.69**	0	0
	1	25	23.64		0
	1	49	23.66		0
	25	0	**21.77**	0-1	1
	25	12	21.74		1
	25	25	21.74		1
	50	0	21.76		1
16QAM	1	0	21.81	0-1	1
	1	25	21.72		1
	1	49	21.78		1
	25	0	20.73	0-2	2
	25	12	20.75		2
	25	25	20.76		2
	50	0	20.83		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.

Table 9-8
LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth

LTE Band 5 (Cell) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20425 (826.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20625 (846.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.66	23.72	23.75	0	0
	1	12	23.62	23.71	23.72		0
	1	24	23.61	23.74	23.72		0
	12	0	22.45	22.55	22.54	0-1	1
	12	6	22.49	22.60	22.62		1
	12	13	22.48	22.59	22.55		1
	25	0	22.42	22.62	22.60		1
16QAM	1	0	21.81	21.94	21.95	0-1	1
	1	12	21.78	21.95	21.89		1
	1	24	21.85	21.92	21.84		1
	12	0	21.47	21.53	21.58	0-2	2
	12	6	21.42	21.52	21.56		2
	12	13	21.43	21.56	21.55		2
	25	0	21.42	21.57	21.58		2

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

LTE Band 5 (Cell) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20415 (825.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20635 (847.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.58	23.66	23.72	0	0
	1	7	23.54	23.65	23.68		0
	1	14	23.51	23.58	23.64		0
	8	0	22.47	22.53	22.56	0-1	1
	8	4	22.40	22.53	22.55		1
	8	7	22.40	22.54	22.50		1
	15	0	22.42	22.51	22.54		1
16QAM	1	0	21.84	21.90	21.97	0-1	1
	1	7	21.78	21.90	22.01		1
	1	14	21.80	21.89	21.98		1
	8	0	21.44	21.57	21.55	0-2	2
	8	4	21.45	21.51	21.62		2
	8	7	21.44	21.55	21.55		2
	15	0	21.44	21.50	21.60		2

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

LTE Band 5 (Cell) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20407 (824.7 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20643 (848.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.50	23.64	23.74	0	0
	1	2	23.55	23.65	23.73		0
	1	5	23.48	23.63	23.69		0
	3	0	23.44	23.52	23.60		0
	3	2	23.42	23.52	23.62		0
	3	3	23.37	23.50	23.57		0
	6	0	22.45	22.55	22.58	0-1	1
16QAM	1	0	21.65	21.80	21.87	0-1	1
	1	2	21.67	21.80	21.88		1
	1	5	21.63	21.78	21.86		1
	3	0	21.92	22.07	22.04		1
	3	2	21.92	22.05	22.01		1
	3	3	21.94	22.04	21.99		1
	6	0	21.41	21.64	21.56	0-2	2

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9.3.4 Maximum LTE Band 66 (AWS)

Table 9-11
LTE Band 66 (AWS) Conducted Powers - 20 MHz Bandwidth

LTE Band 66 (AWS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 132072 (1720.0 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132572 (1770.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.82	23.51	23.64	0	0
	1	50	23.83	23.59	23.72		0
	1	99	**23.86**	23.69	23.81		0
	50	0	22.76	22.69	22.84	0-1	1
	50	25	22.72	22.72	**22.85**		1
	50	50	22.76	22.78	22.84		1
	100	0	22.74	22.71	22.80		1
16QAM	1	0	22.06	21.86	21.95	0-1	1
	1	50	22.12	21.95	21.98		1
	1	99	22.14	22.05	22.01		1
	50	0	21.71	21.72	21.78	0-2	2
	50	25	21.75	21.65	21.76		2
	50	50	21.79	21.71	21.80		2
	100	0	21.77	21.72	21.88		2

Table 9-12
LTE Band 66 (AWS) Conducted Powers - 15 MHz Bandwidth

LTE Band 66 (AWS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 132047 (1717.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132597 (1772.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.53	23.54	23.61	0	0
	1	36	23.58	23.60	23.64		0
	1	74	23.58	23.61	23.61		0
	36	0	22.50	22.54	22.55	0-1	1
	36	18	22.53	22.57	22.57		1
	36	37	22.52	22.57	22.56		1
	75	0	22.50	22.55	22.54		1
16QAM	1	0	22.08	21.80	22.13	0-1	1
	1	36	21.87	21.95	22.00		1
	1	74	21.88	21.87	21.97		1
	36	0	21.48	21.60	21.54	0-2	2
	36	18	21.53	21.52	21.59		2
	36	37	21.50	21.55	21.55		2
	75	0	21.49	21.57	21.56		2

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Table 9-13
LTE Band 66 (AWS) Conducted Powers - 10 MHz Bandwidth

LTE Band 66 (AWS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 132022 (1715.0 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132622 (1775.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.62	23.68	23.52	0	0
	1	25	23.65	23.72	23.70		0
	1	49	23.63	23.70	23.73		0
	25	0	22.47	22.67	22.56	0-1	1
	25	12	22.49	22.54	22.57		1
	25	25	22.50	22.58	22.56		1
	50	0	22.46	22.56	22.59		1
16QAM	1	0	22.03	21.98	22.08	0-1	1
	1	25	21.98	22.07	22.03		1
	1	49	21.96	22.01	22.01		1
	25	0	21.44	21.56	21.58	0-2	2
	25	12	21.43	21.48	21.49		2
	25	25	21.44	21.50	21.50		2
	50	0	21.48	21.55	21.57		2

Table 9-14
LTE Band 66 (AWS) Conducted Powers - 5 MHz Bandwidth

LTE Band 66 (AWS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 131997 (1712.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132647 (1777.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.64	23.73	23.68	0	0
	1	12	23.65	23.63	23.80		0
	1	24	23.64	23.61	23.79		0
	12	0	22.53	22.67	22.73	0-1	1
	12	6	22.49	22.56	22.64		1
	12	13	22.49	22.55	22.61		1
	25	0	22.48	22.59	22.63		1
16QAM	1	0	22.18	22.05	22.05	0-1	1
	1	12	22.06	22.02	22.09		1
	1	24	21.99	22.04	22.04		1
	12	0	21.40	21.56	21.56	0-2	2
	12	6	21.43	21.50	21.56		2
	12	13	21.39	21.51	21.53		2
	25	0	21.45	21.54	21.58		2

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Table 9-15
LTE Band 66 (AWS) Conducted Powers - 3 MHz Bandwidth

LTE Band 66 (AWS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 131987 (1711.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132657 (1778.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.52	23.55	23.63	0	0
	1	7	23.53	23.60	23.68		0
	1	14	23.50	23.58	23.66		0
	8	0	22.49	22.69	22.70	0-1	1
	8	4	22.47	22.55	22.60		1
	8	7	22.49	22.56	22.61		1
	15	0	22.48	22.57	22.61		1
16QAM	1	0	22.03	22.11	22.19	0-1	1
	1	7	21.89	21.97	22.07		1
	1	14	21.88	21.97	22.02		1
	8	0	21.46	21.53	21.62	0-2	2
	8	4	21.43	21.51	21.60		2
	8	7	21.43	21.51	21.58		2
	15	0	21.44	21.52	21.59		2

Table 9-16
LTE Band 66 (AWS) Conducted Powers - 1.4 MHz Bandwidth

LTE Band 66 (AWS) 1.4 MHz Bandwidth								
Modulation	RB Size	RB Offset	Low Channel 131979 (1710.7 MHz)	Low-Mid Channel 132208 (1733.6 MHz)	Mid-High 132436 (1756.4 MHz)	High Channel 132665 (1779.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]					
QPSK	1	0	23.50	23.51	23.67	23.63	0	0
	1	2	23.54	23.59	23.73	23.74		0
	1	5	23.50	23.55	23.71	23.71		0
	3	0	23.47	23.50	23.63	23.66		0
	3	2	23.49	23.49	23.59	23.64		0
	3	3	23.45	23.46	23.60	23.62		0
	6	0	22.49	22.54	22.68	22.72	0-1	1
16QAM	1	0	21.96	22.02	22.20	22.19	0-1	1
	1	2	21.76	21.76	21.90	21.97		1
	1	5	21.72	21.75	21.90	21.94		1
	3	0	21.87	21.94	21.99	22.07		1
	3	2	21.86	21.99	22.06	22.09		1
	3	3	21.88	21.95	22.00	22.06		1
	6	0	21.44	21.51	21.60	21.72	0-2	2

Per FCC KDB Publication 447498 D01v06 Section 4.1g), 4 channels are required for LTE Band 66 with 1.4 MHz Bandwidth.

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9.3.5 Reduced LTE Band 66 (AWS)

Table 9-17
LTE Band 66 (AWS) Conducted Powers - 20 MHz Bandwidth

LTE Band 66 (AWS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 132072 (1720.0 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132572 (1770.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.95	22.75	22.57	0	0
	1	50	22.96	22.82	22.64		0
	1	99	**22.99**	22.94	22.70		0
	50	0	21.88	21.86	21.82	0-1	1
	50	25	21.90	21.92	21.85		1
	50	50	21.87	**21.95**	21.86		1
	100	0	21.85	21.91	21.85		1
16QAM	1	0	21.35	20.99	21.16	0-1	1
	1	50	21.35	21.02	21.22		1
	1	99	21.36	21.11	21.25		1
	50	0	20.78	20.86	20.78	0-2	2
	50	25	20.82	20.88	20.78		2
	50	50	20.85	20.91	20.84		2
	100	0	20.88	20.95	20.87		2

Table 9-18
LTE Band 66 (AWS) Conducted Powers - 15 MHz Bandwidth

LTE Band 66 (AWS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 132047 (1717.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132597 (1772.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.38	22.34	22.49	0	0
	1	36	22.41	22.36	22.54		0
	1	74	22.37	22.38	22.46		0
	36	0	21.26	21.50	21.41	0-1	1
	36	18	21.25	21.38	21.39		1
	36	37	21.25	21.37	21.35		1
	75	0	21.22	21.41	21.32		1
16QAM	1	0	20.81	20.70	20.90	0-1	1
	1	36	20.81	20.72	20.88		1
	1	74	20.71	20.87	20.82		1
	36	0	20.25	20.44	20.30	0-2	2
	36	18	20.26	20.39	20.37		2
	36	37	20.30	20.38	20.40		2
	75	0	20.29	20.43	20.35		2

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Table 9-19
LTE Band 66 (AWS) Conducted Powers - 10 MHz Bandwidth

LTE Band 66 (AWS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 132022 (1715.0 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132622 (1775.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.23	22.23	22.28	0	0
	1	25	22.32	22.37	22.46		0
	1	49	22.30	22.27	22.33		0
	25	0	20.87	20.97	20.95	0-1	1
	25	12	20.74	20.81	20.79		1
	25	25	20.73	20.82	20.81		1
	50	0	20.76	20.87	20.80		1
16QAM	1	0	20.55	20.67	20.73	0-1	1
	1	25	20.71	20.79	20.88		1
	1	49	20.55	20.76	20.80		1
	25	0	19.76	19.95	19.80	0-2	2
	25	12	19.75	19.85	19.79		2
	25	25	19.72	19.86	19.75		2
	50	0	19.76	19.90	19.81		2

Table 9-20
LTE Band 66 (AWS) Conducted Powers - 5 MHz Bandwidth

LTE Band 66 (AWS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 131997 (1712.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132647 (1777.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.25	22.34	22.33	0	0
	1	12	22.25	22.35	22.33		0
	1	24	22.22	22.31	22.27		0
	12	0	21.27	21.40	21.38	0-1	1
	12	6	21.20	21.33	21.28		1
	12	13	21.19	21.32	21.30		1
	25	0	21.19	21.32	21.27		1
16QAM	1	0	20.75	20.77	20.88	0-1	1
	1	12	20.59	20.73	20.68		1
	1	24	20.57	20.68	20.68		1
	12	0	20.18	20.32	20.28	0-2	2
	12	6	20.18	20.34	20.29		2
	12	13	20.19	20.31	20.25		2
	25	0	20.16	20.33	20.27		2

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Table 9-21
LTE Band 66 (AWS) Conducted Powers - 3 MHz Bandwidth

LTE Band 66 (AWS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 131987 (1711.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132657 (1778.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.30	22.19	22.44	0	0
	1	7	22.31	22.23	22.41		0
	1	14	22.28	22.19	22.39		0
	8	0	21.29	21.28	21.43	0-1	1
	8	4	21.22	21.26	21.35		1
	8	7	21.22	21.27	21.34		1
	15	0	21.21	21.27	21.22		1
16QAM	1	0	20.78	20.59	20.86	0-1	1
	1	7	20.67	20.65	20.66		1
	1	14	20.67	20.63	20.63		1
	8	0	20.25	20.33	20.28	0-2	2
	8	4	20.24	20.30	20.28		2
	8	7	20.25	20.31	20.30		2
	15	0	20.22	20.31	20.32		2

Table 9-22
LTE Band 66 (AWS) Conducted Powers - 1.4 MHz Bandwidth

LTE Band 66 (AWS) 1.4 MHz Bandwidth								
Modulation	RB Size	RB Offset	Low Channel 131979 (1710.7 MHz)	Low-Mid Channel 132208 (1733.6 MHz)	Mid-High 132436 (1756.4 MHz)	High Channel 132665 (1779.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]					
QPSK	1	0	22.28	22.30	22.29	22.43	0	0
	1	2	22.29	22.30	22.33	22.45		0
	1	5	22.25	22.28	22.25	22.40		0
	3	0	22.17	22.20	22.21	22.37		0
	3	2	22.17	22.22	22.21	22.36		0
	3	3	22.14	22.20	22.18	22.32		0
	6	0	21.23	21.26	21.27	21.43	0-1	1
16QAM	1	0	20.68	20.68	20.76	20.64	0-1	1
	1	2	20.45	20.50	20.52	20.55		1
	1	5	20.41	20.48	20.49	20.52		1
	3	0	20.62	20.76	20.77	20.81		1
	3	2	20.72	20.80	20.77	20.89		1
	3	3	20.74	20.74	20.71	20.86		1
	6	0	20.26	20.27	20.24	20.40	0-2	2

Per FCC KDB Publication 447498 D01v06 Section 4.1g), 4 channels are required for LTE Band 66 with 1.4 MHz Bandwidth.

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9.3.6 Maximum LTE Band 4 (AWS)

Table 9-23
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth

LTE Band 4 (AWS) 20 MHzBandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20175 (1732.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	23.31	0	0
	1	50	23.37		0
	1	99	**23.44**		0
	50	0	22.40	0-1	1
	50	25	22.44		1
	50	50	**22.46**		1
	100	0	22.45		1
16QAM	1	0	21.60	0-1	1
	1	50	21.64		1
	1	99	21.62		1
	50	0	21.46	0-2	2
	50	25	21.48		2
	50	50	21.40		2
	100	0	21.47		2

Table 9-24
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

LTE Band 4 (AWS) 15 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 20025 (1717.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20325 (1747.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.77	23.90	23.53	0	0
	1	36	23.79	23.88	23.56		0
	1	74	23.80	23.90	23.61		0
	36	0	22.57	22.63	22.49	0-1	1
	36	18	22.54	22.60	22.50		1
	36	37	22.57	22.64	22.49		1
	75	0	22.54	22.65	22.51		1
16QAM	1	0	21.98	22.03	22.24	0-1	1
	1	36	22.00	22.04	22.22		1
	1	74	21.99	22.06	22.23		1
	36	0	21.60	21.66	21.44	0-2	2
	36	18	21.58	21.60	21.41		2
	36	37	21.59	21.62	21.43		2
	75	0	21.54	21.60	21.43		2

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Table 9-25
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth

LTE Band 4 (AWS) 10 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 20000 (1715.0 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20350 (1750.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.45	23.65	23.51	0	0
	1	25	23.44	23.69	23.55		0
	1	49	23.51	23.67	23.62		0
	25	0	22.11	22.15	22.15	0-1	1
	25	12	22.10	22.11	22.16		1
	25	25	22.09	22.16	22.20		1
	50	0	22.06	22.15	22.19		1
16QAM	1	0	22.10	21.99	21.92	0-1	1
	1	25	22.09	22.00	21.93		1
	1	49	22.11	22.03	21.99		1
	25	0	21.10	21.13	21.21	0-2	2
	25	12	21.13	21.11	21.19		2
	25	25	21.15	21.14	21.22		2
	50	0	20.95	21.15	21.11		2

Table 9-26
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth

LTE Band 4 (AWS) 5 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 19975 (1712.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20375 (1752.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.38	23.43	23.50	0	0
	1	12	23.40	23.48	23.48		0
	1	24	23.44	23.50	23.53		0
	12	0	22.34	22.40	22.31	0-1	1
	12	6	22.33	22.44	22.33		1
	12	13	22.33	22.45	22.35		1
	25	0	22.33	22.44	22.29		1
16QAM	1	0	21.80	21.75	21.74	0-1	1
	1	12	21.77	21.76	21.75		1
	1	24	21.76	21.75	21.78		1
	12	0	21.28	21.40	21.17	0-2	2
	12	6	21.29	21.42	21.18		2
	12	13	21.28	21.45	21.20		2
	25	0	21.28	21.50	21.30		2

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Table 9-27
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth

LTE Band 4 (AWS) 3 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 19965 (1711.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20385 (1753.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.53	23.50	23.54	0	0
	1	7	23.55	23.55	23.51		0
	1	14	23.53	23.53	23.52		0
	8	0	22.33	22.43	22.28	0-1	1
	8	4	22.30	22.44	22.29		1
	8	7	22.31	22.45	22.31		1
	15	0	22.34	22.43	22.32		1
16QAM	1	0	21.93	22.30	22.04	0-1	1
	1	7	21.91	22.32	21.98		1
	1	14	21.90	22.33	22.00		1
	8	0	21.42	21.41	21.25	0-2	2
	8	4	21.45	21.39	21.23		2
	8	7	21.43	21.41	21.24		2
	15	0	21.26	21.46	21.20		2

Table 9-28
LTE Band 4 (AWS) Conducted Powers - 1.4 MHz Bandwidth

LTE Band 4 (AWS) 1.4 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel 19957 (1710.7 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20393 (1754.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.44	23.66	23.39	0	0
	1	2	23.45	23.61	23.40		0
	1	5	23.43	23.65	23.41		0
	3	0	23.36	23.46	23.42		0
	3	2	23.42	23.49	23.41		0
	3	3	23.38	23.48	23.40		0
	6	0	22.38	22.45	22.35	0-1	1
16QAM	1	0	21.98	21.71	21.71	0-1	1
	1	2	21.93	21.69	21.80		1
	1	5	21.94	21.70	21.78		1
	3	0	21.81	21.98	21.83		1
	3	2	21.82	21.99	21.89		1
	3	3	21.77	22.00	21.87		1
	6	0	21.30	21.50	21.36	0-2	2

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9.3.7 Maximum LTE Band 2 (PCS)

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

LTE Band 2 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.51	22.93	**23.52**	0	0
	1	50	23.47	23.10	23.33		0
	1	99	23.39	23.27	23.01		0
	50	0	22.41	22.19	22.45	0-1	1
	50	25	22.42	22.22	**22.49**		1
	50	50	22.38	22.31	22.41		1
	100	0	22.45	22.21	22.44		1
16QAM	1	0	21.81	21.38	21.58	0-1	1
	1	50	21.73	21.57	21.68		1
	1	99	21.78	21.61	21.59		1
	50	0	21.45	21.06	21.52	0-2	2
	50	25	21.43	21.14	21.48		2
	50	50	21.46	21.22	21.45		2
	100	0	21.43	21.23	21.44		2

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

LTE Band 2 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.54	23.33	23.64	0	0
	1	36	23.57	23.52	23.66		0
	1	74	23.42	23.61	23.34		0
	36	0	22.43	22.23	22.46	0-1	1
	36	18	22.24	22.63	22.43		1
	36	37	22.12	22.31	22.37		1
	75	0	22.28	22.26	22.47		1
16QAM	1	0	21.70	21.66	21.83	0-1	1
	1	36	21.60	21.64	21.82		1
	1	74	21.70	21.67	21.86		1
	36	0	21.34	21.18	21.66	0-2	2
	36	18	21.28	21.35	21.41		2
	36	37	21.24	21.40	21.40		2
	75	0	21.28	21.32	21.51		2

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Table 9-31
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

LTE Band 2 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.17	23.45	23.68	0	0
	1	25	23.46	23.55	23.64		0
	1	49	23.35	23.59	22.79		0
	25	0	21.84	22.06	22.05	0-1	1
	25	12	21.85	22.09	22.02		1
	25	25	21.81	22.13	21.99		1
	50	0	21.83	22.10	22.03		1
16QAM	1	0	22.03	21.99	22.11	0-1	1
	1	25	22.06	22.02	22.05		1
	1	49	22.00	22.12	21.96		1
	25	0	20.89	21.06	21.07	0-2	2
	25	12	20.88	21.07	21.03		2
	25	25	20.89	21.14	20.99		2
	50	0	20.84	21.11	20.98		2

Table 9-32
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth

LTE Band 2 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.42	23.39	23.67	0	0
	1	12	23.44	23.44	23.59		0
	1	24	23.35	23.45	22.98		0
	12	0	22.13	22.26	22.61	0-1	1
	12	6	22.14	22.30	22.45		1
	12	13	22.14	22.31	22.39		1
	25	0	22.15	22.29	22.48		1
16QAM	1	0	21.77	21.69	21.89	0-1	1
	1	12	21.49	21.76	21.80		1
	1	24	21.46	21.76	21.73		1
	12	0	21.13	21.21	21.40	0-2	2
	12	6	21.09	21.22	21.37		2
	12	13	21.09	21.30	21.36		2
	25	0	21.14	21.26	21.40		2

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

LTE Band 2 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18615 (1851.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19185 (1908.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.17	23.37	23.66	0	0
	1	7	23.22	23.40	23.45		0
	1	14	23.16	23.38	22.99		0
	8	0	22.17	22.31	22.64	0-1	1
	8	4	22.10	22.29	22.50		1
	8	7	22.09	22.29	22.50		1
	15	0	22.11	22.25	22.54		1
16QAM	1	0	21.65	21.80	21.87	0-1	1
	1	7	21.52	21.71	21.84		1
	1	14	21.46	21.72	21.91		1
	8	0	21.07	21.27	21.61	0-2	2
	8	4	21.11	21.31	21.52		2
	8	7	21.10	21.32	21.51		2
	15	0	21.05	21.26	21.53		2

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

LTE Band 2 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19193 (1909.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	23.22	23.40	23.30	0	0
	1	2	23.24	23.44	23.16		0
	1	5	23.22	23.44	22.89		0
	3	0	23.15	23.33	23.12		0
	3	2	23.19	23.37	23.06		0
	3	3	23.15	23.34	22.92		0
	6	0	22.16	22.34	22.68	0-1	1
16QAM	1	0	21.51	21.58	22.00	0-1	1
	1	2	21.33	21.57	21.74		1
	1	5	21.26	21.53	21.76		1
	3	0	21.53	21.67	22.08		1
	3	2	21.56	21.71	22.17		1
	3	3	21.51	21.74	22.14		1
	6	0	21.25	21.52	21.68	0-2	2

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9.3.8 Reduced LTE Band 2 (PCS)

Table 9-35
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

LTE Band 2 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	21.31	21.34	21.60	0	0
	1	50	21.27	21.48	**21.64**		0
	1	99	21.29	21.58	21.56		0
	50	0	20.45	20.57	20.55	0-1	1
	50	25	20.46	20.62	20.57		1
	50	50	20.43	**20.71**	20.55		1
	100	0	20.42	20.62	20.50		1
16QAM	1	0	19.90	19.75	19.67	0-1	1
	1	50	19.82	19.81	19.79		1
	1	99	19.83	19.87	19.71		1
	50	0	19.35	19.55	19.53	0-2	2
	50	25	19.35	19.57	19.41		2
	50	50	19.12	19.70	19.47		2
	100	0	19.48	19.65	19.55		2

Table 9-36
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

LTE Band 2 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	21.06	21.16	21.14	0	0
	1	36	21.03	21.27	21.04		0
	1	74	20.94	21.31	20.97		0
	36	0	20.04	20.10	20.32	0-1	1
	36	18	19.96	20.22	20.09		1
	36	37	19.93	20.31	20.06		1
	75	0	19.97	20.18	20.15		1
16QAM	1	0	19.36	19.52	19.35	0-1	1
	1	36	19.40	19.40	19.35		1
	1	74	19.24	19.57	19.32		1
	36	0	18.96	18.96	19.23	0-2	2
	36	18	18.90	19.20	19.01		2
	36	37	18.91	19.26	19.06		2
	75	0	18.93	19.15	19.09		2

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Table 9-37
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

LTE Band 2 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	21.00	21.22	21.31	0	0
	1	25	20.97	21.38	21.32		0
	1	49	20.89	21.35	21.12		0
	25	0	19.53	19.80	19.93	0-1	1
	25	12	19.49	19.68	19.68		1
	25	25	19.45	19.73	19.60		1
	50	0	19.41	19.65	19.66		1
16QAM	1	0	19.51	19.52	19.64	0-1	1
	1	25	19.33	19.62	19.46		1
	1	49	19.22	19.69	19.40		1
	25	0	18.46	18.60	18.78	0-2	2
	25	12	18.39	18.62	18.45		2
	25	25	18.38	18.64	18.38		2
	50	0	18.42	18.66	18.57		2

Table 9-38
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth

LTE Band 2 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.95	21.12	21.19	0	0
	1	12	20.91	21.21	21.15		0
	1	24	20.92	21.24	21.07		0
	12	0	19.95	20.14	20.27	0-1	1
	12	6	19.88	20.20	20.14		1
	12	13	19.87	20.19	20.09		1
	25	0	19.85	20.17	20.14		1
16QAM	1	0	19.55	19.63	19.53	0-1	1
	1	12	19.17	19.53	19.48		1
	1	24	19.17	19.58	19.42		1
	12	0	18.82	19.06	19.15	0-2	2
	12	6	18.84	19.08	19.04		2
	12	13	18.76	19.08	19.00		2
	25	0	18.79	19.08	19.10		2

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Table 9-39
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

LTE Band 2 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18615 (1851.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19185 (1908.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.88	21.15	21.09	0	0
	1	7	20.90	21.19	21.07		0
	1	14	20.85	21.17	21.05		0
	8	0	19.92	20.19	20.23	0-1	1
	8	4	19.83	20.18	20.08		1
	8	7	19.87	20.15	20.08		1
	15	0	19.86	20.15	20.12		1
16QAM	1	0	19.32	19.69	19.51	0-1	1
	1	7	19.81	19.49	19.48		1
	1	14	19.09	19.51	19.39		1
	8	0	18.76	19.10	19.10	0-2	2
	8	4	18.77	19.15	19.01		2
	8	7	18.81	19.16	19.04		2
	15	0	18.78	19.12	19.09		2

Table 9-40
LTE Band 2 (PCS) Conducted Powers - 1.4 MHz Bandwidth

LTE Band 2 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19193 (1909.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	20.91	21.18	21.17	0	0
	1	2	20.94	21.22	21.22		0
	1	5	20.89	21.21	21.12		0
	3	0	20.83	21.14	21.10		0
	3	2	20.87	21.20	21.15		0
	3	3	20.81	21.12	21.12		0
	6	0	19.90	20.21	20.21	0-1	1
16QAM	1	0	19.22	19.67	19.53	0-1	1
	1	2	19.00	19.44	19.41		1
	1	5	19.02	19.41	19.42		1
	3	0	19.28	19.60	19.56		1
	3	2	19.39	19.65	19.55		1
	3	3	19.39	19.62	19.52		1
	6	0	18.85	19.19	19.14	0-2	2

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9.3.9 LTE Carrier Aggregation Conducted Powers

Table 9-41
LTE Carrier Aggregation Maximum Conducted Powers

PCC									SCC				Power	
PCC Band	PCC Bandwidth [MHz]	PCC (UL) Channel	PCC (UL) Frequency [MHz]	Modulation	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Frequency [MHz]	SCC Band	SCC Bandwidth [MHz]	SCC (DL) Channel	SCC (DL) Frequency [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
LTE B2	10	19150	1905	QPSK	1	0	1150	1985	LTE B4	10	2175	2132.5	23.76	23.68
LTE B2	10	19150	1905	QPSK	1	0	1150	1985	LTE B5	10	2525	881.5	23.78	23.68
LTE B2	10	19150	1905	QPSK	1	0	1150	1985	LTE B17	10	5790	740	23.71	23.68
LTE B2	10	19150	1905	QPSK	1	0	1150	1985	LTE B29	10	9715	722.5	23.72	23.68
LTE B4	10	20175	1732.5	QPSK	1	25	2175	2132.5	LTE B2	10	900	1960	23.65	23.69
LTE B4	10	20175	1732.5	QPSK	1	25	2175	2132.5	LTE B5	10	2525	881.5	23.73	23.69
LTE B4	10	20175	1732.5	QPSK	1	25	2175	2132.5	LTE B12	10	5095	737.5	23.74	23.69
LTE B4	10	20175	1732.5	QPSK	1	25	2175	2132.5	LTE B17	10	5790	740	23.82	23.69
LTE B4	10	20175	1732.5	QPSK	1	25	2175	2132.5	LTE B29	10	9715	722.5	23.72	23.69
LTE B5	5	20625	846.5	QPSK	1	0	2625	891.5	LTE B2	10	900	1960	23.65	23.75
LTE B5	5	20625	846.5	QPSK	1	0	2625	891.5	LTE B4	10	2175	2132.5	23.71	23.75
LTE B17	5	23755	706.5	QPSK	1	0	5755	736.5	LTE B2	10	900	1960	23.63	23.81
LTE B4	10	20175	1732.5	QPSK	1	25	2175	2132.5	LTE B4	5	1975	2112.5	23.72	23.69

Table 9-42
LTE Carrier Aggregation Reduced Conducted Powers

PCC									SCC				Power	
PCC Band	PCC Bandwidth [MHz]	PCC (UL) Channel	PCC (UL) Frequency [MHz]	Modulation	PCC UL# RB	PCC UL RB Offset	PCC (DL) Channel	PCC (DL) Frequency [MHz]	SCC Band	SCC Bandwidth [MHz]	SCC (DL) Channel	SCC (DL) Frequency [MHz]	LTE Tx.Power with DL CA Enabled (dBm)	LTE Single Carrier Tx Power (dBm)
LTE B2	10	18900	1880	QPSK	1	25	900	1960	LTE B4	10	2175	2132.5	21.49	21.38
LTE B2	10	18900	1880	QPSK	1	25	900	1960	LTE B5	10	2525	881.5	21.55	21.38
LTE B2	10	18900	1880	QPSK	1	25	900	1960	LTE B17	10	5790	740	21.58	21.38
LTE B2	10	18900	1880	QPSK	1	25	900	1960	LTE B29	10	9715	722.5	21.52	21.38

Notes:

1. The device only supports downlink Carrier Aggregation. Uplink Carrier Aggregation is not supported. For every supported combination of downlink carrier aggregation, power measurements were performed with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band.
2. All control and acknowledge data is sent on uplink channels that operate identical to specifications when downlink carrier aggregation is inactive.
3. For downlink carrier aggregation combinations, PCC uplink channel was selected based on section C)3)b)ii) of KBD 941225 D05 V01r02. The downlink PCC channel was paired with the selected PCC uplink channel according to normal configurations without carrier aggregation. For inter-band CA, the SCC downlink channels were selected near the middle of their transmission bands. For contiguous intraband CA, the downlink channel spacing between the component carriers was set to multiple of 300 kHz less than the nominal channel spacing defined in section 5.4.1A of 3GPP TS 36.521. For non-contiguous intra-band CA, the downlink channel spacing between the component carriers was set to be larger than the nominal channel spacing and provided maximum separation between the component carriers. All selected downlink channels remained fully within the downlink transmission band of the respective component carrier.
4. Per FCC guidance LTE Band 12 powers were used to select measurement configurations for LTE Band 17.

Figure 9-3
Power Measurement Setup

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9.4 WLAN Conducted Powers

Table 9-43
2.4 GHz WLAN Maximum Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11b	802.11g	802.11n
2412	1	16.61	12.48	12.31
2437	6	**17.12**	13.32	13.30
2462	11	16.60	13.00	12.61

Table 9-44
2.4 GHz WLAN Reduced Average RF Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11b	802.11g	802.11n
2412	1	13.83	12.48	12.31
2437	6	**14.02**	13.32	13.30
2462	11	13.77	13.00	12.61

Table 9-45
5 GHz WLAN Average RF Power

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11a	802.11n
5180	36	12.53	12.53
5200	40	12.51	12.12
5220	44	12.50	12.43
5240	48	12.42	12.05
5260	52	12.40	12.15
5280	56	12.37	12.40
5300	60	12.50	12.43
5320	64	**12.85**	12.80
5500	100	12.45	12.62
5600	120	12.98	13.26
5620	124	**13.21**	13.18
5720	144	13.20	12.71
5745	149	**13.41**	12.37
5785	157	12.77	12.91
5825	165	12.42	12.90

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

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

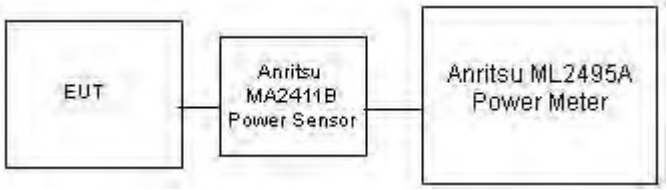

Figure 9-4
Power Measurement Setup

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10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Head Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (˚C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
4/17/2017	750H	19.6	700	0.859	43.456	0.889	42.201	-3.37%	2.97%
			710	0.868	43.336	0.890	42.149	-2.47%	2.82%
			740	0.893	42.939	0.893	41.994	0.00%	2.25%
			755	0.906	42.702	0.894	41.916	1.34%	1.88%
			770	0.920	42.462	0.895	41.838	2.79%	1.49%
			785	0.935	42.253	0.896	41.760	4.35%	1.18%
4/18/2017	835H	20.3	820	0.896	42.202	0.899	41.578	-0.33%	1.50%
			835	0.908	41.988	0.900	41.500	0.89%	1.18%
			850	0.925	41.789	0.916	41.500	0.98%	0.70%
4/25/2017	835H	20.8	820	0.878	40.342	0.899	41.578	-2.34%	-2.97%
			835	0.891	40.147	0.900	41.500	-1.00%	-3.26%
			850	0.907	39.944	0.916	41.500	-0.98%	-3.75%
4/18/2017	1750H	20.5	1710	1.336	39.579	1.348	40.142	-0.89%	-1.40%
			1750	1.373	39.389	1.371	40.079	0.15%	-1.72%
			1790	1.416	39.219	1.394	40.016	1.58%	-1.99%
4/26/2017	1750H	21.2	1710	1.342	40.155	1.348	40.142	-0.45%	0.03%
			1750	1.384	39.929	1.371	40.079	0.95%	-0.37%
			1790	1.435	39.771	1.394	40.016	2.94%	-0.61%
5/8/2017	1750H	20.0	1710	1.363	39.827	1.348	40.142	1.11%	-0.78%
			1750	1.405	39.633	1.371	40.079	2.48%	-1.11%
			1790	1.445	39.450	1.394	40.016	3.66%	-1.41%
4/19/2017	1900H	21.5	1850	1.403	38.480	1.400	40.000	0.21%	-3.80%
			1880	1.436	38.348	1.400	40.000	2.57%	-4.13%
			1910	1.467	38.217	1.400	40.000	4.79%	-4.46%
4/24/2017	1900H	23.3	1850	1.385	40.467	1.400	40.000	-1.07%	1.17%
			1880	1.419	40.366	1.400	40.000	1.36%	0.91%
			1910	1.446	40.275	1.400	40.000	3.29%	0.69%
4/24/2017	2450H	21.1	2400	1.775	38.873	1.756	39.289	1.08%	-1.06%
			2450	1.824	38.648	1.800	39.200	1.33%	-1.41%
			2500	1.879	38.408	1.855	39.136	1.29%	-1.86%
04/24/2017	5250H-5750H	19.5	5240	4.734	34.850	4.696	35.940	0.81%	-3.03%
			5260	4.762	34.835	4.717	35.917	0.95%	-3.01%
			5320	4.802	34.714	4.778	35.849	0.50%	-3.17%
			5600	5.099	34.278	5.065	35.529	0.67%	-3.52%
			5620	5.134	34.225	5.086	35.506	0.94%	-3.61%
			5745	5.272	34.053	5.214	35.363	1.11%	-3.70%
			5765	5.292	34.033	5.234	35.340	1.11%	-3.70%

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Table 10-2
Measured Body Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (˚C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
4/20/2017	750B	22.3	700	0.914	54.929	0.959	55.726	-4.69%	-1.43%
			710	0.923	54.809	0.960	55.687	-3.85%	-1.58%
			740	0.949	54.463	0.963	55.570	-1.45%	-1.99%
			755	0.963	54.295	0.964	55.512	-0.10%	-2.19%
			770	0.978	54.129	0.965	55.453	1.35%	-2.39%
			785	0.991	53.966	0.966	55.395	2.59%	-2.58%
4/17/2017	835B	20.1	820	0.967	54.920	0.969	55.258	-0.21%	-0.61%
			835	0.982	54.813	0.970	55.200	1.24%	-0.70%
			850	0.997	54.651	0.988	55.154	0.91%	-0.91%
4/24/2017	835B	19.9	820	0.976	54.021	0.969	55.258	0.72%	-2.24%
			835	0.991	53.903	0.970	55.200	2.16%	-2.35%
			850	1.006	53.753	0.988	55.154	1.82%	-2.54%
4/24/2017	1750B	20.9	1710	1.458	51.490	1.463	53.537	-0.34%	-3.82%
			1750	1.501	51.353	1.488	53.432	0.87%	-3.89%
			1790	1.545	51.199	1.514	53.326	2.05%	-3.99%
5/8/2017	1750B	20.8	1710	1.477	51.370	1.463	53.537	0.96%	-4.05%
			1750	1.523	51.285	1.488	53.432	2.35%	-4.02%
			1790	1.575	51.067	1.514	53.326	4.03%	-4.24%
4/17/2017	1900B	22.6	1850	1.508	51.287	1.520	53.300	-0.79%	-3.78%
			1880	1.547	51.158	1.520	53.300	1.78%	-4.02%
			1910	1.580	51.030	1.520	53.300	3.95%	-4.26%
4/24/2017	1900B	22.2	1850	1.508	52.675	1.520	53.300	-0.79%	-1.17%
			1880	1.541	52.585	1.520	53.300	1.38%	-1.34%
			1910	1.574	52.492	1.520	53.300	3.55%	-1.52%
4/26/2017	1900B	22.6	1850	1.517	52.172	1.520	53.300	-0.20%	-2.12%
			1880	1.549	52.076	1.520	53.300	1.91%	-2.30%
			1910	1.583	51.999	1.520	53.300	4.14%	-2.44%
4/24/2017	2450B	23.3	2400	1.942	51.259	1.902	52.767	2.10%	-2.86%
			2450	2.005	51.035	1.950	52.700	2.82%	-3.16%
			2500	2.076	50.872	2.021	52.636	2.72%	-3.35%
04/24/2017	5250B-5750B	21.9	5240	5.477	48.130	5.346	48.960	2.45%	-1.70%
			5260	5.505	48.117	5.369	48.933	2.53%	-1.67%
			5320	5.589	47.937	5.439	48.851	2.76%	-1.87%
			5600	5.951	47.517	5.766	48.471	3.21%	-1.97%
			5620	5.980	47.495	5.790	48.444	3.28%	-1.96%
			5745	6.171	47.299	5.936	48.275	3.96%	-2.02%
			5765	6.188	47.258	5.959	48.248	3.84%	-2.05%

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

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10.2 Test System Verification

Prior to SAR assessment, the system is verified to ±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 10-3
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
E	750	HEAD	04/17/2017	22.9	20.0	0.200	1161	3319	1.540	8.170	7.700	-5.75%
J	835	HEAD	04/18/2017	20.5	20.3	0.200	4d133	3334	2.000	9.320	10.000	7.30%
I	835	HEAD	04/25/2017	23.2	20.8	0.200	4d133	3213	1.830	9.320	9.150	-1.82%
E	1750	HEAD	04/18/2017	23.4	21.0	0.100	1008	3319	3.760	36.700	37.600	2.45%
I	1750	HEAD	04/26/2017	22.7	21.2	0.100	1008	3213	3.530	36.700	35.300	-3.81%
E	1750	HEAD	05/08/2017	21.5	21.0	0.100	1051	3319	3.690	36.300	36.900	1.65%
E	1900	HEAD	04/19/2017	23.0	21.5	0.100	5d149	3319	4.180	40.100	41.800	4.24%
J	1900	HEAD	04/24/2017	21.3	23.3	0.100	5d149	3334	4.090	40.100	40.900	2.00%
G	2450	HEAD	04/24/2017	20.0	21.1	0.100	797	3287	5.190	52.100	51.900	-0.38%
K	5250	HEAD	04/24/2017	20.5	20.0	0.050	1120	7308	4.140	83.200	82.800	-0.48%
K	5600	HEAD	04/24/2017	20.5	20.0	0.050	1120	7308	4.060	85.800	81.200	-5.36%
K	5750	HEAD	04/24/2017	20.5	20.0	0.050	1120	7308	3.870	81.800	77.400	-5.38%
J	750	BODY	04/20/2017	19.9	22.3	0.200	1054	3334	1.830	8.610	9.150	6.27%
H	835	BODY	04/17/2017	20.0	20.1	0.200	4d133	3318	1.960	9.500	9.800	3.16%
I	835	BODY	04/24/2017	22.1	19.9	0.200	4d133	3213	1.950	9.500	9.750	2.63%
E	1750	BODY	04/24/2017	21.7	20.9	0.100	1148	3319	3.460	37.100	34.600	-6.74%
G	1750	BODY	05/08/2017	22.3	20.8	0.100	1051	3287	3.870	37.100	38.700	4.31%
K	1900	BODY	04/17/2017	22.7	21.6	0.100	5d080	7409	3.960	39.100	39.600	1.28%
H	1900	BODY	04/24/2017	20.8	20.3	0.100	5d080	3318	3.970	39.100	39.700	1.53%
H	1900	BODY	04/26/2017	22.1	21.8	0.100	5d149	3318	4.210	39.900	42.100	5.51%
G	2450	BODY	04/24/2017	20.5	21.5	0.100	797	3287	5.230	50.700	52.300	3.16%
D	5250	BODY	04/24/2017	21.2	21.0	0.050	1237	3589	3.500	74.800	70.000	-6.42%
D	5600	BODY	04/24/2017	21.2	21.0	0.050	1237	3589	3.770	77.000	75.400	-2.08%
D	5750	BODY	04/24/2017	21.2	21.0	0.050	1237	3589	3.420	75.400	68.400	-9.28%

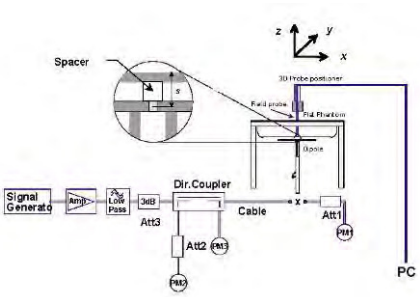

Figure 10-1
System Verification Setup Diagram

Figure 10-2
System Verification Setup Photo

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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 Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.0	32.80	-0.02	Right	Cheek	08968	1:8.3	0.282	1.047	0.295	
836.60	190	GSM 850	GSM	33.0	32.80	0.01	Right	Tilt	08968	1:8.3	0.148	1.047	0.155	
836.60	190	GSM 850	GSM	33.0	32.80	0.03	Left	Cheek	08968	1:8.3	0.367	1.047	0.384	A1
836.60	190	GSM 850	GSM	33.0	32.80	0.10	Left	Tilt	08968	1:8.3	0.171	1.047	0.179	
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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	24.0	23.67	0.04	Right	Cheek	09123	1:1	0.298	1.079	0.322	
836.60	4183	UMTS 850	RMC	24.0	23.67	-0.02	Right	Tilt	09123	1:1	0.262	1.079	0.283	
836.60	4183	UMTS 850	RMC	24.0	23.67	-0.01	Left	Cheek	09123	1:1	0.385	1.079	0.415	A2
836.60	4183	UMTS 850	RMC	24.0	23.67	-0.04	Left	Tilt	09123	1:1	0.350	1.079	0.378	
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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1732.40	1412	UMTS 1750	RMC	24.0	23.82	0.02	Right	Cheek	09123	1:1	0.247	1.042	0.257	
1732.40	1412	UMTS 1750	RMC	24.0	23.82	0.02	Right	Tilt	09123	1:1	0.213	1.042	0.222	
1732.40	1412	UMTS 1750	RMC	24.0	23.82	0.03	Left	Cheek	09123	1:1	0.479	1.042	0.499	A3
1732.40	1412	UMTS 1750	RMC	24.0	23.82	0.01	Left	Tilt	09123	1:1	0.161	1.042	0.168	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

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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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	30.0	29.80	-0.07	Right	Cheek	08968	1:8.3	0.188	1.047	0.197	
1880.00	661	GSM 1900	GSM	30.0	29.80	-0.14	Right	Tilt	08968	1:8.3	0.150	1.047	0.157	
1880.00	661	GSM 1900	GSM	30.0	29.80	-0.01	Left	Cheek	08968	1:8.3	0.304	1.047	0.318	A4
1880.00	661	GSM 1900	GSM	30.0	29.80	0.09	Left	Tilt	08968	1:8.3	0.102	1.047	0.107	
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	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	24.0	23.78	-0.04	Right	Cheek	08968	1:1	0.355	1.052	0.373	
1880.00	9400	UMTS 1900	RMC	24.0	23.78	0.01	Right	Tilt	08968	1:1	0.231	1.052	0.243	
1880.00	9400	UMTS 1900	RMC	24.0	23.78	0.09	Left	Cheek	08968	1:1	0.571	1.052	0.601	A5
1880.00	9400	UMTS 1900	RMC	24.0	23.78	0.01	Left	Tilt	08968	1:1	0.155	1.052	0.163	
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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	0.04	0	Right	Cheek	QPSK	1	49	08620	1:1	0.337	1.067	0.360	
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	0.06	1	Right	Cheek	QPSK	25	0	08620	1:1	0.198	1.318	0.261	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	0.07	0	Right	Tilt	QPSK	1	49	08620	1:1	0.225	1.067	0.240	
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	0.02	1	Right	Tilt	QPSK	25	0	08620	1:1	0.133	1.318	0.175	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	-0.04	0	Left	Cheek	QPSK	1	49	08620	1:1	0.443	1.067	0.473	A6
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	0.08	1	Left	Cheek	QPSK	25	0	08620	1:1	0.259	1.318	0.341	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	0.04	0	Left	Tilt	QPSK	1	49	08620	1:1	0.229	1.067	0.244	
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	0.08	1	Left	Tilt	QPSK	25	0	08620	1:1	0.133	1.318	0.175	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

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Table 11-7
LTE Band 13 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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	0.04	0	Right	Cheek	QPSK	1	0	08620	1:1	0.349	1.138	0.397	
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	0.10	1	Right	Cheek	QPSK	25	12	08620	1:1	0.196	1.422	0.279	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	0.09	0	Right	Tilt	QPSK	1	0	08620	1:1	0.267	1.138	0.304	
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	0.02	1	Right	Tilt	QPSK	25	12	08620	1:1	0.146	1.422	0.208	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	-0.02	0	Left	Cheek	QPSK	1	0	08620	1:1	0.457	1.138	0.520	A7
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	0.04	1	Left	Cheek	QPSK	25	12	08620	1:1	0.268	1.422	0.381	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	0.05	0	Left	Tilt	QPSK	1	0	08620	1:1	0.274	1.138	0.312	
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	0.05	1	Left	Tilt	QPSK	25	12	08620	1:1	0.163	1.422	0.232	
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 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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	0.11	0	Right	Cheek	QPSK	1	0	08612	1:1	0.433	1.074	0.465	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	0.08	1	Right	Cheek	QPSK	25	0	08612	1:1	0.268	1.327	0.356	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	0.00	1	Right	Cheek	QPSK	25	0	08612	1:1	0.335	1.091	0.365	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	-0.15	0	Right	Tilt	QPSK	1	0	08612	1:1	0.215	1.074	0.231	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	0.13	1	Right	Tilt	QPSK	25	0	08612	1:1	0.142	1.327	0.188	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	0.00	1	Right	Tilt	QPSK	25	0	08612	1:1	0.176	1.091	0.192	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	0.06	0	Left	Cheek	QPSK	1	0	08612	1:1	0.514	1.074	0.552	A8
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	0.06	1	Left	Cheek	QPSK	25	0	08612	1:1	0.310	1.327	0.411	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	0.00	1	Left	Cheek	QPSK	25	0	08612	1:1	0.445	1.091	0.485	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	0.09	0	Left	Tilt	QPSK	1	0	08612	1:1	0.214	1.074	0.230	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	0.12	1	Left	Tilt	QPSK	25	0	08612	1:1	0.140	1.327	0.186	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	-0.02	1	Left	Tilt	QPSK	25	0	08612	1:1	0.207	1.091	0.226	
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 66 (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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.0	23.86	0.00	0	Right	Cheek	QPSK	1	99	08620	1:1	0.260	1.033	0.269	
1770.00	132572	High	LTE Band 66 (AWS)	20	23.0	22.85	0.06	1	Right	Cheek	QPSK	50	25	08620	1:1	0.237	1.035	0.245	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.0	23.86	-0.01	0	Right	Tilt	QPSK	1	99	08620	1:1	0.172	1.033	0.178	
1770.00	132572	High	LTE Band 66 (AWS)	20	23.0	22.85	0.16	1	Right	Tilt	QPSK	50	25	08620	1:1	0.188	1.035	0.195	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.0	23.86	-0.03	0	Left	Cheek	QPSK	1	99	08620	1:1	0.421	1.033	0.435	A9
1770.00	132572	High	LTE Band 66 (AWS)	20	23.0	22.85	0.03	1	Left	Cheek	QPSK	50	25	08620	1:1	0.360	1.035	0.373	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.0	23.86	-0.15	0	Left	Tilt	QPSK	1	99	08620	1:1	0.161	1.033	0.166	
1770.00	132572	High	LTE Band 66 (AWS)	20	23.0	22.85	0.16	1	Left	Tilt	QPSK	50	25	08620	1:1	0.142	1.035	0.147	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

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Table 11-10
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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	0.08	0	Right	Cheek	QPSK	1	99	09024	1:1	0.272	1.138	0.310	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	0.03	1	Right	Cheek	QPSK	50	50	09024	1:1	0.228	1.132	0.258	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	0.07	0	Right	Tilt	QPSK	1	99	09024	1:1	0.218	1.138	0.248	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	0.01	1	Right	Tilt	QPSK	50	50	09024	1:1	0.179	1.132	0.203	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	0.07	0	Left	Cheek	QPSK	1	99	09024	1:1	0.621	1.138	0.707	A10
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	0.00	1	Left	Cheek	QPSK	50	50	09024	1:1	0.488	1.132	0.552	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	0.09	0	Left	Tilt	QPSK	1	99	09024	1:1	0.168	1.138	0.191	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	0.05	1	Left	Tilt	QPSK	50	50	09024	1:1	0.132	1.132	0.149	
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
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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.52	0.02	0	Right	Cheek	QPSK	1	0	08992	1:1	0.441	1.117	0.493	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.49	0.03	1	Right	Cheek	QPSK	50	25	08992	1:1	0.329	1.125	0.370	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.52	-0.10	0	Right	Tilt	QPSK	1	0	08992	1:1	0.324	1.117	0.362	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.49	0.04	1	Right	Tilt	QPSK	50	25	08992	1:1	0.257	1.125	0.289	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.52	-0.19	0	Left	Cheek	QPSK	1	0	08992	1:1	0.627	1.117	0.700	A11
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.49	0.04	1	Left	Cheek	QPSK	50	25	08992	1:1	0.511	1.125	0.575	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.52	0.18	0	Left	Tilt	QPSK	1	0	08992	1:1	0.218	1.117	0.244	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.49	-0.02	1	Left	Tilt	QPSK	50	25	08992	1:1	0.162	1.125	0.182	
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 11-12
DTS Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2437	6	802.11b	DSSS	22	14.5	14.02	-0.16	Right	Cheek	10097	1	99.1	0.665	0.544	1.117	1.009	0.613	A12
2437	6	802.11b	DSSS	22	14.5	14.02	-0.10	Right	Tilt	10097	1	99.1	0.451	0.335	1.117	1.009	0.378	
2437	6	802.11b	DSSS	22	14.5	14.02	-0.10	Left	Cheek	10097	1	99.1	0.233	0.191	1.117	1.009	0.215	
2437	6	802.11b	DSSS	22	14.5	14.02	0.04	Left	Tilt	10097	1	99.1	0.230	-	1.117	1.009	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram									

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Table 11-13
NII Head SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
5320	64	802.11a	OFDM	20	13.5	12.85	-0.19	Right	Cheek	09917	6	98.9	0.125	0.044	1.161	1.011	0.052	
5320	64	802.11a	OFDM	20	13.5	12.85	-0.16	Right	Tilt	09917	6	98.9	0.046	-	1.161	1.011	-	
5320	64	802.11a	OFDM	20	13.5	12.85	0.13	Left	Cheek	09917	6	98.9	0.036	-	1.161	1.011	-	
5320	64	802.11a	OFDM	20	13.5	12.85	-0.16	Left	Tilt	09917	6	98.9	0.044	-	1.161	1.011	-	
5620	124	802.11a	OFDM	20	13.5	13.21	-0.17	Right	Cheek	09917	6	98.9	0.245	0.089	1.069	1.011	**0.096**	A13
5620	124	802.11a	OFDM	20	13.5	13.21	-0.12	Right	Tilt	09917	6	98.9	0.093	-	1.069	1.011	-	
5620	124	802.11a	OFDM	20	13.5	13.21	-0.17	Left	Cheek	09917	6	98.9	0.071	-	1.069	1.011	-	
5620	124	802.11a	OFDM	20	13.5	13.21	0.11	Left	Tilt	09917	6	98.9	0.077	-	1.069	1.011	-	
5745	149	802.11a	OFDM	20	13.5	13.41	-0.11	Right	Cheek	09917	6	98.9	0.147	0.061	1.021	1.011	0.063	
5745	149	802.11a	OFDM	20	13.5	13.41	0.19	Right	Tilt	09917	6	98.9	0.060	-	1.021	1.011	-	
5745	149	802.11a	OFDM	20	13.5	13.41	0.13	Left	Cheek	09917	6	98.9	0.046	-	1.021	1.011	-	
5745	149	802.11a	OFDM	20	13.5	13.41	0.12	Left	Tilt	09917	6	98.9	0.057	-	1.021	1.011	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram										

11.2 Standalone Body-Worn SAR Data

Table 11-14
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	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.0	32.80	-0.08	10 mm	08968	1	1:8.3	back	0.585	1.047	0.612	A14
836.60	4183	UMTS 850	RMC	24.0	23.67	-0.09	10 mm	08620	N/A	1:1	back	0.579	1.079	0.625	A16
1732.40	1412	UMTS 1750	RMC	24.0	23.82	-0.09	10 mm	09123	N/A	1:1	back	0.573	1.042	0.597	A17
1880.00	661	GSM 1900	GSM	30.0	29.80	0.03	10 mm	09123	1	1:8.3	back	0.323	1.047	0.338	A19
1880.00	9400	UMTS 1900	RMC	24.0	23.78	-0.02	15 mm	09123	N/A	1:1	back	0.332	1.052	0.349	A21
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram								

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Table 11-15
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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	-0.04	0	09123	QPSK	1	49	10 mm	back	1:1	0.744	1.067	**0.794**	A23
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	0.02	1	09123	QPSK	25	0	10 mm	back	1:1	0.455	1.318	0.600	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	-0.05	0	09123	QPSK	1	0	10 mm	back	1:1	0.620	1.138	0.706	A24
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	-0.07	1	09123	QPSK	25	12	10 mm	back	1:1	0.365	1.422	0.519	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	0.00	0	08612	QPSK	1	0	10 mm	back	1:1	0.714	1.074	0.767	A25
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	0.04	1	08612	QPSK	25	0	10 mm	back	1:1	0.447	1.327	0.593	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	0.00	1	08612	QPSK	25	0	10 mm	back	1:1	0.576	1.091	0.628	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.0	23.86	-0.03	0	09156	QPSK	1	99	15 mm	back	1:1	0.367	1.033	0.379	A26
1770.00	132572	High	LTE Band 66 (AWS)	20	23.0	22.85	0.06	1	09156	QPSK	50	25	15 mm	back	1:1	0.296	1.035	0.306	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	0.00	0	09156	QPSK	1	99	15 mm	back	1:1	0.354	1.138	0.403	A28
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	0.03	1	09156	QPSK	50	50	15 mm	back	1:1	0.297	1.132	0.336	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.52	-0.04	0	08612	QPSK	1	0	15 mm	back	1:1	0.324	1.117	0.362	A30
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.49	0.02	1	08612	QPSK	50	25	15 mm	back	1:1	0.245	1.125	0.276	
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 11-16
DTS Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2437	6	802.11b	DSSS	22	17.5	17.12	-0.08	15 mm	10097	1	back	99.1	0.074	0.063	1.091	1.009	**0.069**	A32
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 11-17
NII Body-Worn SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
5320	64	802.11a	OFDM	20	13.5	12.85	0.05	15 mm	09917	6	back	98.9	0.336	0.149	1.161	1.011	0.175	
5620	124	802.11a	OFDM	20	13.5	13.21	0.13	15 mm	09917	6	back	98.9	0.779	0.340	1.069	1.011	**0.367**	A34
5745	149	802.11a	OFDM	20	13.5	13.41	0.20	15 mm	09917	6	back	98.9	0.508	0.224	1.021	1.011	0.231	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram										

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11.3 Standalone Hotspot SAR Data

Table 11-18
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	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GPRS	29.0	27.30	-0.05	10 mm	08968	4	1:2.076	back	0.442	1.479	0.654	
836.60	190	GSM 850	GPRS	29.0	27.30	0.02	10 mm	08968	4	1:2.076	front	0.371	1.479	0.549	
836.60	190	GSM 850	GPRS	29.0	27.30	0.02	10 mm	08968	4	1:2.076	bottom	0.130	1.479	0.192	
824.20	128	GSM 850	GPRS	29.0	27.04	0.09	10 mm	08968	4	1:2.076	left	0.436	1.570	0.685	
836.60	190	GSM 850	GPRS	29.0	27.30	-0.04	10 mm	08968	4	1:2.076	left	0.599	1.479	**0.886**	A15
848.80	251	GSM 850	GPRS	29.0	27.28	-0.02	10 mm	08968	4	1:2.076	left	0.460	1.486	0.684	
836.60	4183	UMTS 850	RMC	24.0	23.67	-0.09	10 mm	08620	N/A	1:1	back	0.579	1.079	0.625	A16
836.60	4183	UMTS 850	RMC	24.0	23.67	-0.02	10 mm	08620	N/A	1:1	front	0.452	1.079	0.488	
836.60	4183	UMTS 850	RMC	24.0	23.67	-0.03	10 mm	08620	N/A	1:1	bottom	0.211	1.079	0.228	
836.60	4183	UMTS 850	RMC	24.0	23.67	-0.01	10 mm	08620	N/A	1:1	left	0.490	1.079	0.529	
1732.40	1412	UMTS 1750	RMC	24.0	23.82	-0.09	10 mm	09123	N/A	1:1	back	0.573	1.042	0.597	
1732.40	1412	UMTS 1750	RMC	24.0	23.82	0.01	10 mm	09123	N/A	1:1	front	0.750	1.042	0.782	A18
1732.40	1412	UMTS 1750	RMC	24.0	23.82	0.02	10 mm	09123	N/A	1:1	bottom	0.467	1.042	0.487	
1732.40	1412	UMTS 1750	RMC	24.0	23.82	0.01	10 mm	09123	N/A	1:1	left	0.444	1.042	0.463	
1880.00	661	GSM 1900	GPRS	24.5	23.51	-0.19	10 mm	09123	4	1:2.076	back	0.272	1.256	0.342	
1880.00	661	GSM 1900	GPRS	24.5	23.51	-0.08	10 mm	09123	4	1:2.076	front	0.340	1.256	0.427	A20
1880.00	661	GSM 1900	GPRS	24.5	23.51	0.03	10 mm	09123	4	1:2.076	bottom	0.236	1.256	0.296	
1880.00	661	GSM 1900	GPRS	24.5	23.51	0.03	10 mm	09123	4	1:2.076	left	0.241	1.256	0.303	
1880.00	9400	UMTS 1900	RMC	22.0	21.82	-0.01	10 mm	09123	N/A	1:1	back	0.626	1.042	0.652	
1880.00	9400	UMTS 1900	RMC	22.0	21.82	0.00	10 mm	09123	N/A	1:1	front	0.638	1.042	0.665	A22
1880.00	9400	UMTS 1900	RMC	22.0	21.82	0.02	10 mm	09123	N/A	1:1	bottom	0.578	1.042	0.602	
1880.00	9400	UMTS 1900	RMC	22.0	21.82	-0.02	10 mm	09123	N/A	1:1	left	0.556	1.042	0.579	
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 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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	-0.04	0	09123	QPSK	1	49	10 mm	back	1:1	0.744	1.067	0.794	A23
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	0.02	1	09123	QPSK	25	0	10 mm	back	1:1	0.455	1.318	0.600	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	-0.05	0	09123	QPSK	1	49	10 mm	front	1:1	0.539	1.067	0.575	
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	-0.01	1	09123	QPSK	25	0	10 mm	front	1:1	0.324	1.318	0.427	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	0.00	0	09123	QPSK	1	49	10 mm	bottom	1:1	0.165	1.067	0.176	
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	0.04	1	09123	QPSK	25	0	10 mm	bottom	1:1	0.100	1.318	0.132	
707.50	23095	Mid	LTE Band 12	10	24.0	23.72	-0.06	0	09123	QPSK	1	49	10 mm	left	1:1	0.574	1.067	0.612	
707.50	23095	Mid	LTE Band 12	10	23.0	21.80	-0.01	1	09123	QPSK	25	0	10 mm	left	1:1	0.333	1.318	0.439	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

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Table 11-20
LTE Band 13 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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	-0.05	0	09123	QPSK	1	0	10 mm	back	1:1	0.620	1.138	0.706	A24
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	-0.07	1	09123	QPSK	25	12	10 mm	back	1:1	0.365	1.422	0.519	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	-0.01	0	09123	QPSK	1	0	10 mm	front	1:1	0.427	1.138	0.486	
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	-0.01	1	09123	QPSK	25	12	10 mm	front	1:1	0.266	1.422	0.378	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	-0.02	0	09123	QPSK	1	0	10 mm	bottom	1:1	0.207	1.138	0.236	
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	0.00	1	09123	QPSK	25	12	10 mm	bottom	1:1	0.111	1.422	0.158	
782.00	23230	Mid	LTE Band 13	10	24.0	23.44	0.07	0	09123	QPSK	1	0	10 mm	left	1:1	0.515	1.138	0.586	
782.00	23230	Mid	LTE Band 13	10	23.0	21.47	-0.03	1	09123	QPSK	25	12	10 mm	left	1:1	0.321	1.422	0.456	
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
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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	0.00	0	08612	QPSK	1	0	10 mm	back	1:1	0.714	1.074	0.767	A25
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	0.04	1	08612	QPSK	25	0	10 mm	back	1:1	0.447	1.327	0.593	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	0.00	1	08612	QPSK	25	0	10 mm	back	1:1	0.576	1.091	0.628	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	-0.02	0	08612	QPSK	1	0	10 mm	front	1:1	0.603	1.074	0.648	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	0.02	1	08612	QPSK	25	0	10 mm	front	1:1	0.379	1.327	0.503	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	-0.01	1	08612	QPSK	25	0	10 mm	front	1:1	0.488	1.091	0.532	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	0.01	0	08612	QPSK	1	0	10 mm	bottom	1:1	0.182	1.074	0.195	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	0.04	1	08612	QPSK	25	0	10 mm	bottom	1:1	0.112	1.327	0.149	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	0.00	1	08612	QPSK	25	0	10 mm	bottom	1:1	0.148	1.091	0.161	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.0	23.69	0.08	0	08612	QPSK	1	0	10 mm	left	1:1	0.685	1.074	0.736	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.0	21.77	-0.01	1	08612	QPSK	25	0	10 mm	left	1:1	0.445	1.327	0.591	
836.50	20525	Mid	LTE Band 5 (Cell)	5	23.0	22.62	0.00	1	08612	QPSK	25	0	10 mm	left	1:1	0.515	1.091	0.562	
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 11-22
LTE Band 66 (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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1720.00	132072	Low	LTE Band 66 (AWS)	20	23.0	22.99	-0.06	0	09123	QPSK	1	99	10 mm	back	1:1	0.477	1.002	0.478	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	22.0	21.95	0.00	1	09123	QPSK	50	50	10 mm	back	1:1	0.406	1.012	0.411	
1720.00	132072	Low	LTE Band 66 (AWS)	20	23.0	22.99	-0.05	0	09123	QPSK	1	99	10 mm	front	1:1	0.661	1.002	0.662	A27
1745.00	132322	Mid	LTE Band 66 (AWS)	20	22.0	21.95	-0.05	1	09123	QPSK	50	50	10 mm	front	1:1	0.504	1.012	0.510	
1720.00	132072	Low	LTE Band 66 (AWS)	20	23.0	22.99	-0.07	0	09123	QPSK	1	99	10 mm	bottom	1:1	0.407	1.002	0.408	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	22.0	21.95	-0.05	1	09123	QPSK	50	50	10 mm	bottom	1:1	0.367	1.012	0.371	
1720.00	132072	Low	LTE Band 66 (AWS)	20	23.0	22.99	0.15	0	09123	QPSK	1	99	10 mm	left	1:1	0.396	1.002	0.397	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	22.0	21.95	-0.06	1	09123	QPSK	50	50	10 mm	left	1:1	0.333	1.012	0.337	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

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Table 11-23
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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	-0.01	0	08620	QPSK	1	99	10 mm	back	1:1	0.554	1.138	0.630	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	-0.01	1	08620	QPSK	50	50	10 mm	back	1:1	0.442	1.132	0.500	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	-0.11	0	08620	QPSK	1	99	10 mm	front	1:1	0.753	1.138	0.857	A29
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	-0.07	1	08620	QPSK	50	50	10 mm	front	1:1	0.594	1.132	0.672	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.45	-0.10	1	08620	QPSK	100	0	10 mm	front	1:1	0.592	1.135	0.672	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	-0.04	0	08620	QPSK	1	99	10 mm	bottom	1:1	0.493	1.138	0.561	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	-0.06	1	08620	QPSK	50	50	10 mm	bottom	1:1	0.374	1.132	0.423	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	23.44	0.01	0	08620	QPSK	1	99	10 mm	left	1:1	0.478	1.138	0.544	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	22.46	-0.04	1	08620	QPSK	50	50	10 mm	left	1:1	0.375	1.132	0.425	
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 11-24
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	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.0	21.64	0.02	0	09123	QPSK	1	50	10 mm	back	1:1	0.591	1.086	0.642	A31
1880.00	18900	Mid	LTE Band 2 (PCS)	20	21.0	20.71	0.01	1	09123	QPSK	50	50	10 mm	back	1:1	0.473	1.069	0.506	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.0	21.64	-0.04	0	09123	QPSK	1	50	10 mm	front	1:1	0.509	1.086	0.553	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	21.0	20.71	0.03	1	09123	QPSK	50	50	10 mm	front	1:1	0.470	1.069	0.502	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.0	21.64	0.03	0	09123	QPSK	1	50	10 mm	bottom	1:1	0.484	1.086	0.526	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	21.0	20.71	0.03	1	09123	QPSK	50	50	10 mm	bottom	1:1	0.436	1.069	0.466	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.0	21.64	-0.04	0	09123	QPSK	1	50	10 mm	left	1:1	0.478	1.086	0.519	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	21.0	20.71	0.02	1	09123	QPSK	50	50	10 mm	left	1:1	0.408	1.069	0.436	
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 11-25
WLAN Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2437	6	802.11b	DSSS	22	17.5	17.12	-0.14	10 mm	10097	1	back	99.1	0.187	-	1.091	1.009	-	
2437	6	802.11b	DSSS	22	17.5	17.12	0.10	10 mm	10097	1	front	99.1	0.236	0.195	1.091	1.009	**0.215**	A33
2437	6	802.11b	DSSS	22	17.5	17.12	-0.01	10 mm	10097	1	top	99.1	0.128	-	1.091	1.009	-	
2437	6	802.11b	DSSS	22	17.5	17.12	0.05	10 mm	10097	1	left	99.1	0.130	-	1.091	1.009	-	
5745	149	802.11a	OFDM	20	13.5	13.41	0.07	10 mm	09917	6	back	98.9	0.777	0.332	1.021	1.011	**0.343**	A35
5745	149	802.11a	OFDM	20	13.5	13.41	0.00	10 mm	09917	6	front	98.9	0.028	-	1.021	1.011	-	
5745	149	802.11a	OFDM	20	13.5	13.41	0.00	10 mm	09917	6	top	98.9	0.065	-	1.021	1.011	-	
5745	149	802.11a	OFDM	20	13.5	13.41	0.01	10 mm	09917	6	left	98.9	0.336	-	1.021	1.011	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram										

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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 1528-2013, and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. 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. For GSM 850/1900, UMTS 850/1750, and LTE Band 12/13/5, device was tested using a separation distance of 10 mm because it yields more conservative results.
7. Per FCC KDB Publication 648474 D04v01r03, 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 Publication 865664 D01v01r04, variability SAR tests were not required since measured SAR results for all frequency bands were less than 0.8 W/kg.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v02r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).

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 D01v03r01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE 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 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ 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 D01v03r01. AMR and HSPA SAR was not required per the 3G Test Reduction Procedure in KDB Publication 941225 D01v03r01.
2. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

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LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r04. 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 D05Av01r02, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

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 D01v02r02 for 2.4 GHz WIFI operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 8.6.5 for more information.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 8.6.6 for more information.
4. 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.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.

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12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a 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 D01v06 4.3.2 b), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	8.50	15	0.098

Note: Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

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12.3 Head SAR Simultaneous Transmission Analysis

(*) For test positions that were not required to be evaluated for WLAN SAR per FCC KDB Publication 248227, the worst case WLAN head SAR result was used for simultaneous transmission analysis.

Table 12-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.384	0.613	0.997
	UMTS 850	0.415	0.613	1.028
	UMTS 1750	0.499	0.613	1.112
	GSM 1900	0.318	0.613	0.931
	UMTS 1900	0.601	0.613	**1.214**
	LTE Band 12	0.473	0.613	1.086
	LTE Band 13	0.520	0.613	1.133
	LTE Band 5 (Cell)	0.552	0.613	1.165
	LTE Band 66 (AWS)	0.435	0.613	1.048

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.310	0.613	0.923
	Right Tilt	0.248	0.378	0.626
	Left Cheek	0.707	0.215	0.922
	Left Tilt	0.191	0.613*	0.804

Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.493	0.613	1.106
	Right Tilt	0.362	0.378	0.740
	Left Cheek	0.700	0.215	0.915
	Left Tilt	0.244	0.613*	0.857

Table 12-3
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.384	0.096	0.480
	UMTS 850	0.415	0.096	0.511
	UMTS 1750	0.499	0.096	0.595
	GSM 1900	0.318	0.096	0.414
	UMTS 1900	0.601	0.096	0.697
	LTE Band 12	0.473	0.096	0.569
	LTE Band 13	0.520	0.096	0.616
	LTE Band 5 (Cell)	0.552	0.096	0.648
	LTE Band 66 (AWS)	0.435	0.096	0.531
	LTE Band 4 (AWS)	0.707	0.096	**0.803**
	LTE Band 2 (PCS)	0.700	0.096	0.796

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12.4 Body-Worn Simultaneous Transmission Analysis

Note: For body-worn SAR summation at 15mm, SAR values at 10mm for some transmission modes were used since the 10mm test distance was more conservative.

Table 12-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.612	0.069	0.681
	UMTS 850	0.625	0.069	0.694
	UMTS 1750	0.597	0.069	0.666
	GSM 1900	0.338	0.069	0.407
	UMTS 1900	0.349	0.069	0.418
	LTE Band 12	0.794	0.069	**0.863**
	LTE Band 13	0.706	0.069	0.775
	LTE Band 5 (Cell)	0.767	0.069	0.836
	LTE Band 66 (AWS)	0.379	0.069	0.448
	LTE Band 4 (AWS)	0.403	0.069	0.472
	LTE Band 2 (PCS)	0.362	0.069	0.431

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.612	0.367	0.979
	UMTS 850	0.625	0.367	0.992
	UMTS 1750	0.597	0.367	0.964
	GSM 1900	0.338	0.367	0.705
	UMTS 1900	0.349	0.367	0.716
	LTE Band 12	0.794	0.367	**1.161**
	LTE Band 13	0.706	0.367	1.073
	LTE Band 5 (Cell)	0.767	0.367	1.134
	LTE Band 66 (AWS)	0.379	0.367	0.746
	LTE Band 4 (AWS)	0.403	0.367	0.770
	LTE Band 2 (PCS)	0.362	0.367	0.729

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Table 12-6
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)
Body-Worn	GSM 850	0.612	0.098	0.710
	UMTS 850	0.625	0.098	0.723
	UMTS 1750	0.597	0.098	0.695
	GSM 1900	0.338	0.098	0.436
	UMTS 1900	0.349	0.098	0.447
	LTE Band 12	0.794	0.098	**0.892**
	LTE Band 13	0.706	0.098	0.804
	LTE Band 5 (Cell)	0.767	0.098	0.865
	LTE Band 66 (AWS)	0.379	0.098	0.477
	LTE Band 4 (AWS)	0.403	0.098	0.501
	LTE Band 2 (PCS)	0.362	0.098	0.460

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

12.5 Hotspot SAR Simultaneous Transmission Analysis

Table 12-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.886	0.215	**1.101**
	UMTS 850	0.625	0.215	0.840
	UMTS 1750	0.782	0.215	0.997
	GPRS 1900	0.427	0.215	0.642
	UMTS 1900	0.665	0.215	0.880
	LTE Band 12	0.794	0.215	1.009
	LTE Band 13	0.706	0.215	0.921
	LTE Band 5 (Cell)	0.767	0.215	0.982
	LTE Band 66 (AWS)	0.662	0.215	0.877
	LTE Band 4 (AWS)	0.857	0.215	1.072
	LTE Band 2 (PCS)	0.642	0.215	0.857

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Table 12-8
Simultaneous Transmission Scenario with 5 GHz WLAN (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.886	0.343	**1.229**
	UMTS 850	0.625	0.343	0.968
	UMTS 1750	0.782	0.343	1.125
	GPRS 1900	0.427	0.343	0.770
	UMTS 1900	0.665	0.343	1.008
	LTE Band 12	0.794	0.343	1.137
	LTE Band 13	0.706	0.343	1.049
	LTE Band 5 (Cell)	0.767	0.343	1.110
	LTE Band 66 (AWS)	0.662	0.343	1.005
	LTE Band 4 (AWS)	0.857	0.343	1.200
	LTE Band 2 (PCS)	0.642	0.343	0.985

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 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

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13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, variability SAR tests were not required since measured SAR results for all frequency bands were less than 0.8 W/kg.

13.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

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14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/22/2017	Annual	3/22/2018	MY45470194
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
SPEAG	D750V3	750 MHz SAR Dipole	7/13/2016	Annual	7/13/2017	1161
SPEAG	D750V3	750 MHz Dipole	3/7/2017	Annual	3/7/2018	1054
SPEAG	D835V2	835 MHz SAR Dipole	7/14/2016	Annual	7/14/2017	4d133
SPEAG	D1765V2	1765 MHz SAR Dipole	5/11/2016	Annual	5/11/2017	1008
SPEAG	D1750V2	1750 MHz SAR Dipole	5/9/2016	Annual	5/9/2017	1148
SPEAG	D1750V2	1750 MHz SAR Dipole	4/12/2017	Annual	4/12/2018	1051
SPEAG	D1900V2	1900 MHz SAR Dipole	7/15/2016	Annual	7/15/2017	5d149
SPEAG	D1900V2	1900 MHz SAR Dipole	7/8/2016	Annual	7/8/2017	5d080
SPEAG	D2450V2	2450 MHz SAR Dipole	9/13/2016	Annual	9/13/2017	797
SPEAG	D5GHzV2	5 GHz SAR Dipole	2/13/2017	Annual	2/13/2018	1120
SPEAG	D5GHzV2	5 GHz SAR Dipole	8/2/2016	Annual	8/2/2017	1237
SPEAG	ES3DV3	SAR Probe	3/14/2017	Annual	3/14/2018	3319
SPEAG	ES3DV3	SAR Probe	11/15/2016	Annual	11/15/2017	3334
SPEAG	ES3DV3	SAR Probe	2/10/2017	Annual	2/10/2018	3213
SPEAG	ES3DV3	SAR Probe	9/19/2016	Annual	9/19/2017	3287
SPEAG	EX3DV4	SAR Probe	7/21/2016	Annual	7/21/2017	7308
SPEAG	ES3DV3	SAR Probe	2/10/2017	Annual	2/10/2018	3318
SPEAG	EX3DV4	SAR Probe	5/17/2016	Annual	5/17/2017	7409
SPEAG	EX3DV4	SAR Probe	1/13/2017	Annual	1/13/2018	3589
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/8/2017	Annual	3/8/2018	1368
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/11/2016	Annual	11/11/2017	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/9/2017	Annual	2/9/2018	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/14/2016	Annual	9/14/2017	1408
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/11/2016	Annual	5/11/2017	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/9/2017	Annual	2/9/2018	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/16/2017	Annual	1/16/2018	1466
Agilent	E5515C	8960 Series 10 Wireless Communications Test Set	10/5/2016	Annual	10/5/2017	GB42230325
Rohde & Schwarz	CMU200	Base Station Simulator	4/11/2017	Annual	4/11/2018	836371/0079
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/10/2016	Annual	5/10/2017	1070
Mitutoyo	CD-6"CSX	Digital Caliper	3/2/2016	Biennial	3/2/2018	13264165
Agilent	E4438C	ESG Vector Signal Generator	3/24/2017	Biennial	3/24/2019	MY42082385
Agilent	E4438C	ESG Vector Signal Generator	3/23/2017	Annual	3/23/2018	MY47270002
Agilent	N5182A	MXG Vector Signal Generator	2/28/2017	Annual	2/28/2018	MY47420800
Agilent	N5182A	MXG Vector Signal Generator	10/27/2016	Annual	10/27/2017	MY47420603
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	941001
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	1039008
Anritsu	MA2411B	Pulse Power Sensor	8/18/2016	Annual	8/18/2017	1207470
Anritsu	MA2411B	Pulse Power Sensor	2/10/2017	Annual	2/10/2018	1339018
Anritsu	MT8820C	Radio Communication Analyzer	9/15/2016	Annual	9/15/2017	6200901190
Anritsu	MT8820C	Radio Communication Analyzer	12/8/2016	Annual	12/8/2017	6201300731
Rohde & Schwarz	CMW500	Radio Communication Tester	6/3/2016	Annual	6/3/2017	108843
Rohde & Schwarz	CMW500	Radio Communication tester	5/27/2016	Annual	5/27/2017	140144
Agilent	8753ES	S-Parameter Network Analyzer	10/26/2016	Annual	10/26/2017	US39170118
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/2/2016	Biennial	3/2/2018	N/A
Control Company	4352	Ultra Long Stem Thermometer	3/8/2016	Biennial	3/8/2018	160261701
Control Company	4352	Ultra Long Stem Thermometer	3/8/2016	Biennial	3/8/2018	160261729
Anritsu	MA24106A	USB Power Sensor	3/20/2017	Annual	3/20/2018	1344554
Anritsu	MA24106A	USB Power Sensor	3/20/2017	Annual	3/20/2018	1344557
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	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

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 was used solely within its respective calibration period.

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15 MEASUREMENT UNCERTAINTIES

a	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	Tol. (± %)	Prob. Dist.	Div.	c_i 1gm	c_i 10 gms	1gm u_i (± %)	10gms u_i (± %)	v_i
Measurement System								
Probe Calibration	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	2.0	R	1.73	1.0	1.0	1.2	1.2	∞
Linearity	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	0.25	R	1.73	1.0	1.0	0.1	0.1	∞
Readout Electronics	0.3	N	1	1.0	1.0	0.3	0.3	∞
Response Time	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions - Noise	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
RF Ambient Conditions - Reflections	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	6.7	R	1.73	1.0	1.0	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	2.7	N	1	1.0	1.0	2.7	2.7	35
Device Holder Uncertainty	1.67	N	1	1.0	1.0	1.7	1.7	5
Output Power Variation - SAR drift measurement	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
SAR Scaling	0.0	R	1.73	1.0	1.0	0.0	0.0	∞
Phantom & Tissue Parameters								
Phantom Uncertainty (Shape & Thickness tolerances)	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	4.2	N	1	0.78	0.71	3.3	3.0	10
Liquid Permittivity - measurement uncertainty	4.1	N	1	0.23	0.26	1.0	1.1	10
Liquid Conductivity - Temperature Uncertainty	3.4	R	1.73	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	0.6	R	1.73	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)		RSS				11.5	11.3	60
Expanded Uncertainty (95% CONFIDENCE LEVEL)		k=2				23.0	22.6	

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16 CONCLUSION

16.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Innovation, Science, and Economic Development Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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APPENDIX A: SAR TEST DATA

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PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08968

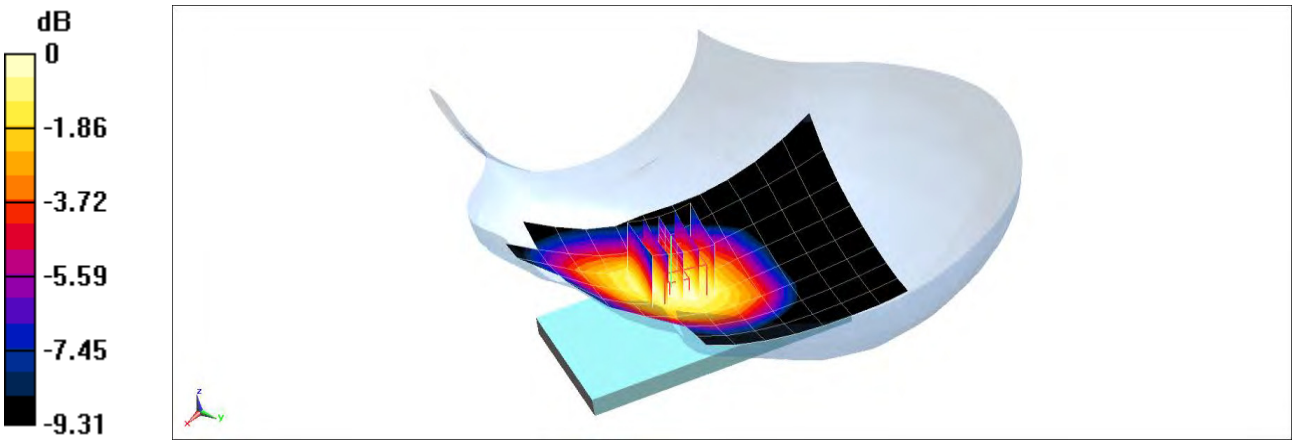
Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.91 S/m; ε_r = 41.967; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-18-2017; Ambient Temp: 20.5°C; Tissue Temp: 20.3°C

Probe: ES3DV3 - SN3334; ConvF(6.49, 6.49, 6.49); Calibrated: 11/15/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 11/11/2016
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.87 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.461 W/kg
SAR(1 g) = 0.367 W/kg



0 dB = 0.402 W/kg = -3.96 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

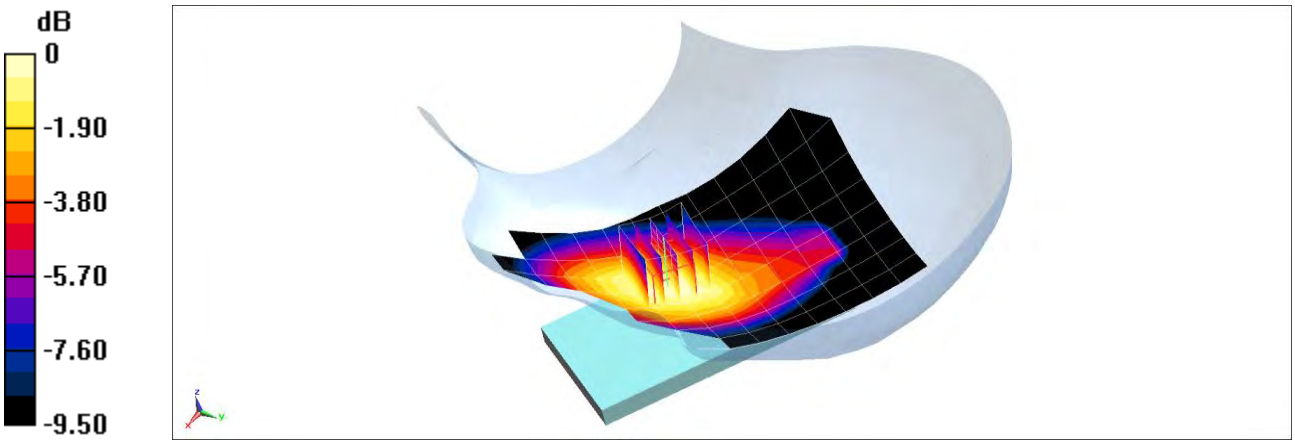
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.893 S/m; ε_r = 40.125; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-25-2017; Ambient Temp: 23.2°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3213; ConvF(6.49, 6.49, 6.49); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/9/2017
Phantom: SAM Right; Type: SAM; Serial: 1757
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: UMTS 850, Left 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 = 21.55 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.494 W/kg
SAR(1 g) = 0.385 W/kg



0 dB = 0.422 W/kg = -3.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

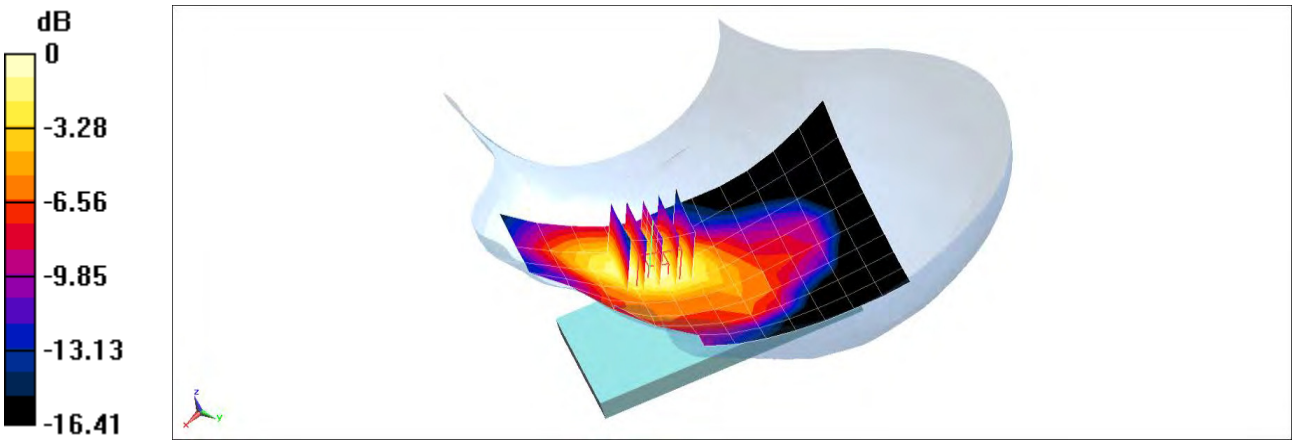
Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1
Medium: 1750 Head Medium parameters used (interpolated):
f = 1732.4 MHz; σ = 1.366 S/m; ε_r = 40.028; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-26-2017; Ambient Temp: 22.7°C; Tissue Temp: 21.2°C

Probe: ES3DV3 - SN3213; ConvF(5.49, 5.49, 5.49); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/9/2017
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: UMTS 1750, Left 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 = 19.66 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.722 W/kg
SAR(1 g) = 0.479 W/kg



0 dB = 0.558 W/kg = -2.53 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08968

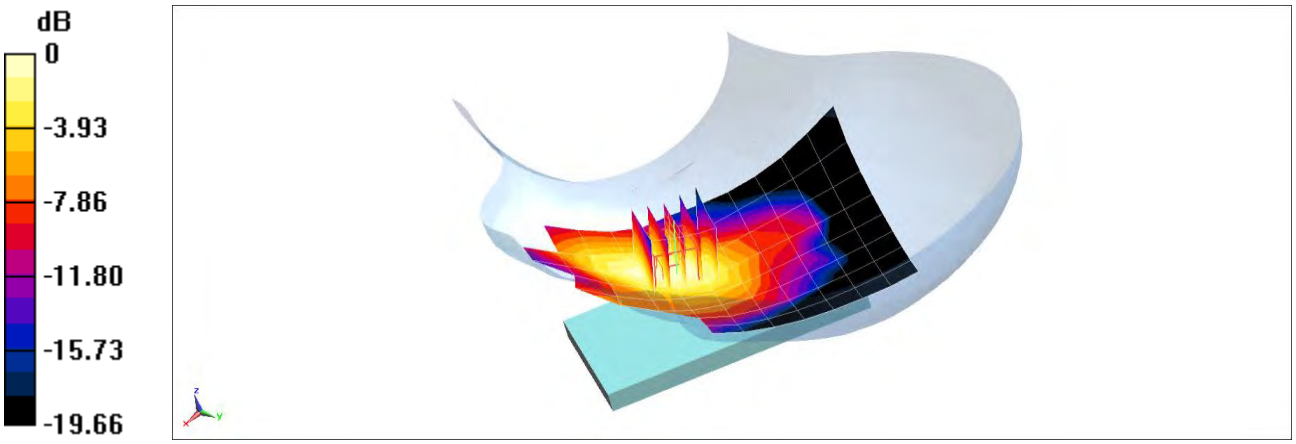
Communication System: UID 0, GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.436 S/m; ε_r = 38.348; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-19-2017; Ambient Temp: 23.0°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3319; ConvF(5.2, 5.2, 5.2); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: GSM 1900, Left 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 = 15.36 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.470 W/kg
SAR(1 g) = 0.304 W/kg



0 dB = 0.353 W/kg = -4.52 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08968

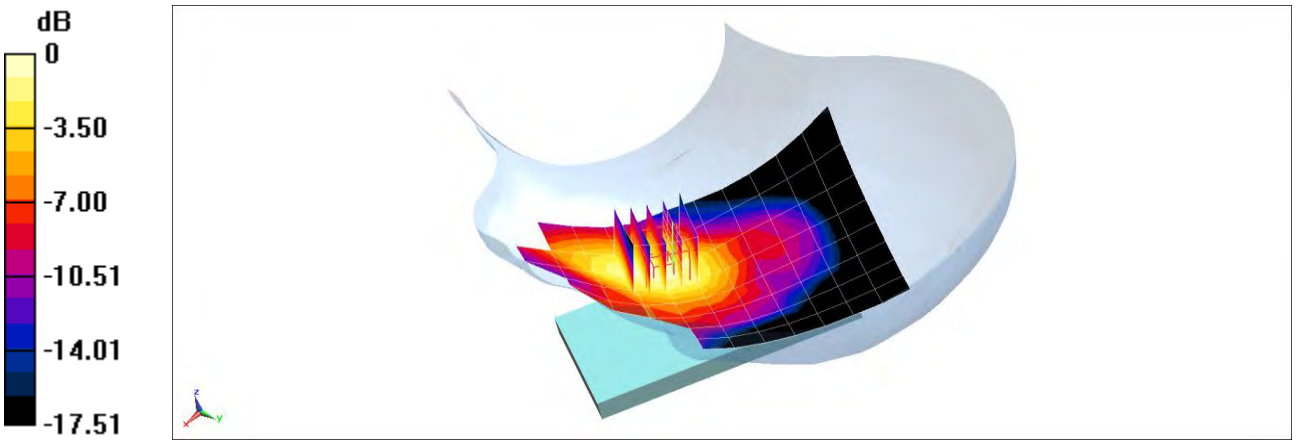
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.419 S/m; ε_r = 40.366; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-24-2017; Ambient Temp: 21.3°C; Tissue Temp: 23.3°C

Probe: ES3DV3 - SN3334; ConvF(5.27, 5.27, 5.27); Calibrated: 11/15/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 11/11/2016
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.98 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.884 W/kg
SAR(1 g) = 0.571 W/kg



0 dB = 0.654 W/kg = -1.84 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08620

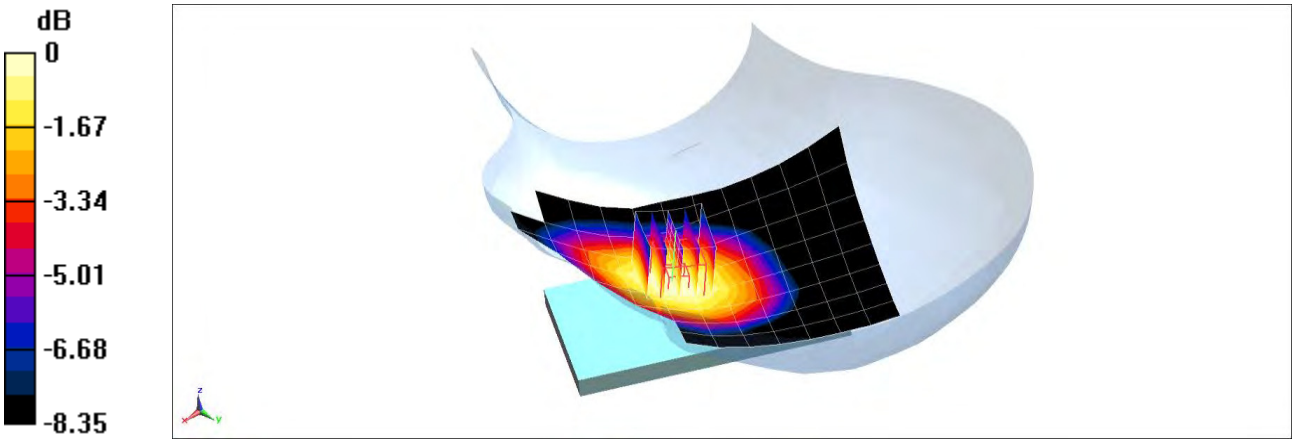
Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: 750 Head Medium parameters used (interpolated):
f = 707.5 MHz; σ = 0.866 S/m; ε_r = 43.366; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-17-2017; Ambient Temp: 22.9°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3319; ConvF(6.76, 6.76, 6.76); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 12, Left Head, Cheek, Mid.ch
QPSK, 10 MHz Bandwidth, 1 RB, 49 RB Offset

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.56 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.546 W/kg
SAR(1 g) = 0.443 W/kg



0 dB = 0.484 W/kg = -3.15 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08620

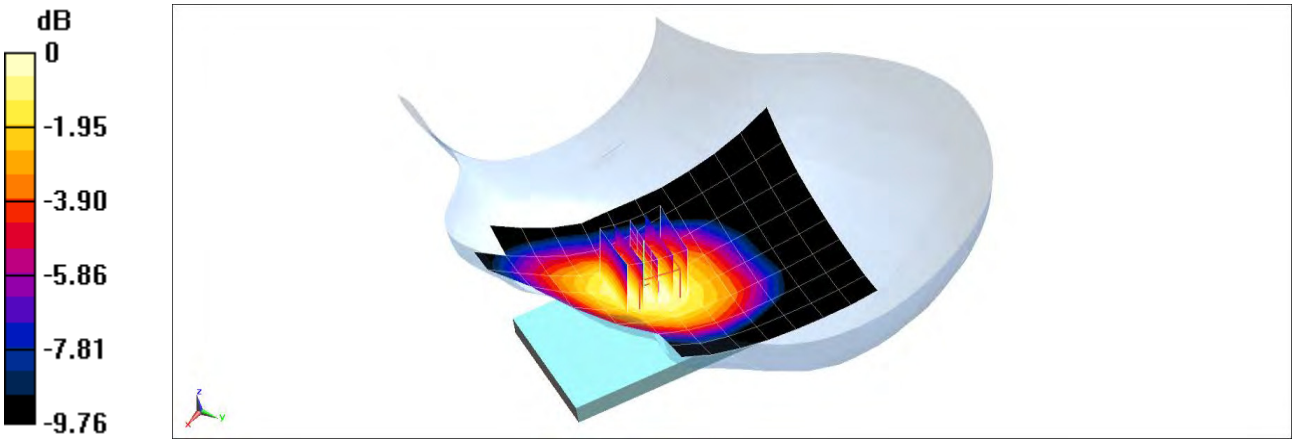
Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1
Medium: 750 Head Medium parameters used (interpolated):
f = 782 MHz; σ = 0.932 S/m; ε_r = 42.295; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-17-2017; Ambient Temp: 22.9°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3319; ConvF(6.76, 6.76, 6.76); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 13, Left Head, Cheek, Mid.ch
QPSK, 10 MHz Bandwidth, 1 RB, 0 RB Offset

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.26 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.586 W/kg
SAR(1 g) = 0.457 W/kg



0 dB = 0.507 W/kg = -2.95 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08612

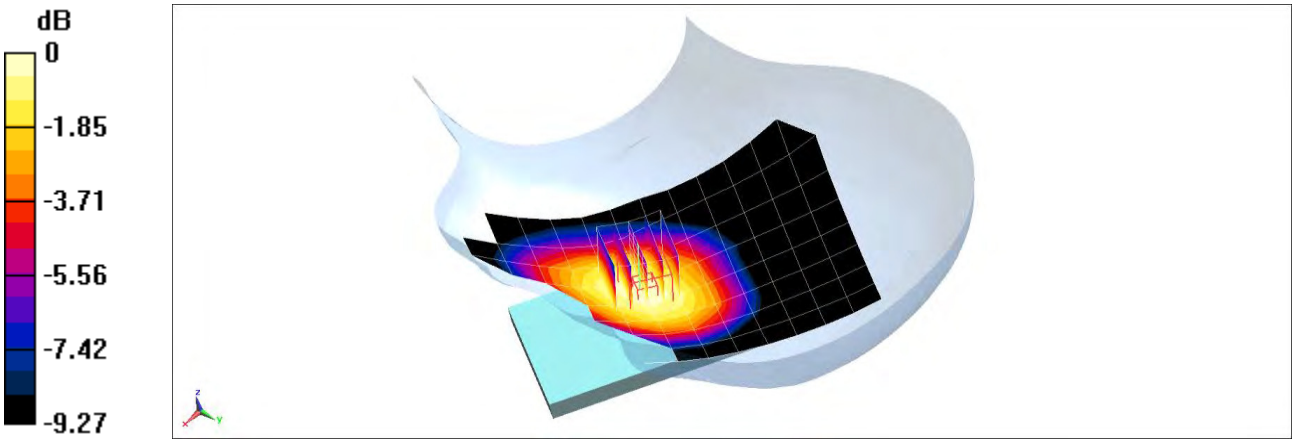
Communication System: UID 0, LTE Band 5 (Cell.); Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.91 S/m; ε_r = 41.968; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-18-2017; Ambient Temp: 20.5°C; Tissue Temp: 20.3°C

Probe: ES3DV3 - SN3334; ConvF(6.49, 6.49, 6.49); Calibrated: 11/15/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 11/11/2016
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 5 (Cell.), Left Head, Cheek, Mid.ch
10 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 = 25.78 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.646 W/kg
SAR(1 g) = 0.514 W/kg



0 dB = 0.563 W/kg = -2.49 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08620

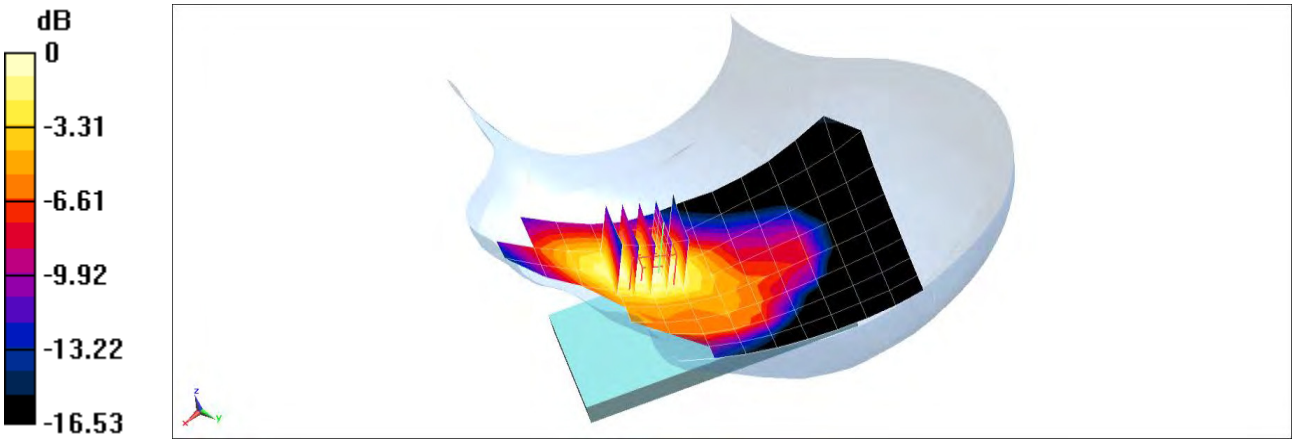
Communication System: UID 0, LTE Band 66 (AWS); Frequency: 1720 MHz; Duty Cycle: 1:1
Medium: 1750 Head Medium parameters used (interpolated):
f = 1720 MHz; σ = 1.345 S/m; ε_r = 39.532; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-18-2017; Ambient Temp: 23.4°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3319; ConvF(5.38, 5.38, 5.38); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 66 (AWS), Left Head, Cheek, Low.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 = 19.69 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.629 W/kg
SAR(1 g) = 0.421 W/kg



0 dB = 0.487 W/kg = -3.12 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09024

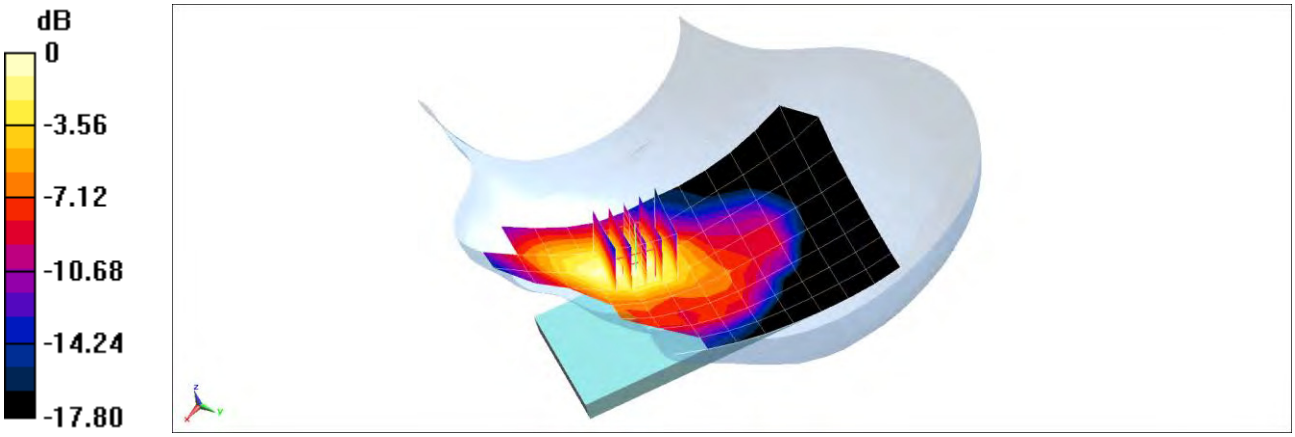
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Head Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.387 S/m; ε_r = 39.718; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 05-08-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3319; ConvF(5.38, 5.38, 5.38); Calibrated: 3/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 3/8/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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 = 23.55 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.954 W/kg
SAR(1 g) = 0.621 W/kg



0 dB = 0.730 W/kg = -1.37 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08992

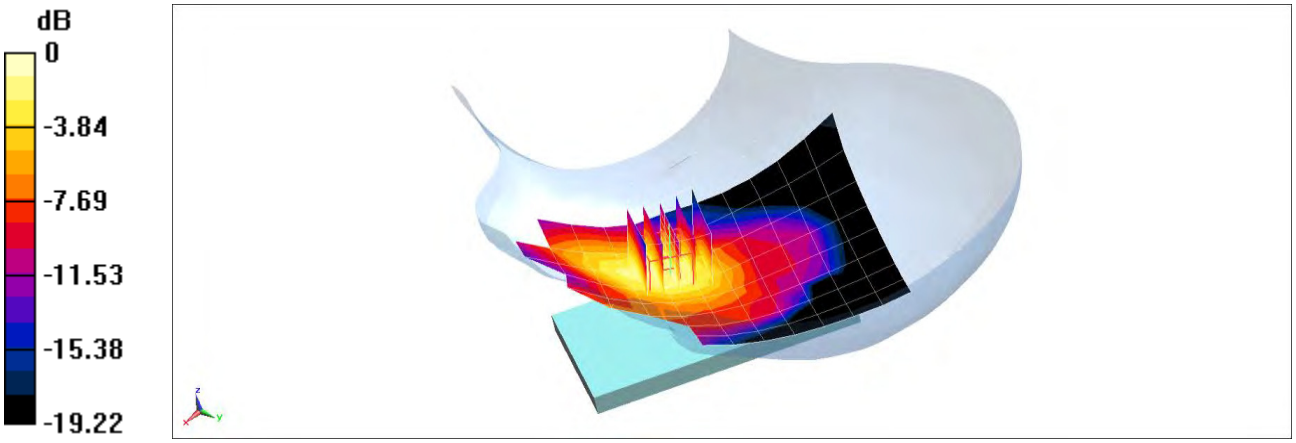
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.457 S/m; ε_r = 38.261; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 04-19-2017; Ambient Temp: 23.0°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3319; ConvF(5.2, 5.2, 5.2); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 2 (PCS), Left Head, Cheek, High.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 = 23.32 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 0.984 W/kg
SAR(1 g) = 0.627 W/kg



0 dB = 0.744 W/kg = -1.28 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 10097

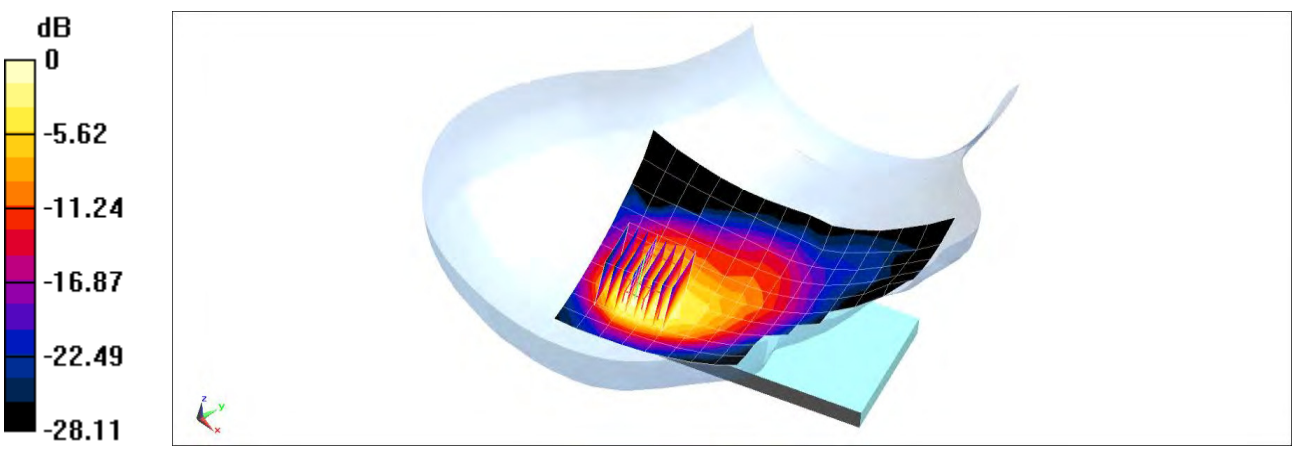
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.811 S/m; ε_r = 38.706; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 04-24-2017; Ambient Temp: 20.0°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3287; ConvF(4.54, 4.54, 4.54); Calibrated: 9/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 9/14/2016
Phantom: SAM Left; Type: QD000P40CA; Serial: TP:82355
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: IEEE 802.11b, 22 MHz Bandwidth, Right Head, Cheek, Ch 6, 1 Mbps

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.46 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 1.32 W/kg
SAR(1 g) = 0.544 W/kg



0 dB = 0.735 W/kg = -1.34 dBW/kg

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DUT: A3LSMG390W; Type: Portable Handset; Serial: 09917

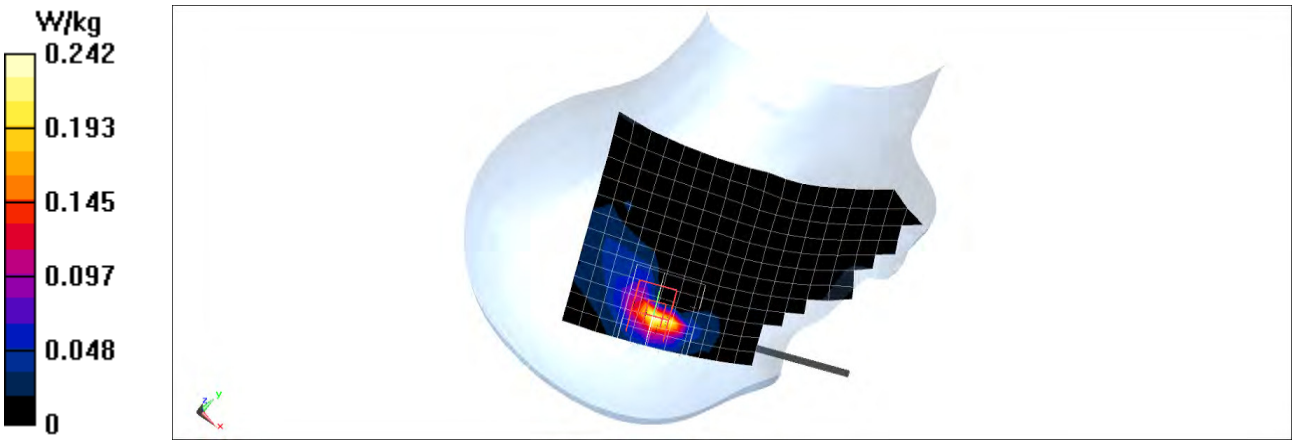
Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5620 MHz; Duty Cycle: 1:1
Medium: 5GHz Head Medium parameters used:
f = 5620 MHz; σ = 5.134 S/m; ε_r = 34.225; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 04-24-2017; Ambient Temp: 20.5°C; Tissue Temp: 20.0°C

Probe: EX3DV4 - SN7308; ConvF(4.63, 4.63, 4.63); Calibrated: 7/21/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: IEEE 802.11a, U-NII-2C, 20 MHz Bandwidth, Right Head, Cheek, Ch 124, 6 Mbps

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (10x11x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 1.361 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 0.384 W/kg
SAR(1 g) = 0.089 W/kg



DUT: A3LSMG390W; Type: Portable Handset; Serial: 08968

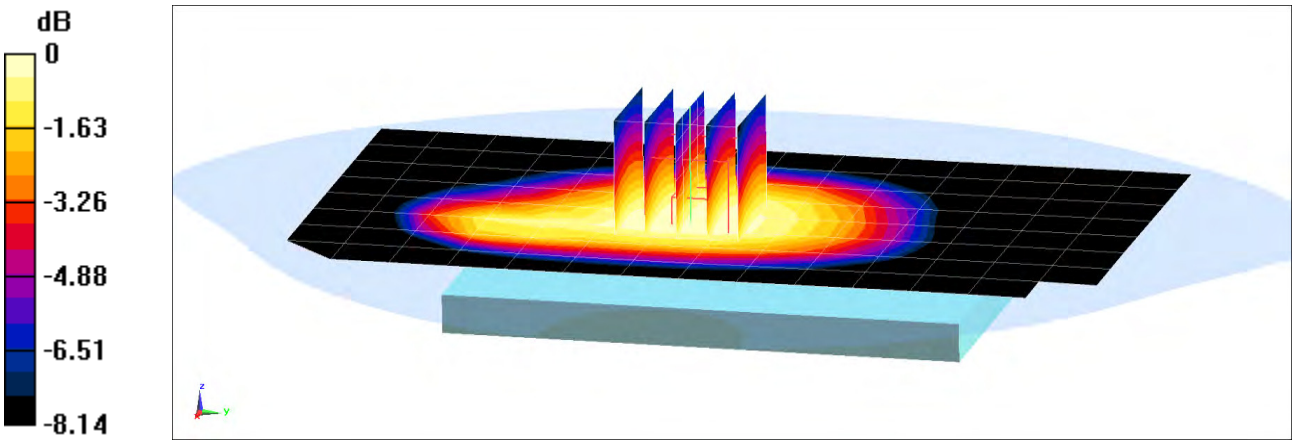
Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.984 S/m; ε_r = 54.796; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-17-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3318; ConvF(6.37, 6.37, 6.37); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: GSM 850, Body SAR, Back side, 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 = 25.35 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.739 W/kg
SAR(1 g) = 0.585 W/kg



0 dB = 0.643 W/kg = -1.92 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08968

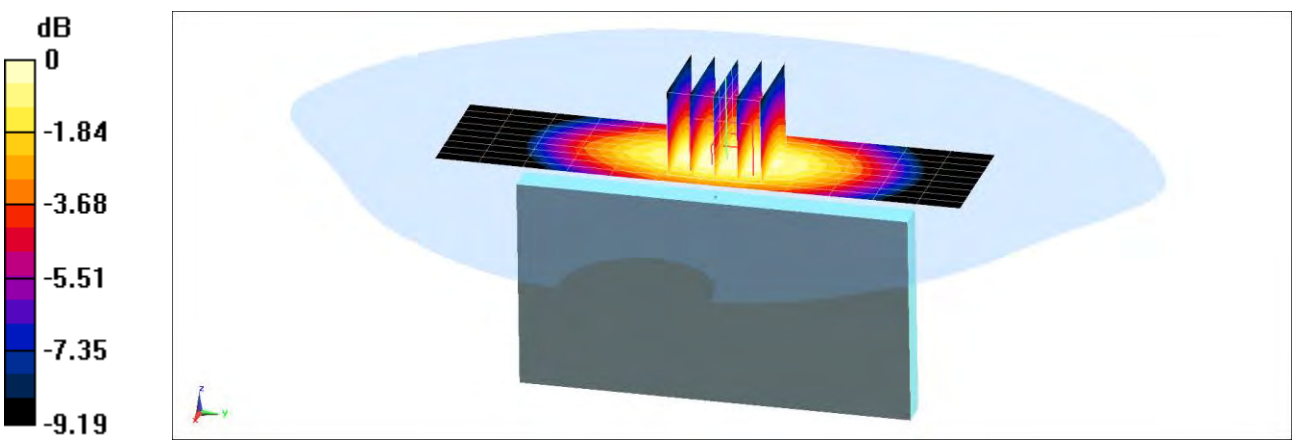
Communication System: UID 0, GSM GPRS; 4 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:2.076
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.984 S/m; ε_r = 54.796; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-17-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3318; ConvF(6.37, 6.37, 6.37); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (10x13x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.85 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.819 W/kg
SAR(1 g) = 0.599 W/kg



0 dB = 0.678 W/kg = -1.69 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08620

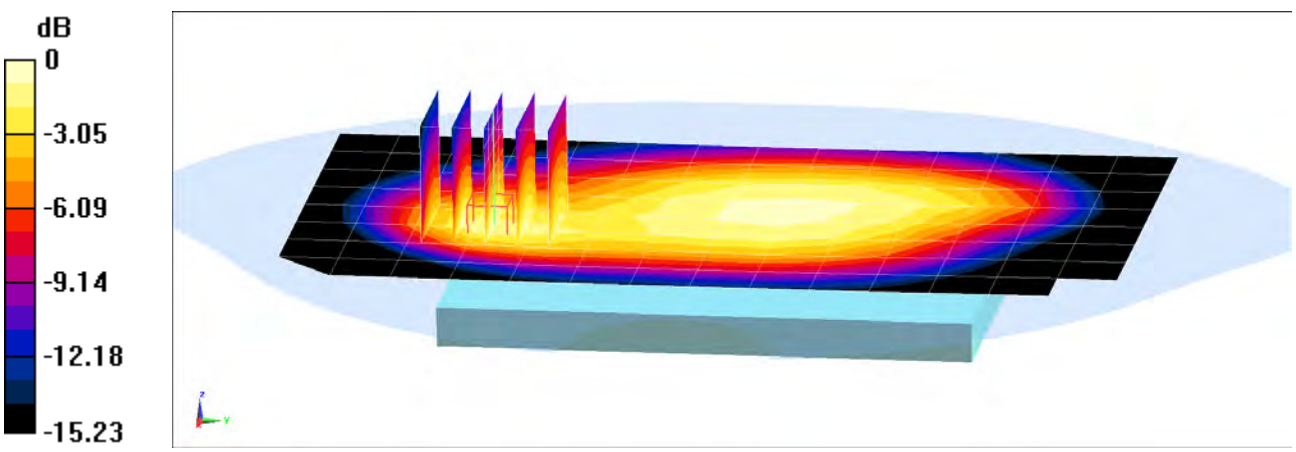
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.993 S/m; ε_r = 53.887; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 22.1°C; Tissue Temp: 19.9°C

Probe: ES3DV3 - SN3213; ConvF(6.28, 6.28, 6.28); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/9/2017
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: UMTS 850, Body SAR, Back side, 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 = 25.29 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.983 W/kg
SAR(1 g) = 0.579 W/kg



0 dB = 0.686 W/kg = -1.64 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

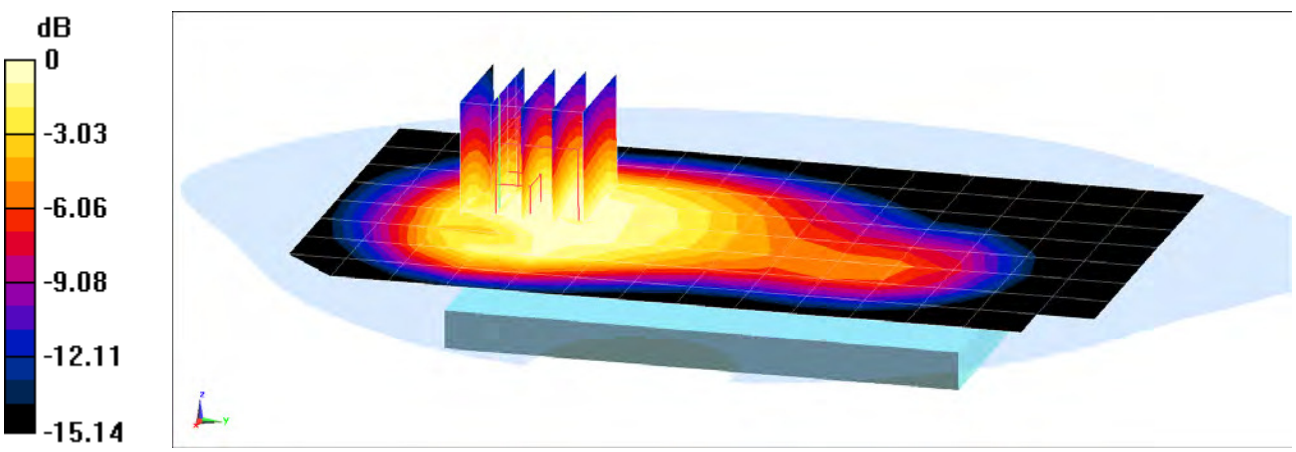
Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1732.4 MHz; σ = 1.482 S/m; ε_r = 51.413; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.7°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3319; ConvF(5.07, 5.07, 5.07); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: UMTS 1750, Body SAR, Back side, 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 = 20.74 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.894 W/kg
SAR(1 g) = 0.573 W/kg



0 dB = 0.682 W/kg = -1.66 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

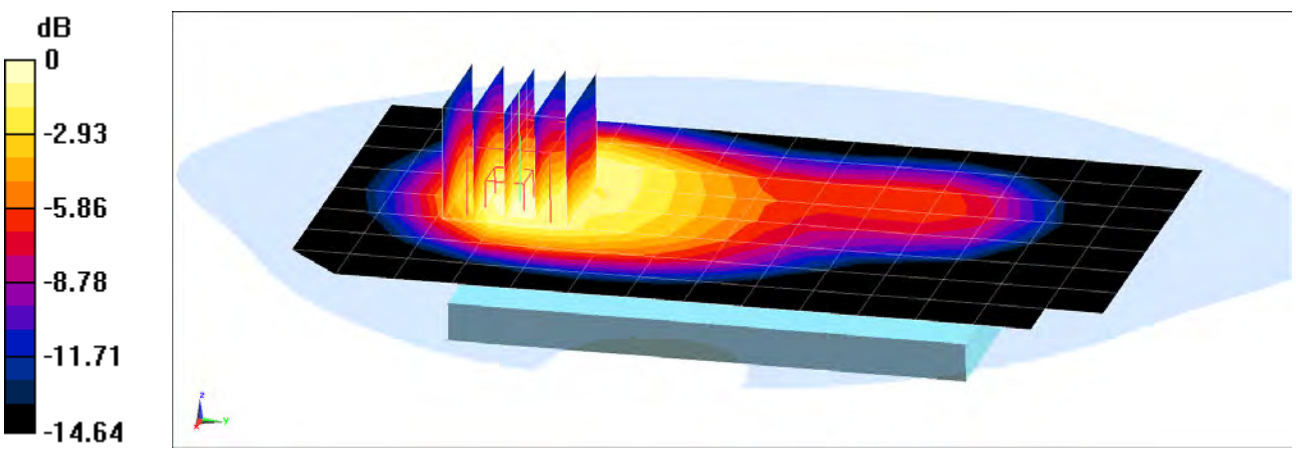
Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1732.4 MHz; σ = 1.482 S/m; ε_r = 51.413; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.7°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3319; ConvF(5.07, 5.07, 5.07); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: UMTS 1750, Body SAR, Front side, 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 = 23.68 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.16 W/kg
SAR(1 g) = 0.750 W/kg



0 dB = 0.877 W/kg = -0.57 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

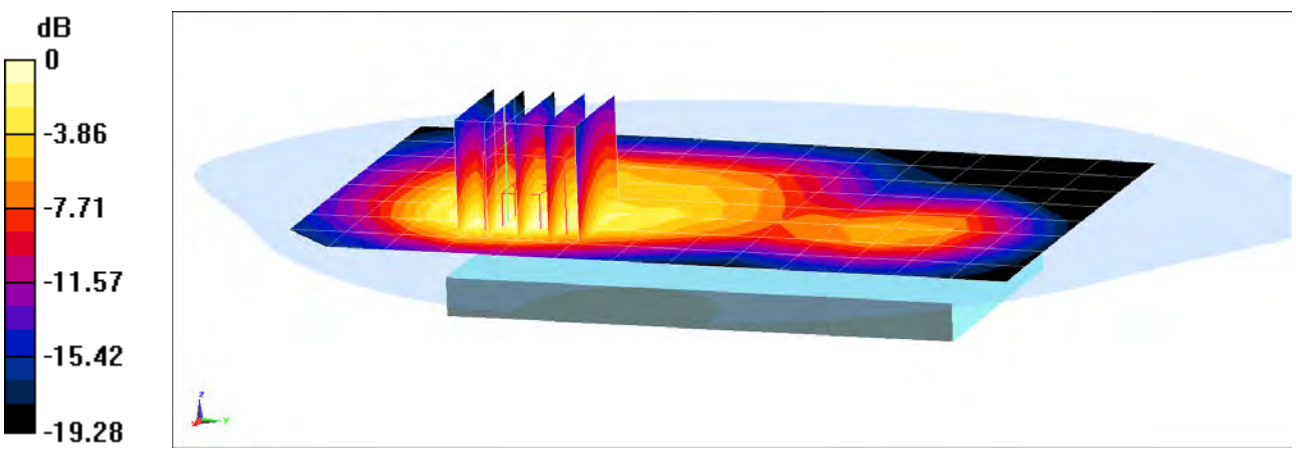
Communication System: UID 0, GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.547 S/m; ε_r = 51.158; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-17-2017; Ambient Temp: 22.7°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.05 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.599 W/kg
SAR(1 g) = 0.323 W/kg



0 dB = 0.476 W/kg = -3.22 dBW/kg

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DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

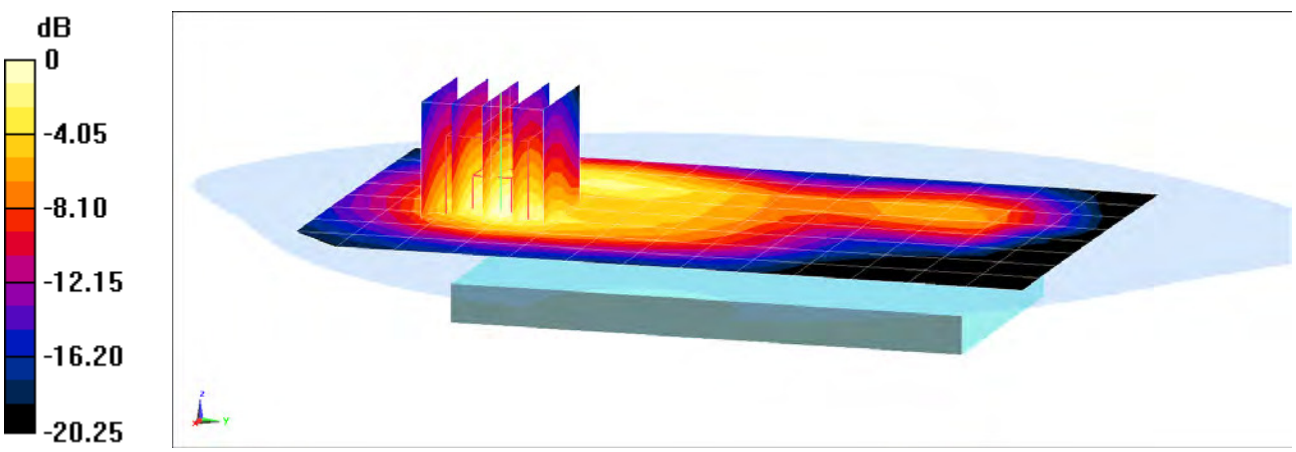
Communication System: UID 0, GSM GPRS; 4 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:2.076
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.547 S/m; ε_r = 51.158; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-17-2017; Ambient Temp: 22.7°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: GPRS 1900, Body SAR, Front side, Mid.ch, 4 Tx Slots

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.65 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.595 W/kg
SAR(1 g) = 0.340 W/kg



0 dB = 0.492 W/kg = -3.08 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

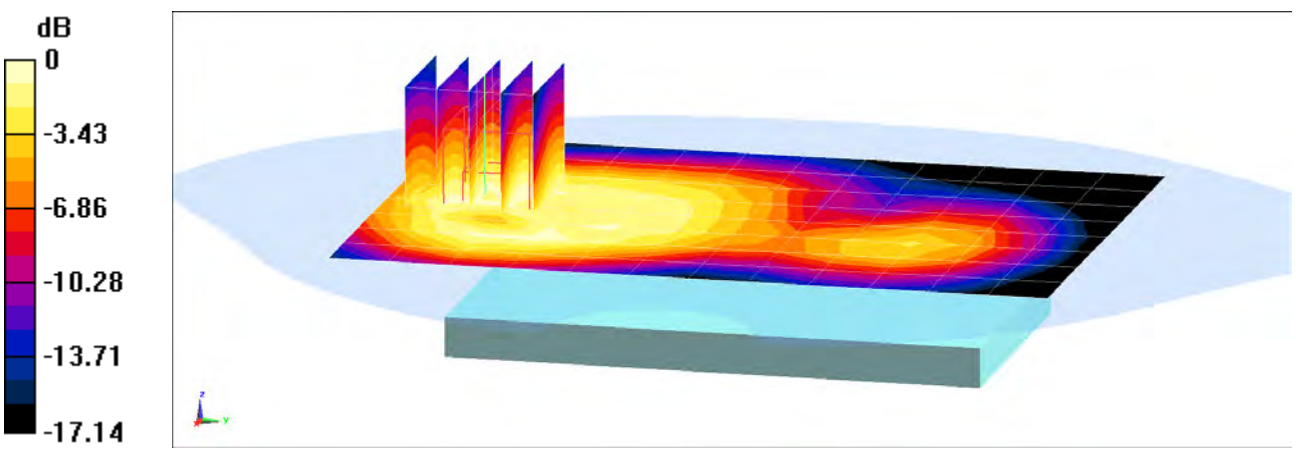
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.549 S/m; ε_r = 52.076; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space:1.5 cm

Test Date: 04-26-2017; Ambient Temp: 22.1°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3318; ConvF(4.96, 4.96, 4.96); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.58 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.534 W/kg
SAR(1 g) = 0.332 W/kg



0 dB = 0.397 W/kg = -4.01 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

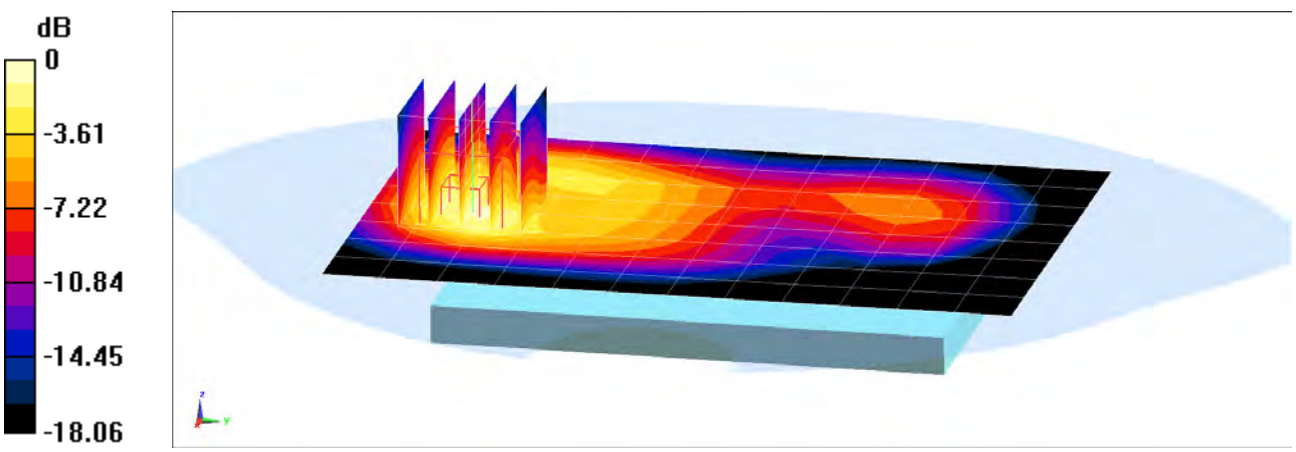
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.549 S/m; ε_r = 52.076; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-26-2017; Ambient Temp: 22.1°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3318; ConvF(4.96, 4.96, 4.96); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.81 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.03 W/kg
SAR(1 g) = 0.638 W/kg



0 dB = 0.770 W/kg = -1.14 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

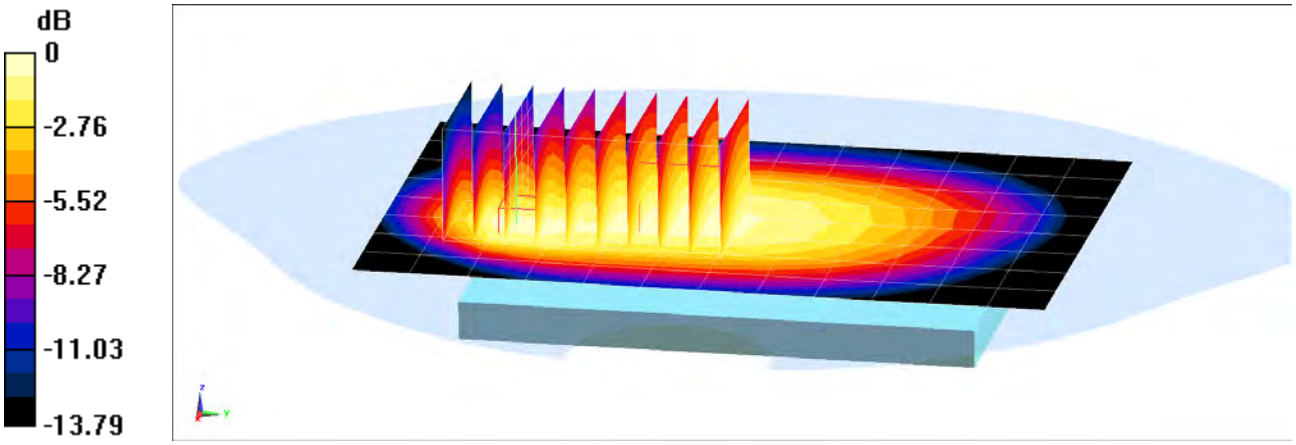
Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: 750 Body Medium parameters used (interpolated):
f = 707.5 MHz; σ = 0.921 S/m; ε_r = 54.839; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-20-2017; Ambient Temp: 19.9°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3334; ConvF(6.33, 6.33, 6.33); Calibrated: 11/15/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 11/11/2016
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 12, Body SAR, Back side, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x10x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.57 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.20 W/kg
SAR(1 g) = 0.744 W/kg



0 dB = 0.861 W/kg = -0.65 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

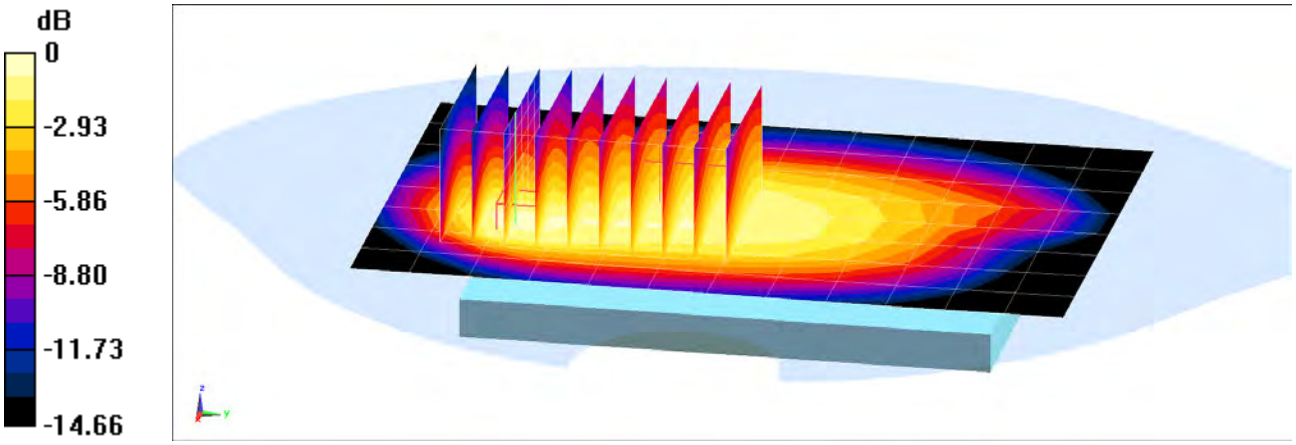
Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1
Medium: 750 Body Medium parameters used (interpolated):
f = 782 MHz; σ = 0.988 S/m; ε_r = 53.999; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-20-2017; Ambient Temp: 19.9°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3334; ConvF(6.33, 6.33, 6.33); Calibrated: 11/15/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 11/11/2016
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 13, Body SAR, Back side, Mid.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x10x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.35 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.983 W/kg
SAR(1 g) = 0.620 W/kg



0 dB = 0.739 W/kg = -1.31 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08612

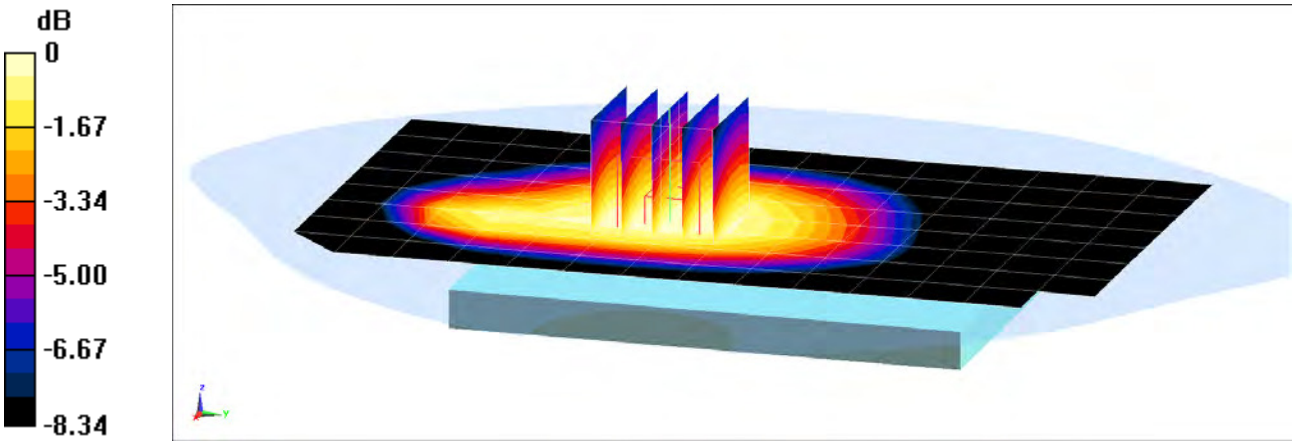
Communication System: UID 0, LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.984 S/m; ε_r = 54.797; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-17-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3318; ConvF(6.37, 6.37, 6.37); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.90 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.894 W/kg
SAR(1 g) = 0.714 W/kg



0 dB = 0.782 W/kg = -1.07 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09156

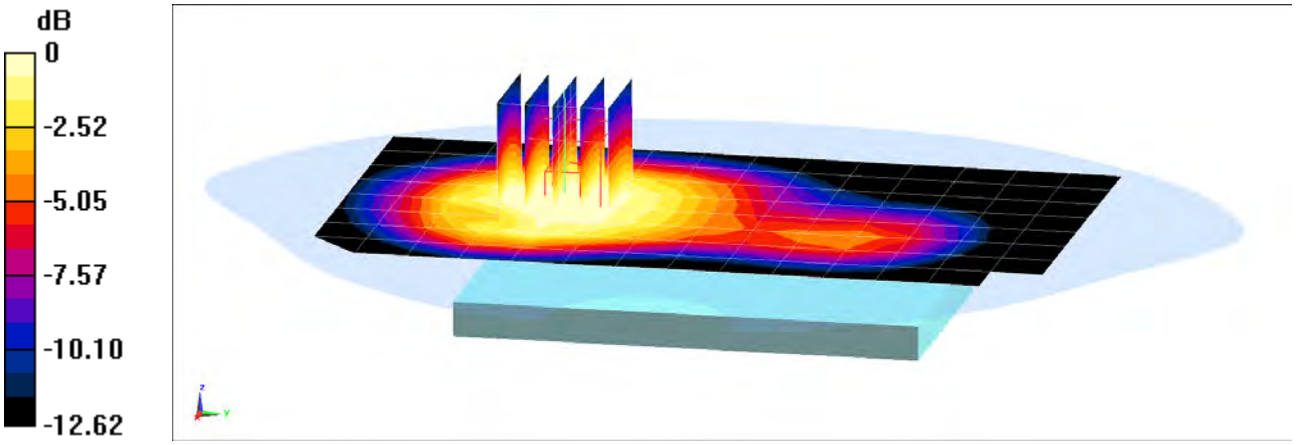
Communication System: UID 0, LTE Band 66 (AWS); Frequency: 1720 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1720 MHz; σ = 1.469 S/m; ε_r = 51.456; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-24-2017; Ambient Temp: 21.7°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3319; ConvF(5.07, 5.07, 5.07); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 66 (AWS), Body SAR, Back side, Low.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 = 16.74 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.545 W/kg
SAR(1 g) = 0.367 W/kg



0 dB = 0.424 W/kg = -3.73 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

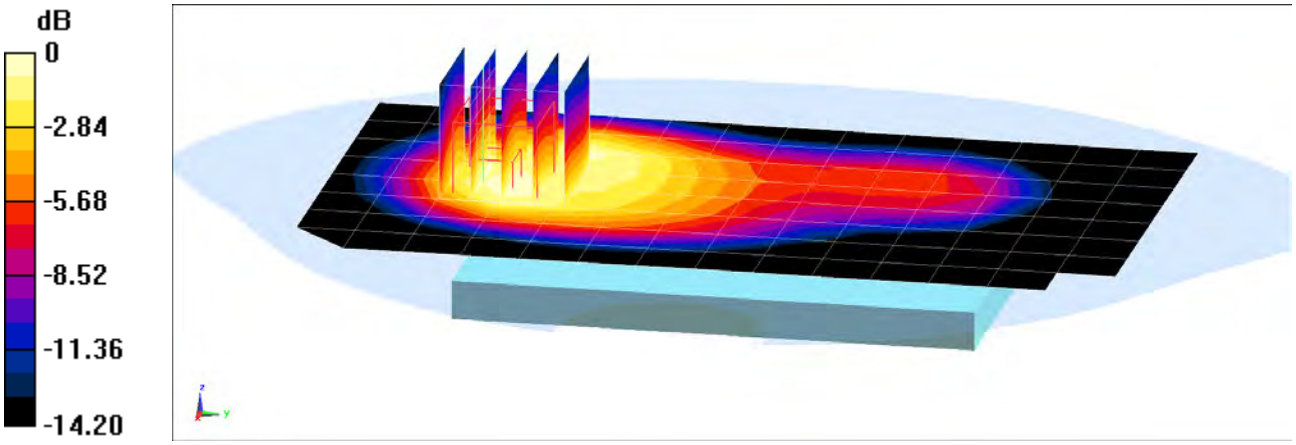
Communication System: UID 0, LTE Band 66 (AWS); Frequency: 1720 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1720 MHz; σ = 1.469 S/m; ε_r = 51.456; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.7°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3319; ConvF(5.07, 5.07, 5.07); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 66 (AWS), Body SAR, Front side, Low.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 = 22.08 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.02 W/kg
SAR(1 g) = 0.661 W/kg



0 dB = 0.749 W/kg = -1.26 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09156

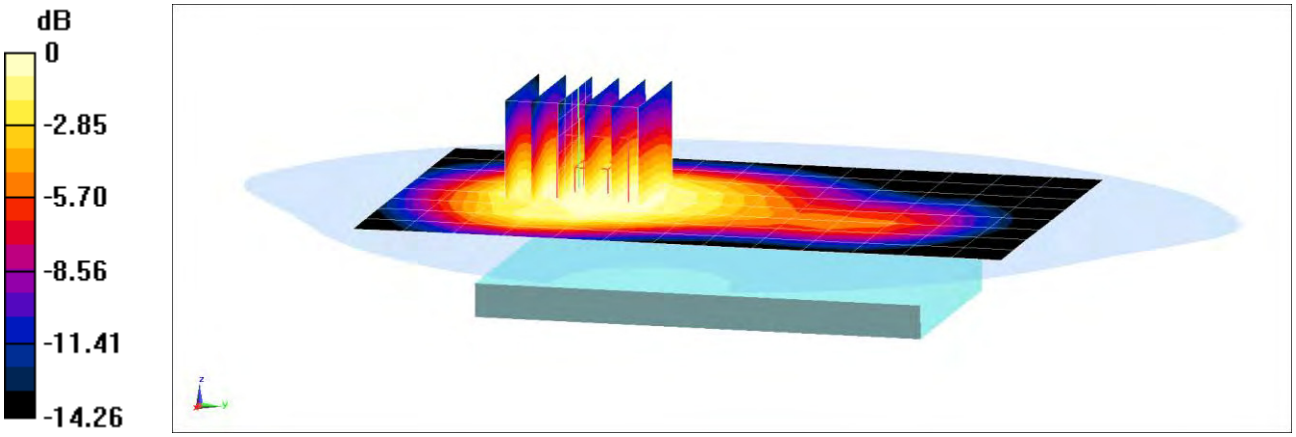
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.503 S/m; ε_r = 51.322; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 05-08-2017; Ambient Temp: 22.3°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3287; ConvF(5.11, 5.11, 5.11); Calibrated: 9/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 9/14/2016
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.05 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.539 W/kg
SAR(1 g) = 0.354 W/kg



0 dB = 0.413 W/kg = -3.84 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08620

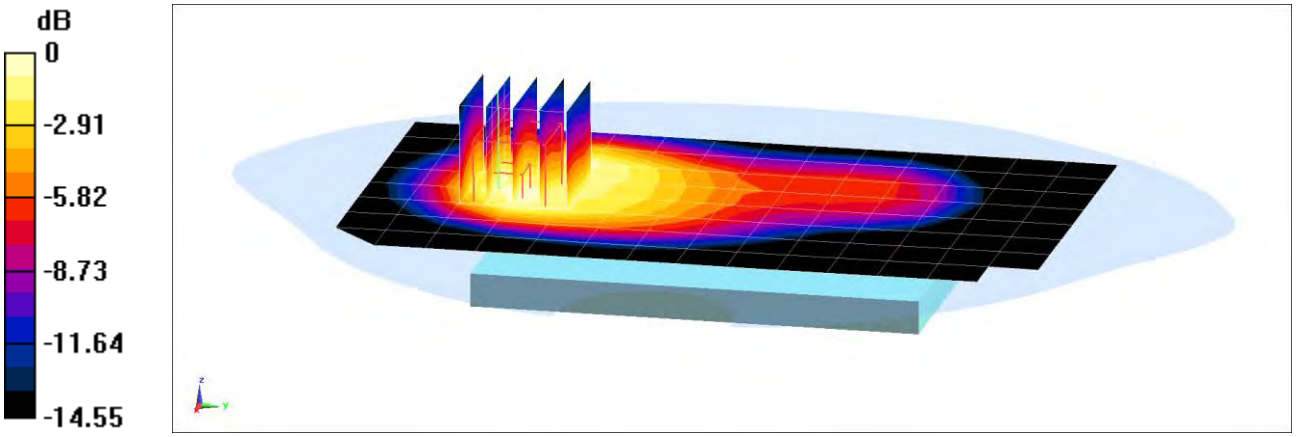
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.503 S/m; ε_r = 51.322; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-08-2017; Ambient Temp: 22.3°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3287; ConvF(5.11, 5.11, 5.11); Calibrated: 9/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 9/14/2016
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: LTE Band 4 (AWS), Body SAR, Front side, 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 = 23.08 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 1.18 W/kg
SAR(1 g) = 0.753 W/kg



0 dB = 0.877 W/kg = -0.57 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 08612

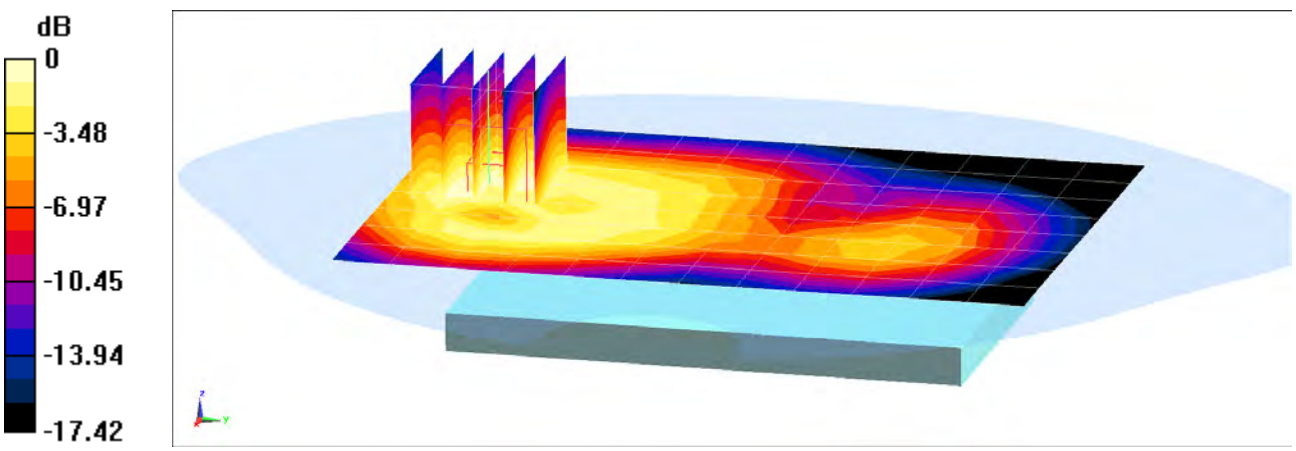
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.563 S/m; ε_r = 52.523; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-24-2017; Ambient Temp: 20.8°C; Tissue Temp: 20.3°C

Probe: ES3DV3 - SN3318; ConvF(4.96, 4.96, 4.96); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.38 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.518 W/kg
SAR(1 g) = 0.324 W/kg



0 dB = 0.386 W/kg = -4.13 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 09123

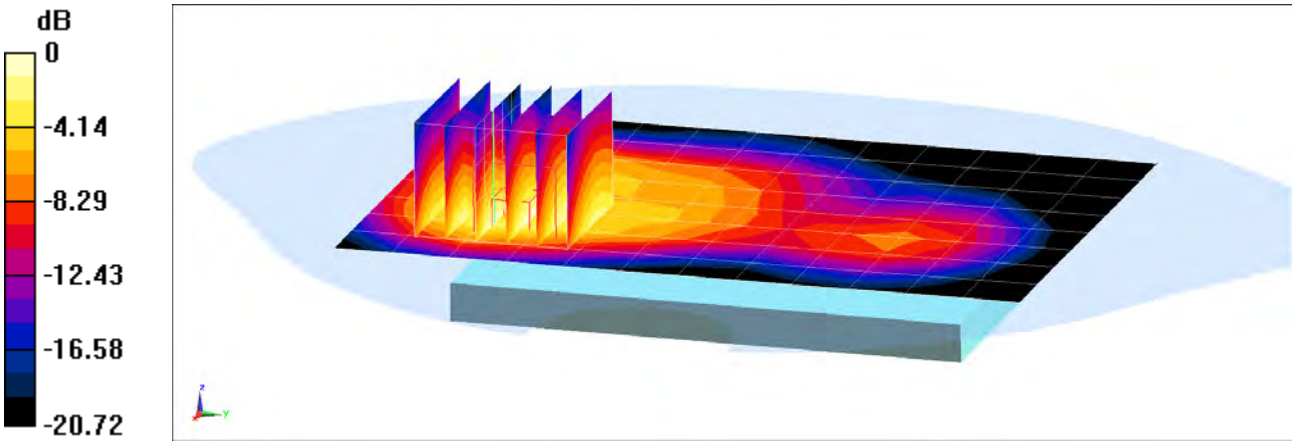
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.563 S/m; ε_r = 52.523; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 20.8°C; Tissue Temp: 20.3°C

Probe: ES3DV3 - SN3318; ConvF(4.96, 4.96, 4.96); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

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

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.61 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.05 W/kg
SAR(1 g) = 0.591 W/kg



0 dB = 0.718 W/kg = -1.44 dBW/kg

DUT: A3LSMG390W; Type: Portable Handset; Serial: 10097

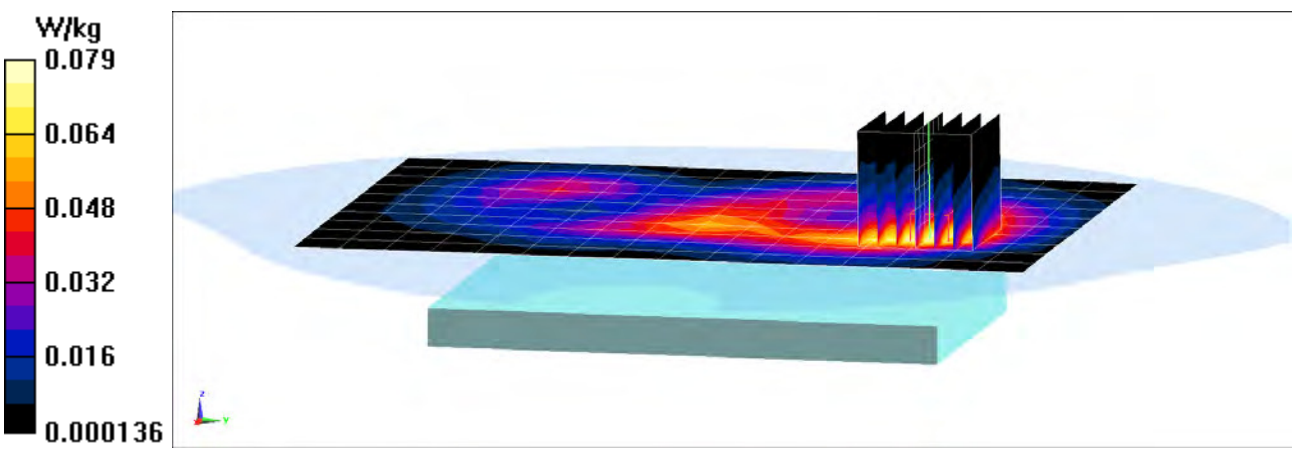
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.989 S/m; ε_r = 51.093; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-24-2017; Ambient Temp: 20.5°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3287; ConvF(4.35, 4.35, 4.35); Calibrated: 9/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 9/14/2016
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: IEEE 802.11b, 22 MHz Bandwidth, Body SAR, Ch 6, 1 Mbps, Back Side

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.204 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.132 W/kg
SAR(1 g) = 0.063 W/kg



DUT: A3LSMG390W; Type: Portable Handset; Serial: 10097

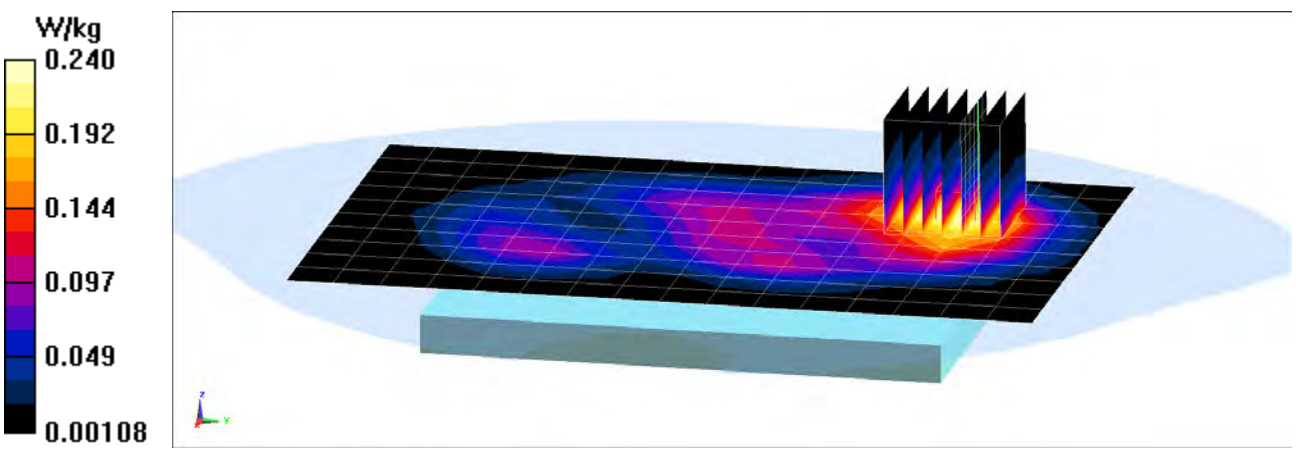
Communication System: UID 0, IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2437 MHz; σ = 1.989 S/m; ε_r = 51.093; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 20.5°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3287; ConvF(4.35, 4.35, 4.35); Calibrated: 9/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 9/14/2016
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: IEEE 802.11b, 22 MHz Bandwidth, Body SAR, Ch 6, 1 Mbps, Front Side

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.530 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.382 W/kg
SAR(1 g) = 0.195 W/kg



DUT: A3LSMG390W; Type: Portable Handset; Serial: 09917

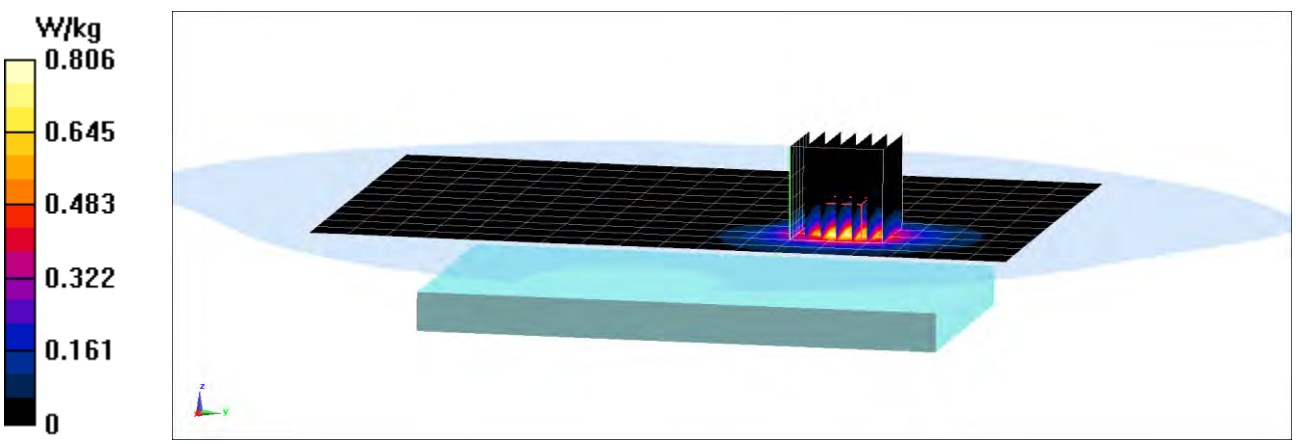
Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5620 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5620 MHz; σ = 5.98 S/m; ε_r = 47.495; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-24-2017; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN3589; ConvF(3.82, 3.82, 3.82); Calibrated: 1/13/2017;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1466; Calibrated: 1/16/2017
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: IEEE 802.11a, UNII-2C, 20 MHz Bandwidth, Body SAR, Ch 124, 6 Mbps, Back Side

Area Scan (13x19x1): 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 = 7.713 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 1.40 W/kg
SAR(1 g) = 0.340 W/kg



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DUT: A3LSMG390W; Type: Portable Handset; Serial: 09917

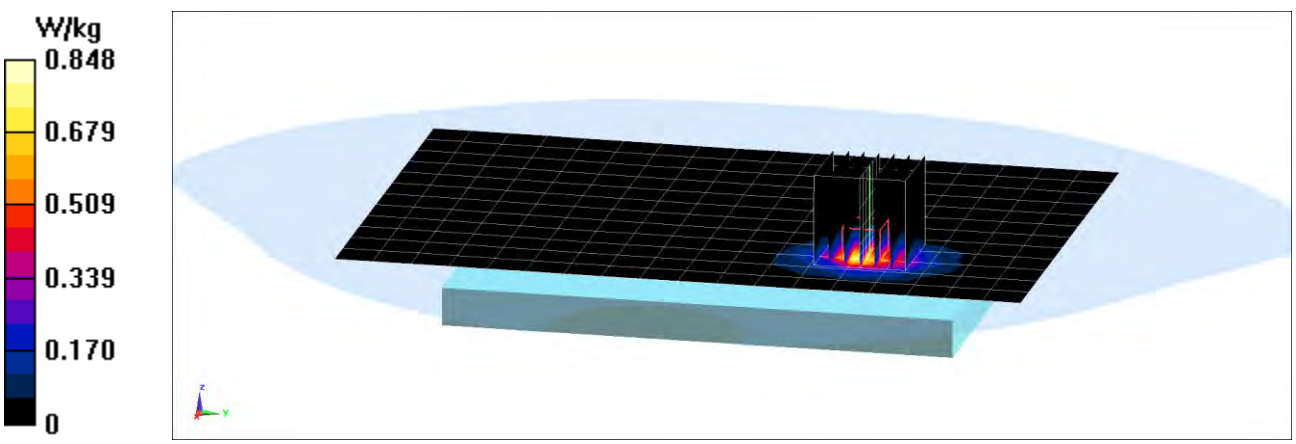
Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5745 MHz; σ = 6.171 S/m; ε_r = 47.299; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN3589; ConvF(3.83, 3.83, 3.83); Calibrated: 1/13/2017;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1466; Calibrated: 1/16/2017
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

Mode: IEEE 802.11a, UNII-3, 20 MHz Bandwidth, Body SAR, Ch 149, 6 Mbps, Back Side

Area Scan (13x19x1): 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 = 7.880 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 1.47 W/kg
SAR(1 g) = 0.332 W/kg



APPENDIX B: SYSTEM VERIFICATION

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PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1161

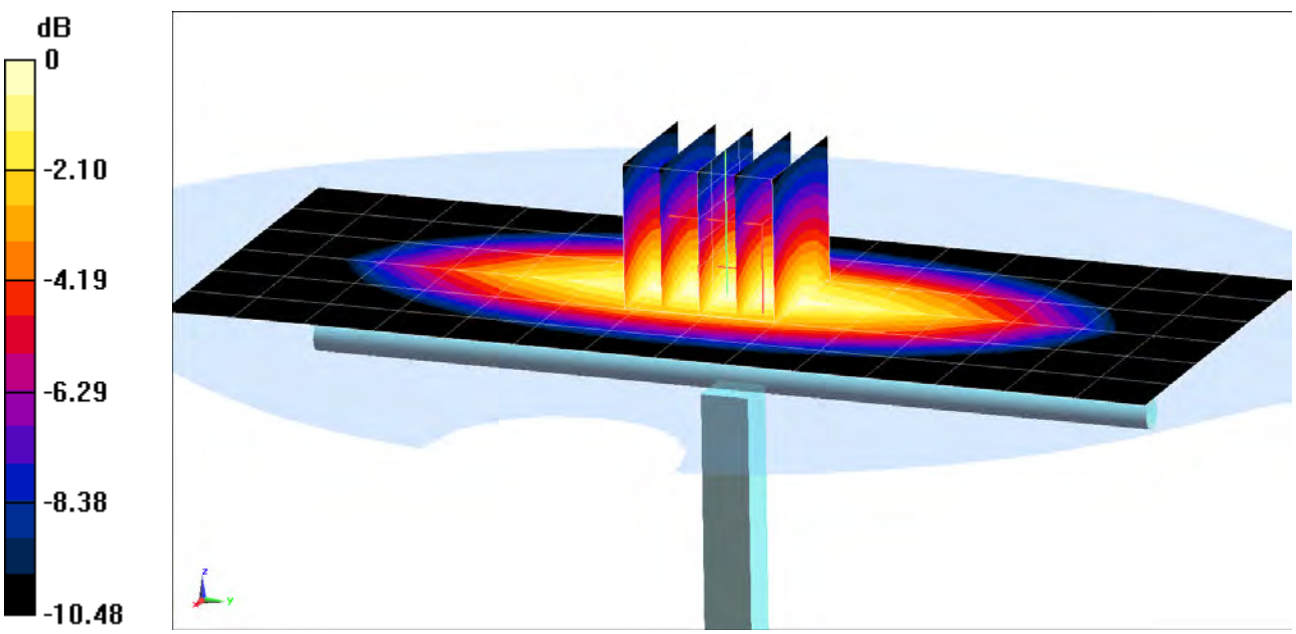
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Head Medium parameters used (interpolated):
f = 750 MHz; σ = 0.902 S/m; ε_r = 42.781; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-17-2017; Ambient Temp: 22.9°C; Tissue Temp: 20.0°C

Probe: ES3DV3 - SN3319; ConvF(6.76, 6.76, 6.76); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

750 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.26 W/kg
SAR(1 g) = 1.54 W/kg
Deviation(1 g) = -5.75%



0 dB = 1.80 W/kg = 2.55 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

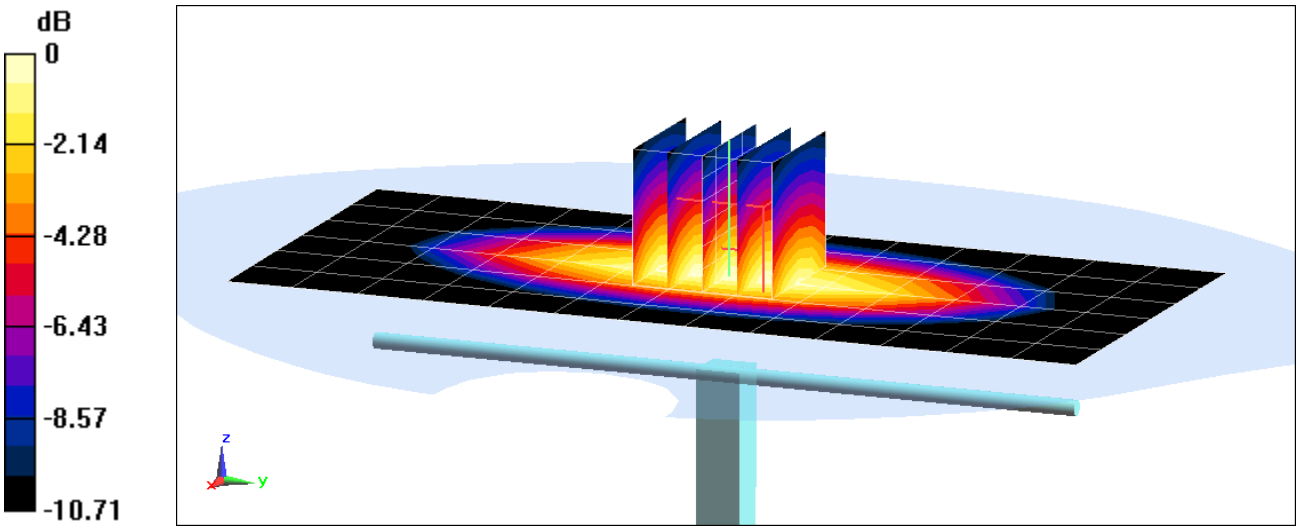
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.908 S/m; ε_r = 41.988; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-18-2017; Ambient Temp: 20.5°C; Tissue Temp: 20.3°C

Probe: ES3DV3 - SN3334; ConvF(6.49, 6.49, 6.49); Calibrated: 11/15/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 11/11/2016
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.95 W/kg
SAR(1 g) = 2.00 W/kg
Deviation(1 g) = 7.30%



0 dB = 2.33 W/kg = 3.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

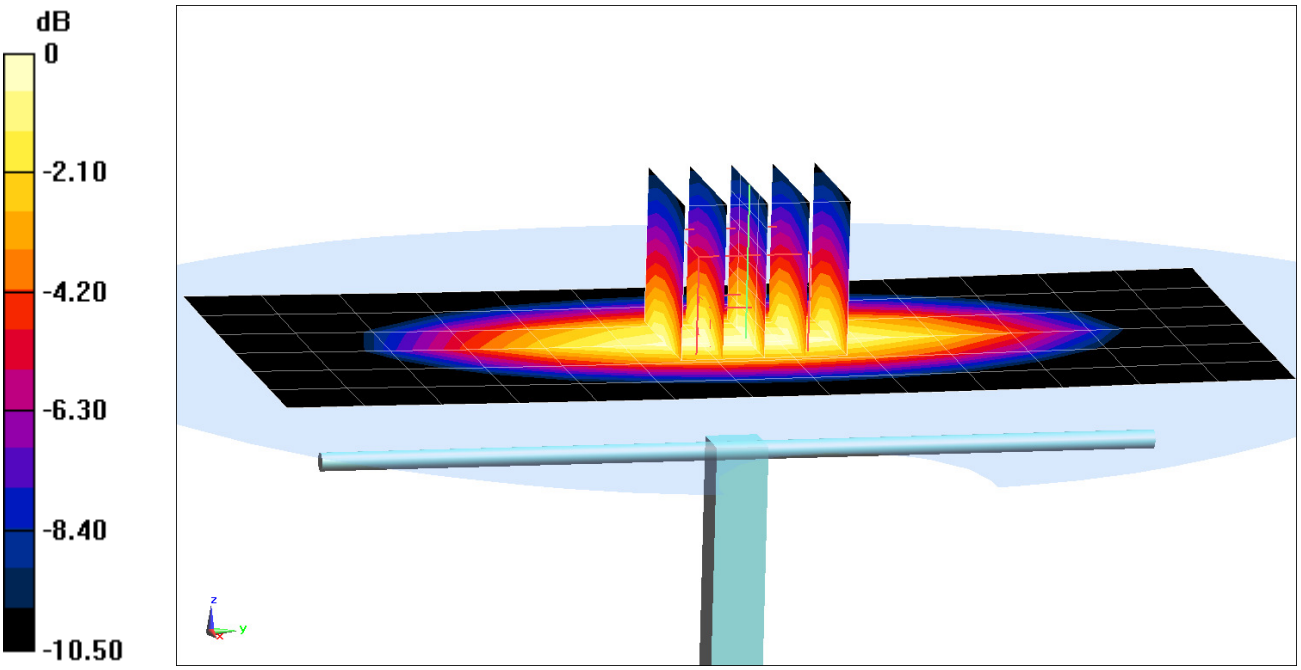
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.891 S/m; ε_r = 40.147; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-25-2017; Ambient Temp: 23.2°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3213; ConvF(6.49, 6.49, 6.49); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/9/2017
Phantom: SAM Right; Type: SAM; Serial: 1757
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.68 W/kg
SAR(1 g) = 1.83 W/kg
Deviation(1 g) = -1.82%



0 dB = 2.12 W/kg = 3.26 dBW/kg

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

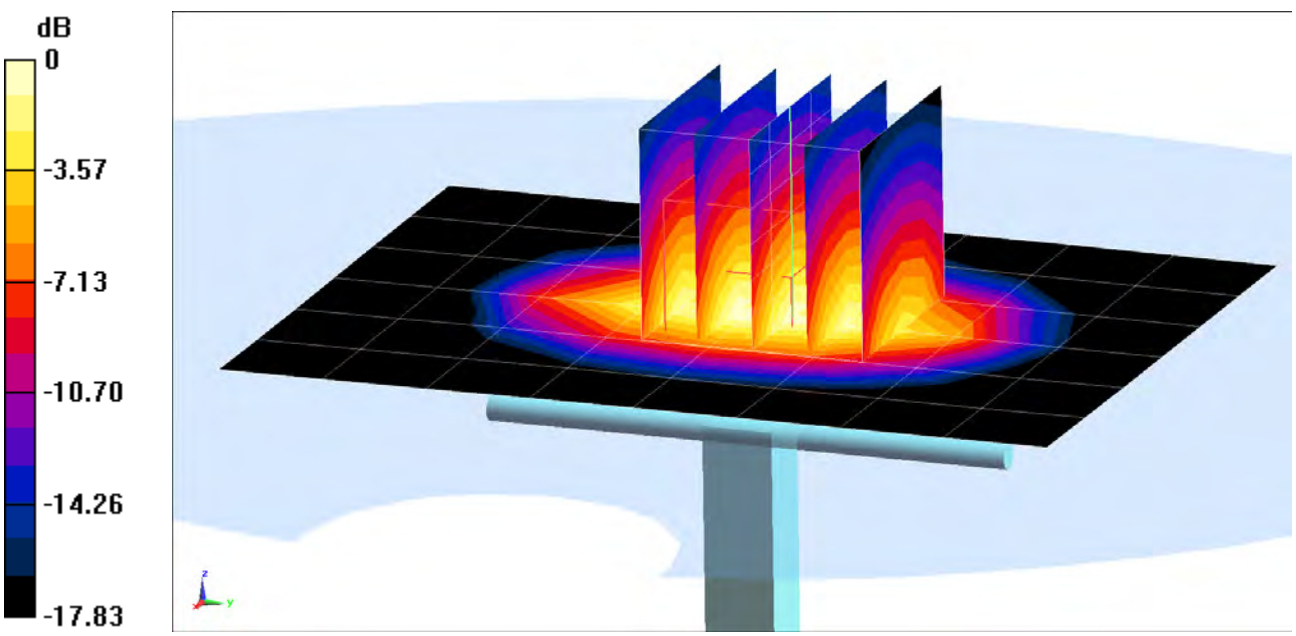
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Head Medium parameters used:
f = 1750 MHz; σ = 1.373 S/m; ε_r = 39.389; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-18-2017; Ambient Temp: 23.4°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3319; ConvF(5.38, 5.38, 5.38); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.75 W/kg
SAR(1 g) = 3.76 W/kg
Deviation(1 g) = 2.45%



0 dB = 4.68 W/kg = 6.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

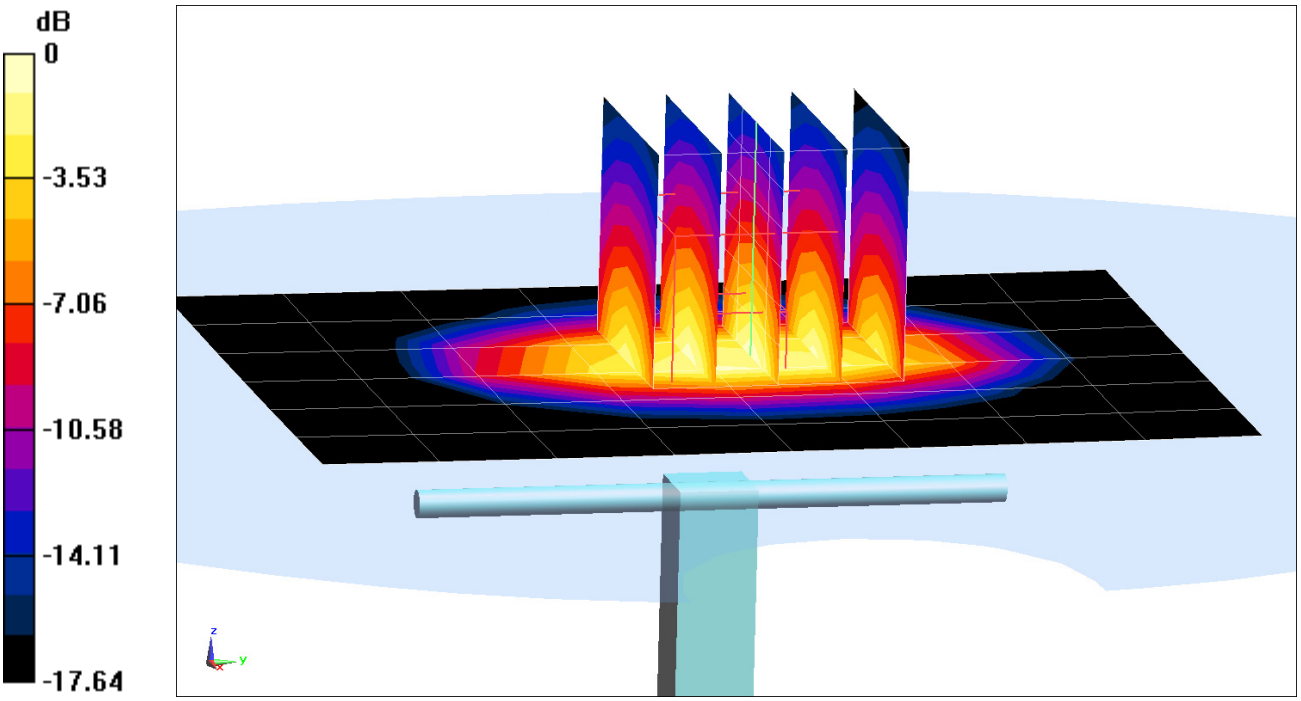
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Head Medium parameters used:
f = 1750 MHz; σ = 1.384 S/m; ε_r = 39.929; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-26-2017; Ambient Temp: 22.7°C; Tissue Temp: 21.2°C

Probe: ES3DV3 - SN3213; ConvF(5.49, 5.49, 5.49); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/9/2017
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.36 W/kg
SAR(1 g) = 3.53 W/kg
Deviation(1 g) = -3.81%



0 dB = 4.43 W/kg = 6.46 dBW/kg

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

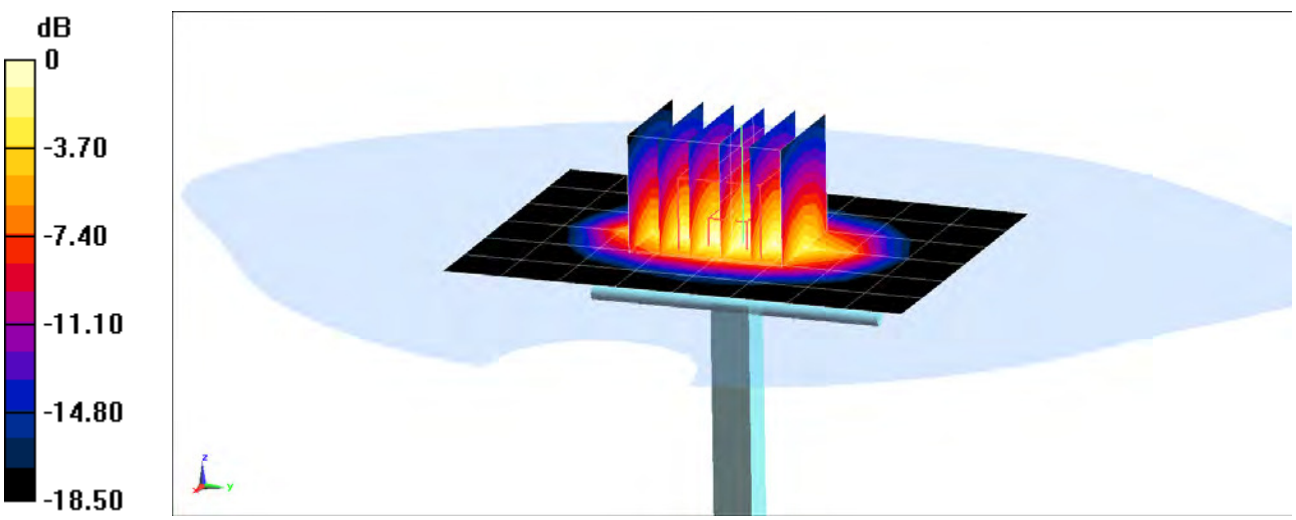
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Head Medium parameters used:
f = 1750 MHz; σ = 1.405 S/m; ε_r = 39.633; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-08-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3319; ConvF(5.38, 5.38, 5.38); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.62 W/kg
SAR(1 g) = 3.69 W/kg
Deviation(1 g) = 1.65%



0 dB = 4.64 W/kg = 6.67 dBW/kg

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

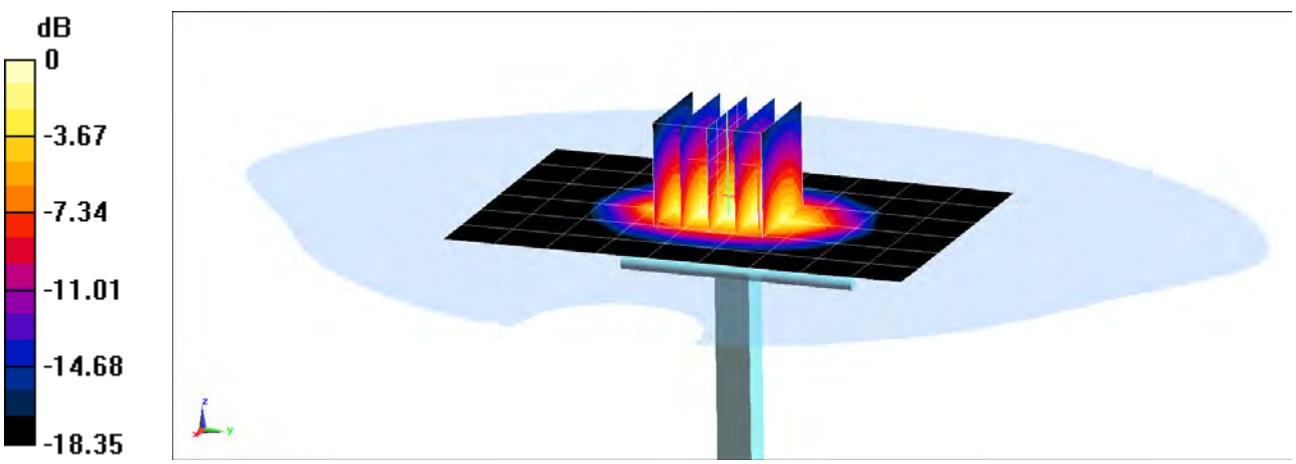
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.457 S/m; ε_r = 38.261; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-19-2017; Ambient Temp: 23.0°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3319; ConvF(5.2, 5.2, 5.2); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.73 W/kg
SAR(1 g) = 4.18 W/kg
Deviation(1 g) = 4.24%



0 dB = 5.30 W/kg = 7.24 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

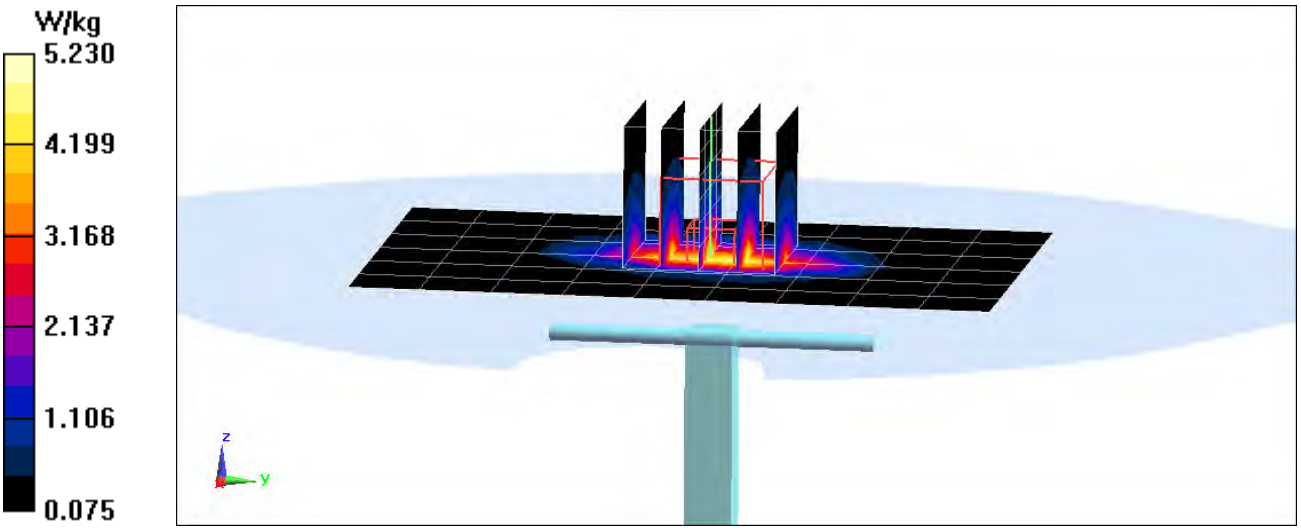
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.437 S/m; ε_r = 40.305; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.3°C; Tissue Temp: 23.3°C

Probe: ES3DV3 - SN3334; ConvF(5.27, 5.27, 5.27); Calibrated: 11/15/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 11/11/2016
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.55 W/kg
SAR(1 g) = 4.09 W/kg
Deviation(1 g) = 2.00%



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

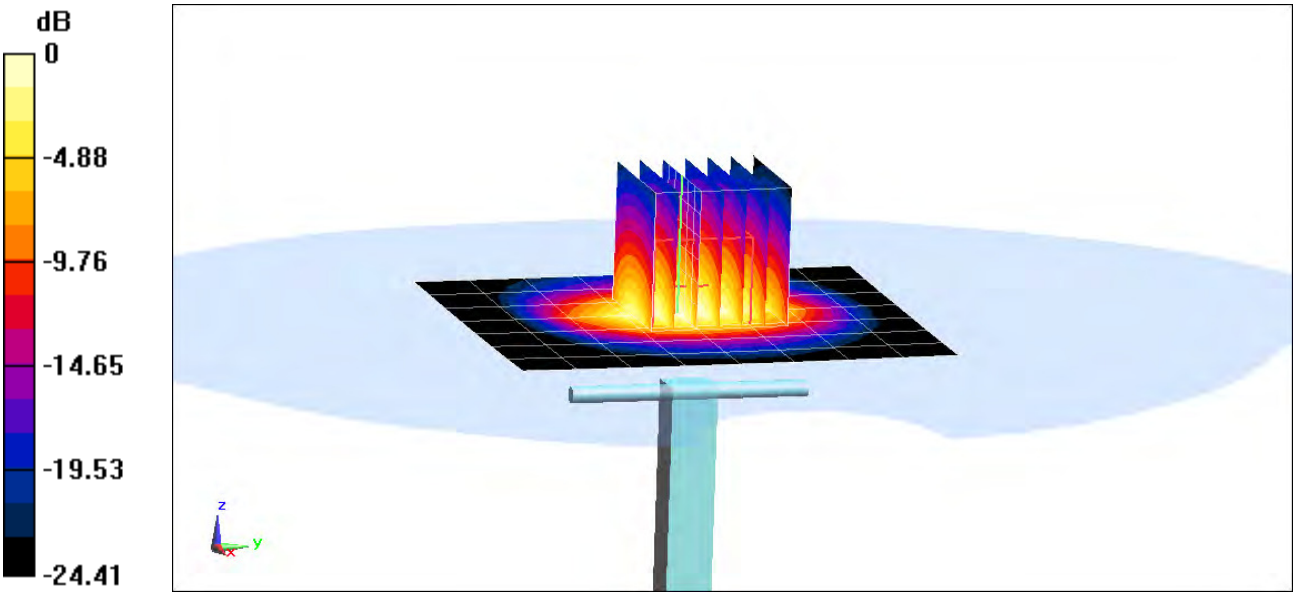
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used:
f = 2450 MHz; σ = 1.824 S/m; ε_r = 38.648; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 20.0°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3287; ConvF(4.54, 4.54, 4.54); Calibrated: 9/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 9/14/2016
Phantom: SAM Left; Type: QD000P40CA; Serial: TP:82355
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 11.1 W/kg
SAR(1 g) = 5.19 W/kg
Deviation(1 g) = -0.38%



0 dB = 6.88 W/kg = 8.38 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1120

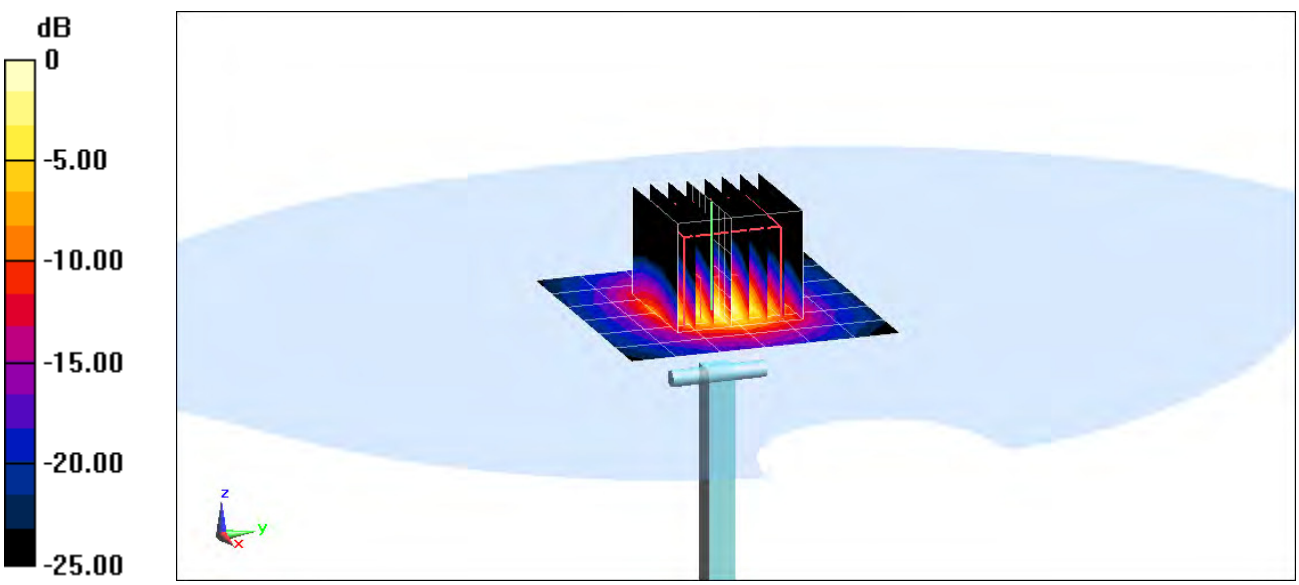
Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: 5GHz Head Medium parameters used (interpolated):
f = 5250 MHz; σ = 4.748 S/m; ε_r = 34.843; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 20.5°C; Tissue Temp: 20.0°C

Probe: EX3DV4 - SN7308; ConvF(5.21, 5.21, 5.21); Calibrated: 7/21/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

5250 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 17.8 W/kg
SAR(1 g) = 4.14 W/kg
Deviation(1 g) = -0.48%



0 dB = 10.2 W/kg = 10.09 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1120

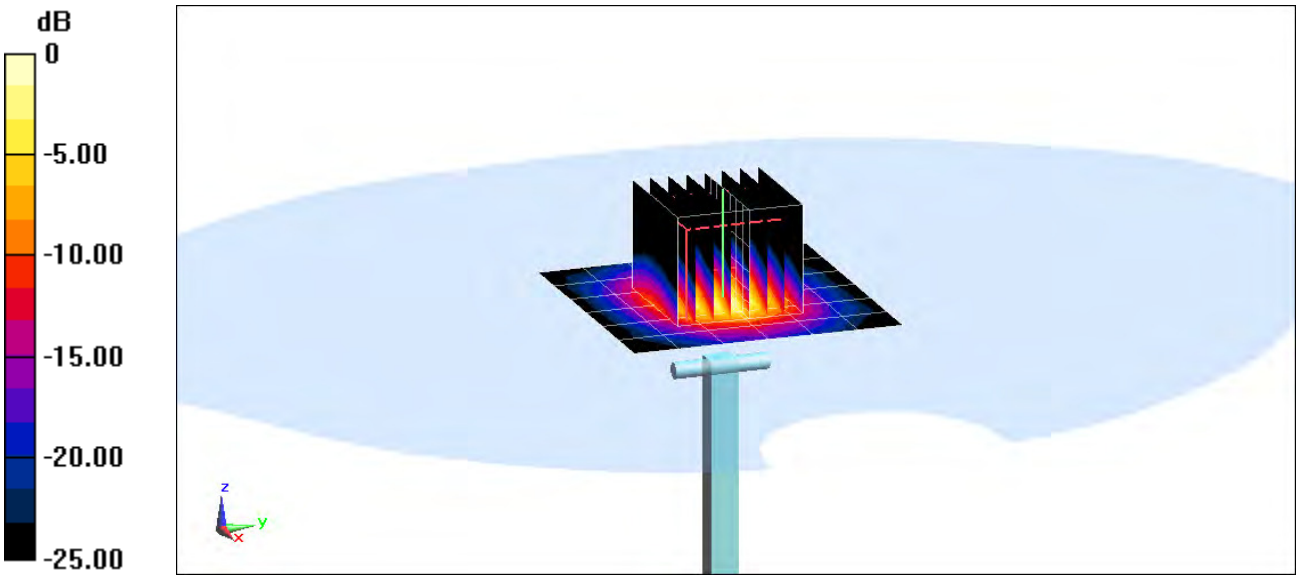
Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5GHz Head Medium parameters used:
f = 5600 MHz; σ = 5.099 S/m; ε_r = 34.278; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 20.5°C; Tissue Temp: 20.0°C

Probe: EX3DV4 - SN7308; ConvF(4.63, 4.63, 4.63); Calibrated: 7/21/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

5600 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 4.06 W/kg
Deviation(1 g) = -5.36%



0 dB = 9.93 W/kg = 9.97 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1120

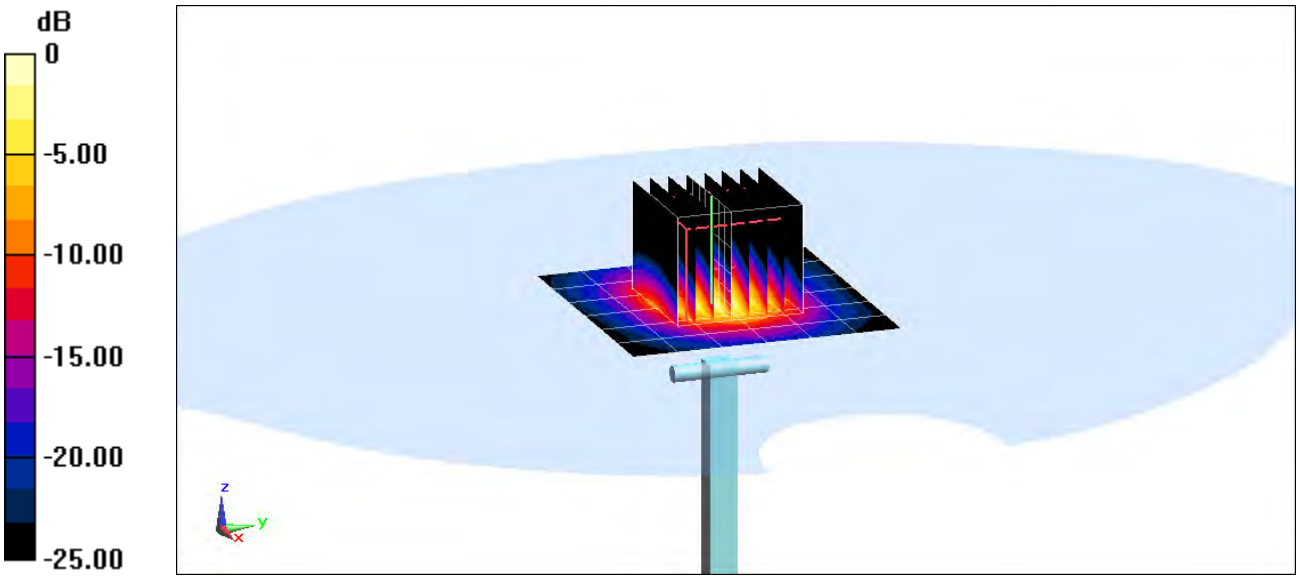
Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: 5GHz Head Medium parameters used (interpolated):
f = 5750 MHz; σ = 5.277 S/m; ε_r = 34.048; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 20.5°C; Tissue Temp: 20.0°C

Probe: EX3DV4 - SN7308; ConvF(4.86, 4.86, 4.86); Calibrated: 7/21/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

5750 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 17.7 W/kg
SAR(1 g) = 3.87 W/kg
Deviation(1 g) = -5.38%



0 dB = 9.53 W/kg = 9.79 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

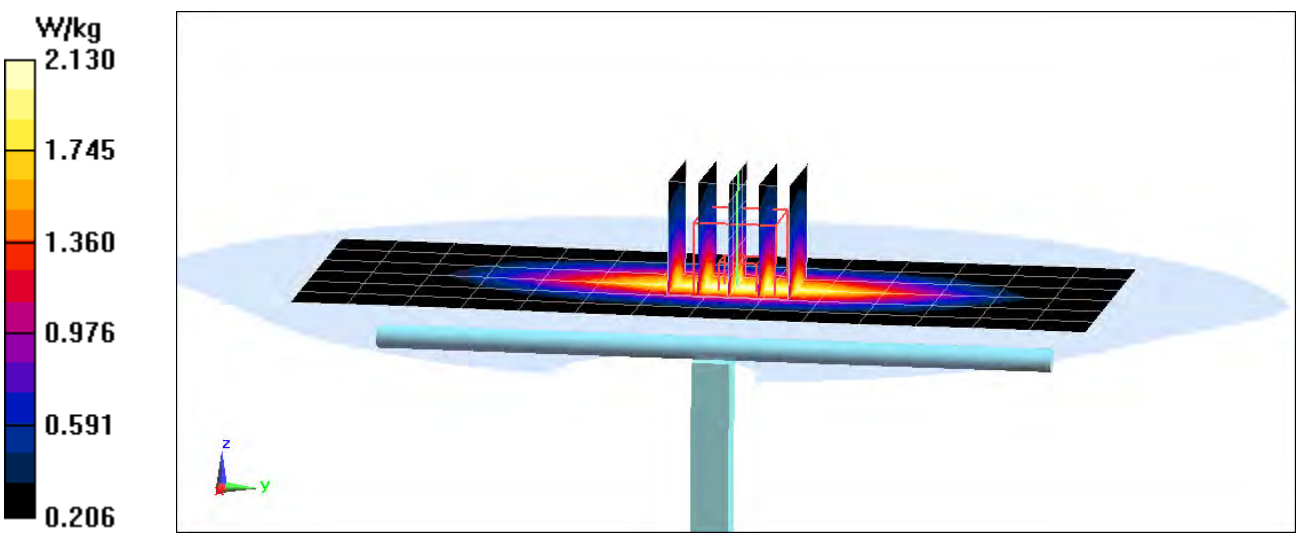
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Body Medium parameters used (interpolated):
f = 750 MHz; σ = 0.958 S/m; ε_r = 54.351; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-20-2017; Ambient Temp: 19.9°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3334; ConvF(6.33, 6.33, 6.33); Calibrated: 11/15/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 11/11/2016
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

750 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.69 W/kg
SAR(1 g) = 1.83 W/kg
Deviation(1 g) = 6.27%



PCTEST ENGINEERING LABORATORY, INC.

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

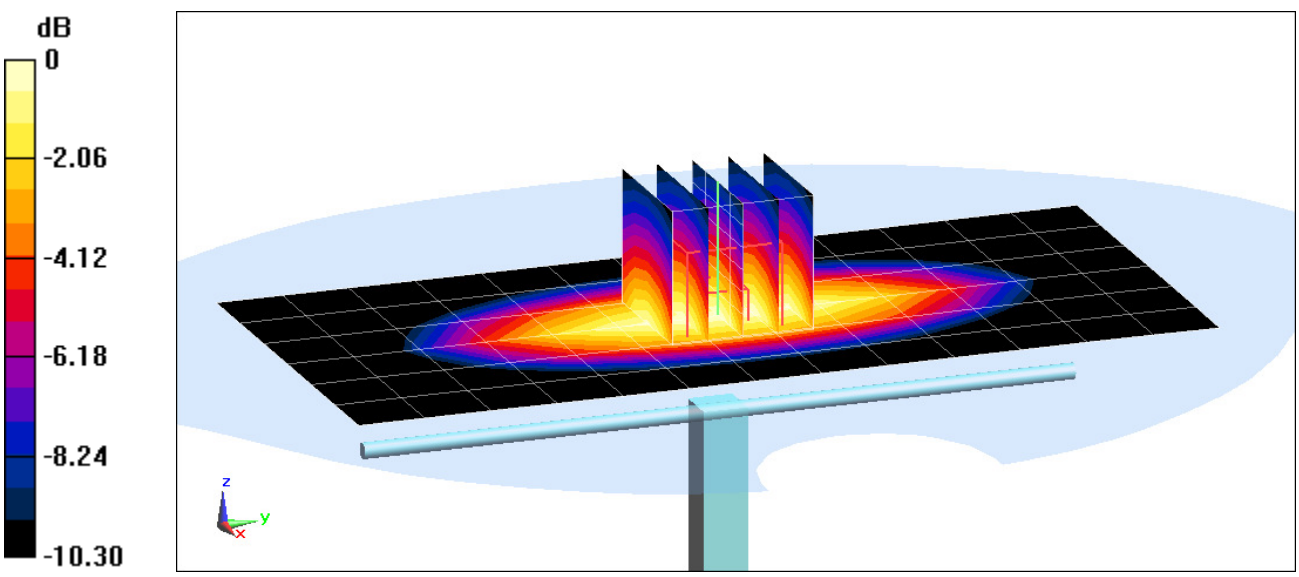
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 0.982 S/m; ε_r = 54.813; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-17-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.1°C

Probe: ES3DV3 - SN3318; ConvF(6.37, 6.37, 6.37); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.85 W/kg
SAR(1 g) = 1.96 W/kg
Deviation(1 g) = 3.16%



0 dB = 2.29 W/kg = 3.60 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

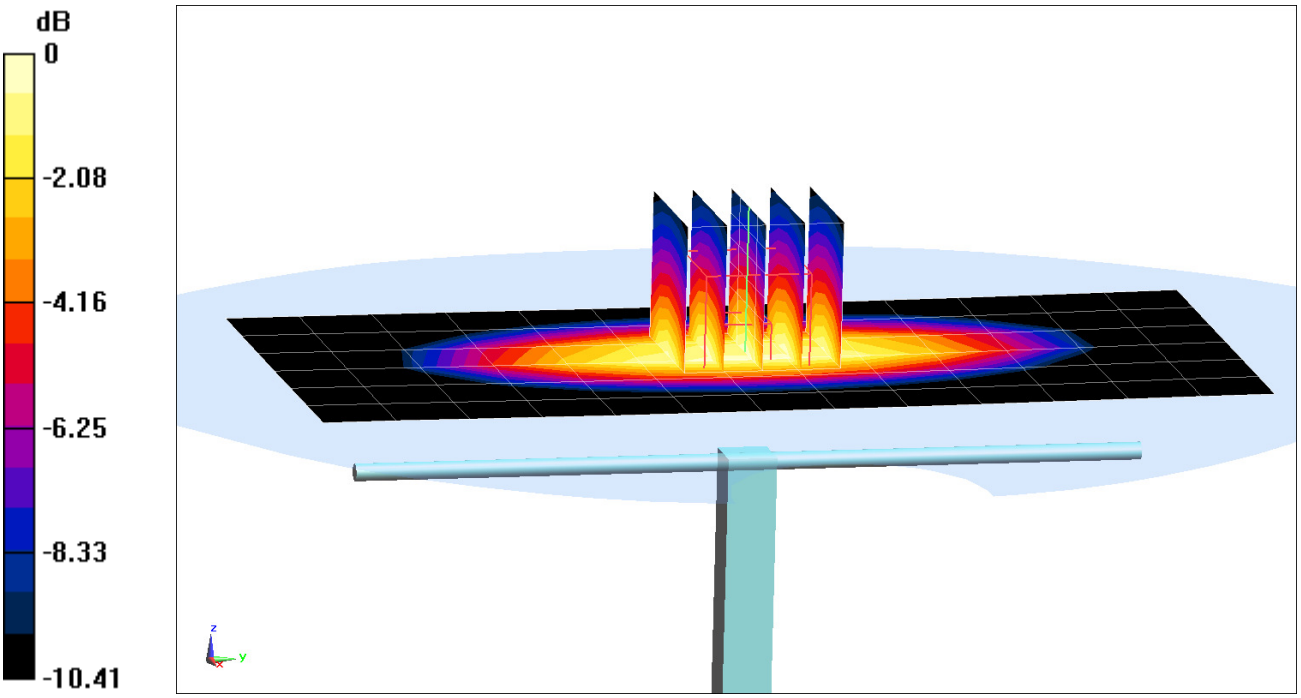
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 0.991 S/m; ε_r = 53.903; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-24-2017; Ambient Temp: 22.1°C; Tissue Temp: 19.9°C

Probe: ES3DV3 - SN3213; ConvF(6.28, 6.28, 6.28); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 2/9/2017
Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.88 W/kg
SAR(1 g) = 1.95 W/kg
Deviation(1 g) = 2.63%



0 dB = 2.29 W/kg = 3.60 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1148

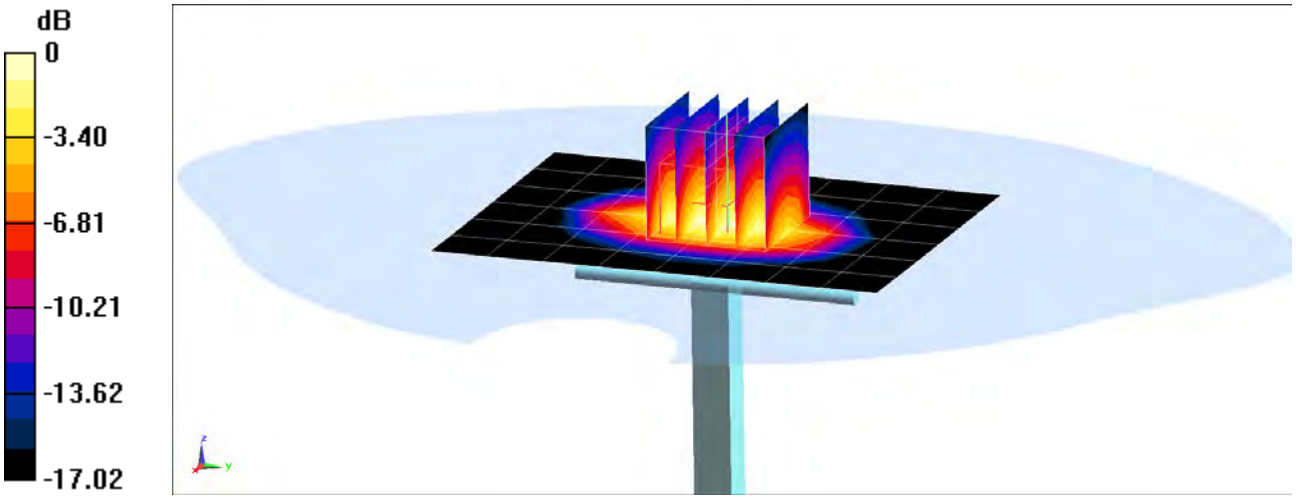
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used:
f = 1750 MHz; σ = 1.501 S/m; ε_r = 51.353; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.7°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3319; ConvF(5.07, 5.07, 5.07); Calibrated: 03/14/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 03/08/2017
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 5.93 W/kg
SAR(1 g) = 3.46 W/kg
Deviation(1 g) = -6.74%



0 dB = 4.27 W/kg = 6.30 dBW/kg

PCTPCTEST ENGINEERING LABORATORY, INC.

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

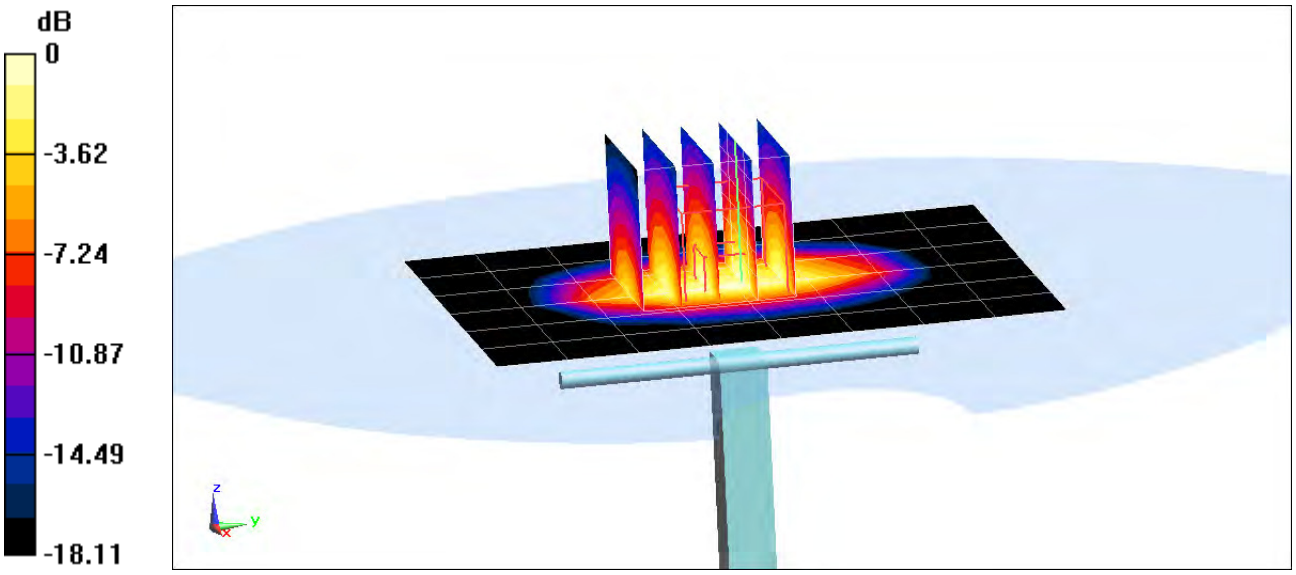
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Body Medium parameters used:
f = 1750 MHz; σ = 1.523 S/m; ε_r = 51.285; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-08-2017; Ambient Temp: 22.3°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3287; ConvF(5.11, 5.11, 5.11); Calibrated: 9/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 9/14/2016
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.79 W/kg
SAR(1 g) = 3.87 W/kg
Deviation(1 g) = 4.31%



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

PCTEST ENGINEERING LABORATORY, INC.

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

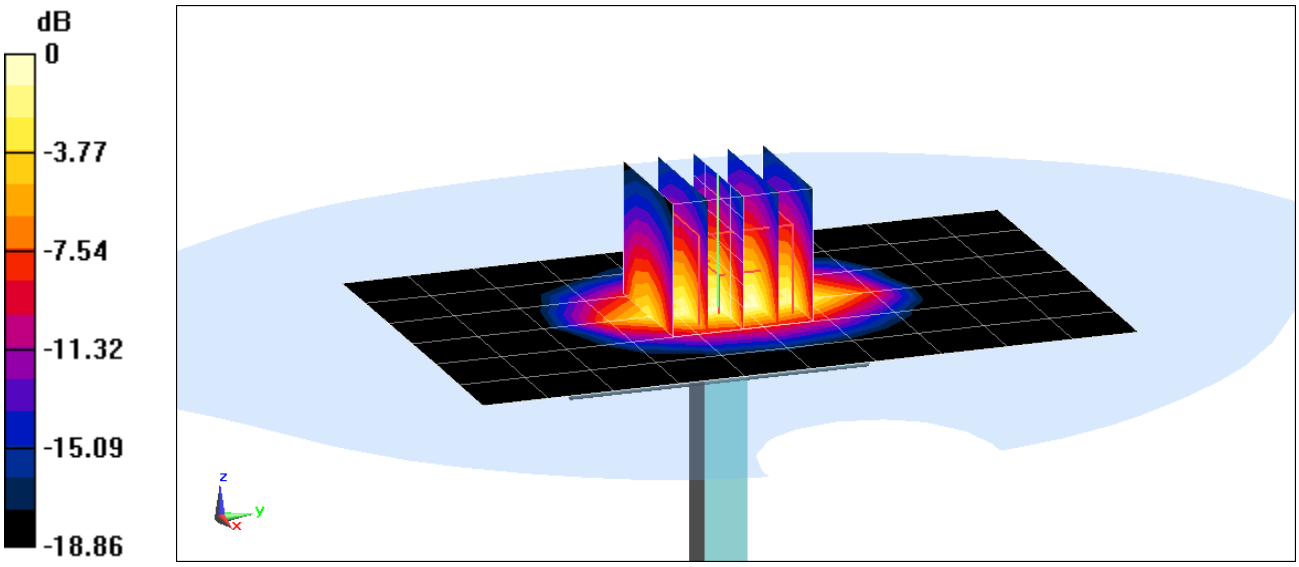
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.569 S/m; ε_r = 51.073; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-17-2017; Ambient Temp: 22.7°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/11/2016
Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.34 W/kg
SAR(1 g) = 3.96 W/kg
Deviation(1 g) = 1.28%



0 dB = 6.08 W/kg = 7.84 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

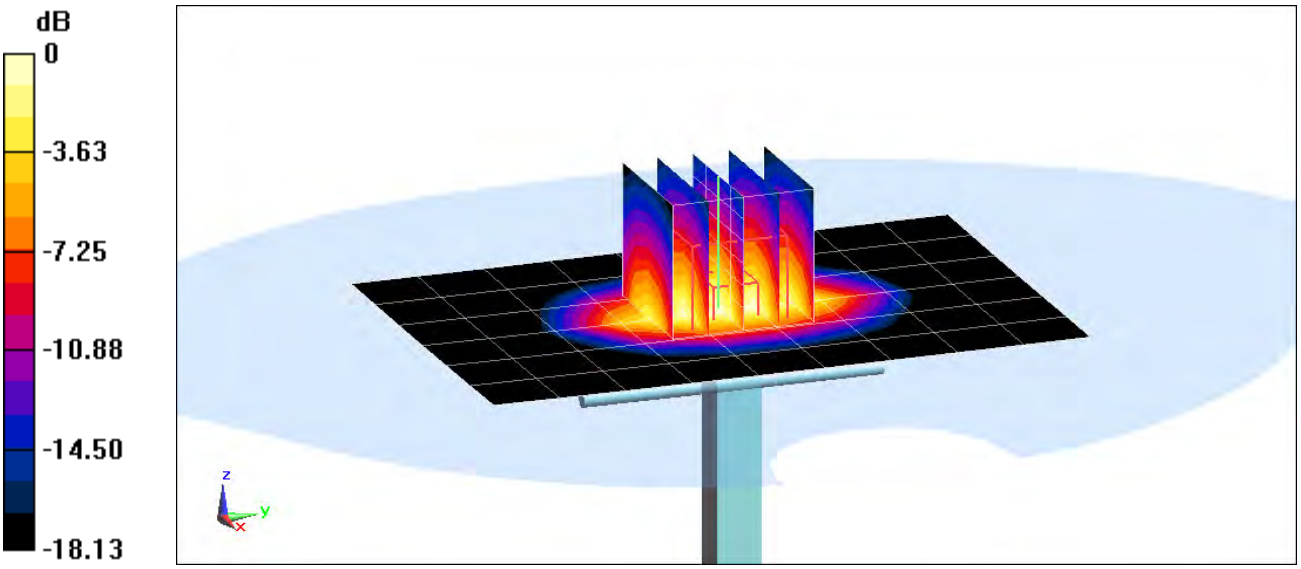
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.563 S/m; ε_r = 52.523; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 20.8°C; Tissue Temp: 20.3°C

Probe: ES3DV3 - SN3318; ConvF(4.96, 4.96, 4.96); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.22 W/kg
SAR(1 g) = 3.97 W/kg
Deviation(1 g) = 1.53%



0 dB = 5.05 W/kg = 7.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

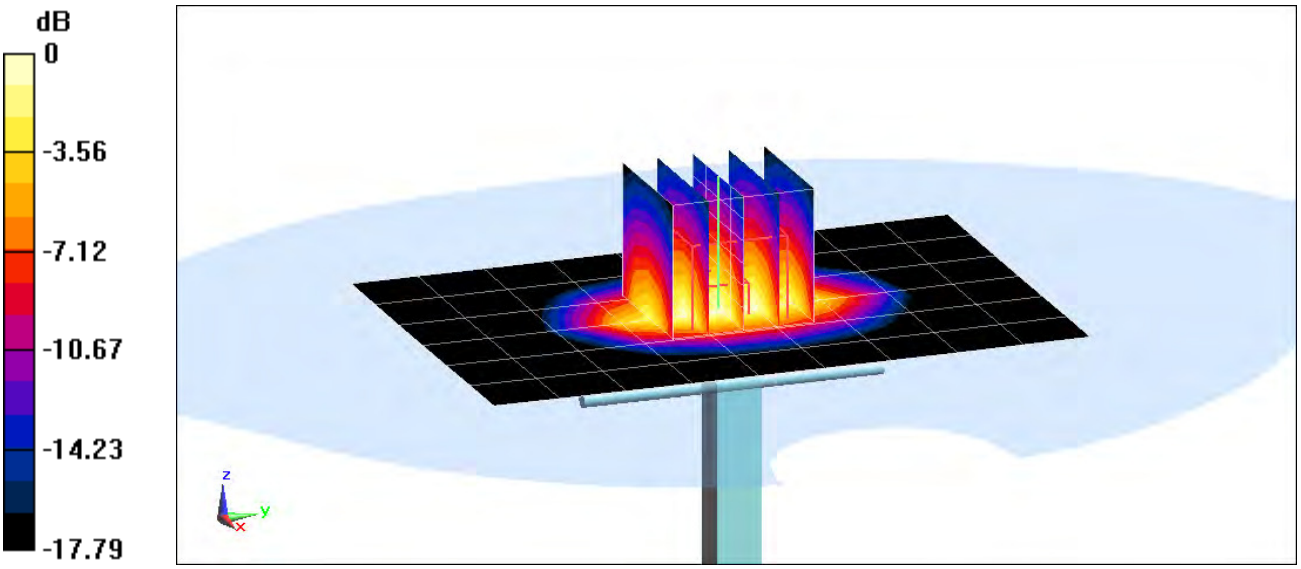
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.572 S/m; ε_r = 52.025; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-26-2017; Ambient Temp: 22.1°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3318; ConvF(4.96, 4.96, 4.96); Calibrated: 2/10/2017;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/9/2017
Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.62 W/kg
SAR(1 g) = 4.21 W/kg
Deviation(1 g) = 5.51%



0 dB = 5.37 W/kg = 7.30 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

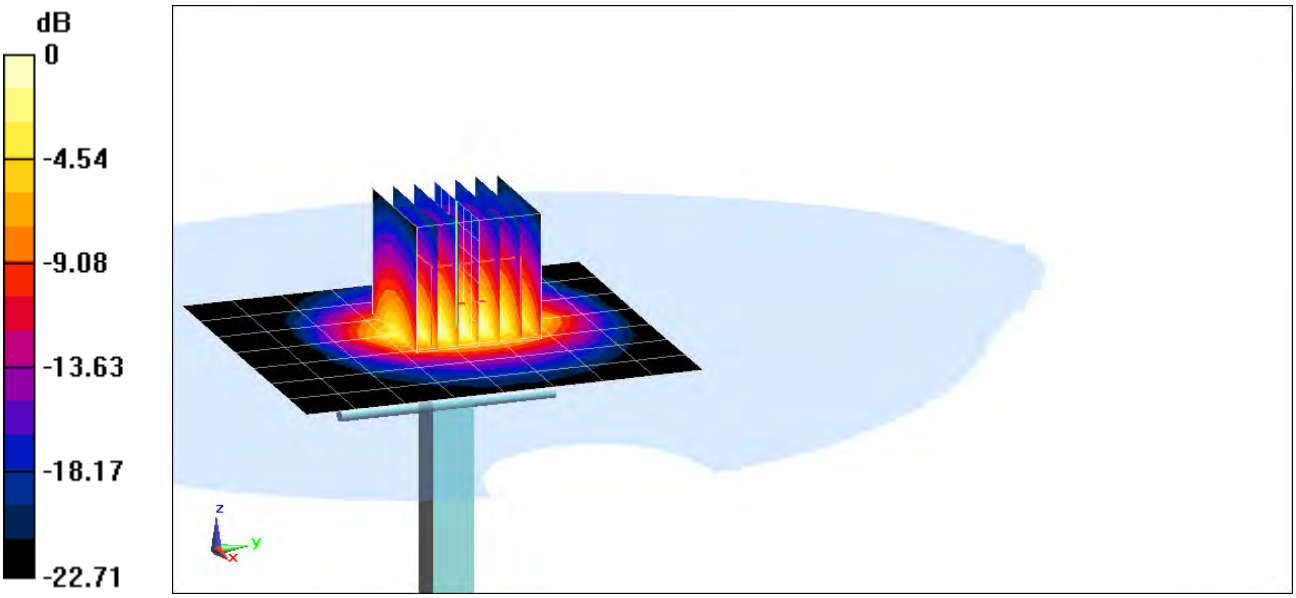
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2450 MHz; σ = 2.005 S/m; ε_r = 51.035; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 20.5°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3287; ConvF(4.35, 4.35, 4.35); Calibrated: 9/19/2016;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 9/14/2016
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 11.3 W/kg
SAR(1 g) = 5.23 W/kg
Deviation(1 g) = 3.16%



0 dB = 6.96 W/kg = 8.43 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237

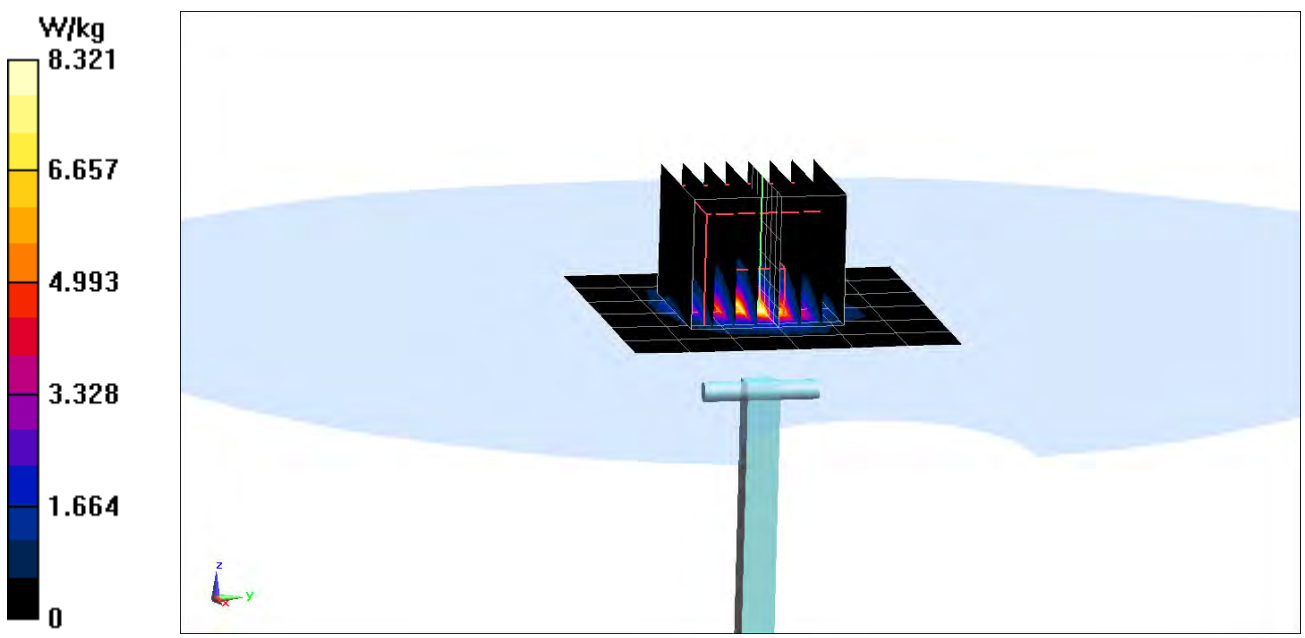
Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5250 MHz; σ = 5.491 S/m; ε_r = 48.124; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN3589; ConvF(4.19, 4.19, 4.19); Calibrated: 1/13/2017;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1466; Calibrated: 1/16/2017
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

5250 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 15.1 W/kg
SAR(1 g) = 3.5 W/kg
Deviation(1 g) = -6.42%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237

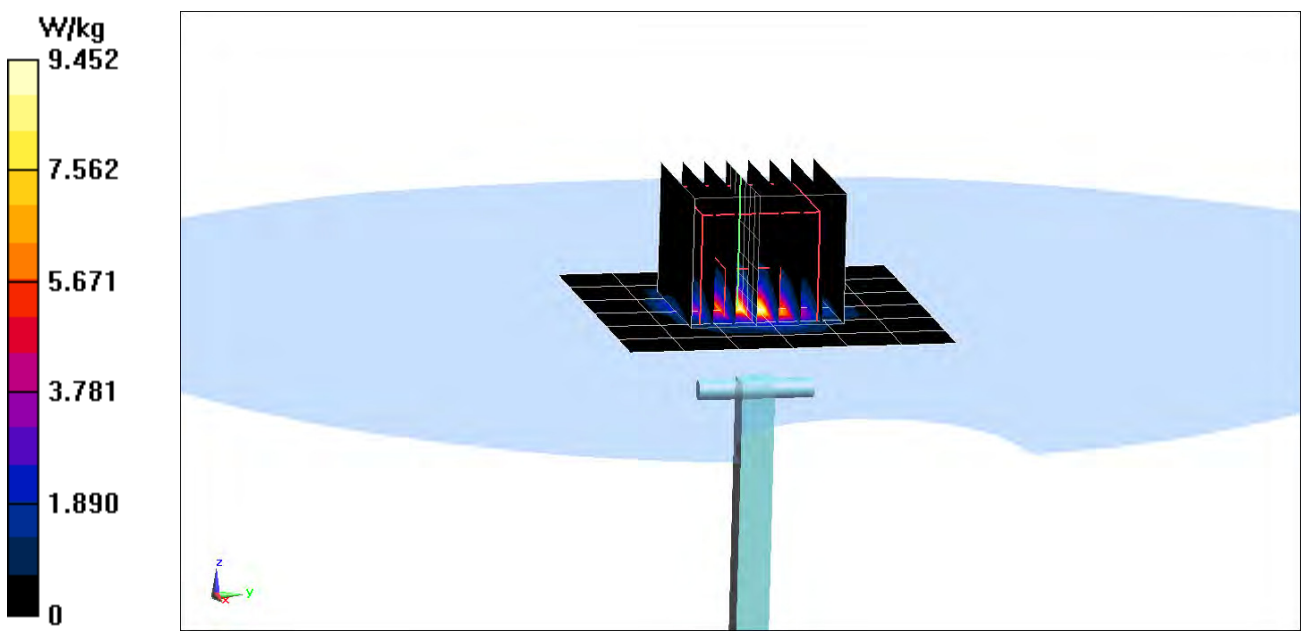
Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.951 S/m; ε_r = 47.517; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN3589; ConvF(3.82, 3.82, 3.82); Calibrated: 1/13/2017;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1466; Calibrated: 1/16/2017
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

5600 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 3.77 W/kg
Deviation(1 g) = -2.08%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1237

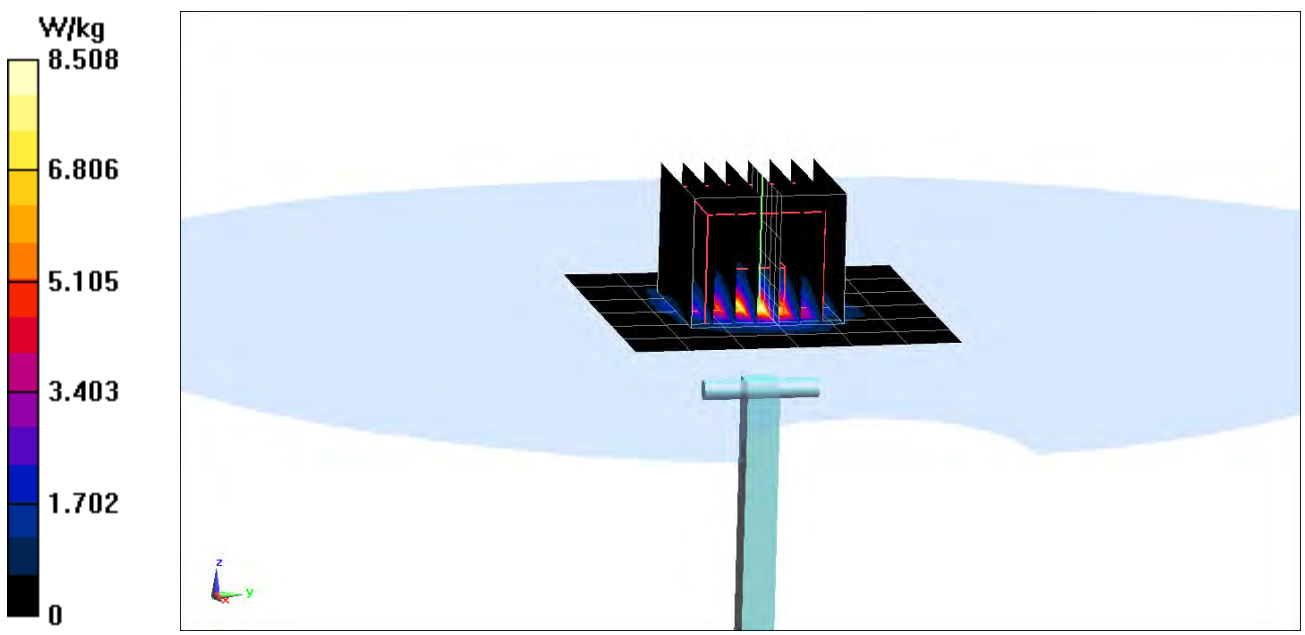
Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5750 MHz; σ = 6.175 S/m; ε_r = 47.289; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 04-24-2017; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN3589; ConvF(3.83, 3.83, 3.83); Calibrated: 1/13/2017;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1466; Calibrated: 1/16/2017
Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7416)

5750 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 15.7 W/kg
SAR(1 g) = 3.42 W/kg
Deviation(1 g) = -9.28%



APPENDIX C: PROBE CALIBRATION

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Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S 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 0108

Client **PC Test**

Certificate No: D750V3-1161_Jul16

CALIBRATION CERTIFICATE

Object	D750V3 - SN:1161
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 13, 2016

√PM
8/9/16

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 13, 2016

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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	750 MHz ± 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 ± 0.2) °C	40.9 ± 6 %	0.91 mho/m ± 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	2.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.17 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.39 W/kg ± 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 ± 0.2) °C	55.1 ± 6 %	0.99 mho/m ± 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	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.43 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.53 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.6 Ω - 0.9 jΩ
Return Loss	- 25.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.2 Ω - 4.0 jΩ
Return Loss	- 28.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 19, 2015

DASY5 Validation Report for Head TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161

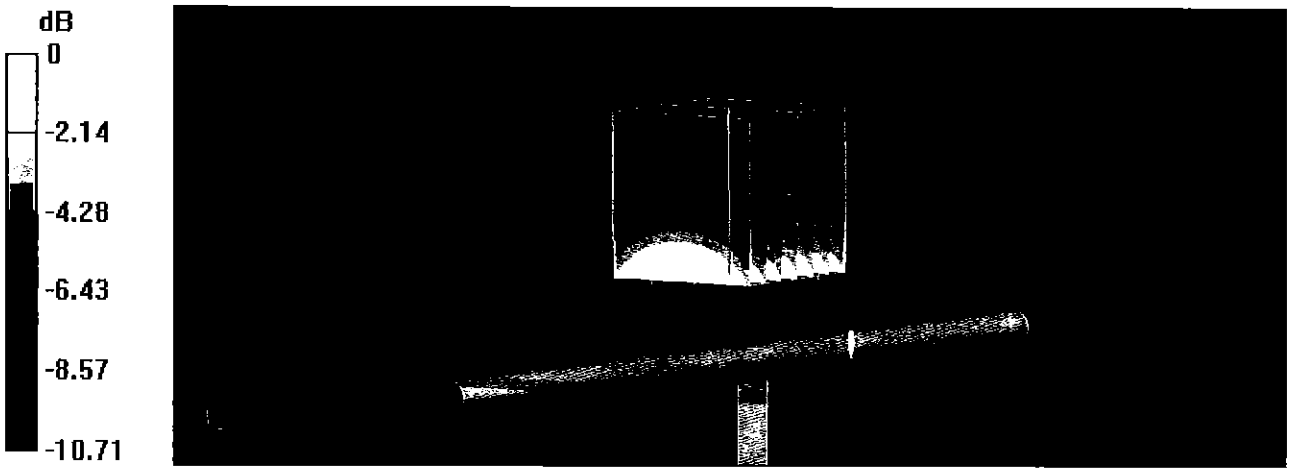
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.91 S/m; ε_r = 40.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

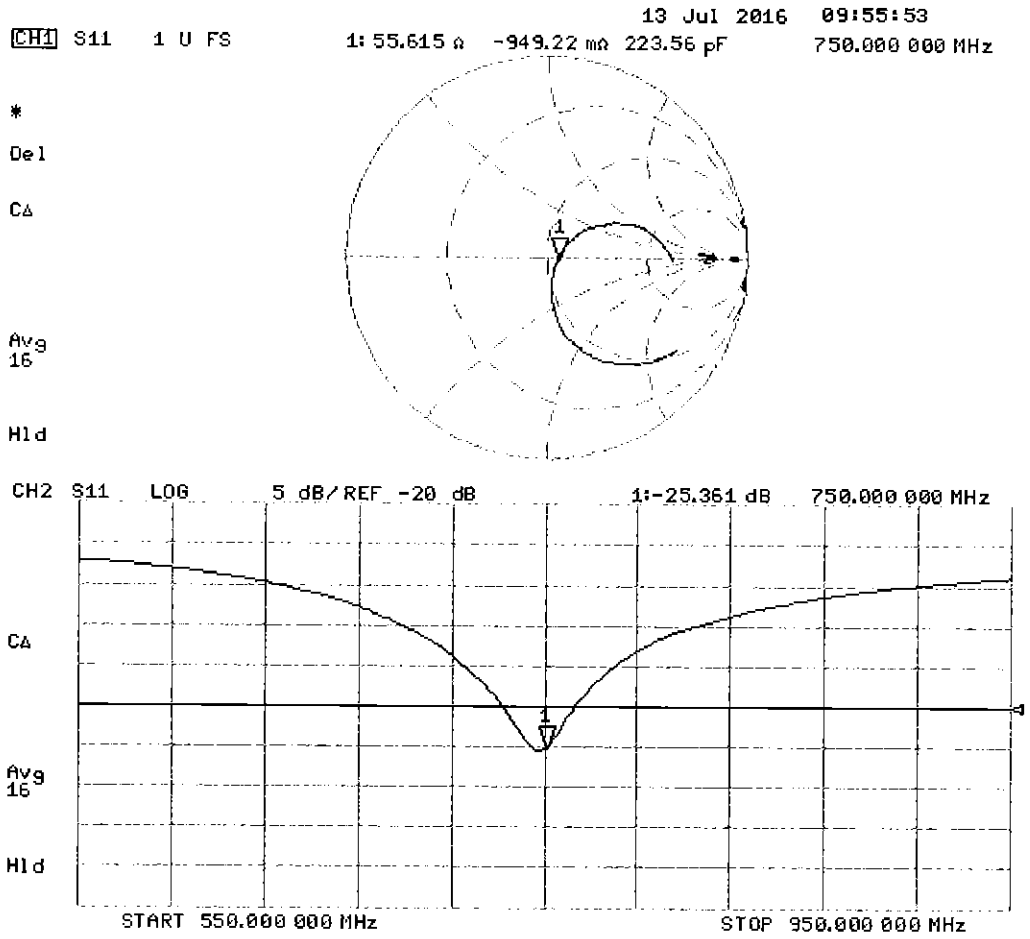
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.07 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.13 W/kg
SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.37 W/kg
Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1161

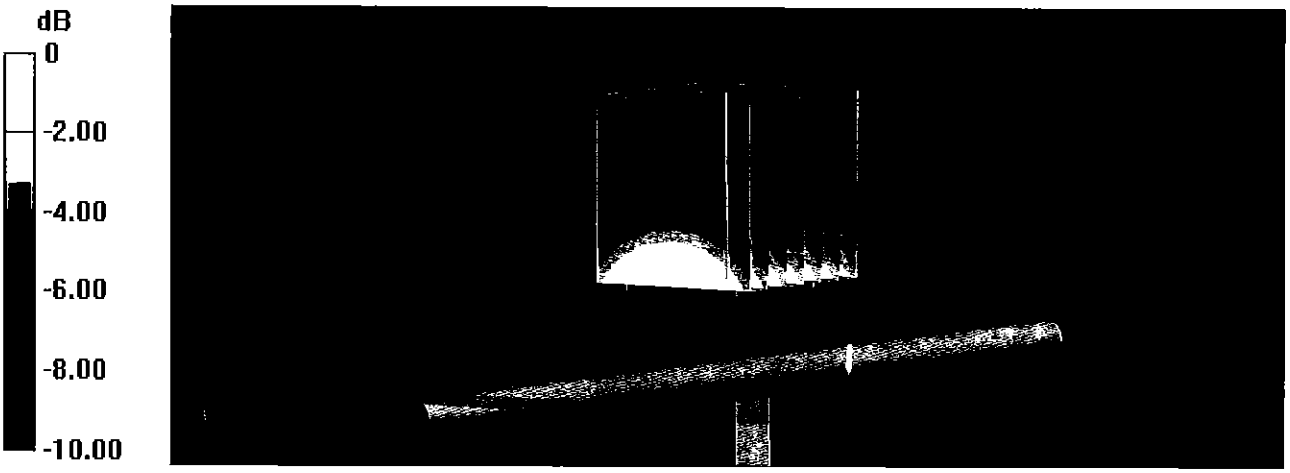
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.99 S/m; ε_r = 55.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.99, 9.99, 9.99); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

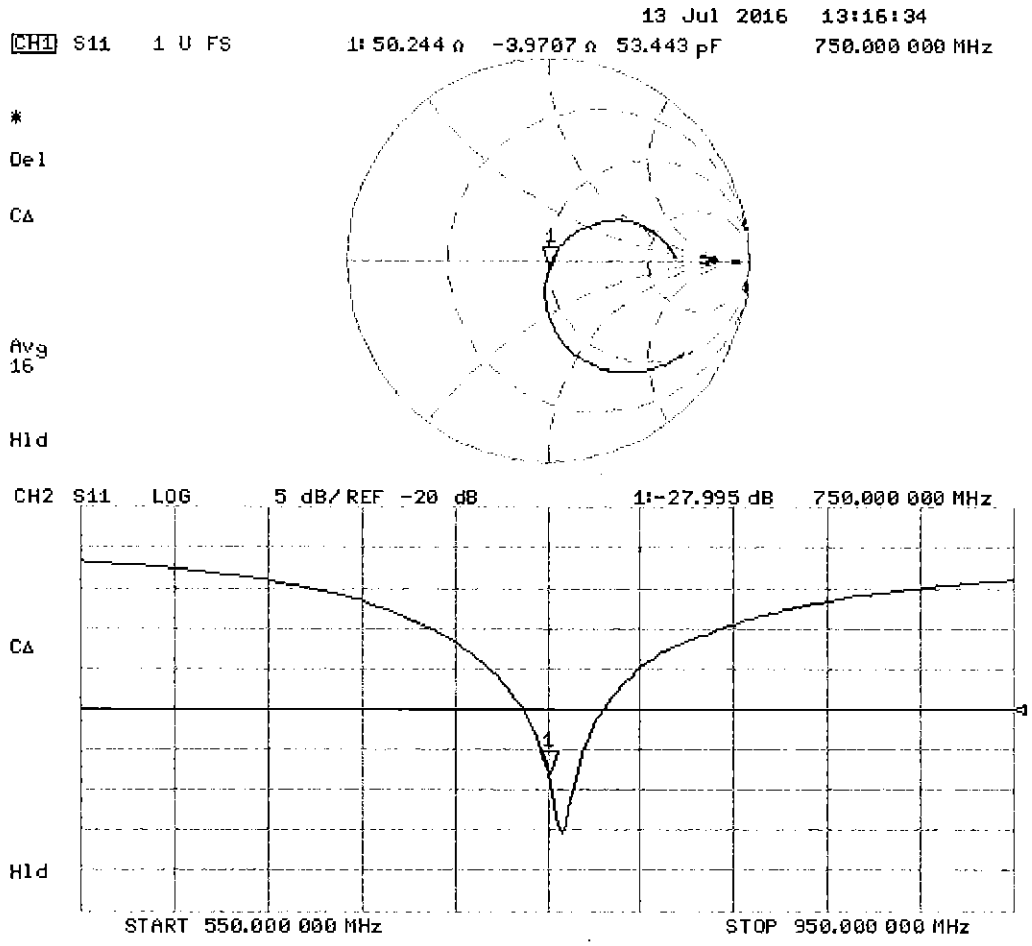
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.33 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.22 W/kg
SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.41 W/kg
Maximum value of SAR (measured) = 2.87 W/kg



0 dB = 2.87 W/kg = 4.58 dBW/kg

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
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Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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S Swiss Calibration Service

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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 0108

Client **PC Test**

Certificate No: D835V2-4d133_Jul16

CALIBRATION CERTIFICATE

Object	D835V2 - SN:4d133
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 14, 2016

BN ✓
07/27/2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: July 14, 2016

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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 ± 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 ± 0.2) °C	40.6 ± 6 %	0.94 mho/m ± 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	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.32 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.10 W/kg ± 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 ± 0.2) °C	54.9 ± 6 %	1.01 mho/m ± 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	2.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.50 W/kg ± 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	**6.20 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.5 Ω - 5.1 jΩ
Return Loss	- 25.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.4 Ω - 7.5 jΩ
Return Loss	- 21.3 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: 14.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

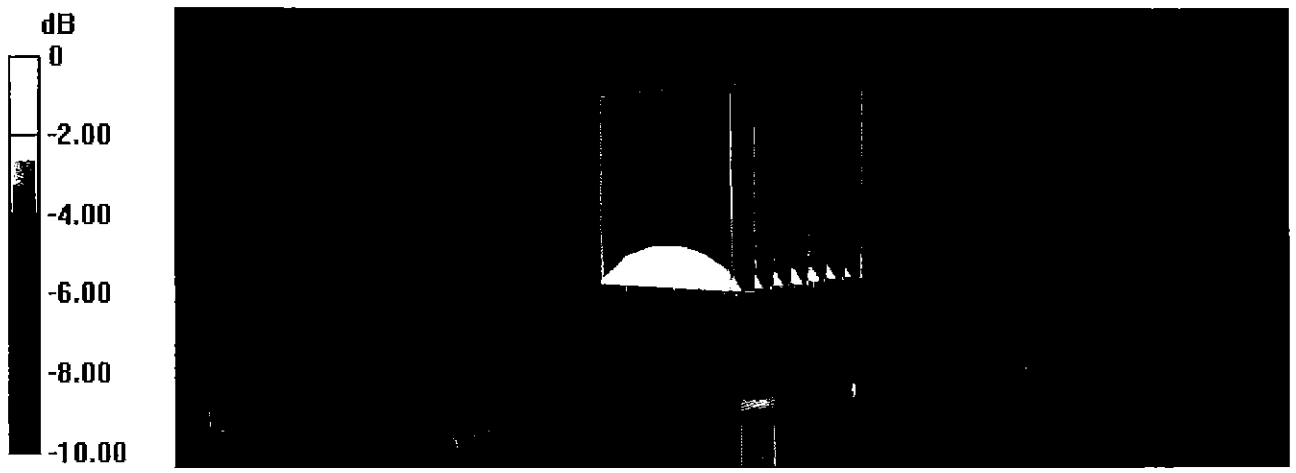
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.72, 9.72, 9.72); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

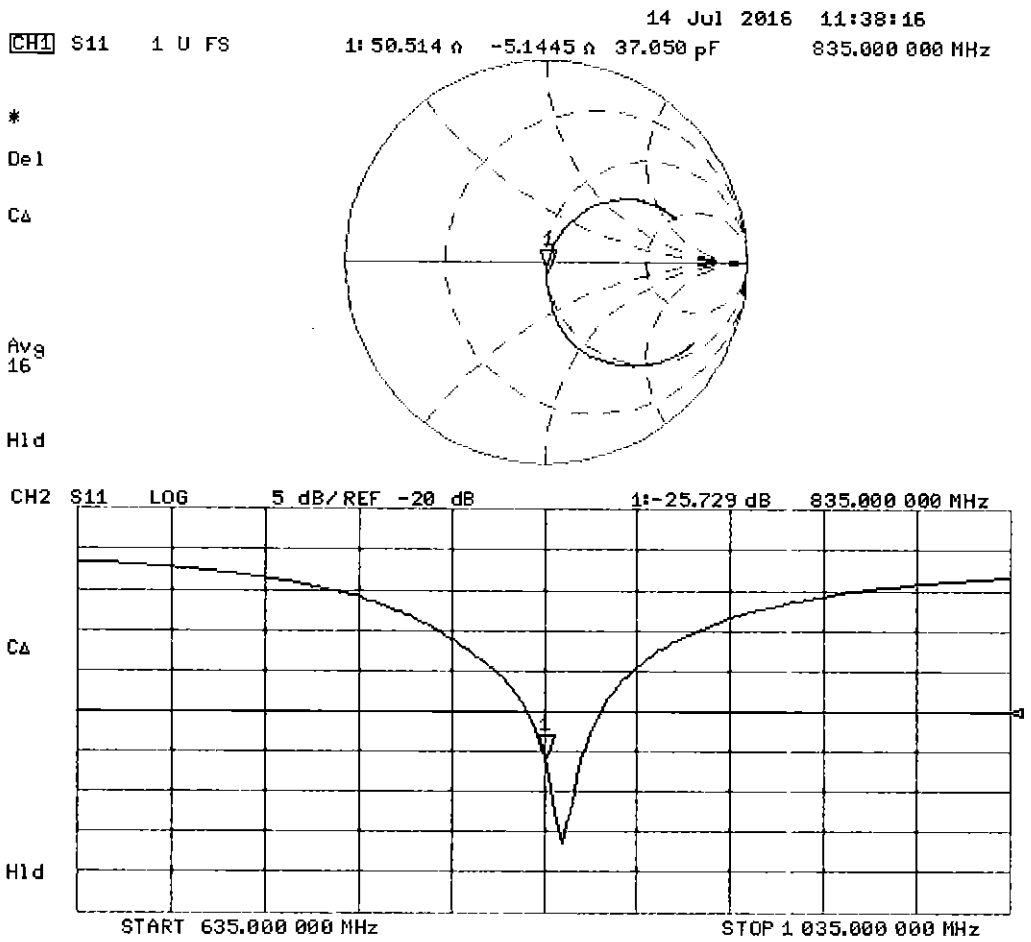
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 61.36 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.64 W/kg
SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 3.23 W/kg



0 dB = 3.23 W/kg = 5.09 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

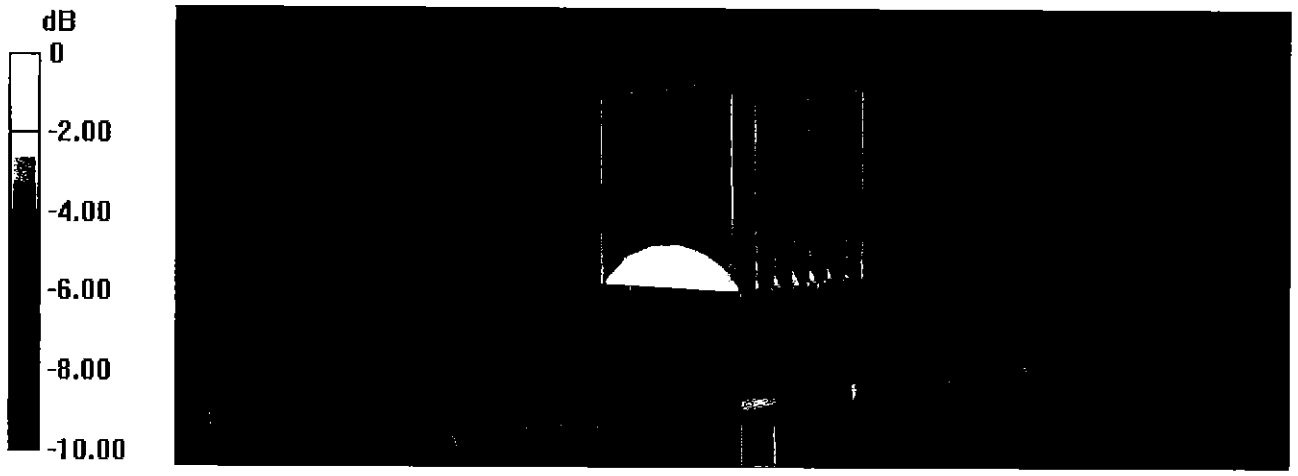
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.01 S/m; ε_r = 54.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.73, 9.73, 9.73); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

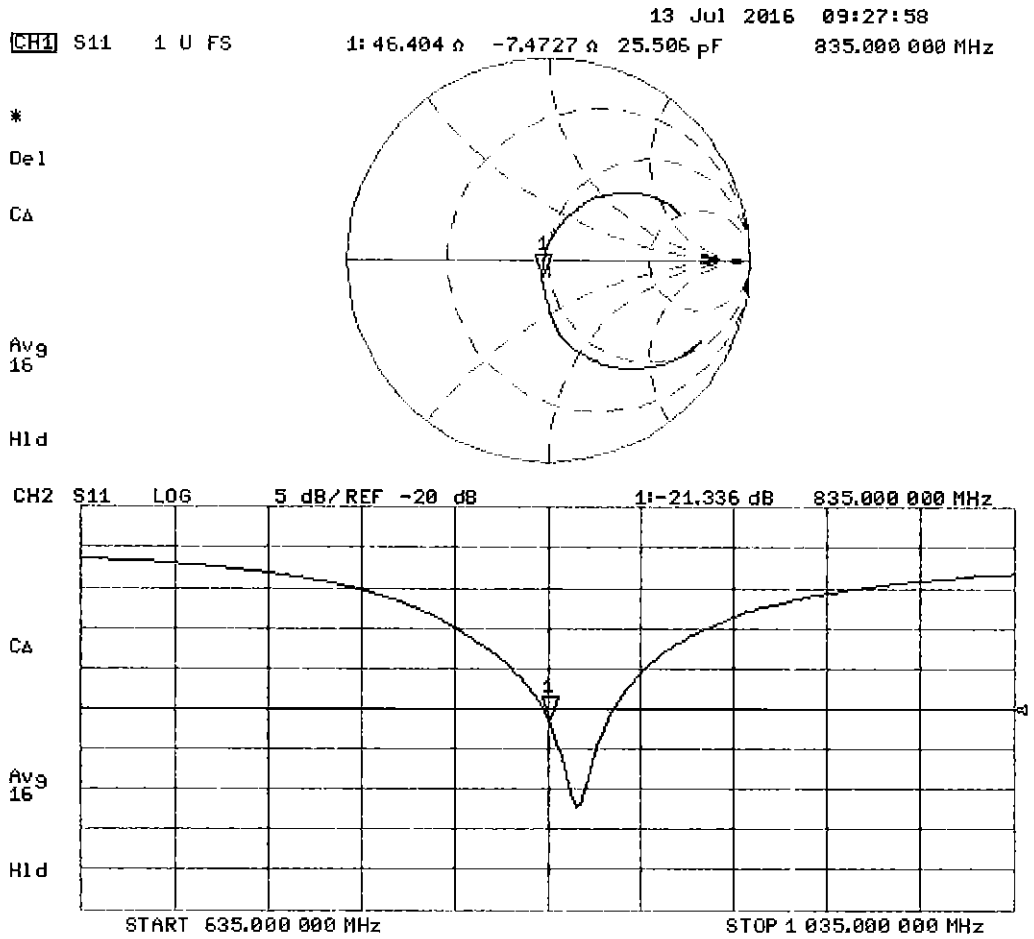
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 59.93 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.62 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 3.24 W/kg



0 dB = 3.24 W/kg = 5.11 dBW/kg

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1765V2-1008_May16

CALIBRATION CERTIFICATE

Object	D1765V2 - SN:1008
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 11, 2016

BNV 05/23/16

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M. Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 17, 2016

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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 ± 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 ± 0.2) °C	39.8 ± 6 %	1.36 mho/m ± 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	9.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.81 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.3 W/kg ± 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	1.50 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.8 ± 6 %	1.50 mho/m ± 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	9.30 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.8 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.8 Ω - 6.0 jΩ
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 6.8 jΩ
Return Loss	- 21.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.211 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2005

DASY5 Validation Report for Head TSL

Date: 11.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

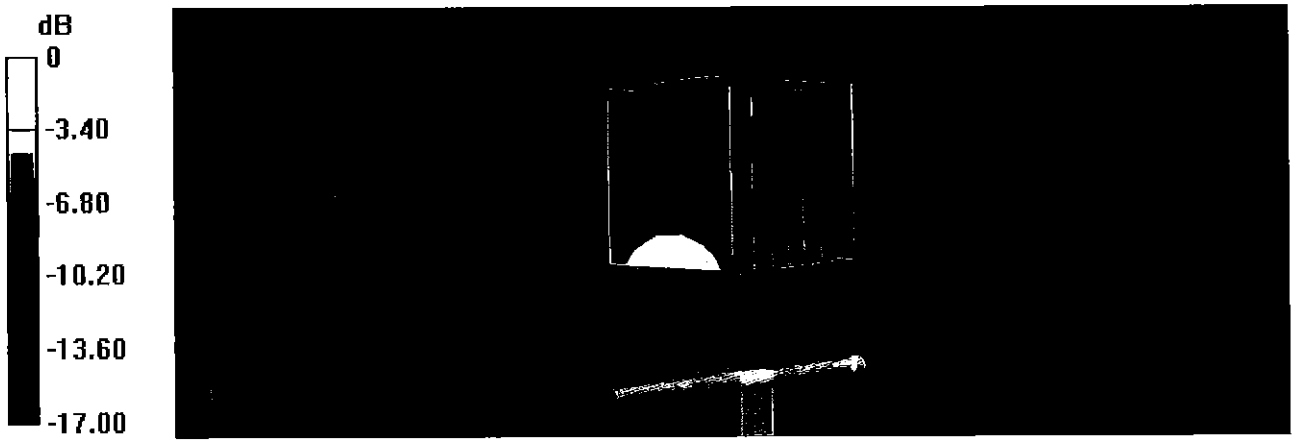
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.36 S/m; ε_r = 39.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.54, 8.54, 8.54); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

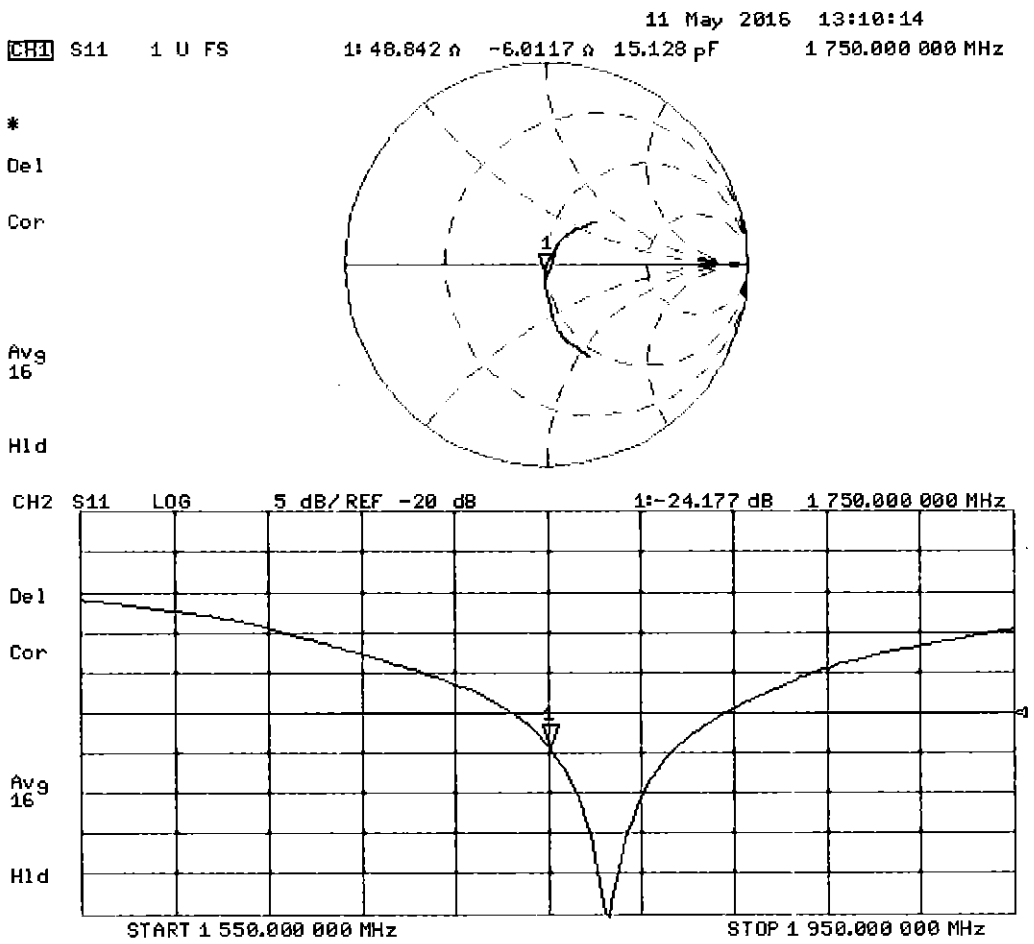
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 104.4 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 16.7 W/kg
SAR(1 g) = 9.1 W/kg; SAR(10 g) = 4.81 W/kg
Maximum value of SAR (measured) = 13.7 W/kg



0 dB = 13.7 W/kg = 11.37 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

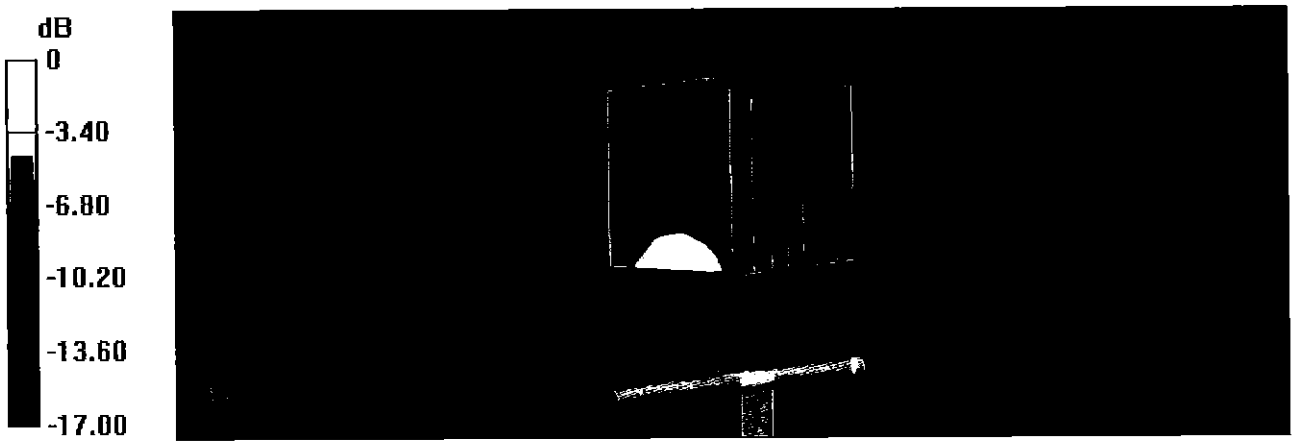
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.5 S/m; ε_r = 53.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.25, 8.25, 8.25); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

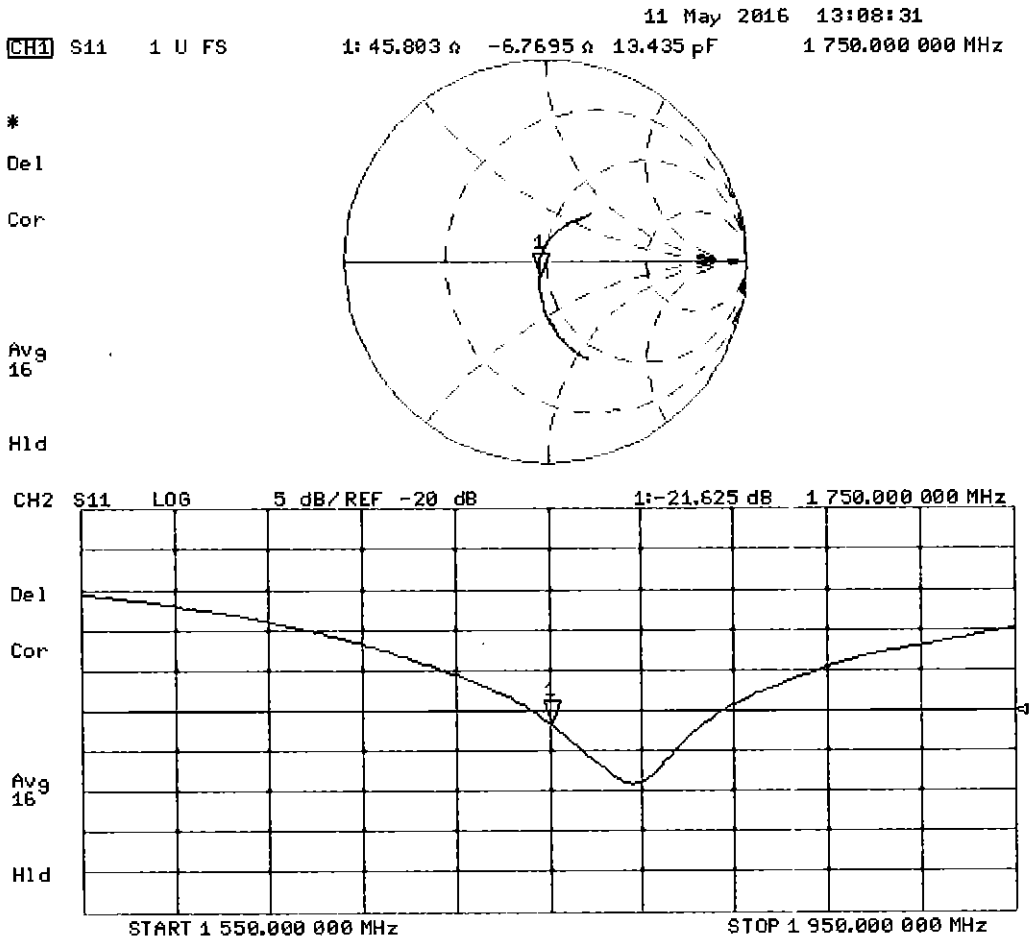
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.9 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 16.4 W/kg
SAR(1 g) = 9.3 W/kg; SAR(10 g) = 4.94 W/kg
Maximum value of SAR (measured) = 14.0 W/kg



0 dB = 14.0 W/kg = 11.46 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1900V2-5d149_Jul16

CALIBRATION CERTIFICATE

Object	D1900V2 - SN:5d149
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 15, 2016

BNV
07/27/2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 19, 2016

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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 ± 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 ± 0.2) °C	39.8 ± 6 %	1.38 mho/m ± 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	9.96 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.0 W/kg ± 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 ± 0.2) °C	52.7 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.95 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4 Ω + 5.5 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω + 7.0 jΩ
Return Loss	- 23.1 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: 15.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

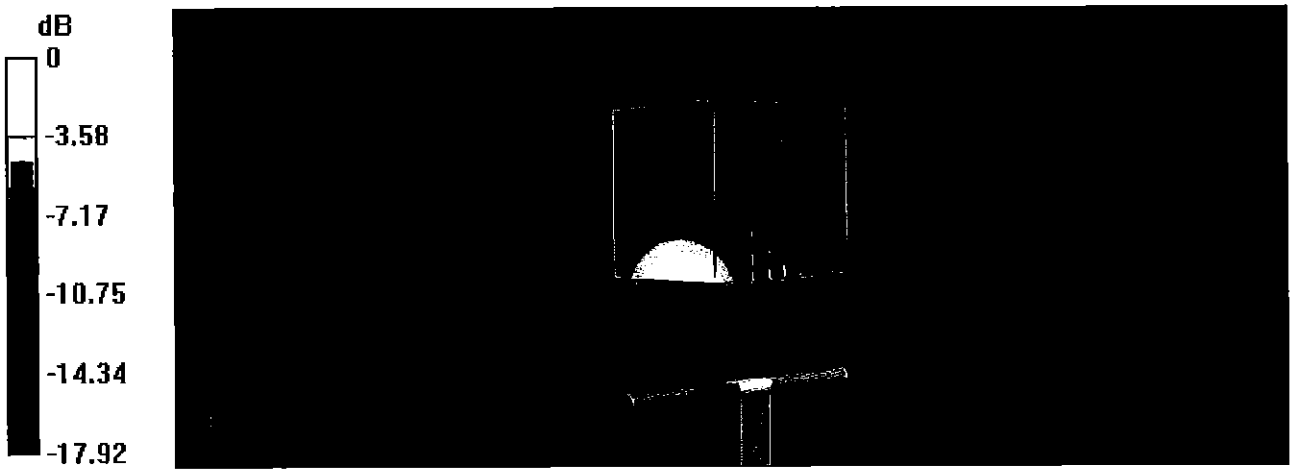
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.99, 7.99, 7.99); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

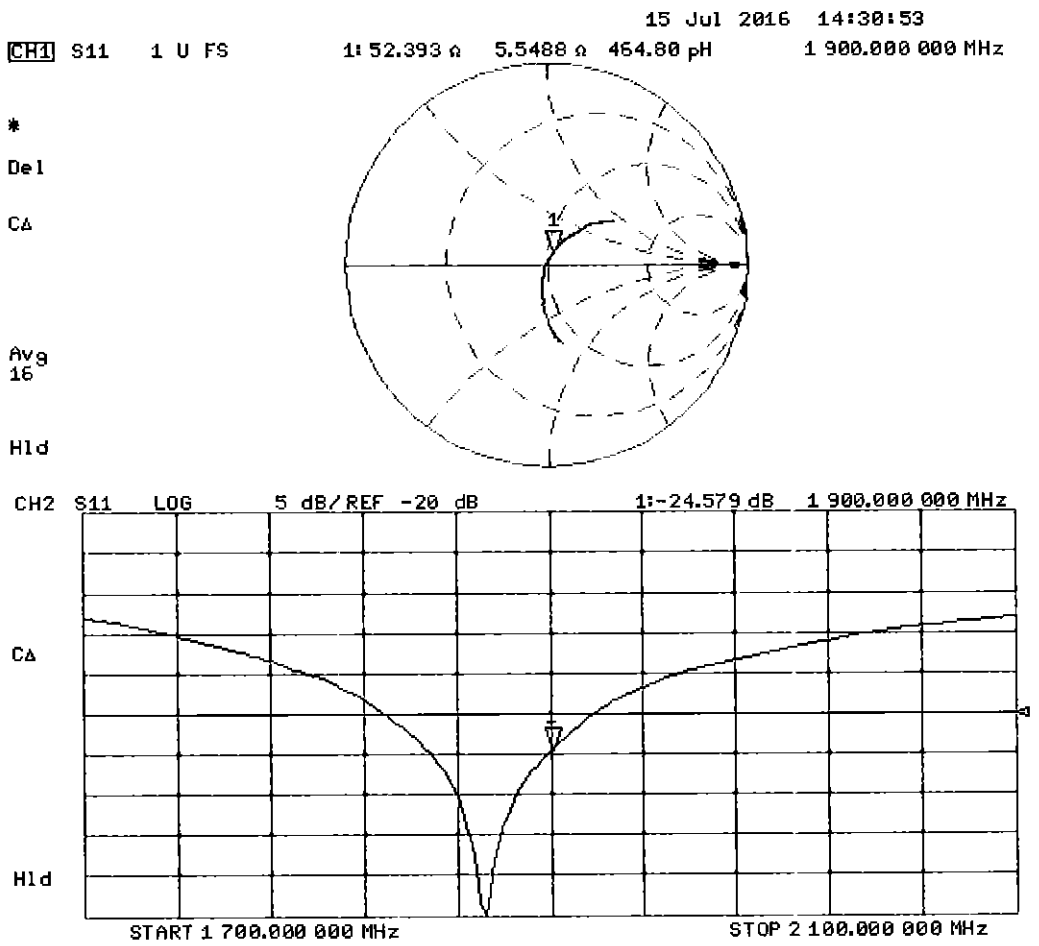
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 107.5 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 18.7 W/kg
SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.23 W/kg
Maximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

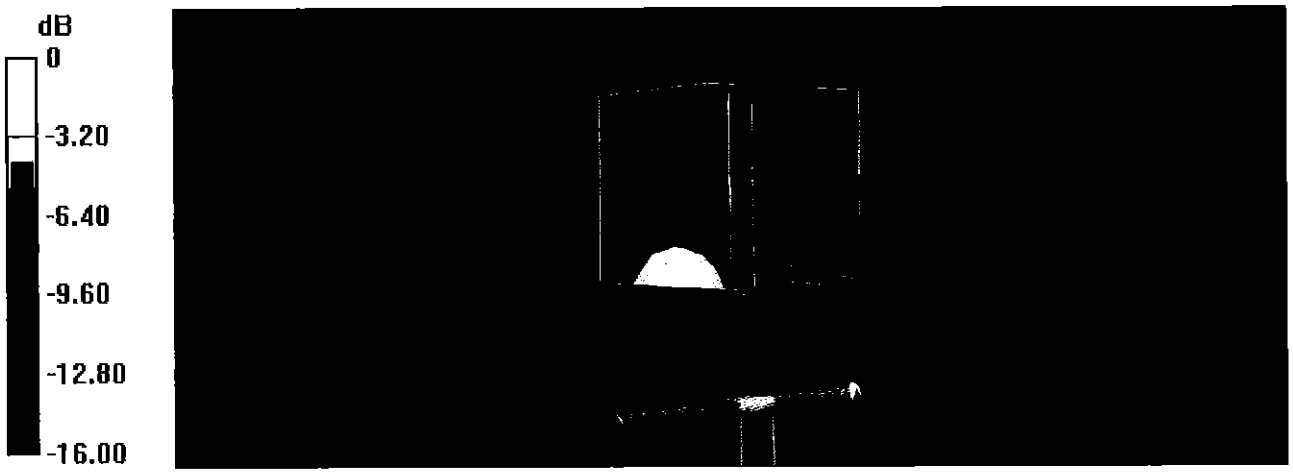
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.51 S/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.03, 8.03, 8.03); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7372)

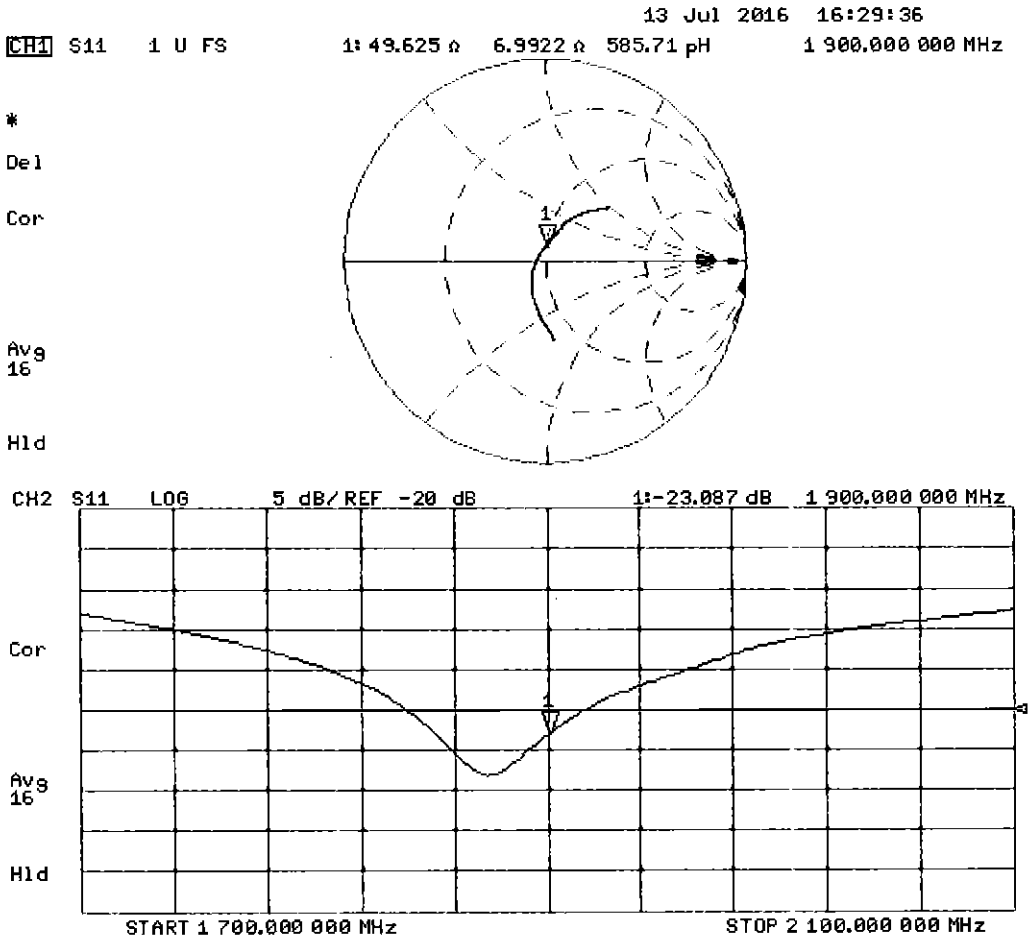
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.9 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 17.4 W/kg
SAR(1 g) = 9.95 W/kg; SAR(10 g) = 5.28 W/kg
Maximum value of SAR (measured) = 14.9 W/kg



0 dB = 14.9 W/kg = 11.73 dBW/kg

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D2450V2-797_Sep16

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:797
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	September 13, 2016

BNV 09-28-2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: September 13, 2016

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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 ± 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 ± 0.2) °C	37.9 ± 6 %	1.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.6 W/kg ± 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 ± 0.2) °C	51.6 ± 6 %	2.04 mho/m ± 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	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.2 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω + 6.0 jΩ
Return Loss	- 23.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.8 Ω + 8.0 jΩ
Return Loss	- 22.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 13.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

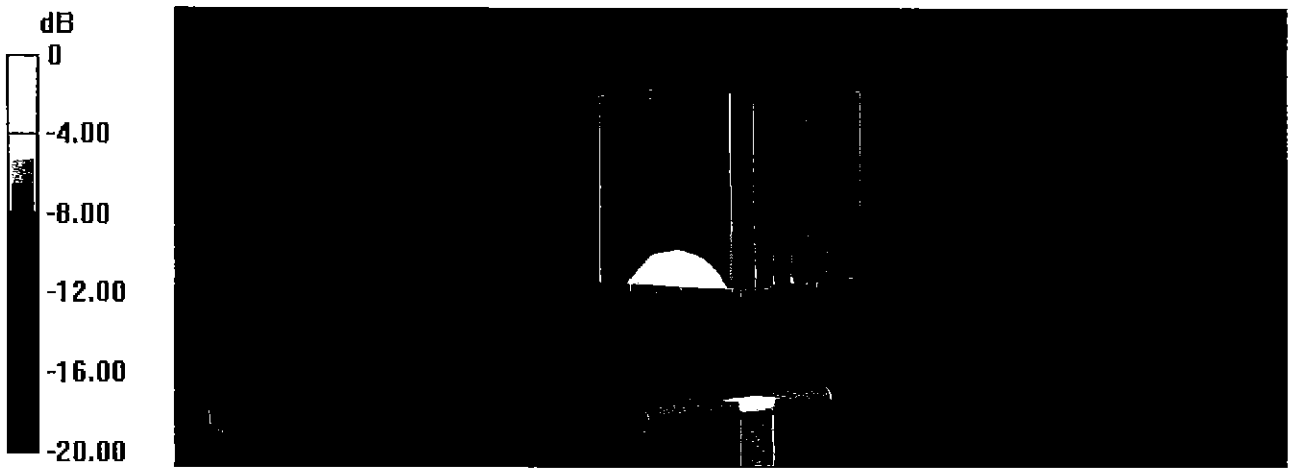
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.88 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.72, 7.72, 7.72); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

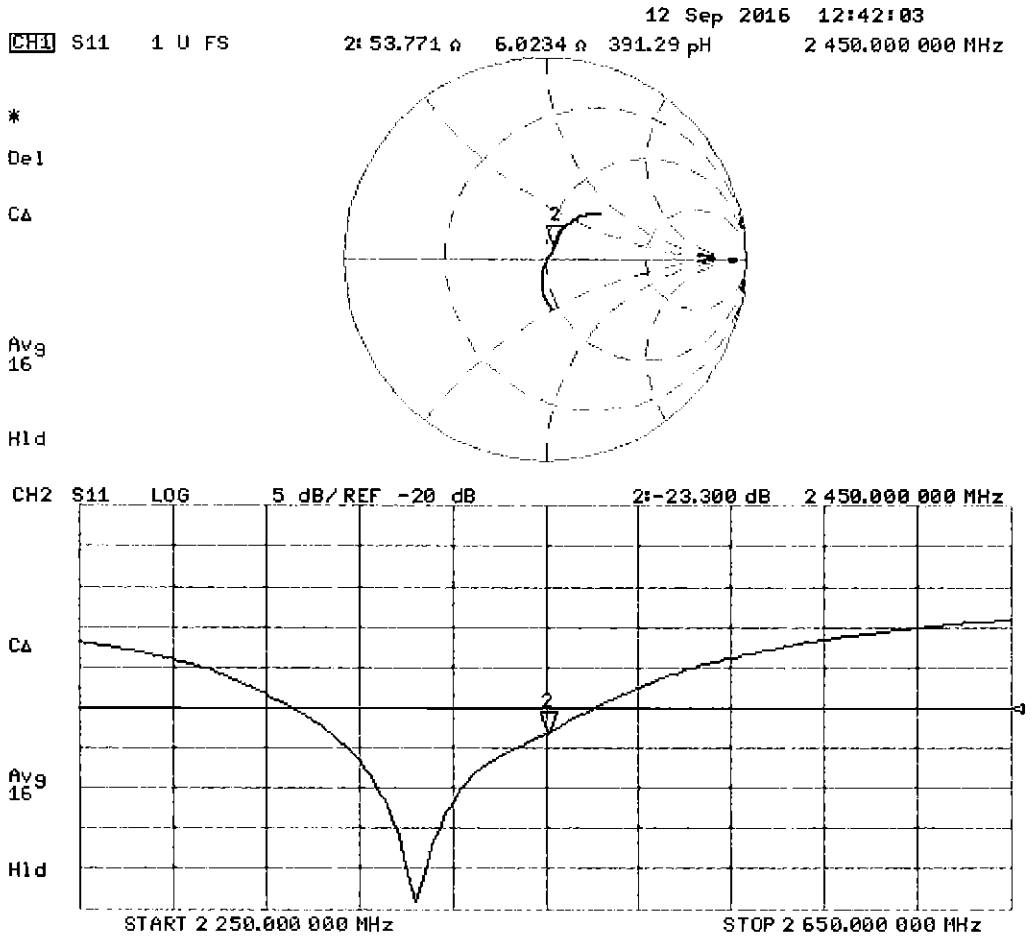
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 113.4 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.26 W/kg
Maximum value of SAR (measured) = 21.9 W/kg



0 dB = 21.9 W/kg = 13.40 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.04 S/m; ε_r = 51.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

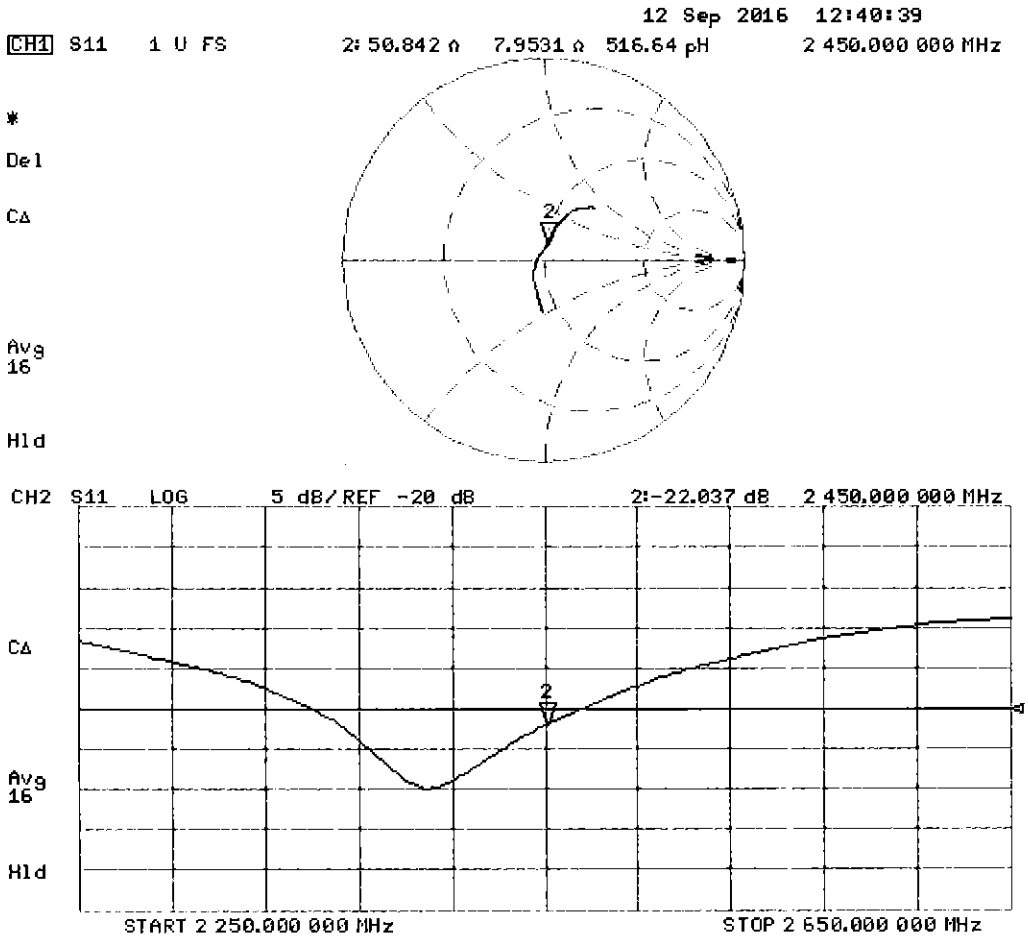
- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 106.5 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 25.6 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.13 W/kg
Maximum value of SAR (measured) = 21.2 W/kg

0 dB = 21.2 W/kg = 13.26 dBW/kg

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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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 0108

Client **PC Test**

Certificate No: D5GHzV2-1120_Feb17

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 13, 2017

BN ✓
03-01-2017

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	31-Dec-16 (No. EX3-3503_Dec16)	Dec-17
DAE4	SN: 601	04-Jan-17 (No. DAE4-601_Jan17)	Jan-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-16 (No. 217-02222)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-16 (No. 217-02222)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-16 (No. 217-02223)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

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

Issued: February 15, 2017

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.3 ± 6 %	4.50 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.6 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.85 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	8.64 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**85.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.99 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.4 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.9 ± 6 %	5.41 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 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	47.2 ± 6 %	5.87 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	7.76 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	6.07 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.74 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.4 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	51.8 Ω - 0.9 jΩ
Return Loss	- 34.2 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	58.5 Ω + 0.1 jΩ
Return Loss	- 22.1 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	53.4 Ω + 5.1 jΩ
Return Loss	- 24.5 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	51.3 Ω - 0.1 jΩ
Return Loss	- 37.9 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.7 Ω + 2.3 jΩ
Return Loss	- 21.7 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	53.6 Ω + 6.9 jΩ
Return Loss	- 22.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.207 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 08, 2011

DASY5 Validation Report for Head TSL

Date: 13.02.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1120

Communication System: UID 0 - CW;
Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 4.5 S/m; ε_r = 35.3; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.85 S/m; ε_r = 34.7; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 4.99 S/m; ε_r = 34.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

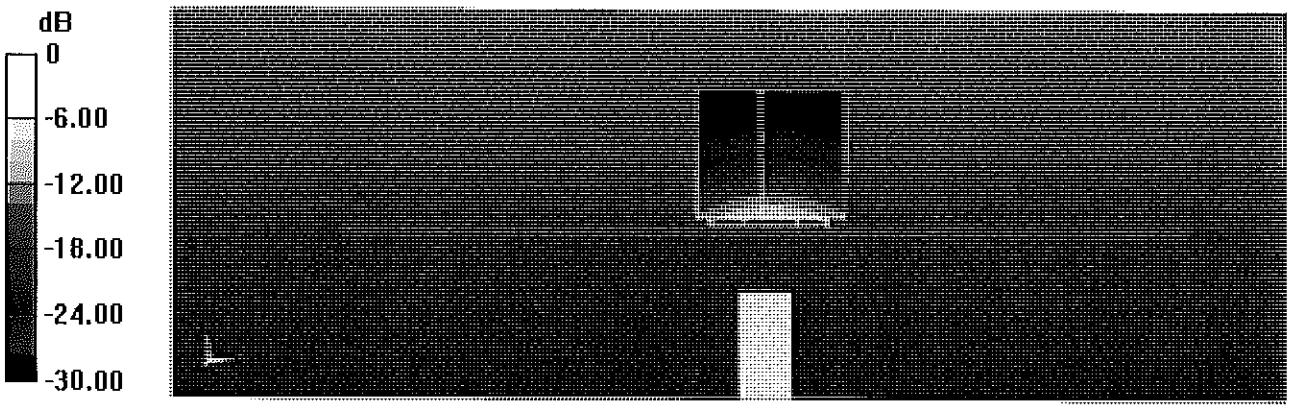
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.42, 5.42, 5.42); Calibrated: 31.12.2016, ConvF(4.94, 4.94, 4.94); Calibrated: 31.12.2016, ConvF(4.92, 4.92, 4.92); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.79 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 31.8 W/kg
SAR(1 g) = 8.36 W/kg; SAR(10 g) = 2.38 W/kg
Maximum value of SAR (measured) = 19.5 W/kg

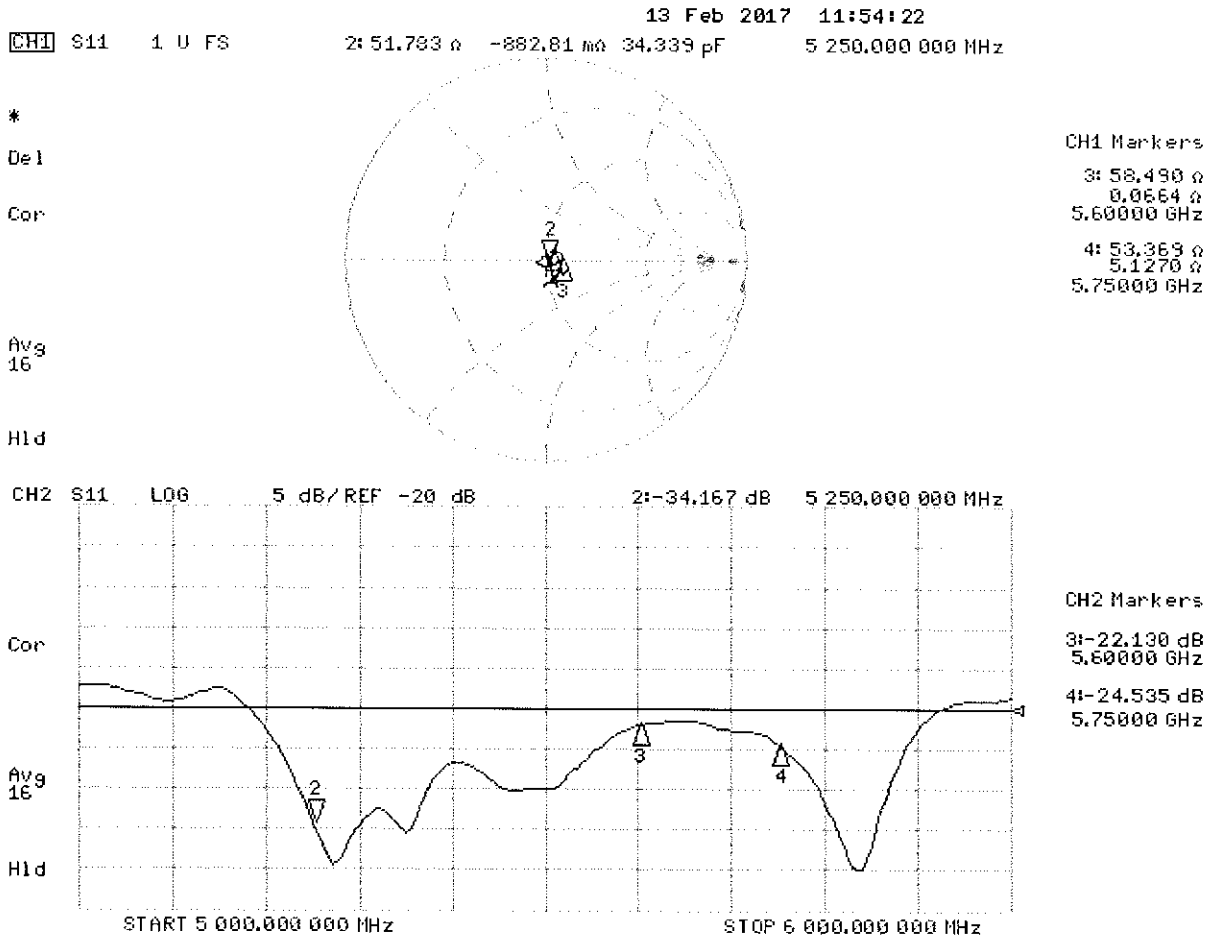
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.28 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 35.1 W/kg
SAR(1 g) = 8.64 W/kg; SAR(10 g) = 2.46 W/kg
Maximum value of SAR (measured) = 20.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.04 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 34.5 W/kg
SAR(1 g) = 8.24 W/kg; SAR(10 g) = 2.36 W/kg
Maximum value of SAR (measured) = 19.9 W/kg



0 dB = 19.5 W/kg = 12.90 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 10.02.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1120

Communication System: UID 0 - CW;
Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 5.41 S/m; ε_r = 47.9; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 5.87 S/m; ε_r = 47.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 6.07 S/m; ε_r = 47; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

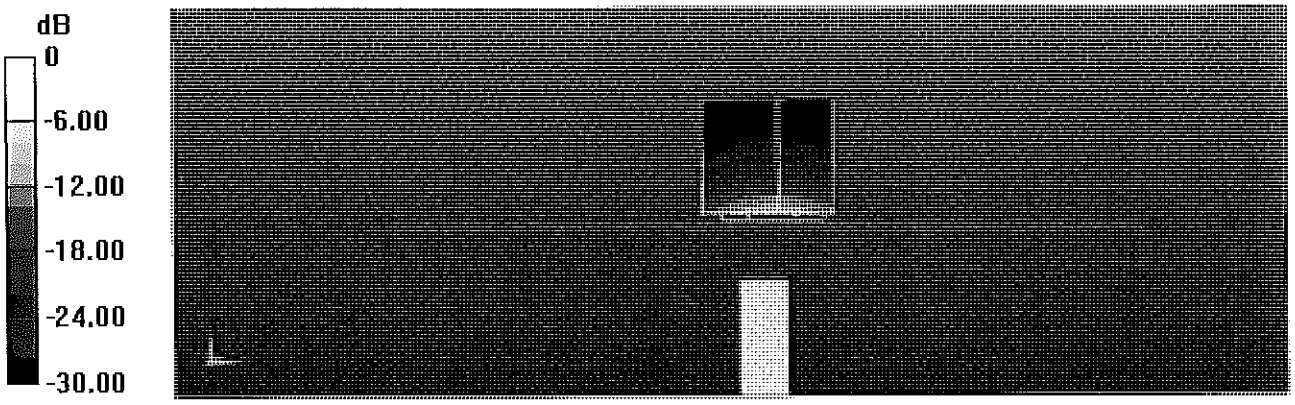
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.52, 4.52, 4.52); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.08 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 29.3 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR (measured) = 17.8 W/kg

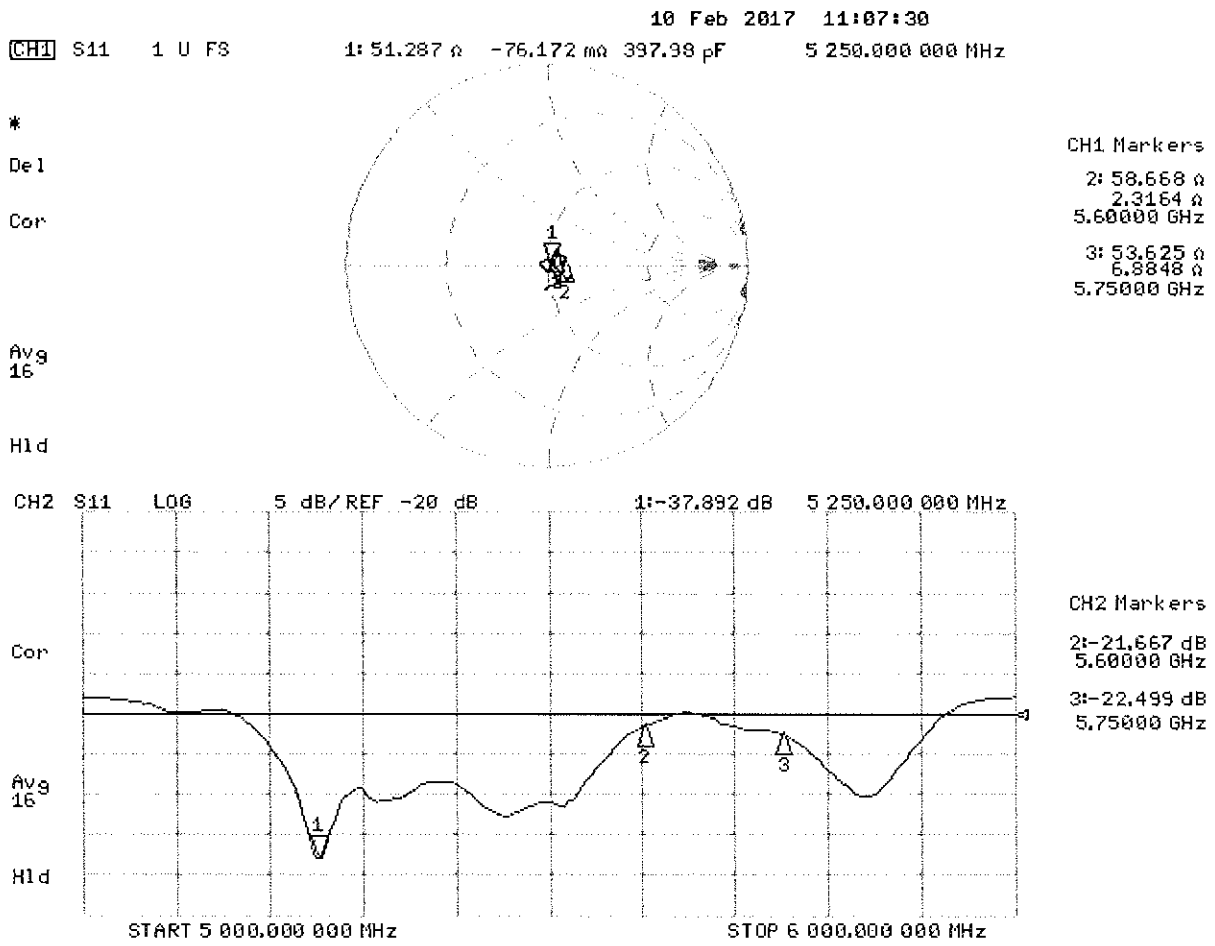
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.70 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 32.8 W/kg
SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.14 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 34.3 W/kg
SAR(1 g) = 7.74 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 17.8 W/kg = 12.50 dBW/kg

Impedance Measurement Plot for Body TSL



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

Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D750V3-1054_Mar17

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 07, 2017

BNV 03-27-2017

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	04-Jan-17 (No. DAE4-601_Jan17)	Jan-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Johannes Kurikka	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 14, 2017

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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	750 MHz ± 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 ± 0.2) °C	40.9 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.37 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.50 W/kg ± 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 ± 0.2) °C	54.6 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.61 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.68 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.7 Ω - 0.7 jΩ
Return Loss	- 26.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.7 Ω - 3.6 jΩ
Return Loss	- 28.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 08, 2011

DASY5 Validation Report for Head TSL

Date: 07.03.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

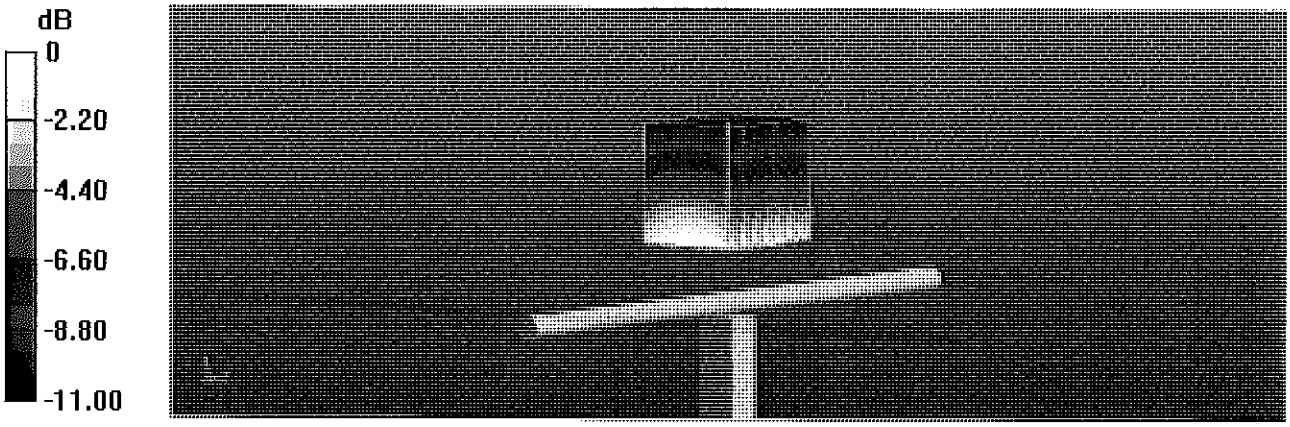
Communication System: UID 0 - CW ; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.91 S/m; ε_r = 40.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.17, 10.17, 10.17); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

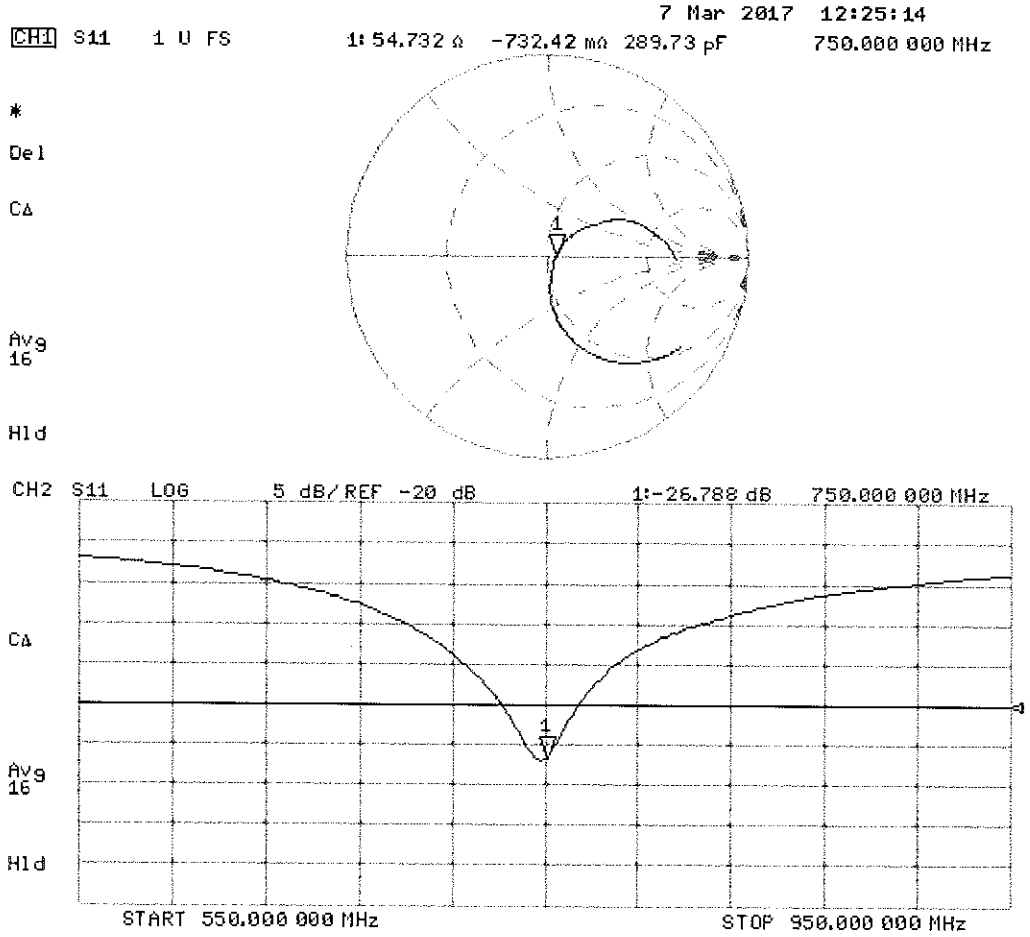
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 59.71 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.21 W/kg
SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.4 W/kg
Maximum value of SAR (measured) = 2.85 W/kg



0 dB = 2.85 W/kg = 4.55 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.03.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

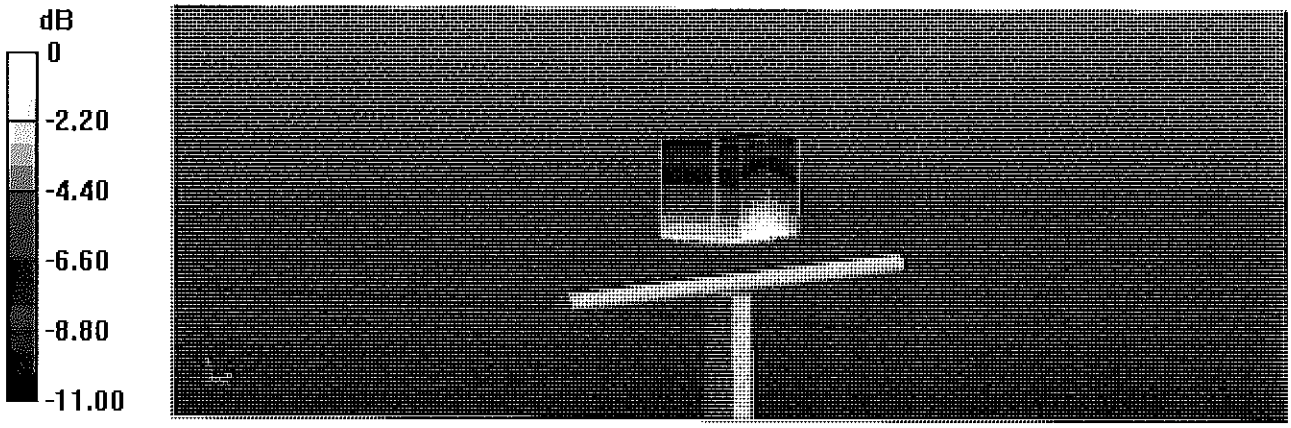
Communication System: UID 0 - CW ; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.99 S/m; ε_r = 54.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.99, 9.99, 9.99); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

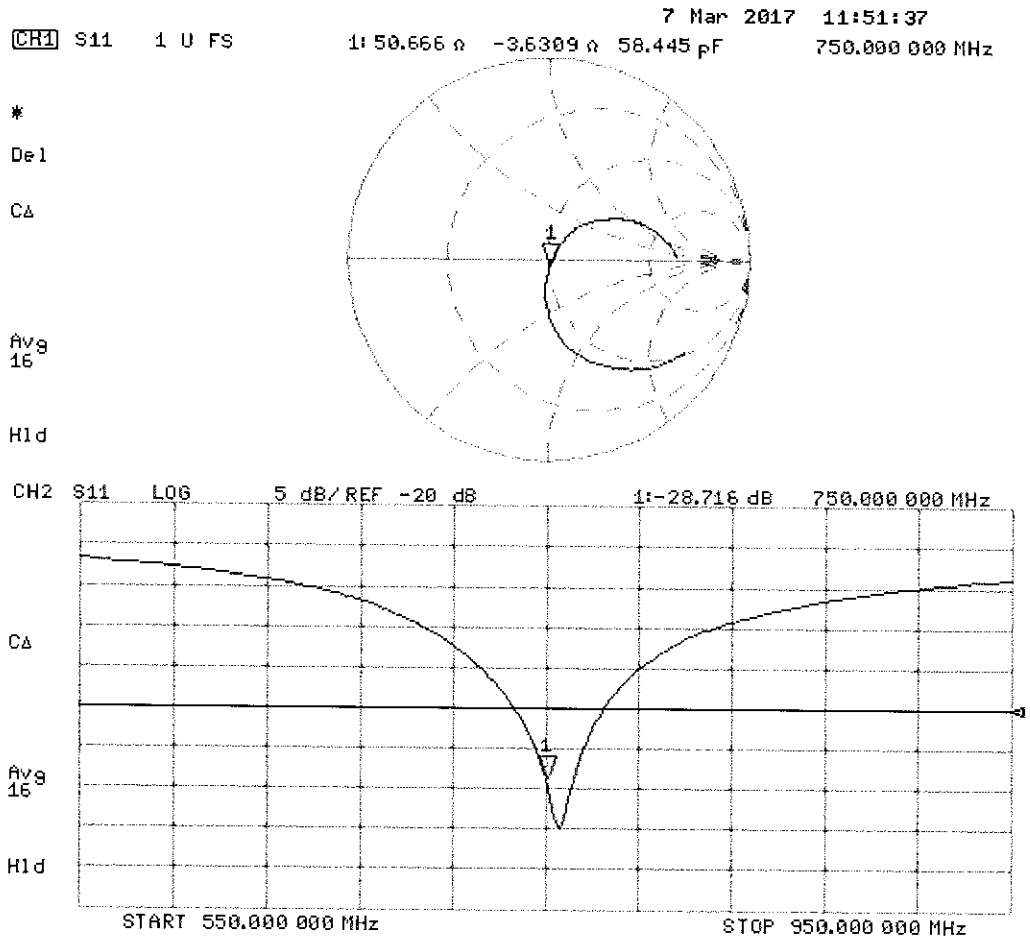
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.88 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.31 W/kg
SAR(1 g) = 2.21 W/kg; SAR(10 g) = 1.45 W/kg
Maximum value of SAR (measured) = 2.94 W/kg



0 dB = 2.94 W/kg = 4.68 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1750V2-1148_May16

CALIBRATION CERTIFICATE

Object	D1750V2 - SN: 1148
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 09, 2016

BN ✓
5/17/2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M. Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 11, 2016

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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 ± 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 ± 0.2) °C	39.7 ± 6 %	1.36 mho/m ± 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	9.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.1 W/kg ± 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 ± 0.2) °C	53.8 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.30 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.93 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.7 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.9 Ω - 0.7 jΩ
Return Loss	- 43.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2 Ω - 1.4 jΩ
Return Loss	- 27.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.221 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 30, 2014

DASY5 Validation Report for Head TSL

Date: 09.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1148

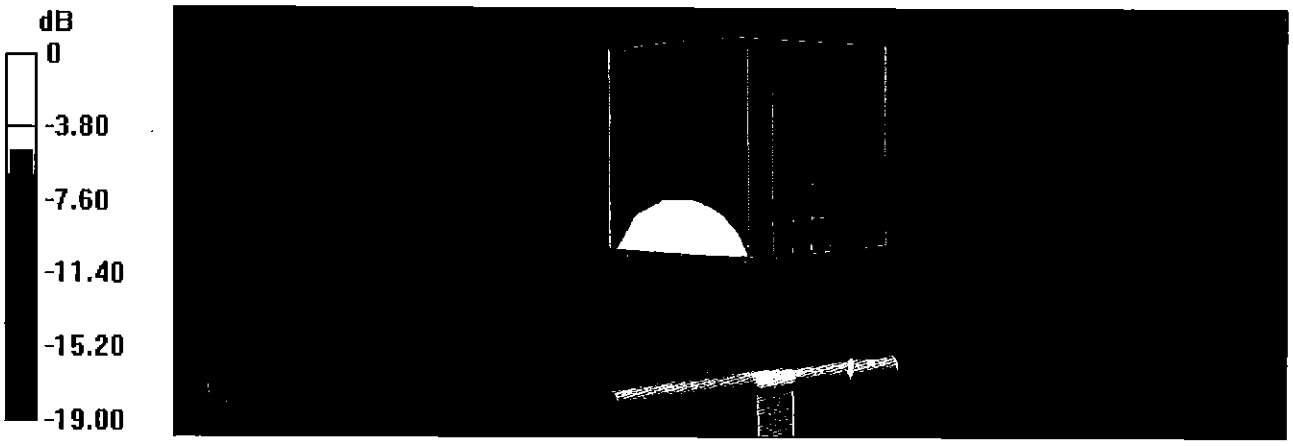
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.36 S/m; ε_r = 39.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.54, 8.54, 8.54); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

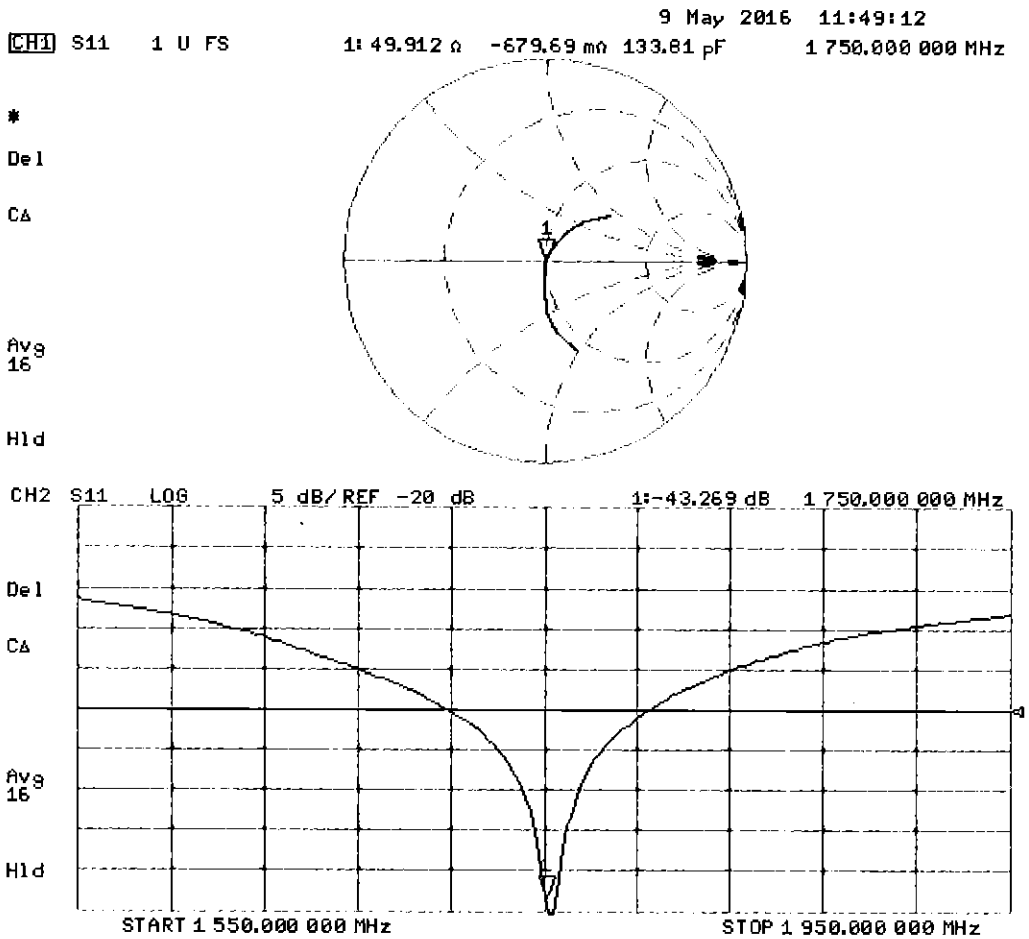
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 103.5 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 16.7 W/kg
SAR(1 g) = 9.03 W/kg; SAR(10 g) = 4.78 W/kg
Maximum value of SAR (measured) = 13.6 W/kg



0 dB = 13.6 W/kg = 11.34 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 09.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1148

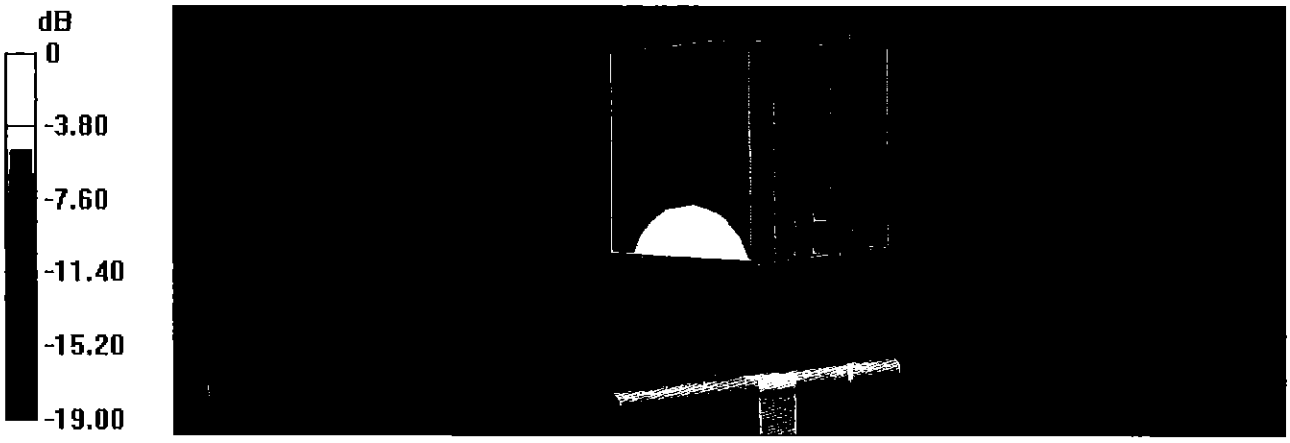
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.5 S/m; ε_r = 53.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.25, 8.25, 8.25); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

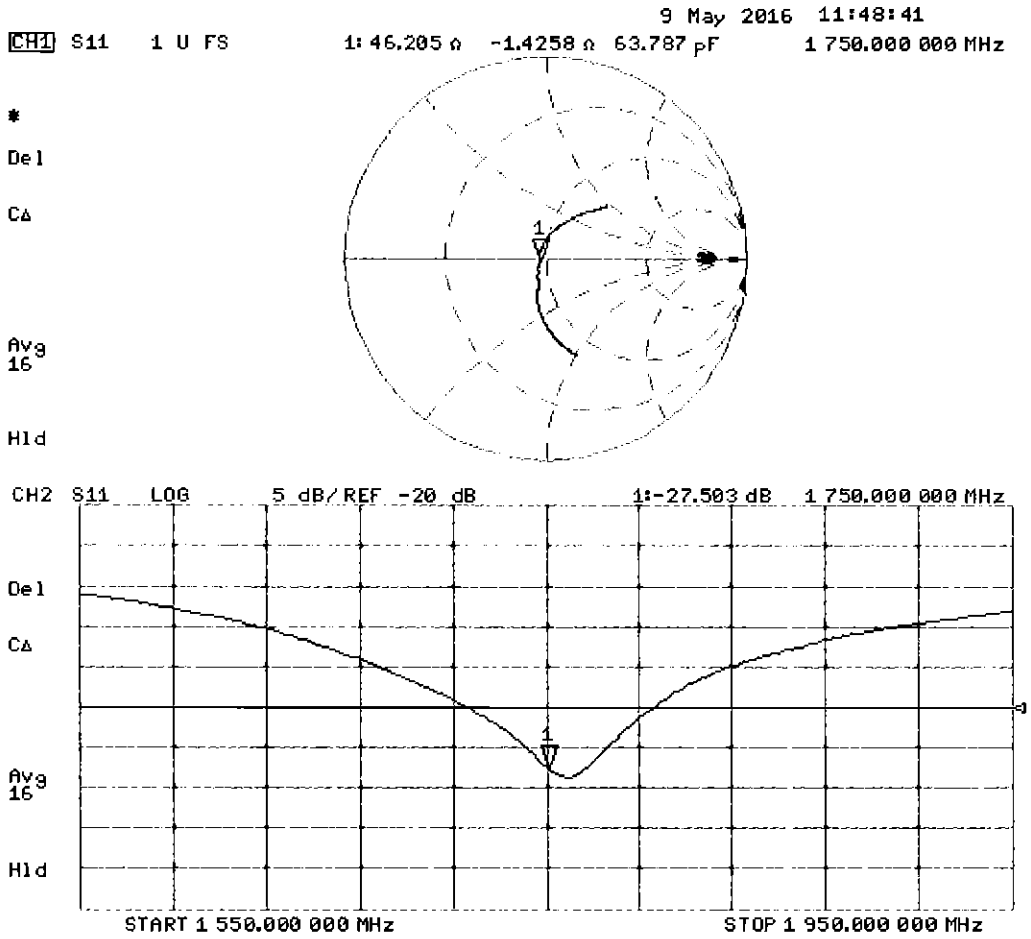
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.0 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 16.6 W/kg
SAR(1 g) = 9.3 W/kg; SAR(10 g) = 4.93 W/kg
Maximum value of SAR (measured) = 14.1 W/kg



0 dB = 14.1 W/kg = 11.49 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D1900V2-5d080_Jul16

CALIBRATION CERTIFICATE

Object	D1900V2 - SN:5d080
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 08, 2016

BN ✓
7/16/2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: July 13, 2016

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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 ± 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 ± 0.2) °C	39.8 ± 6 %	1.38 mho/m ± 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	9.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.5 W/kg ± 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 ± 0.2) °C	52.7 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.7 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 Ω + 5.3 jΩ
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.4 Ω + 6.8 jΩ
Return Loss	- 22.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.192 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 28, 2006

DASY5 Validation Report for Head TSL

Date: 08.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

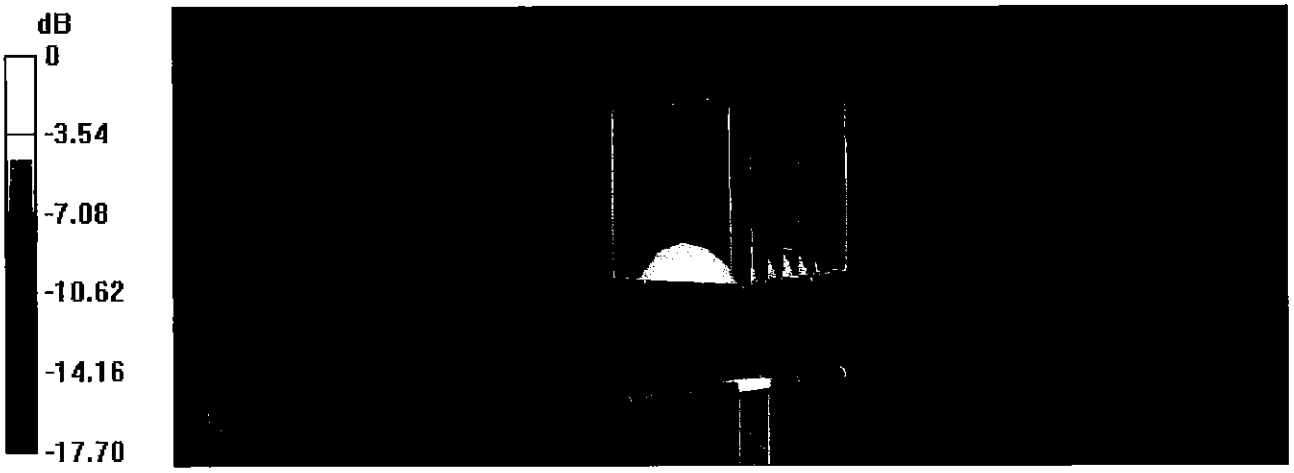
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.99, 7.99, 7.99); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

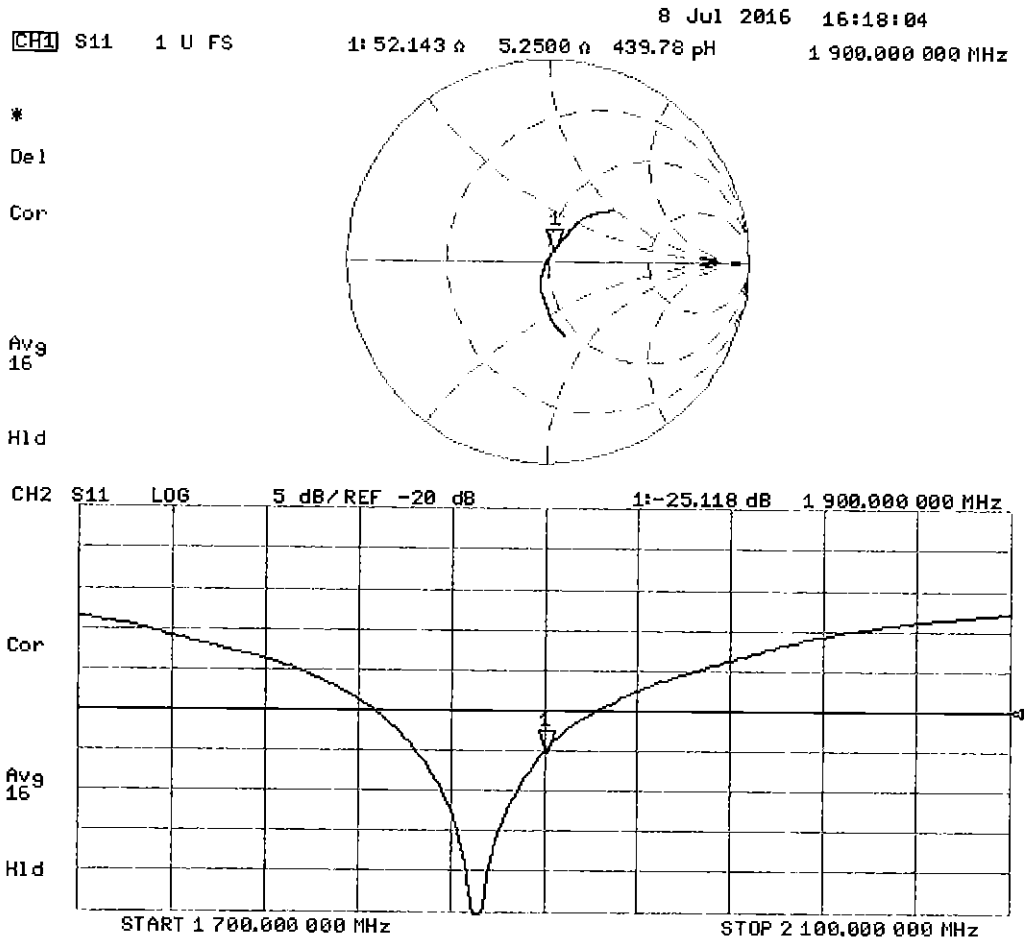
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.6 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 18.4 W/kg
SAR(1 g) = 9.76 W/kg; SAR(10 g) = 5.1 W/kg
Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.76 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 08.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.51 S/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

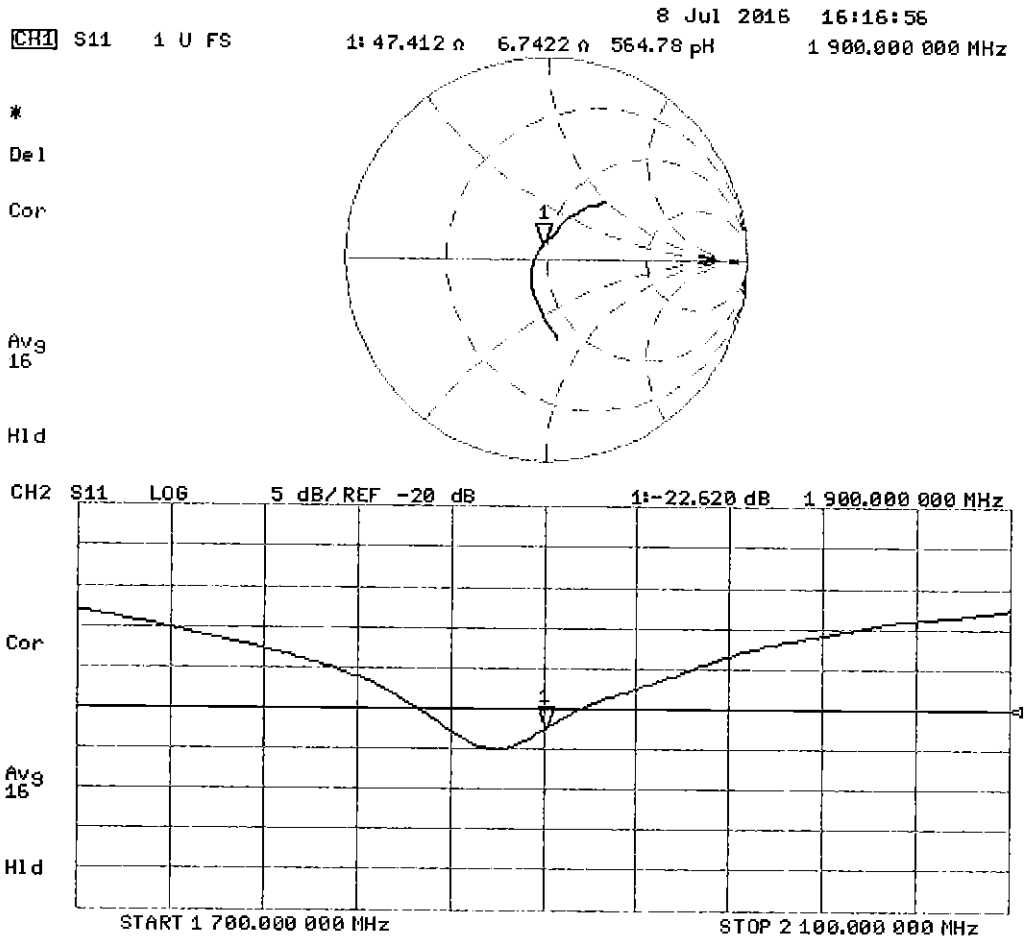
- Probe: EX3DV4 - SN7349; ConvF(8.03, 8.03, 8.03); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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 = 103.1 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 17.1 W/kg
SAR(1 g) = 9.75 W/kg; SAR(10 g) = 5.17 W/kg
Maximum value of SAR (measured) = 14.7 W/kg

0 dB = 14.7 W/kg = 11.67 dBW/kg

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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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 0108**

Client **PC Test**

Certificate No: **D5GHzV2-1237_Aug16**

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN:1237
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	August 02, 2016

vPT
8/9/16

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	30-Jun-16 (No. EX3-3503_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 4, 2016

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.52 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 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	33.9 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.3 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.9 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.7 ± 6 %	5.02 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.2 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.42 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.54 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	5.88 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.76 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	6.11 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	48.6 Ω - 2.5 jΩ
Return Loss	- 30.7 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	50.9 Ω + 1.5 jΩ
Return Loss	- 35.3 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	53.8 Ω + 5.8 jΩ
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	47.0 Ω - 3.9 jΩ
Return Loss	- 25.9 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	51.5 Ω + 3.9 jΩ
Return Loss	- 27.7 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	53.8 Ω + 0.3 jΩ
Return Loss	- 28.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.193 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	May 04, 2015

DASY5 Validation Report for Head TSL

Date: 02.08.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 4.52 S/m; ε_r = 34.4; ρ = 1000 kg/m^3
Medium parameters used: f = 5600 MHz; σ = 4.86 S/m; ε_r = 33.9; ρ = 1000 kg/m^3
Medium parameters used: f = 5750 MHz; σ = 5.02 S/m; ε_r = 33.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

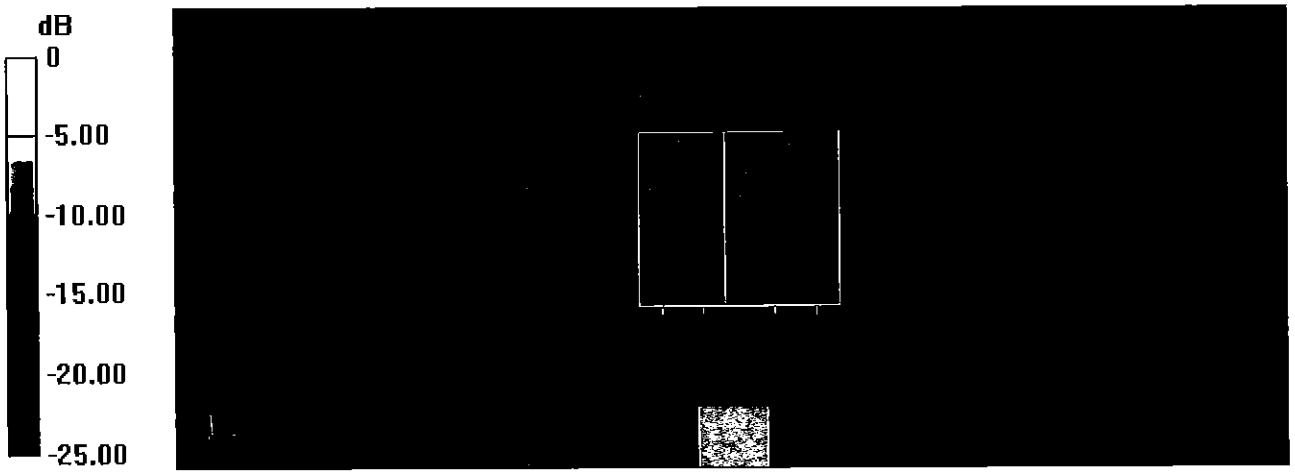
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.42, 5.42, 5.42); Calibrated: 30.06.2016; ConvF(4.89, 4.89, 4.89); Calibrated: 30.06.2016, ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 74.10 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 29.5 W/kg
SAR(1 g) = 8 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (measured) = 18.3 W/kg

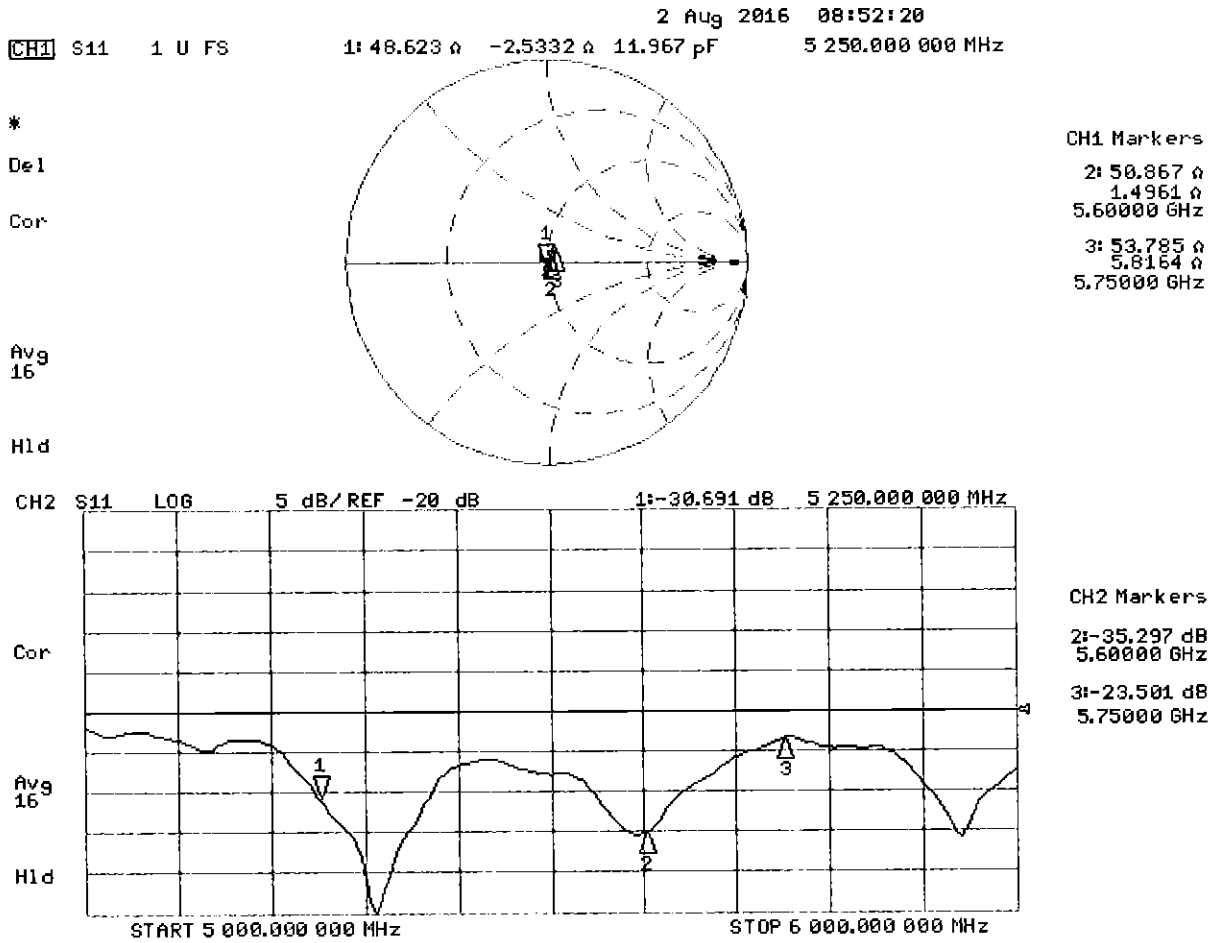
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.55 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 32.9 W/kg
SAR(1 g) = 8.43 W/kg; SAR(10 g) = 2.42 W/kg
Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.23 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 33.6 W/kg
SAR(1 g) = 8.25 W/kg; SAR(10 g) = 2.35 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 18.3 W/kg = 12.62 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 02.08.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 5.42 S/m; ε_r = 47.1; ρ = 1000 kg/m^3
Medium parameters used: f = 5600 MHz; σ = 5.88 S/m; ε_r = 46.5; ρ = 1000 kg/m^3
Medium parameters used: f = 5750 MHz; σ = 6.11 S/m; ε_r = 46.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

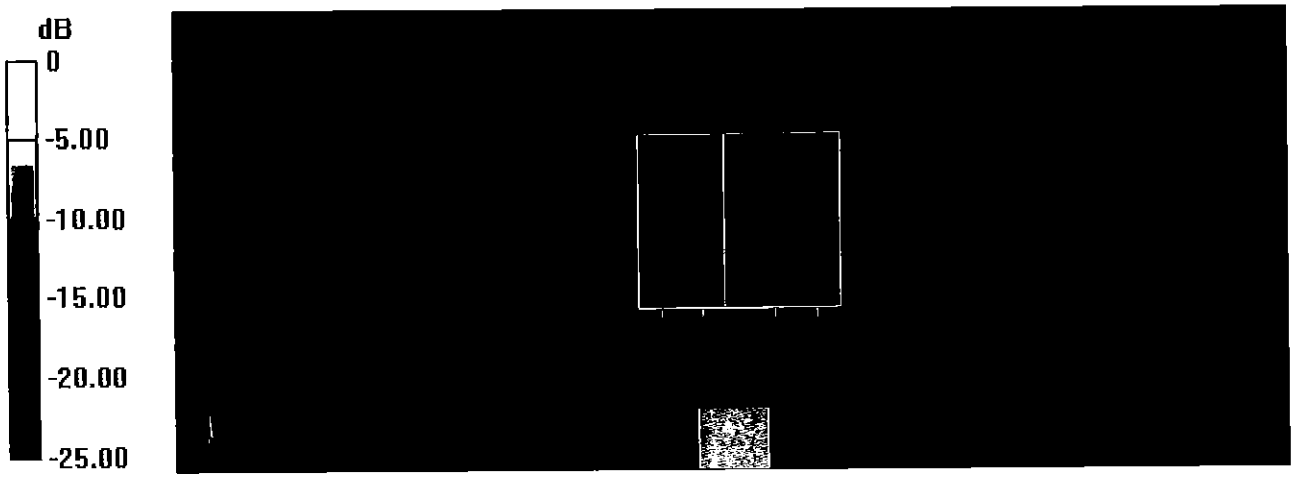
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016, ConvF(4.35, 4.35, 4.35); Calibrated: 30.06.2016, ConvF(4.3, 4.3, 4.3); Calibrated: 30.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.19 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 28.4 W/kg
SAR(1 g) = 7.54 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR (measured) = 17.3 W/kg

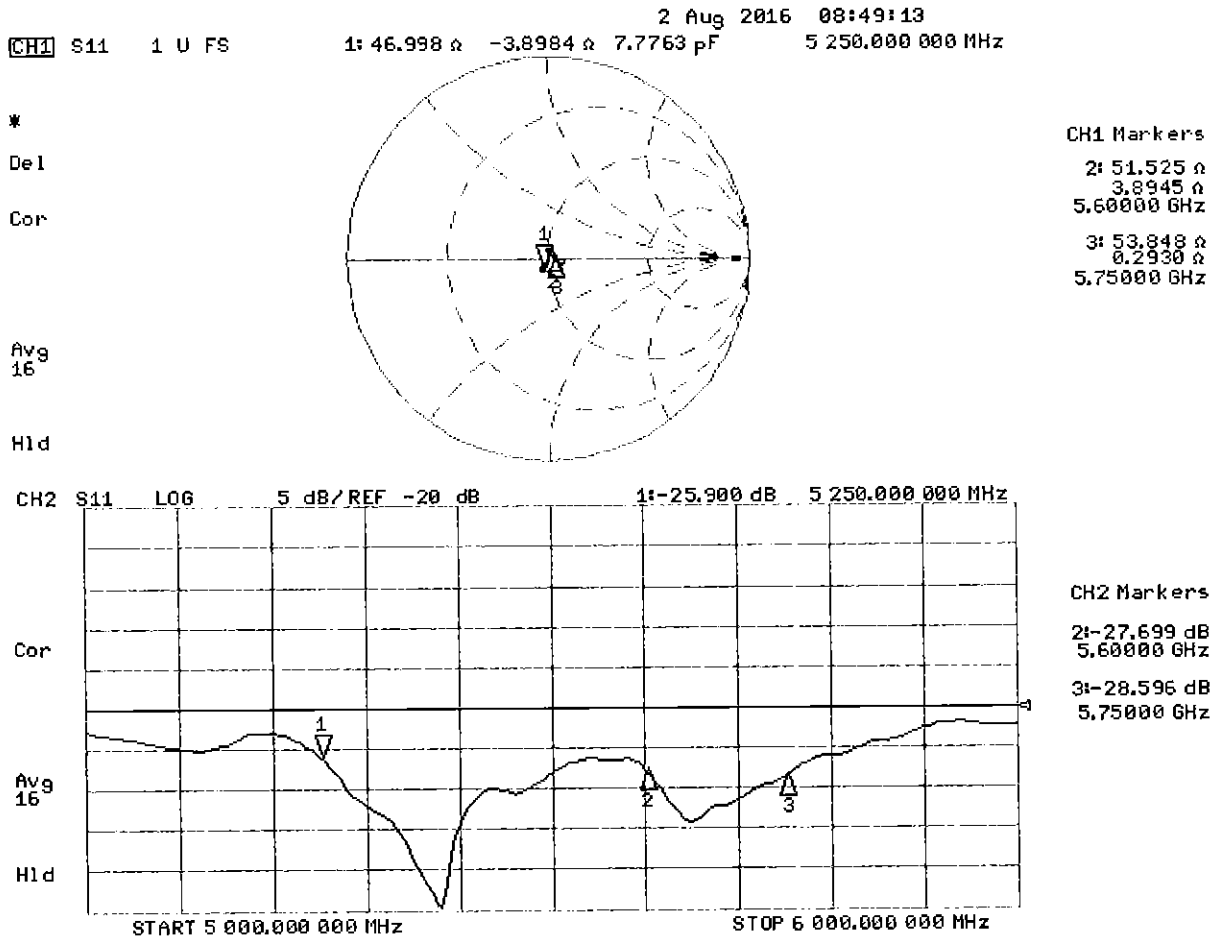
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.80 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 18.3 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.31 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.6 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 18.4 W/kg



0 dB = 17.3 W/kg = 12.38 dBW/kg

Impedance Measurement Plot for Body TSL



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S Schweizerischer Kalibrierdienst
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S Swiss Calibration Service

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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 0108

Client **PC Test**

Certificate No: D1750V2-1051_Apr17

CALIBRATION CERTIFICATE

Object	D1750V2 - SN:1051
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 12, 2017

BNV
5-3-2017

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 NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 12, 2017

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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	V52.10.0
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 ± 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 ± 0.2) °C	39.1 ± 6 %	1.37 mho/m ± 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	9.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.86 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.4 W/kg ± 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 ± 0.2) °C	52.4 ± 6 %	1.49 mho/m ± 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	9.31 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.98 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.9 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.3 Ω + 1.1 jΩ
Return Loss	- 35.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.4 Ω + 1.5 jΩ
Return Loss	- 30.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.221 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	February 19, 2010

DASY5 Validation Report for Head TSL

Date: 12.04.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

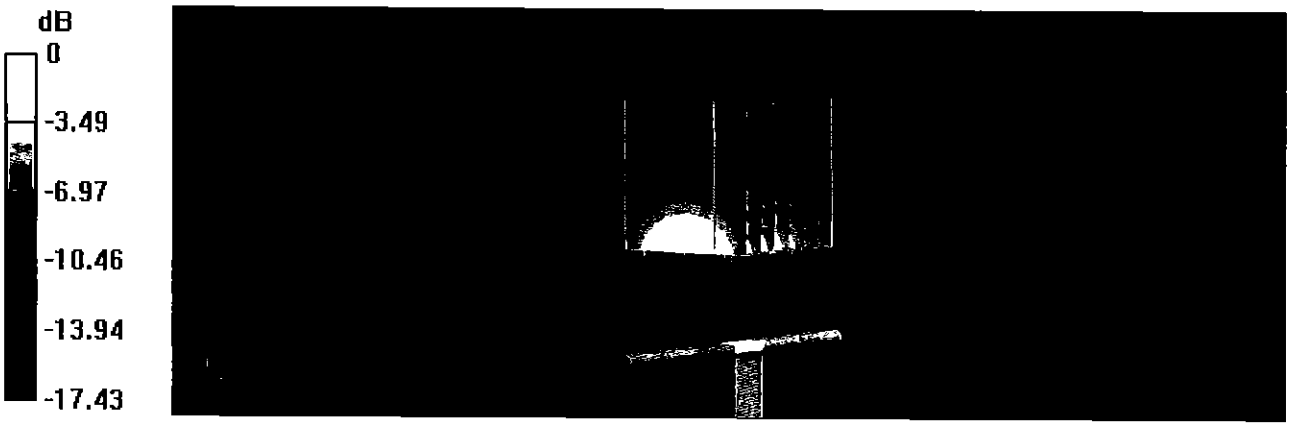
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.37 S/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.46, 8.46, 8.46); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1442); SEMCAD X 14.6.10(7413)

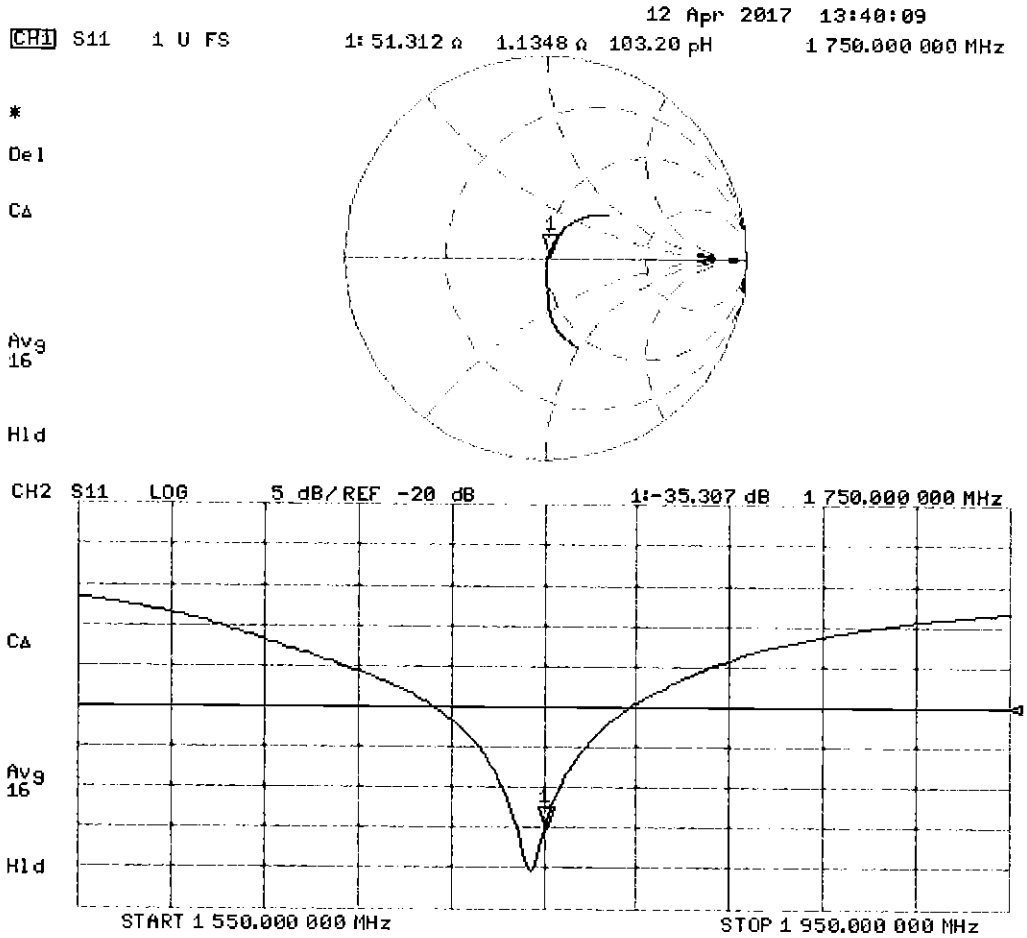
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.7 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 16.4 W/kg
SAR(1 g) = 9.14 W/kg; SAR(10 g) = 4.86 W/kg
Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.04.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

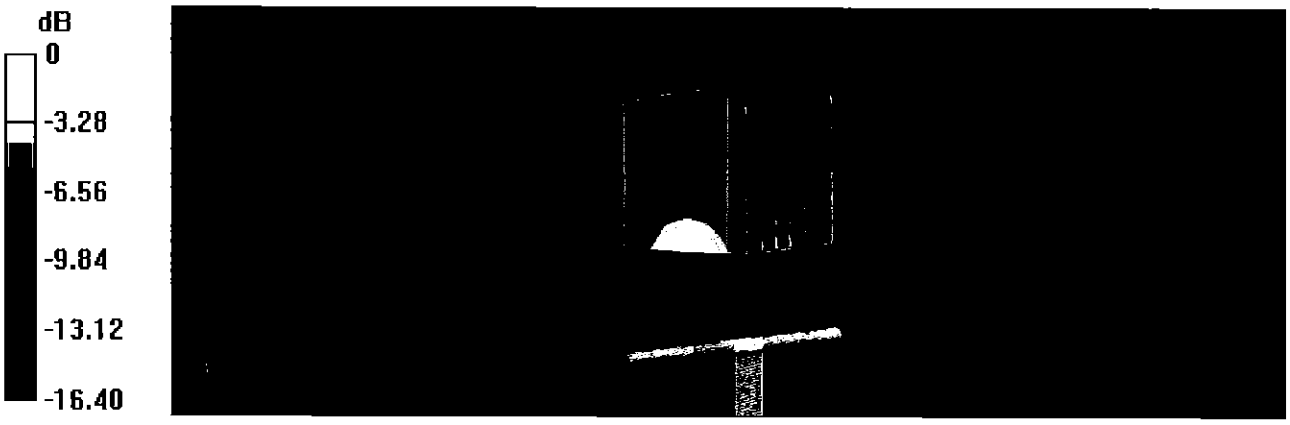
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.49 S/m; ε_r = 52.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

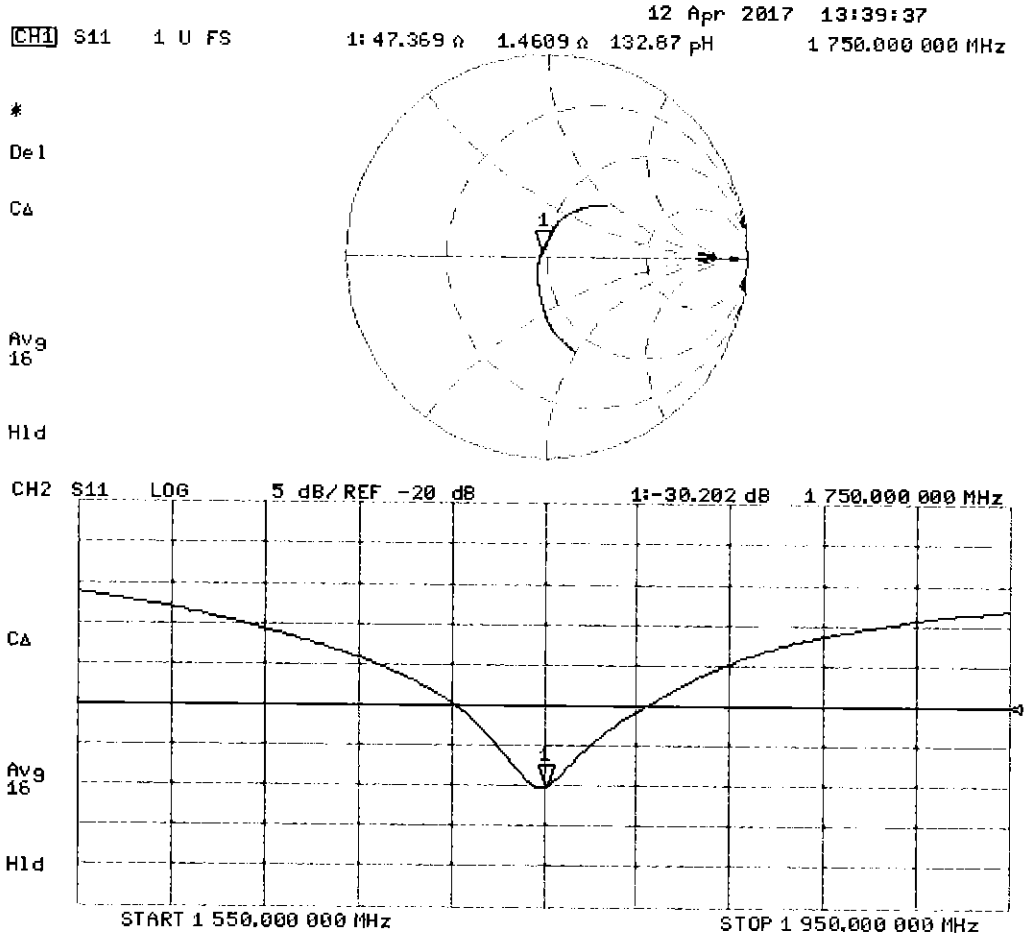
DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.25, 8.25, 8.25); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1442); SEMCAD X 14.6.10(7413)

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 = 102.1 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 16.2 W/kg
SAR(1 g) = 9.31 W/kg; SAR(10 g) = 4.98 W/kg
Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

Impedance Measurement Plot for Body TSL