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SAR EVALUATION REPORT

Applicant Name:
Samsung Electronics, Co. Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

Date of Testing:
01/05/15 - 01/19/15
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1501060001.A3L

FCC ID: A3LSMG925F

APPLICANT: SAMSUNG ELECTRONICS, CO. LTD.

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): SM-G925F

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	< 0.1	0.34	0.59
PCE	UMTS 850	826.40 - 846.60 MHz	0.25	0.34	0.34
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	< 0.1	0.33	0.65
PCE	UMTS 1900	1852.4 - 1907.6 MHz	0.13	0.63	0.94
PCE	LTE Band 12	699.7 - 715.3 MHz	< 0.1	0.11	0.11
PCE	LTE Band 26	814.7 - 848.3 MHz	0.10	0.44	0.44
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.17	0.85	1.08
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.17	0.59	0.94
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.92	0.14	0.14
NII	U-NII-1	5180 - 5240 MHz	N/A		
NII	U-NII-2A	5260 - 5320 MHz	0.60	0.12	
NII	U-NII-2C < 5.65 GHz	5500 - 5580 MHz	0.99	0.19	
NII	U-NII-2C > 5.65 GHz + U-NII-	5660 - 5825 MHz	1.04	0.14	0.14
DSS/DTS	Bluetooth	2402 - 2480 MHz	N/A		
Simultaneous SAR per KDB 690783 D01v01r03:			1.58	1.18	1.34

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
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 26	Voice/Data	814.7 - 848.3 MHz
LTE Band 5	Voice/Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
U-NII-1	Data	5180 - 5240 MHz
U-NII-2A	Data	5260 - 5320 MHz
U-NII-2C	Data	5500 - 5700 MHz
U-NII-3	Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz
ANT+	Data	2402 - 2480 MHz

1.2 Nominal and Maximum Output Power Specifications

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

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 850	Maximum	**33.5**	**33.5**	**32.5**	**30.0**	**29.0**	**27.0**	**26.0**	**23.5**	**22.5**
	Nominal	**33.0**	**33.0**	**32.0**	**29.5**	**28.5**	**26.5**	**25.5**	**23.0**	**22.0**
GSM/GPRS/EDGE 1900	Maximum	**30.0**	**30.0**	**28.5**	**25.5**	**24.0**	**26.0**	**25.0**	**22.5**	**21.5**
	Nominal	**29.5**	**29.5**	**28.0**	**25.0**	**23.5**	**25.5**	**24.5**	**22.0**	**21.0**

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA Rel 99	*3GPP HSDPA Rel 5*	*3GPP HSUPA Rel 6*	*3GPP DC-HSDPA Rel 8*
UMTS Band 5 (850 MHz)	Maximum	**23.5**	**23.5**	**23.5**	**23.5**
	Nominal	**23.0**	**23.0**	**23.0**	**23.0**
UMTS Band 2 (1900 MHz)	Maximum	**23.0**	**23.0**	**23.0**	**23.0**
	Nominal	**22.5**	**22.5**	**22.5**	**22.5**

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Mode / Band		Modulated Average (dBm)
LTE Band 17/12	Maximum	**23.5**
	Nominal	**23.0**
LTE Band 26	Maximum	**24.0**
	Nominal	**23.5**
LTE Band 5	Maximum	**23.5**
	Nominal	**23.0**
LTE Band 4 (AWS)	Maximum	**22.5**
	Nominal	**22.0**
LTE Band 2 (PCS)	Maximum	**23.0**
	Nominal	**22.5**

SISO WLAN/BT

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**17.5**
	Nominal	**17.0**
IEEE 802.11g (2.4 GHz)	Maximum	**14.5**
	Nominal	**14.0**
IEEE 802.11n (2.4 GHz)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11a (5 GHz)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11n (5 GHz) 20 MHz	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11n (5 GHz) 40 MHz	Maximum	**12.5**
	Nominal	**12.0**
IEEE 802.11ac (5 GHz) 20 MHz	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11ac (5 GHz) 40 MHz	Maximum	**12.5**
	Nominal	**12.0**
IEEE 802.11ac (5 GHz) 80 MHz	Maximum	**11.5**
	Nominal	**11.0**
Bluetooth	Maximum	**12.0**
	Nominal	**11.5**
Bluetooth LE	Maximum	**8.5**
	Nominal	**8.0**

MIMO WLAN

Mode / Band		Modulated Average (dBm)
IEEE 802.11n (2.4 GHz)	Maximum	**16.5**
	Nominal	**16.0**
IEEE 802.11n (5 GHz) 20 MHz	Maximum	**16.5**
	Nominal	**16.0**
IEEE 802.11n (5 GHz) 40 MHz	Maximum	**15.5**
	Nominal	**15.0**
IEEE 802.11ac (5 GHz) 20 MHz	Maximum	**16.5**
	Nominal	**16.0**
IEEE 802.11ac (5 GHz) 40 MHz	Maximum	**15.5**
	Nominal	**15.0**
IEEE 802.11ac (5 GHz) 80 MHz	Maximum	**14.5**
	Nominal	**14.0**

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1.3 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. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing.

Table 1-1
Mobile Hotspot Sides for SAR Testing

Sides for SAR Testing						
Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	Yes	Yes
UMTS 850	Yes	Yes	No	Yes	Yes	Yes
GPRS 1900	Yes	Yes	No	Yes	Yes	Yes
UMTS 1900	Yes	Yes	No	Yes	Yes	Yes
LTE Band 12	Yes	Yes	No	Yes	Yes	Yes
LTE Band 26	Yes	Yes	No	Yes	Yes	Yes
LTE Band 4 (AWS)	Yes	Yes	No	Yes	Yes	Yes
LTE Band 2 (PCS)	Yes	Yes	No	Yes	Yes	Yes
2.4 GHz WLAN ANT 1	Yes	Yes	Yes	No	No	Yes
2.4 GHz WLAN ANT 2	Yes	Yes	Yes	No	Yes	Yes
2.4 GHz WLAN MIMO	Yes	Yes	Yes	No	Yes	Yes
U-NII-3 ANT 1	Yes	Yes	Yes	No	No	Yes
U-NII-3 ANT 2	Yes	Yes	Yes	No	Yes	Yes
U-NII-3 MIMO	Yes	Yes	Yes	No	Yes	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 D06v01 guidance, page 2. The distances between the transmit antennas and the edges of the device are included in the filing. When wireless router mode is enabled, U-NII-1, U-NII-2A & U-NII-2C WLAN operations are disabled. Therefore U-NII-1, U-NII-2A & U-NII-2C WLAN operations are not considered in this section.

1.4 Near Field Communications (NFC) Antenna

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

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1.5 Simultaneous Transmission Capabilities

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

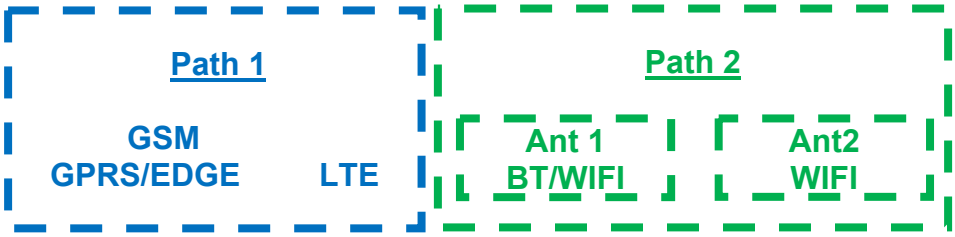

Figure 1-1
Simultaneous Transmission Paths

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

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

Table 1-2
Simultaneous Transmission Scenarios

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 the U-NII-3 Band by S/W, therefore U-NII1, U-NII-2A, & U-NII-2C Bands were not evaluated for wireless router conditions.
6. This device supports 2x2 MIMO Tx for WLAN 802.11n/ac. Each WLAN antenna can transmit independently or together when operating with MIMO.
7. This device supports VoLTE.

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1.6 Miscellaneous SAR Test Considerations

(A) WIFI/BT

Since Wireless Router operations are not allowed by the chipset firmware using U-NII-1, U-NII-2A & U-NII-2C WIFI, only 2.4 GHz and U-NII-3 WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v01.

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

This device supports IEEE 802.11ac with the following features:

a) Up to 80 MHz Bandwidth only
b) No aggregate channel configurations
c) 2 Tx antenna output
d) 256 QAM is supported
e) Band gap channels are not supported

Per FCC KDB 447498 D01v05, 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; [(16/10)* √2.480] = 2.5< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

(B) Licensed Transmitter(s)

GSM/GPRS/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 D01v02.

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

This device supports both LTE Band 5 (Cell) and LTE Band 26 (Cell). Since the supported frequency span for LTE Band 5 (Cell) falls completely within the supported frequency span for LTE Band 26 (Cell), LTE Band 26 has a higher target power than LTE Band 5, and both LTE bands share the same transmission path, SAR was only assessed for LTE Band 26 (Cell).

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

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1.7 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

1.8 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01, D05, D06 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01 DR02-41929 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r03, D02v01r01 (SAR Measurements up to 6 GHz)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)

1.9 Device Serial Numbers

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

.

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
GSM/GPRS/EDGE 850	0100F	00FDE	00FDE
UMTS 850	0100F	00FDE	00FDE
GSM/GPRS/EDGE 1900	00FDE	00FDE	00FDE
UMTS 1900	00FDE	00FDE	00FDE
LTE Band 12	0100F	0100F	0100F
LTE Band 26	0100F	0100F	0100F
LTE Band 4 (AWS)	00FDE	00FEF	00FEF
LTE Band 2 (PCS)	00FDE	01009	01009
2.4 GHz WLAN	0100F	00FEF	00FEF
U-NII-2A & U-NII-2C	00FEF	0100F	-
U-NII-3	00FEF	0100F	0100F

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2 LTE INFORMATION

LTE Information			
FCC ID	**A3LSMG925F**		
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 26 (814.7 - 848.3 MHz)		
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)		
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)		
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
Channel Bandwidths	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
	LTE Band 17: 5 MHz, 10 MHz		
	LTE Band 26: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz		
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 12: 1.4 MHz	699.7 (23017)	707.5 (23095)	715.3 (23173)
LTE Band 12: 3 MHz	700.5 (23025)	707.5 (23095)	714.5 (23165)
LTE Band 12: 5 MHz	701.5 (23035)	707.5 (23095)	713.5 (23155)
LTE Band 12: 10 MHz	704 (23060)	707.5 (23095)	711 (23130)
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
LTE Band 26: 1.4 MHz	814.7 (26697)	831.5 (26865)	848.3 (27033)
LTE Band 26: 3 MHz	815.5 (26705)	831.5 (26865)	847.5 (27025)
LTE Band 26: 5 MHz	816.5 (26715)	831.5 (26865)	846.5 (27015)
LTE Band 26: 10 MHz	819 (26740)	831.5 (26865)	844 (26990)
LTE Band 26: 15 MHz	831.5 (26765)	836.5 (26915)	841.5 (26865)
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)
UE Category	6		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		
LTE Carrier Aggregation Possible Combinations	LTE Carrier Aggregation is not supported in the US for this model		
LTE Carrier Aggregation Additional Information	This device does not support full LTE Release 10 operations in the US.The following LTE Release 10 Features are not supported in the US: Carrier Aggregation, Relay, HetNet, Enhanced MIMO, eICI, WIFI Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.		

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3 INTRODUCTION

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

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [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 D01v01 and IEEE 1528-2013:

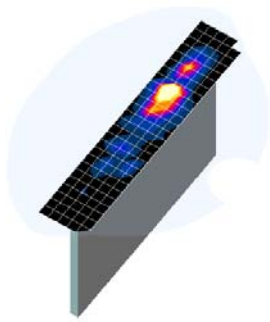

Figure 4-1
Sample SAR Area Scan

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

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

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].

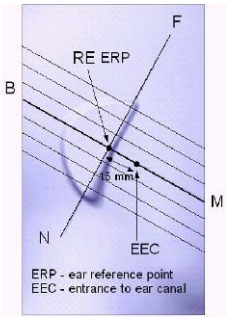

Figure 5-1
Close-Up Side view of ERP

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

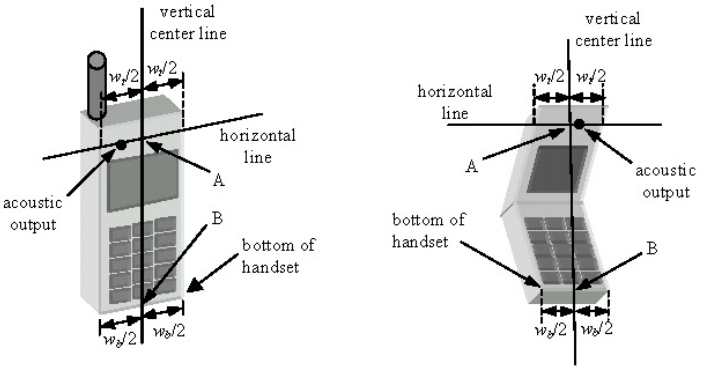

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS FOR HANDSETS

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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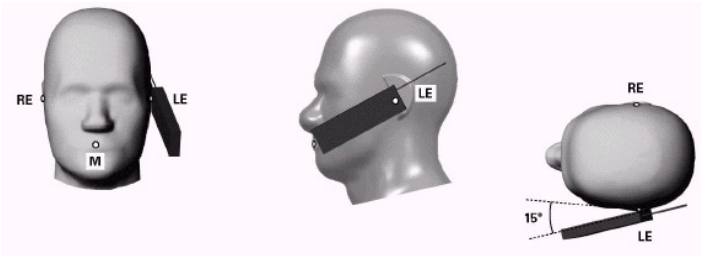

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

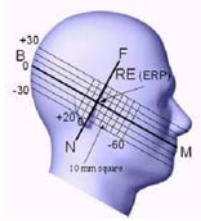

Figure 6-3
Side view w/ relevant markings

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 D04_v01. 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 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 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.

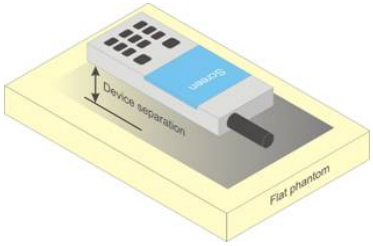

Figure 6-4
Sample Body-Worn Diagram

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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 44798 D01v05 should be applied to determine SAR test requirements.

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

6.7 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 D06 v01 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 D01v05 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

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

8.1 Measured and Reported SAR

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

8.2 3G SAR Test Reduction Procedure

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

8.3 Procedures Used to Establish RF Signal for SAR

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

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

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

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in this test report. All configurations that are not supported by the DUT or cannot be measured due to technical or equipment limitations are identified.

8.4.2 Head SAR Measurements

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to AMR configurations with 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 were tested according to FCC KDB 941225 D05v02 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Closed loop power control

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was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

8.5.1 Spectrum Plots for RB Configurations

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

8.5.2 MPR

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

8.5.3 A-MPR

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

8.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

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

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 D01 DR02-41929 for more details.

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

8.6.4 Initial Test Position Procedure

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

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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

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

8.6.7 Initial Test Configuration Procedure

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

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

8.6.8 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest

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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.

8.6.9 MIMO SAR considerations

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

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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	33.11	33.15	**32.31**	29.93	28.74	26.71	25.52	23.13	22.16
	190	33.03	32.98	**32.36**	29.90	28.88	26.75	25.64	23.17	22.19
	251	32.95	32.94	**32.19**	29.81	28.61	26.58	25.67	23.04	22.06
GSM 1900	512	29.83	29.79	**28.49**	25.30	23.95	26.00	24.69	21.92	20.17
	661	29.87	29.73	**28.33**	25.25	23.94	25.91	24.57	21.78	20.03
	810	29.89	29.77	**28.32**	25.21	23.81	25.86	24.63	21.74	20.05
		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	24.08	24.12	**26.29**	25.67	25.73	17.68	19.50	18.87	19.15
	190	24.00	23.95	**26.34**	25.64	25.87	17.72	19.62	18.91	19.18
	251	23.92	23.91	**26.17**	25.55	25.60	17.55	19.65	18.78	19.05
GSM 1900	512	20.80	20.76	**22.47**	21.04	20.94	16.97	18.67	17.66	17.16
	661	20.84	20.70	**22.31**	20.99	20.93	16.88	18.55	17.52	17.02
	810	20.86	20.74	**22.30**	20.95	20.80	16.83	18.61	17.48	17.04
GSM 850	**Frame Avg.Targets:**	23.97	23.97	**25.98**	25.24	25.49	17.47	19.48	18.74	18.99
GSM 1900		20.47	20.47	**21.98**	20.74	20.49	16.47	18.48	17.74	17.99

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. 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. 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.
4. 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: 33 (Max 4 Tx uplink slots)
EDGE Multislot class: 33 (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

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.10	23.04	23.02	22.74	22.71	22.70	-
99		12.2 kbps AMR	23.04	22.99	22.94	22.66	22.68	22.64	-
6	HSDPA	Subtest 1	23.32	23.27	23.05	22.96	22.40	22.59	0
6		Subtest 2	23.23	23.14	22.84	22.98	22.40	22.90	0
6		Subtest 3	22.96	22.81	22.83	22.14	21.65	21.66	0.5
6		Subtest 4	22.62	22.53	22.27	22.39	21.86	22.11	0.5
6	HSUPA	Subtest 1	22.67	23.07	22.84	22.82	22.56	22.68	0
6		Subtest 2	22.10	21.98	22.05	22.08	21.60	21.65	2
6		Subtest 3	23.06	23.00	22.77	22.92	22.57	22.69	1
6		Subtest 4	22.19	22.02	22.03	21.92	21.66	21.60	2
6		Subtest 5	22.76	22.98	22.81	22.80	22.61	22.64	0
8	DC-HSDPA	Subtest 1	23.08	23.50	22.98	23.00	22.94	22.90	0
8		Subtest 2	21.91	22.72	22.15	22.25	21.75	21.70	0
8		Subtest 3	21.32	22.50	21.67	21.45	21.64	21.56	0.5
8		Subtest 4	21.64	22.44	21.59	20.91	20.67	20.75	0.5

DC-HSDPA considerations

- 3GPP TS 34.121-1 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 1 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model.

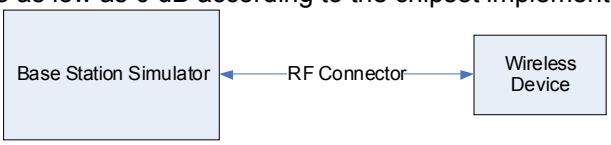

Figure 9-2
Power Measurement Setup

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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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	707.5	23095	10	QPSK	1	0	**23.48**	0	0
	707.5	23095	10	QPSK	1	25	23.38	0	0
	707.5	23095	10	QPSK	1	49	23.33	0	0
	707.5	23095	10	QPSK	25	0	22.14	0-1	1
	707.5	23095	10	QPSK	25	12	**22.15**	0-1	1
	707.5	23095	10	QPSK	25	25	22.09	0-1	1
	707.5	23095	10	QPSK	50	0	22.08	0-1	1
	707.5	23095	10	16QAM	1	0	22.32	0-1	1
	707.5	23095	10	16QAM	1	25	22.22	0-1	1
	707.5	23095	10	16QAM	1	49	22.19	0-1	1
	707.5	23095	10	16QAM	25	0	21.09	0-2	2
	707.5	23095	10	16QAM	25	12	21.05	0-2	2
	707.5	23095	10	16QAM	25	25	21.04	0-2	2
	707.5	23095	10	16QAM	50	0	21.07	0-2	2

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

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	701.5	23035	5	QPSK	1	0	23.36	0	0
	701.5	23035	5	QPSK	1	12	23.24	0	0
	701.5	23035	5	QPSK	1	24	23.35	0	0
	701.5	23035	5	QPSK	12	0	21.97	0-1	1
	701.5	23035	5	QPSK	12	6	21.81	0-1	1
	701.5	23035	5	QPSK	12	13	21.76	0-1	1
	701.5	23035	5	QPSK	25	0	21.88	0-1	1
	701.5	23035	5	16-QAM	1	0	21.59	0-1	1
	701.5	23035	5	16-QAM	1	12	21.58	0-1	1
	701.5	23035	5	16-QAM	1	24	21.66	0-1	1
	701.5	23035	5	16-QAM	12	0	20.73	0-2	2
	701.5	23035	5	16-QAM	12	6	20.52	0-2	2
	701.5	23035	5	16-QAM	12	13	20.54	0-2	2
	701.5	23035	5	16-QAM	25	0	20.74	0-2	2
Mid	707.5	23095	5	QPSK	1	0	23.33	0	0
	707.5	23095	5	QPSK	1	12	23.40	0	0
	707.5	23095	5	QPSK	1	24	23.49	0	0
	707.5	23095	5	QPSK	12	0	21.72	0-1	1
	707.5	23095	5	QPSK	12	6	21.86	0-1	1
	707.5	23095	5	QPSK	12	13	21.92	0-1	1
	707.5	23095	5	QPSK	25	0	21.77	0-1	1
	707.5	23095	5	16-QAM	1	0	21.71	0-1	1
	707.5	23095	5	16-QAM	1	12	21.50	0-1	1
	707.5	23095	5	16-QAM	1	24	21.51	0-1	1
	707.5	23095	5	16-QAM	12	0	20.56	0-2	2
	707.5	23095	5	16-QAM	12	6	20.53	0-2	2
	707.5	23095	5	16-QAM	12	13	20.55	0-2	2
	707.5	23095	5	16-QAM	25	0	20.71	0-2	2
High	713.5	23155	5	QPSK	1	0	23.20	0	0
	713.5	23155	5	QPSK	1	12	23.19	0	0
	713.5	23155	5	QPSK	1	24	23.23	0	0
	713.5	23155	5	QPSK	12	0	21.77	0-1	1
	713.5	23155	5	QPSK	12	6	21.73	0-1	1
	713.5	23155	5	QPSK	12	13	21.73	0-1	1
	713.5	23155	5	QPSK	25	0	21.82	0-1	1
	713.5	23155	5	16-QAM	1	0	21.55	0-1	1
	713.5	23155	5	16-QAM	1	12	21.58	0-1	1
	713.5	23155	5	16-QAM	1	24	21.60	0-1	1
	713.5	23155	5	16-QAM	12	0	20.77	0-2	2
	713.5	23155	5	16-QAM	12	6	20.56	0-2	2
	713.5	23155	5	16-QAM	12	13	20.54	0-2	2
	713.5	23155	5	16-QAM	25	0	20.62	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	700.5	23025	3	QPSK	1	0	23.49	0	0
	700.5	23025	3	QPSK	1	7	23.45	0	0
	700.5	23025	3	QPSK	1	14	23.25	0	0
	700.5	23025	3	QPSK	8	0	22.20	0-1	1
	700.5	23025	3	QPSK	8	4	22.04	0-1	1
	700.5	23025	3	QPSK	8	7	21.88	0-1	1
	700.5	23025	3	QPSK	15	0	22.11	0-1	1
	700.5	23025	3	16-QAM	1	0	21.72	0-1	1
	700.5	23025	3	16-QAM	1	7	21.85	0-1	1
	700.5	23025	3	16-QAM	1	14	21.79	0-1	1
	700.5	23025	3	16-QAM	8	0	20.78	0-2	2
	700.5	23025	3	16-QAM	8	4	20.76	0-2	2
	700.5	23025	3	16-QAM	8	7	20.57	0-2	2
	700.5	23025	3	16-QAM	15	0	20.75	0-2	2
Mid	707.5	23095	3	QPSK	1	0	23.35	0	0
	707.5	23095	3	QPSK	1	7	23.37	0	0
	707.5	23095	3	QPSK	1	14	23.45	0	0
	707.5	23095	3	QPSK	8	0	21.79	0-1	1
	707.5	23095	3	QPSK	8	4	21.82	0-1	1
	707.5	23095	3	QPSK	8	7	22.08	0-1	1
	707.5	23095	3	QPSK	15	0	21.89	0-1	1
	707.5	23095	3	16-QAM	1	0	21.69	0-1	1
	707.5	23095	3	16-QAM	1	7	21.52	0-1	1
	707.5	23095	3	16-QAM	1	14	21.72	0-1	1
	707.5	23095	3	16-QAM	8	0	20.56	0-2	2
	707.5	23095	3	16-QAM	8	4	20.68	0-2	2
	707.5	23095	3	16-QAM	8	7	20.66	0-2	2
	707.5	23095	3	16-QAM	15	0	20.82	0-2	2
High	714.5	23165	3	QPSK	1	0	23.32	0	0
	714.5	23165	3	QPSK	1	7	23.19	0	0
	714.5	23165	3	QPSK	1	14	23.31	0	0
	714.5	23165	3	QPSK	8	0	21.90	0-1	1
	714.5	23165	3	QPSK	8	4	21.93	0-1	1
	714.5	23165	3	QPSK	8	7	21.85	0-1	1
	714.5	23165	3	QPSK	15	0	21.80	0-1	1
	714.5	23165	3	16-QAM	1	0	21.64	0-1	1
	714.5	23165	3	16-QAM	1	7	21.76	0-1	1
	714.5	23165	3	16-QAM	1	14	21.64	0-1	1
	714.5	23165	3	16-QAM	8	0	20.70	0-2	2
	714.5	23165	3	16-QAM	8	4	20.80	0-2	2
	714.5	23165	3	16-QAM	8	7	20.62	0-2	2
	714.5	23165	3	16-QAM	15	0	20.77	0-2	2

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

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	699.7	23017	1.4	QPSK	1	0	23.43	0	0
	699.7	23017	1.4	QPSK	1	2	23.42	0	0
	699.7	23017	1.4	QPSK	1	5	23.28	0	0
	699.7	23017	1.4	QPSK	3	0	23.16	0	0
	699.7	23017	1.4	QPSK	3	2	22.86	0	0
	699.7	23017	1.4	QPSK	3	3	22.95	0	0
	699.7	23017	1.4	QPSK	6	0	22.26	0-1	1
	699.7	23017	1.4	16-QAM	1	0	21.65	0-1	1
	699.7	23017	1.4	16-QAM	1	2	21.93	0-1	1
	699.7	23017	1.4	16-QAM	1	5	21.66	0-1	1
	699.7	23017	1.4	16-QAM	3	0	21.83	0-1	1
	699.7	23017	1.4	16-QAM	3	2	21.84	0-1	1
	699.7	23017	1.4	16-QAM	3	3	21.73	0-1	1
	699.7	23017	1.4	16-QAM	6	0	20.81	0-2	2
Mid	707.5	23095	1.4	QPSK	1	0	23.20	0	0
	707.5	23095	1.4	QPSK	1	2	23.43	0	0
	707.5	23095	1.4	QPSK	1	5	23.27	0	0
	707.5	23095	1.4	QPSK	3	0	22.96	0	0
	707.5	23095	1.4	QPSK	3	2	22.69	0	0
	707.5	23095	1.4	QPSK	3	3	22.88	0	0
	707.5	23095	1.4	QPSK	6	0	21.69	0-1	1
	707.5	23095	1.4	16-QAM	1	0	21.61	0-1	1
	707.5	23095	1.4	16-QAM	1	2	21.54	0-1	1
	707.5	23095	1.4	16-QAM	1	5	21.54	0-1	1
	707.5	23095	1.4	16-QAM	3	0	21.56	0-1	1
	707.5	23095	1.4	16-QAM	3	2	21.70	0-1	1
	707.5	23095	1.4	16-QAM	3	3	21.80	0-1	1
	707.5	23095	1.4	16-QAM	6	0	21.02	0-2	2
High	715.3	23173	1.4	QPSK	1	0	23.39	0	0
	715.3	23173	1.4	QPSK	1	2	23.09	0	0
	715.3	23173	1.4	QPSK	1	5	23.14	0	0
	715.3	23173	1.4	QPSK	3	0	23.04	0	0
	715.3	23173	1.4	QPSK	3	2	23.00	0	0
	715.3	23173	1.4	QPSK	3	3	22.70	0	0
	715.3	23173	1.4	QPSK	6	0	21.93	0-1	1
	715.3	23173	1.4	16-QAM	1	0	21.83	0-1	1
	715.3	23173	1.4	16-QAM	1	2	21.82	0-1	1
	715.3	23173	1.4	16-QAM	1	5	21.56	0-1	1
	715.3	23173	1.4	16-QAM	3	0	21.58	0-1	1
	715.3	23173	1.4	16-QAM	3	2	21.70	0-1	1
	715.3	23173	1.4	16-QAM	3	3	21.68	0-1	1
	715.3	23173	1.4	16-QAM	6	0	20.87	0-2	2

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9.3.2 LTE Band 26

Table 9-5
LTE Band 26 Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	836.5	26915	15	QPSK	1	0	**23.99**	0	0
	836.5	26915	15	QPSK	1	36	23.94	0	0
	836.5	26915	15	QPSK	1	74	23.91	0	0
	836.5	26915	15	QPSK	36	0	**22.86**	0-1	1
	836.5	26915	15	QPSK	36	18	22.80	0-1	1
	836.5	26915	15	QPSK	36	37	22.84	0-1	1
	836.5	26915	15	QPSK	75	0	22.72	0-1	1
	836.5	26915	15	16QAM	1	0	22.74	0-1	1
	836.5	26915	15	16QAM	1	36	22.69	0-1	1
	836.5	26915	15	16QAM	1	74	22.60	0-1	1
	836.5	26915	15	16QAM	36	0	21.92	0-2	2
	836.5	26915	15	16QAM	36	18	21.86	0-2	2
	836.5	26915	15	16QAM	36	37	21.70	0-2	2
	836.5	26915	15	16QAM	75	0	21.72	0-2	2

Note: LTE Band 26 at 15 MHz bandwidth is only supported for FCC Rule Part 22H. There are not three non-overlapping channels within FCC Rule Part 22H. 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 9-6
LTE Band 26 Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	819	26740	10	QPSK	1	0	23.77	0	0
	819	26740	10	QPSK	1	25	23.87	0	0
	819	26740	10	QPSK	1	49	23.78	0	0
	819	26740	10	QPSK	25	0	22.36	0-1	1
	819	26740	10	QPSK	25	12	22.33	0-1	1
	819	26740	10	QPSK	25	25	22.31	0-1	1
	819	26740	10	QPSK	50	0	22.21	0-1	1
	819	26740	10	16QAM	1	0	22.11	0-1	1
	819	26740	10	16QAM	1	25	22.14	0-1	1
	819	26740	10	16QAM	1	49	22.18	0-1	1
	819	26740	10	16QAM	25	0	21.10	0-2	2
	819	26740	10	16QAM	25	12	21.16	0-2	2
	819	26740	10	16QAM	25	25	21.16	0-2	2
	819	26740	10	16QAM	50	0	21.22	0-2	2
Mid	831.5	26865	10	QPSK	1	0	23.54	0	0
	831.5	26865	10	QPSK	1	25	23.62	0	0
	831.5	26865	10	QPSK	1	49	23.56	0	0
	831.5	26865	10	QPSK	25	0	22.02	0-1	1
	831.5	26865	10	QPSK	25	12	22.05	0-1	1
	831.5	26865	10	QPSK	25	25	22.04	0-1	1
	831.5	26865	10	QPSK	50	0	22.01	0-1	1
	831.5	26865	10	16QAM	1	0	22.12	0-1	1
	831.5	26865	10	16QAM	1	25	22.29	0-1	1
	831.5	26865	10	16QAM	1	49	22.12	0-1	1
	831.5	26865	10	16QAM	25	0	21.16	0-2	2
	831.5	26865	10	16QAM	25	12	21.21	0-2	2
	831.5	26865	10	16QAM	25	25	21.14	0-2	2
	831.5	26865	10	16QAM	50	0	21.30	0-2	2
High	844	26990	10	QPSK	1	0	23.68	0	0
	844	26990	10	QPSK	1	25	23.62	0	0
	844	26990	10	QPSK	1	49	23.55	0	0
	844	26990	10	QPSK	25	0	22.24	0-1	1
	844	26990	10	QPSK	25	12	22.17	0-1	1
	844	26990	10	QPSK	25	25	22.17	0-1	1
	844	26990	10	QPSK	50	0	22.23	0-1	1
	844	26990	10	16QAM	1	0	22.12	0-1	1
	844	26990	10	16QAM	1	25	22.04	0-1	1
	844	26990	10	16QAM	1	49	22.02	0-1	1
	844	26990	10	16QAM	25	0	21.17	0-2	2
	844	26990	10	16QAM	25	12	21.00	0-2	2
	844	26990	10	16QAM	25	25	21.02	0-2	2
	844	26990	10	16QAM	50	0	21.18	0-2	2

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Table 9-7
LTE Band 26 Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	816.5	26715	5	QPSK	1	0	23.82	0	0
	816.5	26715	5	QPSK	1	12	23.85	0	0
	816.5	26715	5	QPSK	1	24	24.00	0	0
	816.5	26715	5	QPSK	12	0	22.59	0-1	1
	816.5	26715	5	QPSK	12	6	22.58	0-1	1
	816.5	26715	5	QPSK	12	13	22.39	0-1	1
	816.5	26715	5	QPSK	25	0	22.47	0-1	1
	816.5	26715	5	16-QAM	1	0	22.18	0-1	1
	816.5	26715	5	16-QAM	1	12	22.06	0-1	1
	816.5	26715	5	16-QAM	1	24	22.04	0-1	1
	816.5	26715	5	16-QAM	12	0	21.05	0-2	2
	816.5	26715	5	16-QAM	12	6	21.29	0-2	2
	816.5	26715	5	16-QAM	12	13	21.21	0-2	2
	816.5	26715	5	16-QAM	25	0	21.09	0-2	2
Mid	831.5	26865	5	QPSK	1	0	23.95	0	0
	831.5	26865	5	QPSK	1	12	23.87	0	0
	831.5	26865	5	QPSK	1	24	23.98	0	0
	831.5	26865	5	QPSK	12	0	22.45	0-1	1
	831.5	26865	5	QPSK	12	6	22.40	0-1	1
	831.5	26865	5	QPSK	12	13	22.39	0-1	1
	831.5	26865	5	QPSK	25	0	22.32	0-1	1
	831.5	26865	5	16-QAM	1	0	22.04	0-1	1
	831.5	26865	5	16-QAM	1	12	22.05	0-1	1
	831.5	26865	5	16-QAM	1	24	22.06	0-1	1
	831.5	26865	5	16-QAM	12	0	21.19	0-2	2
	831.5	26865	5	16-QAM	12	6	21.18	0-2	2
	831.5	26865	5	16-QAM	12	13	21.17	0-2	2
	831.5	26865	5	16-QAM	25	0	21.22	0-2	2
High	846.5	27015	5	QPSK	1	0	23.75	0	0
	846.5	27015	5	QPSK	1	12	23.87	0	0
	846.5	27015	5	QPSK	1	24	23.97	0	0
	846.5	27015	5	QPSK	12	0	22.57	0-1	1
	846.5	27015	5	QPSK	12	6	22.20	0-1	1
	846.5	27015	5	QPSK	12	13	22.27	0-1	1
	846.5	27015	5	QPSK	25	0	22.50	0-1	1
	846.5	27015	5	16-QAM	1	0	22.23	0-1	1
	846.5	27015	5	16-QAM	1	12	22.25	0-1	1
	846.5	27015	5	16-QAM	1	24	22.24	0-1	1
	846.5	27015	5	16-QAM	12	0	21.33	0-2	2
	846.5	27015	5	16-QAM	12	6	21.09	0-2	2
	846.5	27015	5	16-QAM	12	13	21.33	0-2	2
	846.5	27015	5	16-QAM	25	0	21.33	0-2	2

Table 9-8
LTE Band 26 Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	815.5	26705	3	QPSK	1	0	23.74	0	0
	815.5	26705	3	QPSK	1	7	23.70	0	0
	815.5	26705	3	QPSK	1	14	23.93	0	0
	815.5	26705	3	QPSK	8	0	22.62	0-1	1
	815.5	26705	3	QPSK	8	4	22.38	0-1	1
	815.5	26705	3	QPSK	8	7	22.41	0-1	1
	815.5	26705	3	QPSK	15	0	22.66	0-1	1
	815.5	26705	3	16-QAM	1	0	22.31	0-1	1
	815.5	26705	3	16-QAM	1	7	22.17	0-1	1
	815.5	26705	3	16-QAM	1	14	22.21	0-1	1
	815.5	26705	3	16-QAM	8	0	21.05	0-2	2
	815.5	26705	3	16-QAM	8	4	21.13	0-2	2
	815.5	26705	3	16-QAM	8	7	21.28	0-2	2
	815.5	26705	3	16-QAM	15	0	21.10	0-2	2
Mid	831.5	26865	3	QPSK	1	0	23.90	0	0
	831.5	26865	3	QPSK	1	7	23.69	0	0
	831.5	26865	3	QPSK	1	14	23.77	0	0
	831.5	26865	3	QPSK	8	0	22.39	0-1	1
	831.5	26865	3	QPSK	8	4	22.44	0-1	1
	831.5	26865	3	QPSK	8	7	22.41	0-1	1
	831.5	26865	3	QPSK	15	0	22.20	0-1	1
	831.5	26865	3	16-QAM	1	0	22.21	0-1	1
	831.5	26865	3	16-QAM	1	7	22.06	0-1	1
	831.5	26865	3	16-QAM	1	14	22.18	0-1	1
	831.5	26865	3	16-QAM	8	0	21.18	0-2	2
	831.5	26865	3	16-QAM	8	4	21.23	0-2	2
	831.5	26865	3	16-QAM	8	7	21.14	0-2	2
	831.5	26865	3	16-QAM	15	0	21.30	0-2	2
High	847.5	27025	3	QPSK	1	0	23.63	0	0
	847.5	27025	3	QPSK	1	7	23.74	0	0
	847.5	27025	3	QPSK	1	14	23.77	0	0
	847.5	27025	3	QPSK	8	0	22.73	0-1	1
	847.5	27025	3	QPSK	8	4	22.30	0-1	1
	847.5	27025	3	QPSK	8	7	22.14	0-1	1
	847.5	27025	3	QPSK	15	0	22.54	0-1	1
	847.5	27025	3	16-QAM	1	0	22.04	0-1	1
	847.5	27025	3	16-QAM	1	7	22.15	0-1	1
	847.5	27025	3	16-QAM	1	14	22.09	0-1	1
	847.5	27025	3	16-QAM	8	0	21.14	0-2	2
	847.5	27025	3	16-QAM	8	4	21.09	0-2	2
	847.5	27025	3	16-QAM	8	7	21.22	0-2	2
	847.5	27025	3	16-QAM	15	0	21.31	0-2	2

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Table 9-9
LTE Band 26 Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	814.7	26697	1.4	QPSK	1	0	23.83	0	0
	814.7	26697	1.4	QPSK	1	2	23.76	0	0
	814.7	26697	1.4	QPSK	1	5	23.81	0	0
	814.7	26697	1.4	QPSK	3	0	23.42	0	0
	814.7	26697	1.4	QPSK	3	2	23.24	0	0
	814.7	26697	1.4	QPSK	3	3	23.55	0	0
	814.7	26697	1.4	QPSK	6	0	22.60	0-1	1
	814.7	26697	1.4	16-QAM	1	0	22.38	0-1	1
	814.7	26697	1.4	16-QAM	1	2	22.05	0-1	1
	814.7	26697	1.4	16-QAM	1	5	22.07	0-1	1
	814.7	26697	1.4	16-QAM	3	0	22.01	0-1	1
	814.7	26697	1.4	16-QAM	3	2	22.08	0-1	1
	814.7	26697	1.4	16-QAM	3	3	22.39	0-1	1
	814.7	26697	1.4	16-QAM	6	0	21.05	0-2	2
Mid	831.5	26865	1.4	QPSK	1	0	23.73	0	0
	831.5	26865	1.4	QPSK	1	2	23.86	0	0
	831.5	26865	1.4	QPSK	1	5	23.64	0	0
	831.5	26865	1.4	QPSK	3	0	23.37	0	0
	831.5	26865	1.4	QPSK	3	2	23.32	0	0
	831.5	26865	1.4	QPSK	3	3	23.52	0	0
	831.5	26865	1.4	QPSK	6	0	22.27	0-1	1
	831.5	26865	1.4	16-QAM	1	0	22.05	0-1	1
	831.5	26865	1.4	16-QAM	1	2	22.12	0-1	1
	831.5	26865	1.4	16-QAM	1	5	22.05	0-1	1
	831.5	26865	1.4	16-QAM	3	0	22.28	0-1	1
	831.5	26865	1.4	16-QAM	3	2	22.42	0-1	1
	831.5	26865	1.4	16-QAM	3	3	22.08	0-1	1
	831.5	26865	1.4	16-QAM	6	0	21.27	0-2	2
High	848.3	27033	1.4	QPSK	1	0	23.63	0	0
	848.3	27033	1.4	QPSK	1	2	23.62	0	0
	848.3	27033	1.4	QPSK	1	5	23.68	0	0
	848.3	27033	1.4	QPSK	3	0	23.58	0	0
	848.3	27033	1.4	QPSK	3	2	23.23	0	0
	848.3	27033	1.4	QPSK	3	3	23.24	0	0
	848.3	27033	1.4	QPSK	6	0	22.55	0-1	1
	848.3	27033	1.4	16-QAM	1	0	22.20	0-1	1
	848.3	27033	1.4	16-QAM	1	2	22.32	0-1	1
	848.3	27033	1.4	16-QAM	1	5	22.20	0-1	1
	848.3	27033	1.4	16-QAM	3	0	22.12	0-1	1
	848.3	27033	1.4	16-QAM	3	2	22.27	0-1	1
	848.3	27033	1.4	16-QAM	3	3	22.35	0-1	1
	848.3	27033	1.4	16-QAM	6	0	21.47	0-2	2

9.3.3 LTE Band 4 (AWS)

Table 9-10
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	**22.39**	0	0
	1732.5	20175	20	QPSK	1	50	22.26	0	0
	1732.5	20175	20	QPSK	1	99	22.22	0	0
	1732.5	20175	20	QPSK	50	0	21.35	0-1	1
	1732.5	20175	20	QPSK	50	25	**21.43**	0-1	1
	1732.5	20175	20	QPSK	50	50	21.40	0-1	1
	1732.5	20175	20	QPSK	100	0	21.33	0-1	1
	1732.5	20175	20	16QAM	1	0	21.28	0-1	1
	1732.5	20175	20	16QAM	1	50	21.30	0-1	1
	1732.5	20175	20	16QAM	1	99	21.22	0-1	1
	1732.5	20175	20	16QAM	50	0	20.38	0-2	2
	1732.5	20175	20	16QAM	50	25	20.46	0-2	2
	1732.5	20175	20	16QAM	50	50	20.39	0-2	2
	1732.5	20175	20	16QAM	100	0	20.33	0-2	2

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

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Table 9-11
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	22.23	0	0
	1717.5	20025	15	QPSK	1	36	22.26	0	0
	1717.5	20025	15	QPSK	1	74	22.06	0	0
	1717.5	20025	15	QPSK	36	0	21.00	0-1	1
	1717.5	20025	15	QPSK	36	18	20.95	0-1	1
	1717.5	20025	15	QPSK	36	37	20.90	0-1	1
	1717.5	20025	15	QPSK	75	0	20.87	0-1	1
	1717.5	20025	15	16QAM	1	0	20.93	0-1	1
	1717.5	20025	15	16QAM	1	36	20.52	0-1	1
	1717.5	20025	15	16QAM	1	74	20.50	0-1	1
	1717.5	20025	15	16QAM	36	0	19.81	0-2	2
	1717.5	20025	15	16QAM	36	18	19.78	0-2	2
	1717.5	20025	15	16QAM	36	37	19.75	0-2	2
	1717.5	20025	15	16QAM	75	0	19.82	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	22.31	0	0
	1732.5	20175	15	QPSK	1	36	22.20	0	0
	1732.5	20175	15	QPSK	1	74	22.14	0	0
	1732.5	20175	15	QPSK	36	0	21.01	0-1	1
	1732.5	20175	15	QPSK	36	18	21.07	0-1	1
	1732.5	20175	15	QPSK	36	37	20.97	0-1	1
	1732.5	20175	15	QPSK	75	0	20.97	0-1	1
	1732.5	20175	15	16QAM	1	0	20.74	0-1	1
	1732.5	20175	15	16QAM	1	36	20.76	0-1	1
	1732.5	20175	15	16QAM	1	74	20.89	0-1	1
	1732.5	20175	15	16QAM	36	0	19.85	0-2	2
	1732.5	20175	15	16QAM	36	18	19.90	0-2	2
	1732.5	20175	15	16QAM	36	37	19.81	0-2	2
	1732.5	20175	15	16QAM	75	0	19.92	0-2	2
High	1747.5	20325	15	QPSK	1	0	22.25	0	0
	1747.5	20325	15	QPSK	1	36	22.16	0	0
	1747.5	20325	15	QPSK	1	74	21.97	0	0
	1747.5	20325	15	QPSK	36	0	20.81	0-1	1
	1747.5	20325	15	QPSK	36	18	20.72	0-1	1
	1747.5	20325	15	QPSK	36	37	20.68	0-1	1
	1747.5	20325	15	QPSK	75	0	20.83	0-1	1
	1747.5	20325	15	16QAM	1	0	20.88	0-1	1
	1747.5	20325	15	16QAM	1	36	20.74	0-1	1
	1747.5	20325	15	16QAM	1	74	20.71	0-1	1
	1747.5	20325	15	16QAM	36	0	19.75	0-2	2
	1747.5	20325	15	16QAM	36	18	19.55	0-2	2
	1747.5	20325	15	16QAM	36	37	19.62	0-2	2
	1747.5	20325	15	16QAM	75	0	19.76	0-2	2

Table 9-12
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1715	20000	10	QPSK	1	0	22.30	0	0
	1715	20000	10	QPSK	1	25	22.25	0	0
	1715	20000	10	QPSK	1	49	22.19	0	0
	1715	20000	10	QPSK	25	0	20.95	0-1	1
	1715	20000	10	QPSK	25	12	20.90	0-1	1
	1715	20000	10	QPSK	25	25	20.76	0-1	1
	1715	20000	10	QPSK	50	0	20.88	0-1	1
	1715	20000	10	16QAM	1	0	20.54	0-1	1
	1715	20000	10	16QAM	1	25	20.53	0-1	1
	1715	20000	10	16QAM	1	49	20.51	0-1	1
	1715	20000	10	16QAM	25	0	19.83	0-2	2
	1715	20000	10	16QAM	25	12	19.77	0-2	2
	1715	20000	10	16QAM	25	25	19.64	0-2	2
	1715	20000	10	16QAM	50	0	19.85	0-2	2
Mid	1732.5	20175	10	QPSK	1	0	22.37	0	0
	1732.5	20175	10	QPSK	1	25	22.36	0	0
	1732.5	20175	10	QPSK	1	49	22.25	0	0
	1732.5	20175	10	QPSK	25	0	20.88	0-1	1
	1732.5	20175	10	QPSK	25	12	20.84	0-1	1
	1732.5	20175	10	QPSK	25	25	20.76	0-1	1
	1732.5	20175	10	QPSK	50	0	20.82	0-1	1
	1732.5	20175	10	16QAM	1	0	20.70	0-1	1
	1732.5	20175	10	16QAM	1	25	20.50	0-1	1
	1732.5	20175	10	16QAM	1	49	20.50	0-1	1
	1732.5	20175	10	16QAM	25	0	19.74	0-2	2
	1732.5	20175	10	16QAM	25	12	19.81	0-2	2
	1732.5	20175	10	16QAM	25	25	19.72	0-2	2
	1732.5	20175	10	16QAM	50	0	19.83	0-2	2
High	1750	20350	10	QPSK	1	0	22.07	0	0
	1750	20350	10	QPSK	1	25	22.25	0	0
	1750	20350	10	QPSK	1	49	21.87	0	0
	1750	20350	10	QPSK	25	0	20.86	0-1	1
	1750	20350	10	QPSK	25	12	20.73	0-1	1
	1750	20350	10	QPSK	25	25	20.59	0-1	1
	1750	20350	10	QPSK	50	0	20.72	0-1	1
	1750	20350	10	16QAM	1	0	20.51	0-1	1
	1750	20350	10	16QAM	1	25	20.50	0-1	1
	1750	20350	10	16QAM	1	49	20.51	0-1	1
	1750	20350	10	16QAM	25	0	19.64	0-2	2
	1750	20350	10	16QAM	25	12	19.63	0-2	2
	1750	20350	10	16QAM	25	25	19.52	0-2	2
	1750	20350	10	16QAM	50	0	19.73	0-2	2

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Table 9-13
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1712.5	19975	5	QPSK	1	0	22.25	0	0
	1712.5	19975	5	QPSK	1	12	22.21	0	0
	1712.5	19975	5	QPSK	1	24	22.15	0	0
	1712.5	19975	5	QPSK	12	0	20.77	0-1	1
	1712.5	19975	5	QPSK	12	6	20.78	0-1	1
	1712.5	19975	5	QPSK	12	13	20.74	0-1	1
	1712.5	19975	5	QPSK	25	0	20.76	0-1	1
	1712.5	19975	5	16-QAM	1	0	20.68	0-1	1
	1712.5	19975	5	16-QAM	1	12	20.80	0-1	1
	1712.5	19975	5	16-QAM	1	24	20.86	0-1	1
	1712.5	19975	5	16-QAM	12	0	19.64	0-2	2
	1712.5	19975	5	16-QAM	12	6	19.80	0-2	2
	1712.5	19975	5	16-QAM	12	13	19.76	0-2	2
	1712.5	19975	5	16-QAM	25	0	19.72	0-2	2
Mid	1732.5	20175	5	QPSK	1	0	22.27	0	0
	1732.5	20175	5	QPSK	1	12	22.33	0	0
	1732.5	20175	5	QPSK	1	24	22.30	0	0
	1732.5	20175	5	QPSK	12	0	20.85	0-1	1
	1732.5	20175	5	QPSK	12	6	20.77	0-1	1
	1732.5	20175	5	QPSK	12	13	20.76	0-1	1
	1732.5	20175	5	QPSK	25	0	20.73	0-1	1
	1732.5	20175	5	16-QAM	1	0	20.66	0-1	1
	1732.5	20175	5	16-QAM	1	12	20.54	0-1	1
	1732.5	20175	5	16-QAM	1	24	20.87	0-1	1
	1732.5	20175	5	16-QAM	12	0	19.65	0-2	2
	1732.5	20175	5	16-QAM	12	6	19.56	0-2	2
	1732.5	20175	5	16-QAM	12	13	19.54	0-2	2
	1732.5	20175	5	16-QAM	25	0	19.67	0-2	2
High	1752.5	20375	5	QPSK	1	0	22.03	0	0
	1752.5	20375	5	QPSK	1	12	21.87	0	0
	1752.5	20375	5	QPSK	1	24	21.82	0	0
	1752.5	20375	5	QPSK	12	0	20.55	0-1	1
	1752.5	20375	5	QPSK	12	6	20.52	0-1	1
	1752.5	20375	5	QPSK	12	13	20.51	0-1	1
	1752.5	20375	5	QPSK	25	0	20.58	0-1	1
	1752.5	20375	5	16-QAM	1	0	20.52	0-1	1
	1752.5	20375	5	16-QAM	1	12	20.64	0-1	1
	1752.5	20375	5	16-QAM	1	24	20.56	0-1	1
	1752.5	20375	5	16-QAM	12	0	19.50	0-2	2
	1752.5	20375	5	16-QAM	12	6	19.50	0-2	2
	1752.5	20375	5	16-QAM	12	13	19.51	0-2	2
	1752.5	20375	5	16-QAM	25	0	19.50	0-2	2

Table 9-14
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1711.5	19965	3	QPSK	1	0	22.30	0	0
	1711.5	19965	3	QPSK	1	7	22.25	0	0
	1711.5	19965	3	QPSK	1	14	22.22	0	0
	1711.5	19965	3	QPSK	8	0	20.91	0-1	1
	1711.5	19965	3	QPSK	8	4	20.80	0-1	1
	1711.5	19965	3	QPSK	8	7	20.78	0-1	1
	1711.5	19965	3	QPSK	15	0	20.91	0-1	1
	1711.5	19965	3	16-QAM	1	0	20.95	0-1	1
	1711.5	19965	3	16-QAM	1	7	20.63	0-1	1
	1711.5	19965	3	16-QAM	1	14	20.72	0-1	1
	1711.5	19965	3	16-QAM	8	0	19.63	0-2	2
	1711.5	19965	3	16-QAM	8	4	19.61	0-2	2
	1711.5	19965	3	16-QAM	8	7	19.69	0-2	2
	1711.5	19965	3	16-QAM	15	0	19.77	0-2	2
Mid	1732.5	20175	3	QPSK	1	0	22.32	0	0
	1732.5	20175	3	QPSK	1	7	22.38	0	0
	1732.5	20175	3	QPSK	1	14	22.22	0	0
	1732.5	20175	3	QPSK	8	0	20.88	0-1	1
	1732.5	20175	3	QPSK	8	4	20.89	0-1	1
	1732.5	20175	3	QPSK	8	7	20.81	0-1	1
	1732.5	20175	3	QPSK	15	0	20.79	0-1	1
	1732.5	20175	3	16-QAM	1	0	21.35	0-1	1
	1732.5	20175	3	16-QAM	1	7	20.80	0-1	1
	1732.5	20175	3	16-QAM	1	14	20.88	0-1	1
	1732.5	20175	3	16-QAM	8	0	19.68	0-2	2
	1732.5	20175	3	16-QAM	8	4	19.61	0-2	2
	1732.5	20175	3	16-QAM	8	7	19.60	0-2	2
	1732.5	20175	3	16-QAM	15	0	19.75	0-2	2
High	1753.5	20385	3	QPSK	1	0	21.94	0	0
	1753.5	20385	3	QPSK	1	7	21.95	0	0
	1753.5	20385	3	QPSK	1	14	21.81	0	0
	1753.5	20385	3	QPSK	8	0	20.69	0-1	1
	1753.5	20385	3	QPSK	8	4	20.55	0-1	1
	1753.5	20385	3	QPSK	8	7	20.52	0-1	1
	1753.5	20385	3	QPSK	15	0	20.56	0-1	1
	1753.5	20385	3	16-QAM	1	0	20.59	0-1	1
	1753.5	20385	3	16-QAM	1	7	20.50	0-1	1
	1753.5	20385	3	16-QAM	1	14	20.52	0-1	1
	1753.5	20385	3	16-QAM	8	0	19.50	0-2	2
	1753.5	20385	3	16-QAM	8	4	19.53	0-2	2
	1753.5	20385	3	16-QAM	8	7	19.50	0-2	2
	1753.5	20385	3	16-QAM	15	0	19.55	0-2	2

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Table 9-15
LTE Band 4 (AWS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1710.7	19957	1.4	QPSK	1	0	22.18	0	0
	1710.7	19957	1.4	QPSK	1	2	22.21	0	0
	1710.7	19957	1.4	QPSK	1	5	22.25	0	0
	1710.7	19957	1.4	QPSK	3	0	21.92	0	0
	1710.7	19957	1.4	QPSK	3	2	21.82	0	0
	1710.7	19957	1.4	QPSK	3	3	21.87	0	0
	1710.7	19957	1.4	QPSK	6	0	20.78	0-1	1
	1710.7	19957	1.4	16-QAM	1	0	21.12	0-1	1
	1710.7	19957	1.4	16-QAM	1	2	20.64	0-1	1
	1710.7	19957	1.4	16-QAM	1	5	20.71	0-1	1
	1710.7	19957	1.4	16-QAM	3	0	20.85	0-1	1
	1710.7	19957	1.4	16-QAM	3	2	20.77	0-1	1
	1710.7	19957	1.4	16-QAM	3	3	20.78	0-1	1
	1710.7	19957	1.4	16-QAM	6	0	19.65	0-2	2
Mid	1732.5	20175	1.4	QPSK	1	0	22.26	0	0
	1732.5	20175	1.4	QPSK	1	2	22.33	0	0
	1732.5	20175	1.4	QPSK	1	5	22.25	0	0
	1732.5	20175	1.4	QPSK	3	0	21.94	0	0
	1732.5	20175	1.4	QPSK	3	2	21.92	0	0
	1732.5	20175	1.4	QPSK	3	3	21.92	0	0
	1732.5	20175	1.4	QPSK	6	0	20.75	0-1	1
	1732.5	20175	1.4	16-QAM	1	0	20.69	0-1	1
	1732.5	20175	1.4	16-QAM	1	2	20.79	0-1	1
	1732.5	20175	1.4	16-QAM	1	5	20.68	0-1	1
	1732.5	20175	1.4	16-QAM	3	0	21.03	0-1	1
	1732.5	20175	1.4	16-QAM	3	2	20.86	0-1	1
	1732.5	20175	1.4	16-QAM	3	3	20.93	0-1	1
	1732.5	20175	1.4	16-QAM	6	0	19.80	0-2	2
High	1754.3	20393	1.4	QPSK	1	0	22.09	0	0
	1754.3	20393	1.4	QPSK	1	2	22.04	0	0
	1754.3	20393	1.4	QPSK	1	5	22.06	0	0
	1754.3	20393	1.4	QPSK	3	0	21.70	0	0
	1754.3	20393	1.4	QPSK	3	2	21.61	0	0
	1754.3	20393	1.4	QPSK	3	3	21.66	0	0
	1754.3	20393	1.4	QPSK	6	0	20.58	0-1	1
	1754.3	20393	1.4	16-QAM	1	0	21.08	0-1	1
	1754.3	20393	1.4	16-QAM	1	2	20.56	0-1	1
	1754.3	20393	1.4	16-QAM	1	5	20.62	0-1	1
	1754.3	20393	1.4	16-QAM	3	0	20.61	0-1	1
	1754.3	20393	1.4	16-QAM	3	2	20.72	0-1	1
	1754.3	20393	1.4	16-QAM	3	3	20.78	0-1	1
	1754.3	20393	1.4	16-QAM	6	0	19.57	0-2	2

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9.3.4 LTE Band 2 (PCS)

Table 9-16
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	18700	20	QPSK	1	0	22.96	0	0
	1860	18700	20	QPSK	1	50	22.98	0	0
	1860	18700	20	QPSK	1	99	**22.99**	0	0
	1860	18700	20	QPSK	50	0	21.95	0-1	1
	1860	18700	20	QPSK	50	25	**22.00**	0-1	1
	1860	18700	20	QPSK	50	50	21.96	0-1	1
	1860	18700	20	QPSK	100	0	21.95	0-1	1
	1860	18700	20	16QAM	1	0	22.00	0-1	1
	1860	18700	20	16QAM	1	50	21.93	0-1	1
	1860	18700	20	16QAM	1	99	21.97	0-1	1
	1860	18700	20	16QAM	50	0	20.99	0-2	2
	1860	18700	20	16QAM	50	25	20.98	0-2	2
	1860	18700	20	16QAM	50	50	20.92	0-2	2
	1860	18700	20	16QAM	100	0	20.93	0-2	2
Mid	1880.0	18900	20	QPSK	1	0	22.63	0	0
	1880.0	18900	20	QPSK	1	50	22.61	0	0
	1880.0	18900	20	QPSK	1	99	22.65	0	0
	1880.0	18900	20	QPSK	50	0	21.84	0-1	1
	1880.0	18900	20	QPSK	50	25	21.81	0-1	1
	1880.0	18900	20	QPSK	50	50	21.85	0-1	1
	1880.0	18900	20	QPSK	100	0	21.81	0-1	1
	1880.0	18900	20	16QAM	1	0	21.52	0-1	1
	1880.0	18900	20	16QAM	1	50	21.50	0-1	1
	1880.0	18900	20	16QAM	1	99	21.52	0-1	1
	1880.0	18900	20	16QAM	50	0	20.76	0-2	2
	1880.0	18900	20	16QAM	50	25	20.83	0-2	2
	1880.0	18900	20	16QAM	50	50	20.80	0-2	2
	1880.0	18900	20	16QAM	100	0	20.84	0-2	2
High	1900	19100	20	QPSK	1	0	22.82	0	0
	1900	19100	20	QPSK	1	50	22.78	0	0
	1900	19100	20	QPSK	1	99	22.73	0	0
	1900	19100	20	QPSK	50	0	21.97	0-1	1
	1900	19100	20	QPSK	50	25	21.92	0-1	1
	1900	19100	20	QPSK	50	50	21.91	0-1	1
	1900	19100	20	QPSK	100	0	21.98	0-1	1
	1900	19100	20	16QAM	1	0	21.75	0-1	1
	1900	19100	20	16QAM	1	50	21.73	0-1	1
	1900	19100	20	16QAM	1	99	21.69	0-1	1
	1900	19100	20	16QAM	50	0	20.87	0-2	2
	1900	19100	20	16QAM	50	25	20.92	0-2	2
	1900	19100	20	16QAM	50	50	20.87	0-2	2
	1900	19100	20	16QAM	100	0	20.93	0-2	2

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Table 9-17
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	18675	15	QPSK	1	0	22.84	0	0
	1857.5	18675	15	QPSK	1	36	22.94	0	0
	1857.5	18675	15	QPSK	1	74	22.97	0	0
	1857.5	18675	15	QPSK	36	0	21.94	0-1	1
	1857.5	18675	15	QPSK	36	18	21.91	0-1	1
	1857.5	18675	15	QPSK	36	37	21.87	0-1	1
	1857.5	18675	15	QPSK	75	0	21.87	0-1	1
	1857.5	18675	15	16QAM	1	0	21.82	0-1	1
	1857.5	18675	15	16QAM	1	36	21.84	0-1	1
	1857.5	18675	15	16QAM	1	74	21.78	0-1	1
	1857.5	18675	15	16QAM	36	0	20.98	0-2	2
	1857.5	18675	15	16QAM	36	18	20.87	0-2	2
	1857.5	18675	15	16QAM	36	37	20.94	0-2	2
	1857.5	18675	15	16QAM	75	0	20.95	0-2	2
Mid	1880.0	18900	15	QPSK	1	0	22.44	0	0
	1880.0	18900	15	QPSK	1	36	22.49	0	0
	1880.0	18900	15	QPSK	1	74	22.53	0	0
	1880.0	18900	15	QPSK	36	0	21.82	0-1	1
	1880.0	18900	15	QPSK	36	18	21.75	0-1	1
	1880.0	18900	15	QPSK	36	37	21.90	0-1	1
	1880.0	18900	15	QPSK	75	0	21.77	0-1	1
	1880.0	18900	15	16QAM	1	0	21.61	0-1	1
	1880.0	18900	15	16QAM	1	36	21.38	0-1	1
	1880.0	18900	15	16QAM	1	74	21.72	0-1	1
	1880.0	18900	15	16QAM	36	0	20.59	0-2	2
	1880.0	18900	15	16QAM	36	18	20.77	0-2	2
	1880.0	18900	15	16QAM	36	37	20.89	0-2	2
	1880.0	18900	15	16QAM	75	0	20.95	0-2	2
High	1902.5	19125	15	QPSK	1	0	22.73	0	0
	1902.5	19125	15	QPSK	1	36	22.81	0	0
	1902.5	19125	15	QPSK	1	74	22.62	0	0
	1902.5	19125	15	QPSK	36	0	21.89	0-1	1
	1902.5	19125	15	QPSK	36	18	21.91	0-1	1
	1902.5	19125	15	QPSK	36	37	21.80	0-1	1
	1902.5	19125	15	QPSK	75	0	21.86	0-1	1
	1902.5	19125	15	16QAM	1	0	21.80	0-1	1
	1902.5	19125	15	16QAM	1	36	21.81	0-1	1
	1902.5	19125	15	16QAM	1	74	21.66	0-1	1
	1902.5	19125	15	16QAM	36	0	20.73	0-2	2
	1902.5	19125	15	16QAM	36	18	20.88	0-2	2
	1902.5	19125	15	16QAM	36	37	20.95	0-2	2
	1902.5	19125	15	16QAM	75	0	20.89	0-2	2

Table 9-18
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1855	18650	10	QPSK	1	0	22.98	0	0
	1855	18650	10	QPSK	1	25	22.74	0	0
	1855	18650	10	QPSK	1	49	22.83	0	0
	1855	18650	10	QPSK	25	0	21.79	0-1	1
	1855	18650	10	QPSK	25	12	21.87	0-1	1
	1855	18650	10	QPSK	25	25	21.91	0-1	1
	1855	18650	10	QPSK	50	0	21.80	0-1	1
	1855	18650	10	16QAM	1	0	21.86	0-1	1
	1855	18650	10	16QAM	1	25	21.96	0-1	1
	1855	18650	10	16QAM	1	49	21.79	0-1	1
	1855	18650	10	16QAM	25	0	20.95	0-2	2
	1855	18650	10	16QAM	25	12	20.92	0-2	2
	1855	18650	10	16QAM	25	25	20.84	0-2	2
	1855	18650	10	16QAM	50	0	20.97	0-2	2
Mid	1880.0	18900	10	QPSK	1	0	22.24	0	0
	1880.0	18900	10	QPSK	1	25	22.45	0	0
	1880.0	18900	10	QPSK	1	49	22.64	0	0
	1880.0	18900	10	QPSK	25	0	21.95	0-1	1
	1880.0	18900	10	QPSK	25	12	21.67	0-1	1
	1880.0	18900	10	QPSK	25	25	21.70	0-1	1
	1880.0	18900	10	QPSK	50	0	21.72	0-1	1
	1880.0	18900	10	16QAM	1	0	21.66	0-1	1
	1880.0	18900	10	16QAM	1	25	21.32	0-1	1
	1880.0	18900	10	16QAM	1	49	21.62	0-1	1
	1880.0	18900	10	16QAM	25	0	20.48	0-2	2
	1880.0	18900	10	16QAM	25	12	20.84	0-2	2
	1880.0	18900	10	16QAM	25	25	20.81	0-2	2
	1880.0	18900	10	16QAM	50	0	20.85	0-2	2
High	1905	19150	10	QPSK	1	0	22.73	0	0
	1905	19150	10	QPSK	1	25	22.95	0	0
	1905	19150	10	QPSK	1	49	22.72	0	0
	1905	19150	10	QPSK	25	0	21.90	0-1	1
	1905	19150	10	QPSK	25	12	22.00	0-1	1
	1905	19150	10	QPSK	25	25	21.91	0-1	1
	1905	19150	10	QPSK	50	0	21.83	0-1	1
	1905	19150	10	16QAM	1	0	21.91	0-1	1
	1905	19150	10	16QAM	1	25	21.88	0-1	1
	1905	19150	10	16QAM	1	49	21.57	0-1	1
	1905	19150	10	16QAM	25	0	20.76	0-2	2
	1905	19150	10	16QAM	25	12	20.88	0-2	2
	1905	19150	10	16QAM	25	25	20.79	0-2	2
	1905	19150	10	16QAM	50	0	20.90	0-2	2

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Table 9-19
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1852.5	18625	5	QPSK	1	0	22.97	0	0
	1852.5	18625	5	QPSK	1	12	22.86	0	0
	1852.5	18625	5	QPSK	1	24	22.98	0	0
	1852.5	18625	5	QPSK	12	0	21.59	0-1	1
	1852.5	18625	5	QPSK	12	6	21.86	0-1	1
	1852.5	18625	5	QPSK	12	13	21.84	0-1	1
	1852.5	18625	5	QPSK	25	0	21.68	0-1	1
	1852.5	18625	5	16-QAM	1	0	21.70	0-1	1
	1852.5	18625	5	16-QAM	1	12	21.98	0-1	1
	1852.5	18625	5	16-QAM	1	24	21.63	0-1	1
	1852.5	18625	5	16-QAM	12	0	20.95	0-2	2
	1852.5	18625	5	16-QAM	12	6	20.88	0-2	2
	1852.5	18625	5	16-QAM	12	13	20.70	0-2	2
	1852.5	18625	5	16-QAM	25	0	20.97	0-2	2
Mid	1880.0	18900	5	QPSK	1	0	22.07	0	0
	1880.0	18900	5	QPSK	1	12	22.31	0	0
	1880.0	18900	5	QPSK	1	24	22.68	0	0
	1880.0	18900	5	QPSK	12	0	22.00	0-1	1
	1880.0	18900	5	QPSK	12	6	21.55	0-1	1
	1880.0	18900	5	QPSK	12	13	21.64	0-1	1
	1880.0	18900	5	QPSK	25	0	21.92	0-1	1
	1880.0	18900	5	16-QAM	1	0	21.46	0-1	1
	1880.0	18900	5	16-QAM	1	12	21.44	0-1	1
	1880.0	18900	5	16-QAM	1	24	21.68	0-1	1
	1880.0	18900	5	16-QAM	12	0	20.33	0-2	2
	1880.0	18900	5	16-QAM	12	6	20.66	0-2	2
	1880.0	18900	5	16-QAM	12	13	20.82	0-2	2
	1880.0	18900	5	16-QAM	25	0	20.97	0-2	2
High	1907.5	19175	5	QPSK	1	0	22.75	0	0
	1907.5	19175	5	QPSK	1	12	22.89	0	0
	1907.5	19175	5	QPSK	1	24	22.84	0	0
	1907.5	19175	5	QPSK	12	0	22.00	0-1	1
	1907.5	19175	5	QPSK	12	6	21.91	0-1	1
	1907.5	19175	5	QPSK	12	13	21.91	0-1	1
	1907.5	19175	5	QPSK	25	0	21.70	0-1	1
	1907.5	19175	5	16-QAM	1	0	21.83	0-1	1
	1907.5	19175	5	16-QAM	1	12	21.92	0-1	1
	1907.5	19175	5	16-QAM	1	24	21.40	0-1	1
	1907.5	19175	5	16-QAM	12	0	20.80	0-2	2
	1907.5	19175	5	16-QAM	12	6	20.76	0-2	2
	1907.5	19175	5	16-QAM	12	13	20.67	0-2	2
	1907.5	19175	5	16-QAM	25	0	20.73	0-2	2

Table 9-20
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1851.5	18615	3	QPSK	1	0	22.80	0	0
	1851.5	18615	3	QPSK	1	7	22.94	0	0
	1851.5	18615	3	QPSK	1	14	22.86	0	0
	1851.5	18615	3	QPSK	8	0	21.64	0-1	1
	1851.5	18615	3	QPSK	8	4	21.67	0-1	1
	1851.5	18615	3	QPSK	8	7	21.80	0-1	1
	1851.5	18615	3	QPSK	15	0	21.51	0-1	1
	1851.5	18615	3	16-QAM	1	0	21.59	0-1	1
	1851.5	18615	3	16-QAM	1	7	21.86	0-1	1
	1851.5	18615	3	16-QAM	1	14	21.54	0-1	1
	1851.5	18615	3	16-QAM	8	0	20.80	0-2	2
	1851.5	18615	3	16-QAM	8	4	20.80	0-2	2
	1851.5	18615	3	16-QAM	8	7	20.52	0-2	2
	1851.5	18615	3	16-QAM	15	0	20.80	0-2	2
Mid	1880.0	18900	3	QPSK	1	0	22.39	0	0
	1880.0	18900	3	QPSK	1	7	22.24	0	0
	1880.0	18900	3	QPSK	1	14	22.54	0	0
	1880.0	18900	3	QPSK	8	0	22.00	0-1	1
	1880.0	18900	3	QPSK	8	4	21.67	0-1	1
	1880.0	18900	3	QPSK	8	7	21.56	0-1	1
	1880.0	18900	3	QPSK	15	0	21.86	0-1	1
	1880.0	18900	3	16-QAM	1	0	21.28	0-1	1
	1880.0	18900	3	16-QAM	1	7	21.38	0-1	1
	1880.0	18900	3	16-QAM	1	14	21.65	0-1	1
	1880.0	18900	3	16-QAM	8	0	20.30	0-2	2
	1880.0	18900	3	16-QAM	8	4	20.70	0-2	2
	1880.0	18900	3	16-QAM	8	7	20.68	0-2	2
	1880.0	18900	3	16-QAM	15	0	20.90	0-2	2
High	1908.5	19185	3	QPSK	1	0	22.68	0	0
	1908.5	19185	3	QPSK	1	7	22.94	0	0
	1908.5	19185	3	QPSK	1	14	22.75	0	0
	1908.5	19185	3	QPSK	8	0	21.81	0-1	1
	1908.5	19185	3	QPSK	8	4	21.73	0-1	1
	1908.5	19185	3	QPSK	8	7	21.72	0-1	1
	1908.5	19185	3	QPSK	15	0	21.90	0-1	1
	1908.5	19185	3	16-QAM	1	0	21.80	0-1	1
	1908.5	19185	3	16-QAM	1	7	21.83	0-1	1
	1908.5	19185	3	16-QAM	1	14	21.59	0-1	1
	1908.5	19185	3	16-QAM	8	0	20.86	0-2	2
	1908.5	19185	3	16-QAM	8	4	20.70	0-2	2
	1908.5	19185	3	16-QAM	8	7	20.58	0-2	2
	1908.5	19185	3	16-QAM	15	0	20.90	0-2	2

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Table 9-21
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1850.7	18607	1.4	QPSK	1	0	22.67	0	0
	1850.7	18607	1.4	QPSK	1	2	22.90	0	0
	1850.7	18607	1.4	QPSK	1	5	22.88	0	0
	1850.7	18607	1.4	QPSK	3	0	22.83	0	0
	1850.7	18607	1.4	QPSK	3	2	22.47	0	0
	1850.7	18607	1.4	QPSK	3	3	22.99	0	0
	1850.7	18607	1.4	QPSK	6	0	21.62	0-1	1
	1850.7	18607	1.4	16-QAM	1	0	21.59	0-1	1
	1850.7	18607	1.4	16-QAM	1	2	21.78	0-1	1
	1850.7	18607	1.4	16-QAM	1	5	21.74	0-1	1
	1850.7	18607	1.4	16-QAM	3	0	21.68	0-1	1
	1850.7	18607	1.4	16-QAM	3	2	21.66	0-1	1
	1850.7	18607	1.4	16-QAM	3	3	21.55	0-1	1
	1850.7	18607	1.4	16-QAM	6	0	20.90	0-2	2
Mid	1880.0	18900	1.4	QPSK	1	0	22.53	0	0
	1880.0	18900	1.4	QPSK	1	2	22.30	0	0
	1880.0	18900	1.4	QPSK	1	5	22.64	0	0
	1880.0	18900	1.4	QPSK	3	0	22.90	0	0
	1880.0	18900	1.4	QPSK	3	2	22.61	0	0
	1880.0	18900	1.4	QPSK	3	3	22.60	0	0
	1880.0	18900	1.4	QPSK	6	0	21.73	0-1	1
	1880.0	18900	1.4	16-QAM	1	0	21.16	0-1	1
	1880.0	18900	1.4	16-QAM	1	2	21.56	0-1	1
	1880.0	18900	1.4	16-QAM	1	5	21.59	0-1	1
	1880.0	18900	1.4	16-QAM	3	0	21.24	0-1	1
	1880.0	18900	1.4	16-QAM	3	2	21.85	0-1	1
	1880.0	18900	1.4	16-QAM	3	3	21.77	0-1	1
	1880.0	18900	1.4	16-QAM	6	0	20.81	0-2	2
High	1909.3	19193	1.4	QPSK	1	0	22.52	0	0
	1909.3	19193	1.4	QPSK	1	2	22.81	0	0
	1909.3	19193	1.4	QPSK	1	5	22.70	0	0
	1909.3	19193	1.4	QPSK	3	0	22.89	0	0
	1909.3	19193	1.4	QPSK	3	2	22.88	0	0
	1909.3	19193	1.4	QPSK	3	3	22.82	0	0
	1909.3	19193	1.4	QPSK	6	0	21.76	0-1	1
	1909.3	19193	1.4	16-QAM	1	0	21.97	0-1	1
	1909.3	19193	1.4	16-QAM	1	2	21.86	0-1	1
	1909.3	19193	1.4	16-QAM	1	5	21.56	0-1	1
	1909.3	19193	1.4	16-QAM	3	0	22.00	0-1	1
	1909.3	19193	1.4	16-QAM	3	2	21.81	0-1	1
	1909.3	19193	1.4	16-QAM	3	3	21.65	0-1	1
	1909.3	19193	1.4	16-QAM	6	0	20.55	0-2	2

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9.4 WLAN Conducted Powers

Table 9-22
2.4 GHz Average RF Power – Antenna 1

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11b
2412	1	17.00
2437	6	16.60
2462	11	**17.16**

Table 9-23
2.4 GHz Average RF Power – Antenna 2

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11b
2412	1	16.98
2437	6	16.51
2462	11	**17.29**

Table 9-24
2.4 GHz Average RF Power – MIMO

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]
		IEEE Transmission Mode
		802.11n
2412	1	16.03
2437	6	15.69
2462	11	**16.15**

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Table 9-25
5 GHz (20 MHz Bandwidth) Average RF Power – Antenna 1

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11a	802.11n	802.11ac
5180	36	13.21	13.22	13.43
5200	40	13.28	13.16	13.39
5220	44	13.32	13.27	13.30
5240	48	13.33	13.29	13.31
5260	52	13.45	13.46	13.41
5280	56	12.55	12.51	12.52
5300	60	**13.49**	13.37	13.48
5320	64	13.40	13.36	13.43
5500	100	**13.46**	13.37	13.43
5540	108	12.91	12.98	13.01
5580	116	13.16	13.24	13.13
5660	132	13.21	13.25	13.14
5745	149	**13.42**	13.34	13.31
5825	165	13.42	13.31	13.24

Table 9-26
5 GHz (20 MHz Bandwidth) Average RF Power – Antenna 2

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11a	802.11n	802.11ac
5180	36	12.98	12.93	12.82
5200	40	13.00	12.85	12.82
5220	44	12.95	12.91	12.80
5240	48	12.97	12.90	12.74
5260	52	**13.15**	13.13	13.10
5280	56	13.13	12.93	12.99
5300	60	13.06	12.96	12.90
5320	64	13.05	12.87	12.86
5500	100	**13.15**	12.89	12.97
5540	108	12.72	12.63	12.58
5580	116	12.83	12.66	12.62
5660	132	12.70	12.61	12.73
5745	149	**13.17**	13.02	13.02
5825	165	13.02	12.77	12.82

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Table 9-27
5 GHz (20 MHz Bandwidth) Average RF Power – MIMO

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11n	802.11ac
5180	36	16.39	16.21
5200	40	16.29	16.26
5220	44	16.32	16.18
5240	48	16.47	16.15
5260	52	16.34	16.39
5280	56	16.27	16.30
5300	60	16.30	16.34
5320	64	**16.41**	16.16
5500	100	**16.16**	16.16
5540	108	15.82	15.81
5580	116	15.97	15.89
5660	132	15.95	15.95
5745	149	**16.26**	15.81
5825	165	16.15	15.77

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

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

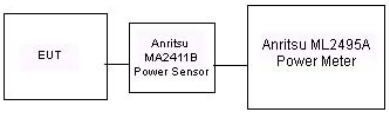

Figure 9-3
Power Measurement Setup for Bandwidths < 50 MHz

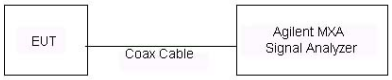

Figure 9-4
Power Measurement Setup for Bandwidths > 50 MHz

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10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C˚)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
1/5/2015	750H	21.9	695	0.863	41.829	0.889	42.227	-2.92%	-0.94%
			710	0.878	41.609	0.890	42.149	-1.35%	-1.28%
			725	0.889	41.415	0.891	42.071	-0.22%	-1.56%
			740	0.902	41.245	0.893	41.994	1.01%	-1.78%
			755	0.916	41.049	0.894	41.916	2.46%	-2.07%
1/6/2015	835H	22.2	820	0.894	41.627	0.899	41.578	-0.56%	0.12%
			835	0.909	41.434	0.900	41.500	1.00%	-0.16%
			850	0.921	41.261	0.916	41.500	0.55%	-0.58%
1/8/2015	1750H	22.0	1710	1.341	39.172	1.348	40.142	-0.52%	-2.42%
			1750	1.381	38.933	1.371	40.079	0.73%	-2.86%
			1790	1.434	38.813	1.394	40.016	2.87%	-3.01%
1/5/2015	1900H	23.1	1850	1.344	39.441	1.400	40.000	-4.00%	-1.40%
			1880	1.374	39.346	1.400	40.000	-1.86%	-1.64%
			1910	1.403	39.238	1.400	40.000	0.21%	-1.91%
1/9/2015	2450H	21.9	2401	1.766	37.895	1.756	39.287	0.57%	-3.54%
			2450	1.819	37.694	1.800	39.200	1.06%	-3.84%
			2499	1.871	37.524	1.853	39.138	0.97%	-4.12%
1/15/2015	2450H	22.0	2401	1.737	38.478	1.756	39.287	-1.08%	-2.06%
			2450	1.787	38.287	1.800	39.200	-0.72%	-2.33%
			2499	1.842	38.112	1.853	39.138	-0.59%	-2.62%
01/19/2015	5200H-5800H	21.0	5260	4.732	35.798	4.717	35.917	0.32%	-0.33%
			5300	4.785	35.717	4.758	35.871	0.57%	-0.43%
			5320	4.802	35.712	4.778	35.849	0.50%	-0.38%
			5500	4.989	35.418	4.963	35.643	0.52%	-0.63%
			5540	5.037	35.351	5.004	35.597	0.66%	-0.69%
			5580	5.097	35.297	5.045	35.551	1.03%	-0.71%
			5600	5.119	35.278	5.065	35.529	1.07%	-0.71%
			5660	5.175	35.157	5.127	35.460	0.94%	-0.85%
			5700	5.234	35.090	5.168	35.414	1.28%	-0.91%
			5745	5.274	35.031	5.214	35.363	1.15%	-0.94%
			5785	5.318	34.943	5.255	35.317	1.20%	-1.06%
			5800	5.332	34.954	5.270	35.300	1.18%	-0.98%
			5825	5.366	34.923	5.296	35.271	1.32%	-0.99%
1/6/2015	750B	23.0	695	0.917	55.331	0.959	55.745	-4.38%	-0.74%
			710	0.931	56.175	0.960	55.687	-3.02%	0.88%
			725	0.942	55.996	0.961	55.629	-1.98%	0.66%
			740	0.955	55.830	0.963	55.570	-0.83%	0.47%
			755	0.970	55.660	0.964	55.512	0.62%	0.27%
1/8/2015	835B	20.5	820	0.977	53.302	0.969	55.258	0.83%	-3.54%
			835	0.992	53.127	0.970	55.200	2.27%	-3.76%
			850	1.008	52.964	0.988	55.154	2.02%	-3.97%
1/8/2015	1750B	22.0	1710	1.450	51.968	1.463	53.537	-0.89%	-2.93%
			1750	1.501	51.771	1.488	53.432	0.87%	-3.11%
			1790	1.554	51.672	1.514	53.326	2.64%	-3.10%
1/12/2015	1750B	22.0	1710	1.481	51.753	1.463	53.537	1.23%	-3.33%
			1750	1.526	51.581	1.488	53.432	2.55%	-3.46%
			1790	1.572	51.435	1.514	53.326	3.83%	-3.55%
1/8/2015	1900B	22.5	1850	1.454	52.809	1.520	53.300	-4.34%	-0.92%
			1880	1.490	52.726	1.520	53.300	-1.97%	-1.08%
			1910	1.528	52.675	1.520	53.300	0.53%	-1.17%
1/12/2015	2450B	23.0	2401	1.922	52.122	1.903	52.765	1.00%	-1.22%
			2450	1.990	51.901	1.950	52.700	2.05%	-1.52%
			2499	2.058	51.716	2.019	52.638	1.93%	-1.75%
01/13/2015	5200B-5800B	23.1	5260	5.532	47.218	5.369	48.933	3.04%	-3.50%
			5300	5.589	47.162	5.416	48.879	3.19%	-3.51%
			5500	5.847	46.781	5.650	48.607	3.49%	-3.76%
			5600	5.996	46.661	5.766	48.471	3.99%	-3.73%
			5700	6.121	46.456	5.883	48.336	4.05%	-3.89%
			5745	6.175	46.360	5.936	48.275	4.03%	-3.97%
			5785	6.241	46.288	5.982	48.220	4.33%	-4.01%
			5800	6.263	46.274	6.000	48.200	4.38%	-4.00%

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

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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 10-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
D	750	HEAD	01/05/2015	23.1	22.3	0.100	1054	3263	0.888	8.330	8.880	6.60%
J	835	HEAD	01/06/2015	23.9	22.4	0.100	4d119	3022	0.896	9.220	8.960	-2.82%
D	1750	HEAD	01/08/2015	23.8	22.0	0.100	1008	3263	3.440	36.900	34.400	-6.78%
G	1900	HEAD	01/05/2015	24.0	22.5	0.100	5d141	3258	4.100	40.100	41.000	2.24%
D	2450	HEAD	01/09/2015	23.9	22.2	0.100	719	3263	5.630	52.100	56.300	8.06%
D	2450	HEAD	01/15/2015	23.9	22.3	0.100	719	3263	5.660	52.100	56.600	8.64%
E	5300	HEAD	01/19/2015	22.4	21.0	0.100	1120	7308	7.700	83.400	77.000	-7.67%
E	5500	HEAD	01/19/2015	22.5	21.1	0.100	1120	7308	7.840	84.900	78.400	-7.66%
E	5600	HEAD	01/19/2015	22.5	21.1	0.100	1120	7308	8.200	82.200	82.000	-0.24%
E	5800	HEAD	01/19/2015	22.5	21.1	0.100	1120	7308	7.370	79.100	73.700	-6.83%
D	750	BODY	01/06/2015	23.3	22.5	0.100	1054	3263	0.948	8.640	9.480	9.72%
K	835	BODY	01/08/2015	21.6	20.9	0.100	4d133	3288	1.010	9.350	10.100	8.02%
D	1750	BODY	01/08/2015	23.8	22.0	0.100	1008	3263	3.640	37.600	36.400	-3.19%
D	1750	BODY	01/12/2015	23.8	22.4	0.100	1008	3263	3.930	37.600	39.300	4.52%
G	1900	BODY	01/08/2015	23.6	22.5	0.100	5d141	3258	4.050	40.600	40.500	-0.25%
G	2450	BODY	01/12/2015	23.1	23.0	0.100	719	3258	5.540	51.800	55.400	6.95%
H	5300	BODY	01/13/2015	24.8	22.5	0.100	1191	3920	7.360	79.900	73.600	-7.88%
H	5500	BODY	01/13/2015	24.8	22.5	0.100	1191	3920	7.500	83.100	75.000	-9.75%
H	5600	BODY	01/13/2015	24.8	22.5	0.100	1191	3920	7.740	84.100	77.400	-7.97%
H	5800	BODY	01/13/2015	24.8	22.5	0.100	1191	3920	7.040	78.000	70.400	-9.74%

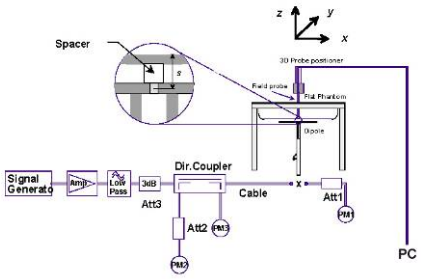

Figure 10-1
System Verification Setup Diagram

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	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.5	33.03	0.03	Right	Cheek	0100F	1:8.3	0.082	1.114	0.091	
836.60	190	GSM 850	GSM	33.5	33.03	0.03	Right	Tilt	0100F	1:8.3	0.033	1.114	0.037	
836.60	190	GSM 850	GSM	33.5	33.03	0.07	Left	Cheek	0100F	1:8.3	0.082	1.114	0.091	A1
836.60	190	GSM 850	GSM	33.5	33.03	0.20	Left	Tilt	0100F	1:8.3	0.035	1.114	0.039	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-2
UMTS 850 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	23.5	23.04	0.03	Right	Cheek	0100F	1:1	0.193	1.112	0.215	
836.60	4183	UMTS 850	RMC	23.5	23.04	0.10	Right	Tilt	0100F	1:1	0.100	1.112	0.111	
836.60	4183	UMTS 850	RMC	23.5	23.04	0.11	Left	Cheek	0100F	1:1	0.225	1.112	**0.250**	A2
836.60	4183	UMTS 850	RMC	23.5	23.04	0.07	Left	Tilt	0100F	1:1	0.101	1.112	0.112	
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
GSM 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	30.0	29.87	0.06	Right	Cheek	00FDE	1:8.3	0.072	1.030	0.074	A3
1880.00	661	GSM 1900	GSM	30.0	29.87	0.05	Right	Tilt	00FDE	1:8.3	0.025	1.030	0.026	
1880.00	661	GSM 1900	GSM	30.0	29.87	0.02	Left	Cheek	00FDE	1:8.3	0.042	1.030	0.043	
1880.00	661	GSM 1900	GSM	30.0	29.87	-0.04	Left	Tilt	00FDE	1:8.3	0.028	1.030	0.029	
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
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	23.0	22.71	-0.19	Right	Cheek	00FDE	1:1	0.125	1.069	0.134	A4
1880.00	9400	UMTS 1900	RMC	23.0	22.71	0.04	Right	Tilt	00FDE	1:1	0.045	1.069	0.048	
1880.00	9400	UMTS 1900	RMC	23.0	22.71	-0.11	Left	Cheek	00FDE	1:1	0.068	1.069	0.073	
1880.00	9400	UMTS 1900	RMC	23.0	22.71	-0.05	Left	Tilt	00FDE	1:1	0.041	1.069	0.044	
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
LTE Band 12 Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	0.12	0	Right	Cheek	QPSK	1	0	0100F	1:1	0.024	1.005	0.024	
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	0.04	1	Right	Cheek	QPSK	25	12	0100F	1:1	0.019	1.084	0.021	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	0.04	0	Right	Tilt	QPSK	1	0	0100F	1:1	0.013	1.005	0.013	
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	0.03	1	Right	Tilt	QPSK	25	12	0100F	1:1	0.012	1.084	0.013	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	0.12	0	Left	Cheek	QPSK	1	0	0100F	1:1	0.031	1.005	0.031	A5
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	0.06	1	Left	Cheek	QPSK	25	12	0100F	1:1	0.024	1.084	0.026	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	0.05	0	Left	Tilt	QPSK	1	0	0100F	1:1	0.014	1.005	0.014	
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	0.05	1	Left	Tilt	QPSK	25	12	0100F	1:1	0.010	1.084	0.011	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-6
LTE Band 26 Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	0.10	0	Right	Cheek	QPSK	1	0	0100F	1:1	0.080	1.002	0.080	
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	0.03	1	Right	Cheek	QPSK	36	0	0100F	1:1	0.053	1.033	0.055	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	0.15	0	Right	Tilt	QPSK	1	0	0100F	1:1	0.035	1.002	0.035	
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	0.07	1	Right	Tilt	QPSK	36	0	0100F	1:1	0.025	1.033	0.026	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	0.05	0	Left	Cheek	QPSK	1	0	0100F	1:1	0.098	1.002	0.098	A6
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	0.12	1	Left	Cheek	QPSK	36	0	0100F	1:1	0.059	1.033	0.061	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	0.19	0	Left	Tilt	QPSK	1	0	0100F	1:1	0.047	1.002	0.047	
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	0.02	1	Left	Tilt	QPSK	36	0	0100F	1:1	0.027	1.033	0.028	
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 4 (AWS) Head SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	-0.02	0	Right	Cheek	QPSK	1	0	00FDE	1:1	0.170	1.026	0.174	A7
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	-0.15	1	Right	Cheek	QPSK	50	25	00FDE	1:1	0.140	1.016	0.142	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	0.03	0	Right	Tilt	QPSK	1	0	00FDE	1:1	0.118	1.026	0.121	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	0.02	1	Right	Tilt	QPSK	50	25	00FDE	1:1	0.085	1.016	0.086	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	0.12	0	Left	Cheek	QPSK	1	0	00FDE	1:1	0.157	1.026	0.161	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	0.14	1	Left	Cheek	QPSK	50	25	00FDE	1:1	0.119	1.016	0.121	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	0.02	0	Left	Tilt	QPSK	1	0	00FDE	1:1	0.117	1.026	0.120	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	0.01	1	Left	Tilt	QPSK	50	25	00FDE	1:1	0.094	1.016	0.096	
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 2 (PCS) Head SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	-0.03	0	Right	Cheek	QPSK	1	99	00FDE	1:1	0.169	1.002	0.169	A8
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	0.17	1	Right	Cheek	QPSK	50	25	00FDE	1:1	0.127	1.000	0.127	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	0.05	0	Right	Tilt	QPSK	1	99	00FDE	1:1	0.071	1.002	0.071	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	0.02	1	Right	Tilt	QPSK	50	25	00FDE	1:1	0.039	1.000	0.039	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	0.01	0	Left	Cheek	QPSK	1	99	00FDE	1:1	0.111	1.002	0.111	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	-0.02	1	Left	Cheek	QPSK	50	25	00FDE	1:1	0.078	1.000	0.078	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	-0.01	0	Left	Tilt	QPSK	1	99	00FDE	1:1	0.058	1.002	0.058	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	-0.07	1	Left	Tilt	QPSK	50	25	00FDE	1:1	0.046	1.000	0.046	
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 11-9
DTS Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	17.5	17.00	-0.15	Right	Cheek	1	0100F	1	99.4	0.989	0.814	1.122	1.007	**0.919**	
2462	11	802.11b	DSSS	22	17.5	17.16	0.01	Right	Cheek	1	0100F	1	99.4	1.141	0.837	1.081	1.007	0.911	A9
2462	11	802.11b	DSSS	22	17.5	17.16	0.00	Right	Tilt	1	0100F	1	99.4	0.896	0.634	1.081	1.007	0.690	
2462	11	802.11b	DSSS	22	17.5	17.16	-	Left	Cheek	1	0100F	1	99.4	0.560	-	1.081	1.007	-	
2462	11	802.11b	DSSS	22	17.5	17.16	-	Left	Tilt	1	0100F	1	99.4	0.312	-	1.081	1.007	-	
2462	11	802.11b	DSSS	22	17.5	17.29	0.03	Right	Cheek	2	0100F	1	99.8	0.227	0.226	1.050	1.002	0.237	
2462	11	802.11b	DSSS	22	17.5	17.29	-	Right	Tilt	2	0100F	1	99.8	0.207	-	1.050	1.002	-	
2462	11	802.11b	DSSS	22	17.5	17.29	-	Left	Cheek	2	0100F	1	99.8	0.166	-	1.050	1.002	-	
2462	11	802.11b	DSSS	22	17.5	17.29	-	Left	Tilt	2	0100F	1	99.8	0.138	-	1.050	1.002	-	
2462	11	802.11n	OFDM	20	16.5	16.15	-0.05	Right	Cheek	MIMO	0100F	13	97.9	0.950	0.698	1.084	1.021	0.773	
2462	11	802.11n	OFDM	20	16.5	16.15	-0.03	Right	Tilt	MIMO	0100F	13	97.9	0.702	0.511	1.084	1.021	0.566	
2462	11	802.11n	OFDM	20	16.5	16.15	-	Left	Cheek	MIMO	0100F	13	97.9	0.531	-	1.084	1.021	-	
2462	11	802.11n	OFDM	20	16.5	16.15	-	Left	Tilt	MIMO	0100F	13	97.9	0.319	-	1.084	1.021	-	
2462	11	802.11b	DSSS	22	17.5	17.16	0.07	Right	Cheek	1	0100F	1	99.4	1.000	0.801	1.081	1.007	0.872	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram											

Blue entry represents variability measurement.

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Table 11-10
NII Head SAR

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5300	60	802.11a	OFDM	20	13.5	13.49	0.10	Right	Cheek	1	00FEF	6	98.6	1.370	0.594	1.002	1.014	0.603	
5300	60	802.11a	OFDM	20	13.5	13.49	0.15	Right	Tilt	1	00FEF	6	98.6	0.970	0.398	1.002	1.014	0.405	
5300	60	802.11a	OFDM	20	13.5	13.49	-	Left	Cheek	1	00FEF	6	98.6	0.952	-	1.002	1.014	-	
5300	60	802.11a	OFDM	20	13.5	13.49	-	Left	Tilt	1	00FEF	6	98.6	0.757	-	1.002	1.014	-	
5260	52	802.11a	OFDM	20	13.5	13.15	0.09	Right	Cheek	2	00FEF	6	98.3	0.286	0.101	1.084	1.018	0.111	
5260	52	802.11a	OFDM	20	13.5	13.15	-	Right	Tilt	2	00FEF	6	98.3	0.203	-	1.084	1.018	-	
5260	52	802.11a	OFDM	20	13.5	13.15	-	Left	Cheek	2	00FEF	6	98.3	0.195	-	1.084	1.018	-	
5260	52	802.11a	OFDM	20	13.5	13.15	-	Left	Tilt	2	00FEF	6	98.3	0.121	-	1.084	1.018	-	
5320	64	802.11n	OFDM	20	16.5	16.41	0.04	Right	Cheek	MIMO	00FEF	13	97.9	0.949	0.567	1.021	1.021	0.591	
5320	64	802.11n	OFDM	20	16.5	16.41	-	Right	Tilt	MIMO	00FEF	13	97.9	0.782	-	1.021	1.021	-	
5320	64	802.11n	OFDM	20	16.5	16.41	0.03	Left	Cheek	MIMO	00FEF	13	97.9	1.000	0.469	1.021	1.021	0.489	
5320	64	802.11n	OFDM	20	16.5	16.41	-	Left	Tilt	MIMO	00FEF	13	97.9	0.679	-	1.021	1.021	-	
5500	100	802.11a	OFDM	20	13.5	13.46	0.05	Right	Cheek	1	00FEF	6	98.6	1.403	0.893	1.009	1.014	0.914	
5580	116	802.11n	OFDM	20	13.5	13.24	0.04	Right	Cheek	1	00FEF	6.5	98.5	1.585	0.918	1.062	1.015	0.990	
5500	100	802.11a	OFDM	20	13.5	13.46	0.11	Right	Tilt	1	00FEF	6	98.6	1.029	0.586	1.009	1.014	0.599	
5500	100	802.11a	OFDM	20	13.5	13.46	-	Left	Cheek	1	00FEF	6	98.6	0.959	-	1.009	1.014	-	
5500	100	802.11a	OFDM	20	13.5	13.46	-	Left	Tilt	1	00FEF	6	98.6	0.788	-	1.009	1.014	-	
5500	100	802.11a	OFDM	20	13.5	13.15	-0.01	Right	Cheek	2	00FEF	6	98.3	1.391	0.752	1.084	1.018	0.830	
5580	116	802.11a	OFDM	20	13.5	12.83	0.12	Right	Cheek	2	00FEF	6	98.3	0.998	0.368	1.167	1.018	0.437	
5500	100	802.11a	OFDM	20	13.5	13.15	0.19	Right	Tilt	2	00FEF	6	98.3	1.239	0.604	1.084	1.018	0.667	
5500	100	802.11a	OFDM	20	13.5	13.15	-	Left	Cheek	2	00FEF	6	98.3	0.745	-	1.084	1.018	-	
5500	100	802.11a	OFDM	20	13.5	13.15	-	Left	Tilt	2	00FEF	6	98.3	0.636	-	1.084	1.018	-	
5500	100	802.11n	OFDM	20	16.5	16.16	0.07	Right	Cheek	MIMO	00FEF	13	97.9	2.226	1.080	1.081	1.021	1.192	
5540	108	802.11n	OFDM	20	16.5	15.82	0.18	Right	Cheek	MIMO	00FEF	13	97.9	2.238	1.090	1.169	1.021	1.301	
5580	116	802.11n	OFDM	20	16.5	15.97	0.11	Right	Cheek	MIMO	00FEF	13	97.9	2.367	1.080	1.130	1.021	1.246	
5500	100	802.11n	OFDM	20	16.5	16.16	0.02	Right	Tilt	MIMO	00FEF	13	97.9	2.026	0.908	1.081	1.021	1.003	
5580	116	802.11n	OFDM	20	16.5	15.97	0.03	Right	Tilt	MIMO	00FEF	13	97.9	1.977	0.794	1.130	1.021	0.916	
5500	100	802.11n	OFDM	20	16.5	16.16	0.02	Left	Cheek	MIMO	00FEF	13	97.9	1.351	0.613	1.081	1.021	0.677	
5500	100	802.11n	OFDM	20	16.5	16.16	-	Left	Tilt	MIMO	00FEF	13	97.9	1.071	-	1.081	1.021	-	
5540	108	802.11n	OFDM	20	16.5	15.82	-0.08	Right	Cheek	MIMO	00FEF	13	97.9	2.201	1.200	1.169	1.021	1.432	
5745	149	802.11a	OFDM	20	13.5	13.42	0.11	Right	Cheek	1	00FEF	6	98.6	1.718	0.713	1.019	1.014	0.737	
5745	149	802.11a	OFDM	20	13.5	13.42	0.15	Right	Tilt	1	00FEF	6	98.6	1.430	0.634	1.019	1.014	0.655	
5745	149	802.11a	OFDM	20	13.5	13.42	-	Left	Cheek	1	00FEF	6	98.6	1.082	-	1.019	1.014	-	
5745	149	802.11a	OFDM	20	13.5	13.42	-	Left	Tilt	1	00FEF	6	98.6	0.894	-	1.019	1.014	-	
5745	149	802.11a	OFDM	20	13.5	13.17	0.05	Right	Cheek	2	00FEF	6	98.3	1.714	0.949	1.079	1.018	1.042	
5825	165	802.11a	OFDM	20	13.5	13.02	0.04	Right	Cheek	2	00FEF	6	98.3	1.867	0.845	1.117	1.018	0.961	
5745	149	802.11a	OFDM	20	13.5	13.17	0.11	Right	Tilt	2	00FEF	6	98.3	1.544	0.740	1.079	1.018	0.812	
5825	165	802.11a	OFDM	20	13.5	13.02	0.06	Right	Tilt	2	00FEF	6	98.3	1.636	0.681	1.117	1.018	0.775	
5745	149	802.11a	OFDM	20	13.5	13.17	-	Left	Cheek	2	00FEF	6	98.3	0.922	-	1.079	1.018	-	
5745	149	802.11a	OFDM	20	13.5	13.17	0.12	Left	Tilt	2	00FEF	6	98.3	1.007	0.402	1.079	1.018	0.442	
5745	149	802.11n	OFDM	20	16.5	16.26	0.15	Right	Cheek	MIMO	00FEF	13	97.9	1.760	1.160	1.057	1.021	1.252	
5660	132	802.11n	OFDM	20	16.5	15.95	0.09	Right	Cheek	MIMO	00FEF	13	97.9	1.678	1.110	1.135	1.021	1.286	
5825	165	802.11n	OFDM	20	16.5	16.15	0.11	Right	Cheek	MIMO	00FEF	13	97.9	1.787	1.230	1.084	1.021	1.361	
5745	149	802.11n	OFDM	20	16.5	16.26	0.18	Right	Tilt	MIMO	00FEF	13	97.9	1.412	0.823	1.057	1.021	0.888	
5825	165	802.11n	OFDM	20	16.5	16.15	0.18	Right	Tilt	MIMO	00FEF	13	97.9	1.615	0.846	1.084	1.021	0.936	
5745	149	802.11n	OFDM	20	16.5	16.26	0.02	Left	Cheek	MIMO	00FEF	13	97.9	1.086	0.589	1.057	1.021	0.636	
5745	149	802.11n	OFDM	20	16.5	16.26	-0.04	Left	Tilt	MIMO	00FEF	13	97.9	0.931	0.390	1.057	1.021	0.421	
5825	165	802.11n	OFDM	20	16.5	16.15	0.10	Right	Cheek	MIMO	00FEF	13	97.9	2.312	1.340	1.084	1.021	1.484	A10
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram											

Blue entry represents variability measurement.

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11.2 Standalone Body-Worn SAR Data

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

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.5	33.03	0.10	10 mm	00FDE	1	1:8.3	back	0.306	1.114	0.341	A11
836.60	4183	UMTS 850	RMC	23.5	23.04	0.01	10 mm	00FDE	N/A	1:1	back	0.305	1.112	0.339	A13
1880.00	661	GSM 1900	GSM	30.0	29.87	0.06	10 mm	00FDE	1	1:8.3	back	0.316	1.030	0.325	A14
1880.00	9400	UMTS 1900	RMC	23.0	22.71	-0.01	10 mm	00FDE	N/A	1:1	back	0.592	1.069	0.633	A16
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 11-12
LTE Body-Worn SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	-0.06	0	0100F	QPSK	1	0	10 mm	back	1:1	0.106	1.005	0.107	A18
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	-0.05	1	0100F	QPSK	25	12	10 mm	back	1:1	0.078	1.084	0.085	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	0.00	0	0100F	QPSK	1	0	10 mm	back	1:1	0.438	1.002	0.439	A19
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	-0.04	1	0100F	QPSK	36	0	10 mm	back	1:1	0.317	1.033	0.327	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	-0.17	0	00FEF	QPSK	1	0	10 mm	back	1:1	0.826	1.026	**0.847**	A20
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	-0.06	1	00FEF	QPSK	50	25	10 mm	back	1:1	0.696	1.016	0.707	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.33	-0.02	1	00FEF	QPSK	100	0	10 mm	back	1:1	0.672	1.040	0.699	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	0.03	0	01009	QPSK	1	99	10 mm	back	1:1	0.586	1.002	0.587	A22
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	0.04	1	01009	QPSK	50	25	10 mm	back	1:1	0.455	1.000	0.455	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-13
DTS Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2462	11	802.11b	DSSS	22	17.5	17.16	-0.05	10 mm	1	00FEF	1	back	99.4	0.144	0.128	1.081	1.007	**0.139**	A24
2462	11	802.11b	DSSS	22	17.5	17.29	0.16	10 mm	2	00FEF	1	back	99.8	0.078	0.060	1.050	1.002	0.063	
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 11-14
NII Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5300	60	802.11a	OFDM	20	13.5	13.49	0.03	10 mm	1	0100F	6	back	98.6	0.229	0.121	1.002	1.014	0.123	
5260	52	802.11a	OFDM	20	13.5	13.15	0.03	10 mm	2	0100F	6	back	98.3	0.153	0.070	1.084	1.018	0.077	
5500	100	802.11a	OFDM	20	13.5	13.46	0.20	10 mm	1	0100F	6	back	98.6	0.289	0.182	1.009	1.014	**0.187**	A25
5500	100	802.11a	OFDM	20	13.5	13.15	-0.01	10 mm	2	0100F	6	back	98.3	0.264	0.124	1.084	1.018	0.136	
5745	149	802.11a	OFDM	20	13.5	13.42	0.11	10 mm	1	0100F	6	back	98.6	0.163	0.093	1.019	1.014	0.096	
5745	149	802.11a	OFDM	20	13.5	13.17	0.08	10 mm	2	0100F	6	back	98.3	0.249	0.123	1.079	1.018	0.135	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram													

11.3 Standalone Wireless Router SAR Data

Table 11-15
GPRS/UMTS Hotspot SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GPRS	32.5	32.36	0.03	10 mm	00FDE	2	1:4.15	back	0.470	1.033	0.486	
836.60	190	GSM 850	GPRS	32.5	32.36	0.03	10 mm	00FDE	2	1:4.15	front	0.483	1.033	0.499	
836.60	190	GSM 850	GPRS	32.5	32.36	0.19	10 mm	00FDE	2	1:4.15	bottom	0.120	1.033	0.124	
836.60	190	GSM 850	GPRS	32.5	32.36	-0.05	10 mm	00FDE	2	1:4.15	right	0.392	1.033	0.405	
836.60	190	GSM 850	GPRS	32.5	32.36	0.20	10 mm	00FDE	2	1:4.15	left	0.568	1.033	0.587	A12
836.60	4183	UMTS 850	RMC	23.5	23.04	0.01	10 mm	00FDE	N/A	1:1	back	0.305	1.112	0.339	A13
836.60	4183	UMTS 850	RMC	23.5	23.04	0.00	10 mm	00FDE	N/A	1:1	front	0.257	1.112	0.286	
836.60	4183	UMTS 850	RMC	23.5	23.04	-0.12	10 mm	00FDE	N/A	1:1	bottom	0.076	1.112	0.085	
836.60	4183	UMTS 850	RMC	23.5	23.04	0.04	10 mm	00FDE	N/A	1:1	right	0.217	1.112	0.241	
836.60	4183	UMTS 850	RMC	23.5	23.04	0.02	10 mm	00FDE	N/A	1:1	left	0.203	1.112	0.226	
1880.00	661	GSM 1900	GPRS	28.5	28.33	0.00	10 mm	00FDE	2	1:4.15	back	0.621	1.040	0.646	A15
1880.00	661	GSM 1900	GPRS	28.5	28.33	0.02	10 mm	00FDE	2	1:4.15	front	0.518	1.040	0.539	
1880.00	661	GSM 1900	GPRS	28.5	28.33	-0.01	10 mm	00FDE	2	1:4.15	bottom	0.586	1.040	0.609	
1880.00	661	GSM 1900	GPRS	28.5	28.33	-0.01	10 mm	00FDE	2	1:4.15	right	0.112	1.040	0.116	
1880.00	661	GSM 1900	GPRS	28.5	28.33	-0.14	10 mm	00FDE	2	1:4.15	left	0.071	1.040	0.074	
1880.00	9400	UMTS 1900	RMC	23.0	22.71	-0.01	10 mm	00FDE	N/A	1:1	back	0.592	1.069	0.633	
1880.00	9400	UMTS 1900	RMC	23.0	22.71	-0.01	10 mm	00FDE	N/A	1:1	front	0.594	1.069	0.635	
1852.40	9262	UMTS 1900	RMC	23.0	22.74	-0.02	10 mm	00FDE	N/A	1:1	bottom	0.886	1.062	0.941	A17
1880.00	9400	UMTS 1900	RMC	23.0	22.71	0.07	10 mm	00FDE	N/A	1:1	bottom	0.790	1.069	0.845	
1907.60	9538	UMTS 1900	RMC	23.0	22.70	0.11	10 mm	00FDE	N/A	1:1	bottom	0.740	1.072	0.793	
1880.00	9400	UMTS 1900	RMC	23.0	22.71	-0.03	10 mm	00FDE	N/A	1:1	right	0.143	1.069	0.153	
1880.00	9400	UMTS 1900	RMC	23.0	22.71	0.04	10 mm	00FDE	N/A	1:1	left	0.094	1.069	0.100	
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 11-16
LTE Band 12 Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	-0.06	0	0100F	QPSK	1	0	10 mm	back	1:1	0.106	1.005	0.107	A18
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	-0.05	1	0100F	QPSK	25	12	10 mm	back	1:1	0.078	1.084	0.085	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	-0.07	0	0100F	QPSK	1	0	10 mm	front	1:1	0.098	1.005	0.098	
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	-0.08	1	0100F	QPSK	25	12	10 mm	front	1:1	0.071	1.084	0.077	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	0.03	0	0100F	QPSK	1	0	10 mm	bottom	1:1	0.018	1.005	0.018	
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	-0.04	1	0100F	QPSK	25	12	10 mm	bottom	1:1	0.013	1.084	0.014	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	0.00	0	0100F	QPSK	1	0	10 mm	right	1:1	0.034	1.005	0.034	
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	0.03	1	0100F	QPSK	25	12	10 mm	right	1:1	0.024	1.084	0.026	
707.50	23095	Mid	LTE Band 12	10	23.5	23.48	0.04	0	0100F	QPSK	1	0	10 mm	left	1:1	0.049	1.005	0.049	
707.50	23095	Mid	LTE Band 12	10	22.5	22.15	-0.07	1	0100F	QPSK	25	12	10 mm	left	1:1	0.038	1.084	0.041	
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
LTE Band 26 Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	0.00	0	0100F	QPSK	1	0	10 mm	back	1:1	0.438	1.002	0.439	A19
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	-0.04	1	0100F	QPSK	36	0	10 mm	back	1:1	0.317	1.033	0.327	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	-0.03	0	0100F	QPSK	1	0	10 mm	front	1:1	0.438	1.002	0.439	
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	-0.01	1	0100F	QPSK	36	0	10 mm	front	1:1	0.310	1.033	0.320	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	-0.02	0	0100F	QPSK	1	0	10 mm	bottom	1:1	0.083	1.002	0.083	
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	0.10	1	0100F	QPSK	36	0	10 mm	bottom	1:1	0.056	1.033	0.058	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	-0.13	0	0100F	QPSK	1	0	10 mm	right	1:1	0.293	1.002	0.294	
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	0.00	1	0100F	QPSK	36	0	10 mm	right	1:1	0.222	1.033	0.229	
836.50	26915	Mid	LTE Band 26	15	24.0	23.99	-0.02	0	0100F	QPSK	1	0	10 mm	left	1:1	0.402	1.002	0.403	
836.50	26915	Mid	LTE Band 26	15	23.0	22.86	0.04	1	0100F	QPSK	36	0	10 mm	left	1:1	0.306	1.033	0.316	
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 11-18
LTE Band 4 (AWS) Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	-0.17	0	00FEF	QPSK	1	0	10 mm	back	1:1	0.826	1.026	0.847	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	-0.06	1	00FEF	QPSK	50	25	10 mm	back	1:1	0.696	1.016	0.707	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.33	-0.02	1	00FEF	QPSK	100	0	10 mm	back	1:1	0.672	1.040	0.699	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	0.00	0	00FEF	QPSK	1	0	10 mm	front	1:1	0.670	1.026	0.687	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	0.04	1	00FEF	QPSK	50	25	10 mm	front	1:1	0.554	1.016	0.563	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	0.04	0	00FEF	QPSK	1	0	10 mm	bottom	1:1	1.050	1.026	1.077	A21
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	-0.08	1	00FEF	QPSK	50	25	10 mm	bottom	1:1	0.813	1.016	0.826	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.33	-0.01	1	00FEF	QPSK	100	0	10 mm	bottom	1:1	0.824	1.040	0.857	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	0.01	0	00FEF	QPSK	1	0	10 mm	right	1:1	0.086	1.026	0.088	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	0.00	1	00FEF	QPSK	50	25	10 mm	right	1:1	0.071	1.016	0.072	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	0.03	0	00FEF	QPSK	1	0	10 mm	left	1:1	0.126	1.026	0.129	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	21.5	21.43	0.00	1	00FEF	QPSK	50	25	10 mm	left	1:1	0.113	1.016	0.115	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	22.39	-0.06	0	00FEF	QPSK	1	0	10 mm	bottom	1:1	1.010	1.026	1.036	
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Blue entry represents variability measurement.

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Table 11-19
LTE Band 2 (PCS) Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	0.03	0	01009	QPSK	1	99	10 mm	back	1:1	0.586	1.002	0.587	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	0.04	1	01009	QPSK	50	25	10 mm	back	1:1	0.455	1.000	0.455	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	0.01	0	01009	QPSK	1	99	10 mm	front	1:1	0.497	1.002	0.498	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	-0.08	1	01009	QPSK	50	25	10 mm	front	1:1	0.379	1.000	0.379	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	-0.14	0	01009	QPSK	1	99	10 mm	bottom	1:1	0.924	1.002	0.926	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.0	22.65	-0.17	0	01009	QPSK	1	99	10 mm	bottom	1:1	0.840	1.084	0.911	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.82	-0.08	0	01009	QPSK	1	0	10 mm	bottom	1:1	0.898	1.042	0.936	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	-0.02	1	01009	QPSK	50	25	10 mm	bottom	1:1	0.732	1.000	0.732	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.0	21.98	-0.07	1	01009	QPSK	100	0	10 mm	bottom	1:1	0.776	1.005	0.780	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	0.06	0	01009	QPSK	1	99	10 mm	right	1:1	0.096	1.002	0.096	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	0.06	1	01009	QPSK	50	25	10 mm	right	1:1	0.072	1.000	0.072	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	-0.11	0	01009	QPSK	1	99	10 mm	left	1:1	0.088	1.002	0.088	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.0	22.00	-0.07	1	01009	QPSK	50	25	10 mm	left	1:1	0.066	1.000	0.066	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.0	22.99	0.01	0	01009	QPSK	1	99	10 mm	bottom	1:1	0.931	1.002	0.933	A23
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 11-20
WLAN Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2462	11	802.11b	DSSS	22	17.5	17.16	-0.05	10 mm	1	00FEF	1	back	99.4	0.144	0.128	1.081	1.007	**0.139**	A24
2462	11	802.11b	DSSS	22	17.5	17.16	-	10 mm	1	00FEF	1	front	99.4	0.105	-	1.081	1.007	-	
2462	11	802.11b	DSSS	22	17.5	17.16	-	10 mm	1	00FEF	1	top	99.4	0.087	-	1.081	1.007	-	
2462	11	802.11b	DSSS	22	17.5	17.16	-	10 mm	1	00FEF	1	left	99.4	0.084	-	1.081	1.007	-	
2462	11	802.11b	DSSS	22	17.5	17.29	0.16	10 mm	2	00FEF	1	back	99.8	0.078	0.060	1.050	1.002	0.063	
2462	11	802.11b	DSSS	22	17.5	17.29	-	10 mm	2	00FEF	1	front	99.8	0.026	-	1.050	1.002	-	
2462	11	802.11b	DSSS	22	17.5	17.29	-	10 mm	2	00FEF	1	top	99.8	0.045	-	1.050	1.002	-	
2462	11	802.11b	DSSS	22	17.5	17.29	-	10 mm	2	00FEF	1	right	99.8	0.004	-	1.050	1.002	-	
2462	11	802.11b	DSSS	22	17.5	17.29	-	10 mm	2	00FEF	1	left	99.8	0.013	-	1.050	1.002	-	
5745	149	802.11a	OFDM	20	13.5	13.42	-	10 mm	1	0100F	6	back	98.6	0.163	-	1.019	1.014	-	
5745	149	802.11a	OFDM	20	13.5	13.42	0.03	10 mm	1	0100F	6	front	98.6	0.229	0.125	1.019	1.014	0.129	A26
5745	149	802.11a	OFDM	20	13.5	13.42	-	10 mm	1	0100F	6	top	98.6	0.169	-	1.019	1.014	-	
5745	149	802.11a	OFDM	20	13.5	13.42	-	10 mm	1	0100F	6	left	98.6	0.055	-	1.019	1.014	-	
5745	149	802.11a	OFDM	20	13.5	13.17	0.08	10 mm	2	0100F	6	back	98.3	0.249	0.123	1.079	1.018	**0.135**	
5745	149	802.11a	OFDM	20	13.5	13.17	-	10 mm	2	0100F	6	front	98.3	0.171	-	1.079	1.018	-	
5745	149	802.11a	OFDM	20	13.5	13.17	-	10 mm	2	0100F	6	top	98.3	0.128	-	1.079	1.018	-	
5745	149	802.11a	OFDM	20	13.5	13.17	-	10 mm	2	0100F	6	right	98.3	0.043	-	1.079	1.018	-	
5745	149	802.11a	OFDM	20	13.5	13.17	-	10 mm	2	0100F	6	left	98.3	0.017	-	1.079	1.018	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.

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6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 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.
7. Per FCC KDB Publication 648474 D04v01, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 13 for variability analysis.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 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 D03v01 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 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > 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 D01v03. 3G SAR test reduction procedure is applied to HSPA and DC-HSDPA with 12.2 kbps RMC as the primary mode.
2. Per FCC KDB Publication 447498 D01v05, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r01. 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).

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WLAN Notes:

1. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 8.6.5 for more information.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01DR02-41929 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 8.6.6 for more information.
4. MIMO Head SAR was measured with both antennas transmitting simultaneously at the specified maximum output power in MIMO mode following the initial test configuration procedures. Body-Worn and Hotspot MIMO SAR measurements were excluded per KDB 248227 D01 DR02-41929 since the sum onf the 1g single transmission chain SAR measurements is <1.6 W/kg. Please see Section 12 for complete analysis.
5. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
6. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.

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12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

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

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter. 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.

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

Table 12-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	12.00	10	0.336

Note:

- Held-to-ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
- MIMO Head SAR was evaluated per KDB 248227 D01 DR02-41929. MIMO Head SAR was measured with both antennas transmitting simultaneously at the specified maximum output power in MIMO mode following the initial test configuration procedures
- MIMO body-worn and Hotspot SAR MIMO SAR is determined by the sum of 1g single transmission chain SAR values because the summation represents higher output power and yields more conservative result per KDB 248227 D01 DR02- 41929
- The highest Reported SAR for each exposure condition is used for SAR summation purpose.

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12.3 Head SAR Simultaneous Transmission Analysis

Table 12-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 1 (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.091	0.919	1.010
	UMTS 850	0.250	0.919	**1.169**
	GSM 1900	0.074	0.919	0.993
	UMTS 1900	0.134	0.919	1.053
	LTE Band 12	0.031	0.919	0.950
	LTE Band 26	0.098	0.919	1.017
	LTE Band 4 (AWS)	0.174	0.919	1.093
	LTE Band 2 (PCS)	0.169	0.919	1.088

Table 12-3
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 2 (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.091	0.237	0.328
	UMTS 850	0.250	0.237	**0.487**
	GSM 1900	0.074	0.237	0.311
	UMTS 1900	0.134	0.237	0.371
	LTE Band 12	0.031	0.237	0.268
	LTE Band 26	0.098	0.237	0.335
	LTE Band 4 (AWS)	0.174	0.237	0.411
	LTE Band 2 (PCS)	0.169	0.237	0.406

Table 12-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN – MIMO (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.091	0.773	0.864
	UMTS 850	0.250	0.773	**1.023**
	GSM 1900	0.074	0.773	0.847
	UMTS 1900	0.134	0.773	0.907
	LTE Band 12	0.031	0.773	0.804
	LTE Band 26	0.098	0.773	0.871
	LTE Band 4 (AWS)	0.174	0.773	0.947
	LTE Band 2 (PCS)	0.169	0.773	0.942

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.091	0.990	1.081
	UMTS 850	0.250	0.990	**1.240**
	GSM 1900	0.074	0.990	1.064
	UMTS 1900	0.134	0.990	1.124
	LTE Band 12	0.031	0.990	1.021
	LTE Band 26	0.098	0.990	1.088
	LTE Band 4 (AWS)	0.174	0.990	1.164
	LTE Band 2 (PCS)	0.169	0.990	1.159

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.091	1.042	1.133
	UMTS 850	0.250	1.042	**1.292**
	GSM 1900	0.074	1.042	1.116
	UMTS 1900	0.134	1.042	1.176
	LTE Band 12	0.031	1.042	1.073
	LTE Band 26	0.098	1.042	1.140
	LTE Band 4 (AWS)	0.174	1.042	1.216
	LTE Band 2 (PCS)	0.169	1.042	1.211

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

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)	SPLSR	Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Head SAR	Right Cheek	0.091	1.484	**1.575**	N/A	Head SAR	Right Cheek	0.215	1.484	See Note 1	0.04
	Right Tilt	0.037	1.003	1.040	N/A		Right Tilt	0.111	1.003	**1.114**	N/A
	Left Cheek	0.091	0.677	0.768	N/A		Left Cheek	0.250	0.677	0.927	N/A
	Left Tilt	0.039	0.421	0.460	N/A		Left Tilt	0.112	0.421	0.533	N/A
Simult Tx	**Configuration**	**GSM 1900 SAR (W/kg)**	**5 GHz WLAN MIMO SAR (W/kg)**	**Σ SAR (W/kg)**	**SPLSR**	**Simult Tx**	**Configuration**	**UMTS 1900 SAR (W/kg)**	**5 GHz WLAN MIMO SAR (W/kg)**	**Σ SAR (W/kg)**	**SPLSR**
Head SAR	Right Cheek	0.074	1.484	**1.558**	N/A	Head SAR	Right Cheek	0.134	1.484	See Note 1	0.02
	Right Tilt	0.026	1.003	1.029	N/A		Right Tilt	0.048	1.003	**1.051**	N/A
	Left Cheek	0.043	0.677	0.720	N/A		Left Cheek	0.073	0.677	0.750	N/A
	Left Tilt	0.029	0.421	0.450	N/A		Left Tilt	0.044	0.421	0.465	N/A
Simult Tx	**Configuration**	**LTE Band 12 SAR (W/kg)**	**5 GHz WLAN MIMO SAR (W/kg)**	**Σ SAR (W/kg)**	**SPLSR**	**Simult Tx**	**Configuration**	**LTE Band 26 SAR (W/kg)**	**5 GHz WLAN MIMO SAR (W/kg)**	**Σ SAR (W/kg)**	**SPLSR**
Head SAR	Right Cheek	0.024	1.484	**1.508**	N/A	Head SAR	Right Cheek	0.080	1.484	**1.564**	N/A
	Right Tilt	0.013	1.003	1.016	N/A		Right Tilt	0.035	1.003	1.038	N/A
	Left Cheek	0.031	0.677	0.708	N/A		Left Cheek	0.098	0.677	0.775	N/A
	Left Tilt	0.014	0.421	0.435	N/A		Left Tilt	0.047	0.421	0.468	N/A
Simult Tx	**Configuration**	**LTE Band 4 (AWS) SAR (W/kg)**	**5 GHz WLAN MIMO SAR (W/kg)**	**Σ SAR (W/kg)**	**SPLSR**	**Simult Tx**	**Configuration**	**LTE Band 2 (PCS) SAR (W/kg)**	**5 GHz WLAN MIMO SAR (W/kg)**	**Σ SAR (W/kg)**	**SPLSR**
Head SAR	Right Cheek	0.174	1.484	See Note 1	0.02	Head SAR	Right Cheek	0.169	1.484	See Note 1	0.02
	Right Tilt	0.121	1.003	**1.124**	N/A		Right Tilt	0.071	1.003	**1.074**	N/A
	Left Cheek	0.161	0.677	0.838	N/A		Left Cheek	0.111	0.677	0.788	N/A
	Left Tilt	0.120	0.421	0.541	N/A		Left Tilt	0.058	0.421	0.479	N/A

Note:
1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not higher than 0.04 per FCC KDB 447498 D01v05. See Section 12.6 for detailed SPLS ratio analysis.

12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 1(Body-Worn at 1.0 cm))

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.341	0.139	0.480
	UMTS 850	0.339	0.139	0.478
	GSM 1900	0.325	0.139	0.464
	UMTS 1900	0.633	0.139	0.772
	LTE Band 12	0.107	0.139	0.246
	LTE Band 26	0.439	0.139	0.578
	LTE Band 4 (AWS)	0.847	0.139	**0.986**
	LTE Band 2 (PCS)	0.587	0.139	0.726

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Table 12-9
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 2 (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.341	0.063	0.404
	UMTS 850	0.339	0.063	0.402
	GSM 1900	0.325	0.063	0.388
	UMTS 1900	0.633	0.063	0.696
	LTE Band 12	0.107	0.063	0.170
	LTE Band 26	0.439	0.063	0.502
	LTE Band 4 (AWS)	0.847	0.063	**0.910**
	LTE Band 2 (PCS)	0.587	0.063	0.650

Table 12-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN MIMO (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.341	0.139	0.063	0.543
	UMTS 850	0.339	0.139	0.063	0.541
	GSM 1900	0.325	0.139	0.063	0.527
	UMTS 1900	0.633	0.139	0.063	0.835
	LTE Band 12	0.107	0.139	0.063	0.309
	LTE Band 26	0.439	0.139	0.063	0.641
	LTE Band 4 (AWS)	0.847	0.139	0.063	**1.049**
	LTE Band 2 (PCS)	0.587	0.139	0.063	0.789

Table 12-11
Simultaneous Transmission Scenario with 5 GHz WLAN - Ant 1 (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.341	0.187	0.528
	UMTS 850	0.339	0.187	0.526
	GSM 1900	0.325	0.187	0.512
	UMTS 1900	0.633	0.187	0.820
	LTE Band 12	0.107	0.187	0.294
	LTE Band 26	0.439	0.187	0.626
	LTE Band 4 (AWS)	0.847	0.187	**1.034**
	LTE Band 2 (PCS)	0.587	0.187	0.774

Table 12-12
Simultaneous Transmission Scenario with 5 GHz WLAN - Ant 2 (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.341	0.136	0.477
	UMTS 850	0.339	0.136	0.475
	GSM 1900	0.325	0.136	0.461
	UMTS 1900	0.633	0.136	0.769
	LTE Band 12	0.107	0.136	0.243
	LTE Band 26	0.439	0.136	0.575
	LTE Band 4 (AWS)	0.847	0.136	**0.983**
	LTE Band 2 (PCS)	0.587	0.136	0.723

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Table 12-13
Simultaneous Transmission Scenario with 5 GHz WLAN - MIMO (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.341	0.187	0.136	0.664
	UMTS 850	0.339	0.187	0.136	0.662
	GSM 1900	0.325	0.187	0.136	0.648
	UMTS 1900	0.633	0.187	0.136	0.956
	LTE Band 12	0.107	0.187	0.136	0.430
	LTE Band 26	0.439	0.187	0.136	0.762
	LTE Band 4 (AWS)	0.847	0.187	0.136	**1.170**
	LTE Band 2 (PCS)	0.587	0.187	0.136	0.910

.

Table 12-14
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Body-Worn	GSM 850	0.341	0.336	0.677
	UMTS 850	0.339	0.336	0.675
	GSM 1900	0.325	0.336	0.661
	UMTS 1900	0.633	0.336	0.969
	LTE Band 12	0.107	0.336	0.443
	LTE Band 26	0.439	0.336	0.775
	LTE Band 4 (AWS)	0.847	0.336	**1.183**
	LTE Band 2 (PCS)	0.587	0.336	0.923

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

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

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.587	0.139	0.726
	UMTS 850	0.339	0.139	0.478
	GPRS 1900	0.646	0.139	0.785
	UMTS 1900	0.941	0.139	1.080
	LTE Band 12	0.107	0.139	0.246
	LTE Band 26	0.439	0.139	0.578
	LTE Band 4 (AWS)	1.077	0.139	**1.216**
	LTE Band 2 (PCS)	0.936	0.139	1.075

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.587	0.063	0.650
	UMTS 850	0.339	0.063	0.402
	GPRS 1900	0.646	0.063	0.709
	UMTS 1900	0.941	0.063	1.004
	LTE Band 12	0.107	0.063	0.170
	LTE Band 26	0.439	0.063	0.502
	LTE Band 4 (AWS)	1.077	0.063	**1.140**
	LTE Band 2 (PCS)	0.936	0.063	0.999

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.587	0.139	0.063	0.789
	UMTS 850	0.339	0.139	0.063	0.541
	GPRS 1900	0.646	0.139	0.063	0.848
	UMTS 1900	0.941	0.139	0.063	1.143
	LTE Band 12	0.107	0.139	0.063	0.309
	LTE Band 26	0.439	0.139	0.063	0.641
	LTE Band 4 (AWS)	1.077	0.139	0.063	**1.279**
	LTE Band 2 (PCS)	0.936	0.139	0.063	1.138

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.587	0.129	0.716
	UMTS 850	0.339	0.129	0.468
	GPRS 1900	0.646	0.129	0.775
	UMTS 1900	0.941	0.129	1.070
	LTE Band 12	0.107	0.129	0.236
	LTE Band 26	0.439	0.129	0.568
	LTE Band 4 (AWS)	1.077	0.129	**1.206**
	LTE Band 2 (PCS)	0.936	0.129	1.065

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.587	0.135	0.722
	UMTS 850	0.339	0.135	0.474
	GPRS 1900	0.646	0.135	0.781
	UMTS 1900	0.941	0.135	1.076
	LTE Band 12	0.107	0.135	0.242
	LTE Band 26	0.439	0.135	0.574
	LTE Band 4 (AWS)	1.077	0.135	**1.212**
	LTE Band 2 (PCS)	0.936	0.135	1.071

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Hotspot SAR	GPRS 850	0.587	0.129	0.135	0.851
	UMTS 850	0.339	0.129	0.135	0.603
	GPRS 1900	0.646	0.129	0.135	0.910
	UMTS 1900	0.941	0.129	0.135	1.205
	LTE Band 12	0.107	0.129	0.135	0.371
	LTE Band 26	0.439	0.129	0.135	0.703
	LTE Band 4 (AWS)	1.077	0.129	0.135	**1.341**
	LTE Band 2 (PCS)	0.936	0.129	0.135	1.200

12.6 SPLSR Evaluation Analysis

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

$$\text{Distance}_{Tx1-Tx2} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

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

Table 12-21
Peak SAR Locations for Right Cheek

Mode/Band	x (mm)	y (mm)	z (mm)	Reported SAR (W/kg)
5 GHz WLAN MIMO	12.53	-327.09	-174.84	1.484
UMTS 850 MHz	51.03	-275.77	-171.23	0.215
UMTS 1900 MHz	41.76	-246.98	-172.80	0.134
LTE B4	49.61	-247.63	-174.60	0.174
LTE B2	50.62	-240.38	-170.07	0.169

Table 12-22
SAR Sum to Peak Location Separation Ratio Calculations

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
5 GHz WLAN MIMO	UMTS 850 MHz	1.484	0.215	1.699	64.16	0.04
5 GHz WLAN MIMO	UMTS 1900 MHz	1.484	0.134	1.618	85.28	0.02
5 GHz WLAN MIMO	LTE B4	1.484	0.174	1.658	87.69	0.02
5 GHz WLAN MIMO	LTE B2	1.484	0.169	1.653	94.71	0.02

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Figure 12-1
Peak SAR Locations for Right Cheek 5GHz WLAN MIMO and UMTS 850 MHz

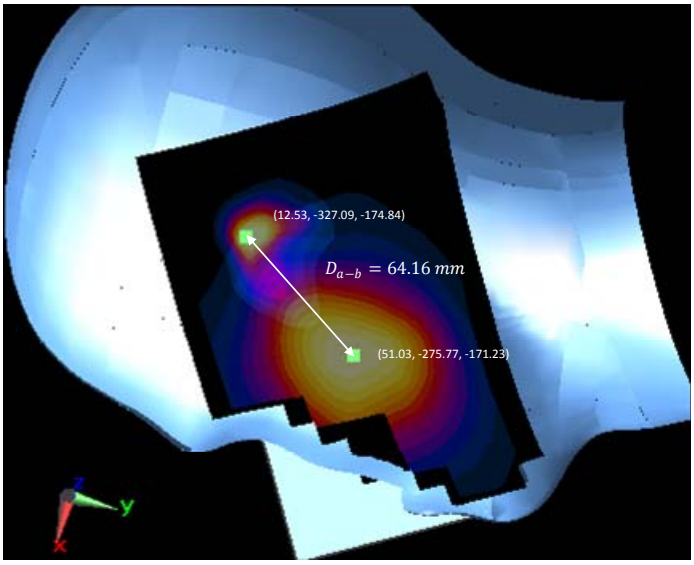

Figure 12-2
Peak SAR Locations for Right Cheek 5GHz WLAN MIMO and UMTS 1900 MHz

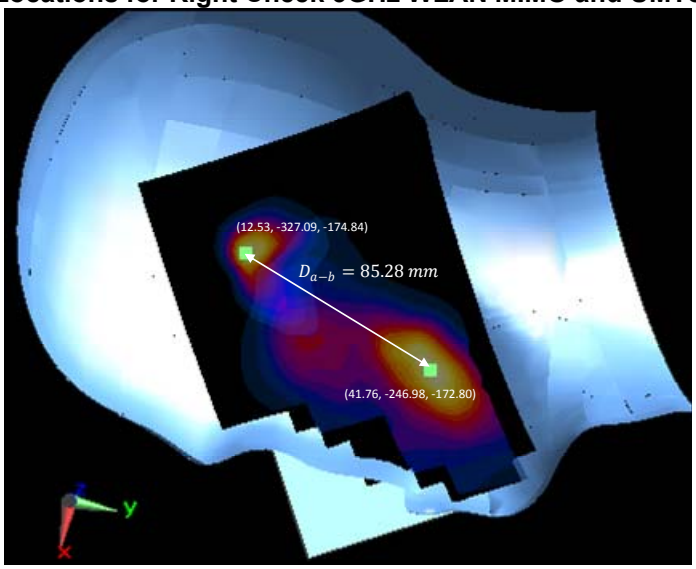

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Figure 12-2
Peak SAR Locations for Right Cheek 5GHz WLAN MIMO and LTE B4

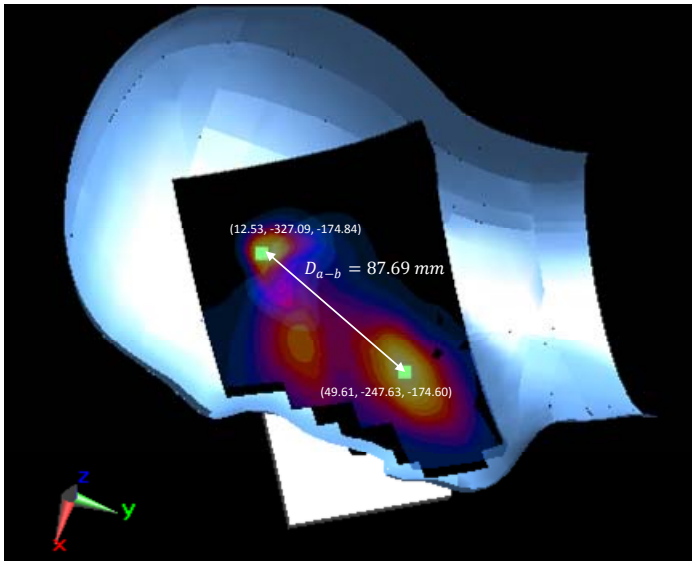
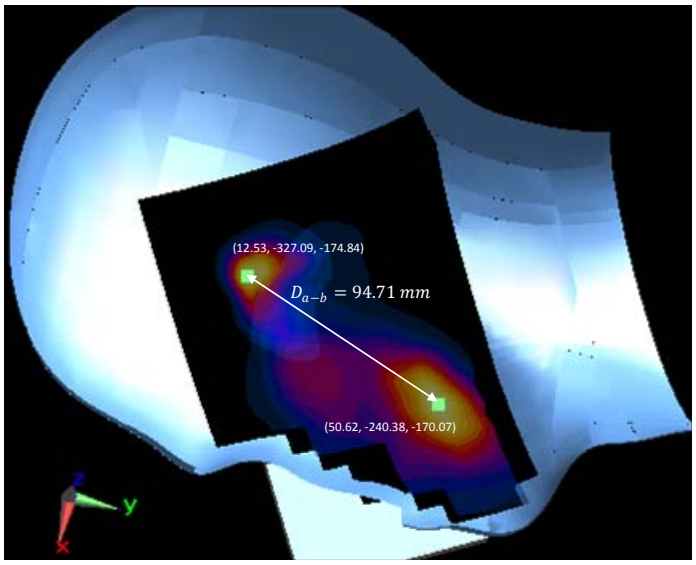


Figure 12-2
Peak SAR Locations for Right Cheek 5GHz WLAN MIMO and LTE B2



12.7 Simultaneous Transmission Conclusion

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

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13 SAR MEASURMENT VARIABILTY

13.1 Measurement Variability

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

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

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

Table 13-1
Head SAR Measurement Variability Results

HEAD VARIABILITY RESULTS															
Band	FREQUENCY		Mode/Band	Service	Side	Test Position	Data Rate (Mbps)	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.						(W/kg)	(W/kg)		(W/kg)		(W/kg)	
2450	2462.00	11	802.11b 22 MHz Bandwidth	DSSS , ANT 1	Right	Cheek	1	0.837	0.801	1.04	N/A	N/A	N/A	N/A
5600	5540.00	108	802.11n 20 MHz Bandwidth	OFDM , MIMO	Right	Cheek	13	1.090	1.200	1.10	N/A	N/A	N/A	N/A
5750	5825.00	165	802.11n 20 MHz Bandwidth	OFDM , MIMO	Right	Cheek	13	1.230	1.340	1.09	N/A	N/A	N/A	N/A
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 13-2
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS													
Band	FREQUENCY		Mode	Service	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1750	1732.50	20175	LTE Band 4 (AWS)	QPSK, 1 RB, 0 RB Offset	bottom	10 mm	1.050	1.010	1.04	N/A	N/A	N/A	N/A
1900	1860.00	18700	LTE Band 2 (PCS)	QPSK, 1 RB, 99 RB Offset	bottom	10 mm	0.924	0.931	1.01	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					Body 1.6 W/kg (mW/g) averaged over 1 gram								

13.2 Measurement Uncertainty

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

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14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	12/30/2014	Annual	12/30/2015	JP38020182
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/15/2014	Annual	4/15/2015	3629U00687
Agilent	N9020A	MXA Signal Analyzer	10/27/2014	Annual	10/27/2015	US46470561
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420800
Agilent	8753ES	S-Parameter Network Analyzer	5/22/2014	Annual	5/22/2015	US39170118
Agilent	E5515C	Wireless Communications Test Set	3/18/2014	Annual	3/18/2015	GB46110872
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	ML2495A	Power Meter	7/12/2013	Biennial	7/12/2015	1328004
Anritsu	MA2411B	Pulse Power Sensor	3/25/2014	Annual	3/25/2015	1207470
Anritsu	MT8820C	Radio Communication Analyzer	5/6/2014	Annual	5/6/2015	6201144419
Anritsu	MA24106A	USB Power Sensor	5/15/2014	Annual	5/15/2015	1244524
Anritsu	MA24106A	USB Power Sensor	5/15/2014	Annual	5/15/2015	1244512
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Control Company	4052	Long Stem Thermometer	9/27/2013	Biennial	9/27/2015	130567447
Control Company	61220-416	Long-Stem Thermometer	4/29/2014	Biennial	4/29/2016	111331323
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/30/2014	Annual	10/30/2015	1833460
Gigatronics	8651A	Universal Power Meter	10/30/2014	Annual	10/30/2015	8650319
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	10/4/2013	Biennial	10/4/2015	108798
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
SPEAG	D750V3	750 MHz Dipole	3/17/2014	Annual	3/17/2015	1054
SPEAG	D835V2	835 MHz SAR Dipole	4/7/2014	Annual	4/7/2015	4d119
SPEAG	D1765V2	1765 MHz SAR Dipole	5/7/2014	Annual	5/7/2015	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	4/9/2014	Annual	4/9/2015	5d141
SPEAG	D2450V2	2450 MHz SAR Dipole	8/11/2014	Annual	8/11/2015	719
SPEAG	D5GHzV2	5 GHz SAR Dipole	2/26/2014	Annual	2/26/2015	1120
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/25/2014	Annual	9/25/2015	1191
SPEAG	D835V2	835 MHz SAR Dipole	7/24/2014	Annual	7/24/2015	4d133
SPEAG	ES3DV3	SAR Probe	5/15/2014	Annual	5/15/2015	3263
SPEAG	ES3DV2	SAR Probe	8/19/2014	Annual	8/19/2015	3022
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258
SPEAG	EX3DV4	SAR Probe	7/16/2014	Annual	7/16/2015	7308
SPEAG	ES3DV3	SAR Probe	9/24/2014	Annual	9/24/2015	3288
SPEAG	EX3DV4	SAR Probe	12/12/2014	Annual	12/12/2015	3920
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/14/2014	Annual	5/14/2015	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/12/2014	Annual	8/12/2015	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2014	Annual	9/17/2015	1323
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/18/2014	Annual	9/18/2015	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/11/2014	Annual	4/11/2015	1368
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/6/2014	Annual	5/6/2015	1070
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/16/2014	Annual	4/16/2015	B010177

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

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15 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz.

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

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

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Applicable for frequencies up to 6 GHz.

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	**IEEE 1528 Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i 1gm**	**c_i 10 gms**	**1gm u_i (± %)**	**10gms u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)			RSS				12.4	12.0	299
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.7	24.0	

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

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16 CONCLUSION

16.1 Measurement Conclusion

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

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

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17 REFERENCES

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, 2006.

[3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sept. 1992.

[4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.

[5] IEEE Standards Coordinating Committee 39 –Standards Coordinating Committee 34 – IEEE Std. 1528-2003, Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head Due to Wireless Communications Devices: Measurement Techniques.

[6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

[7] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.

[8] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. -124.

[9] K. Pokovic, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.

[10] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.

[11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.

[12] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[13] G. Hartsgrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bioelectromagnetics, Canada: 1987, pp. 29-36.

[14] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.

[15] W. Gander, Computermathematick, Birkhaeuser, Basel, 1992.

[16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.

[17] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

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[18] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.

[19] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hoschschule Zürich, Dosimetric Evaluation of the Cellular Phone.

[20] IEC 62209-1, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz), Feb. 2005.

[21] Industry Canada RSS-102 Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) Issue 4, March 2010.

[22] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2009

[23] FCC SAR Test Procedures for 2G-3G Devices, Mobile Hotspot and UMPC Devices KDB Publications 941225, D01-D07

[24] SAR Measurement procedures for IEEE 802.11a/b/g KDB Publication 248227 D01v01r02

[25] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474 D02-D04

[26] FCC SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers, FCC KDB Publication 616217 D04

[27] FCC SAR Measurement and Reporting Requirements for 100MHz – 6 GHz, KDB Publications 865664 D01-D02

[28] FCC General RF Exposure Guidance and SAR Procedures for Dongles, KDB Publication 447498, D01-D02

[29] Anexo à Resolução No. 533, de 10 de Septembro de 2009.

[30] IEC 62209-2, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 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), Mar. 2010.

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APPENDIX A: SAR TEST DATA

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PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

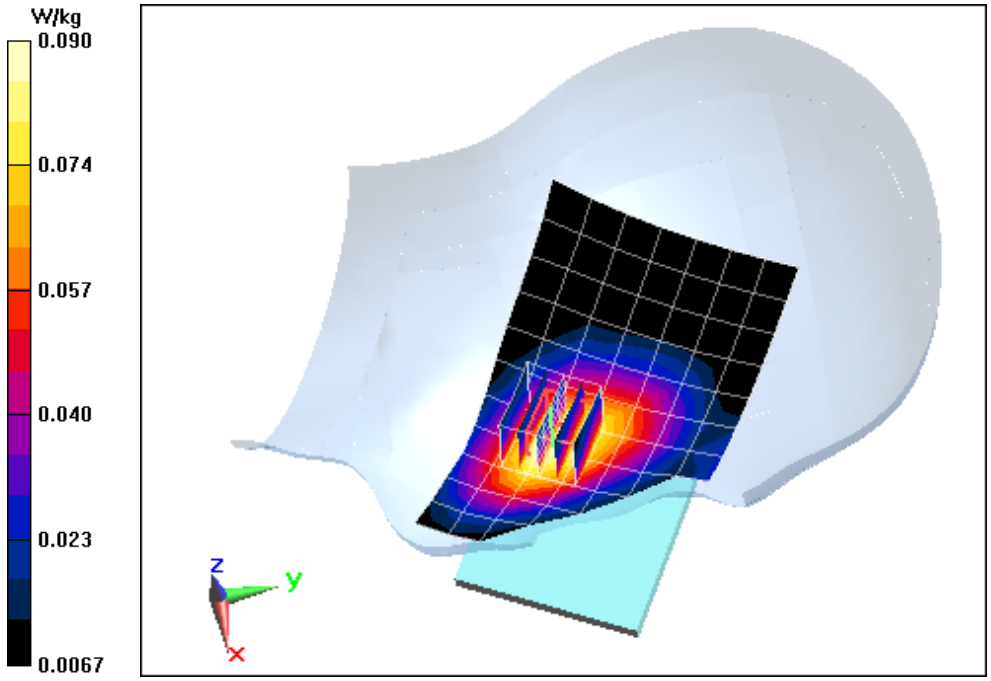
Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium: 835 Head, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.91 S/m; ε_r = 41.416; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 01-06-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.4°C

Probe: ES3DV2 - SN3022; ConvF(6.18, 6.18, 6.18); Calibrated: 8/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/12/2014
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.770 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.110 W/kg
SAR(1 g) = 0.082 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

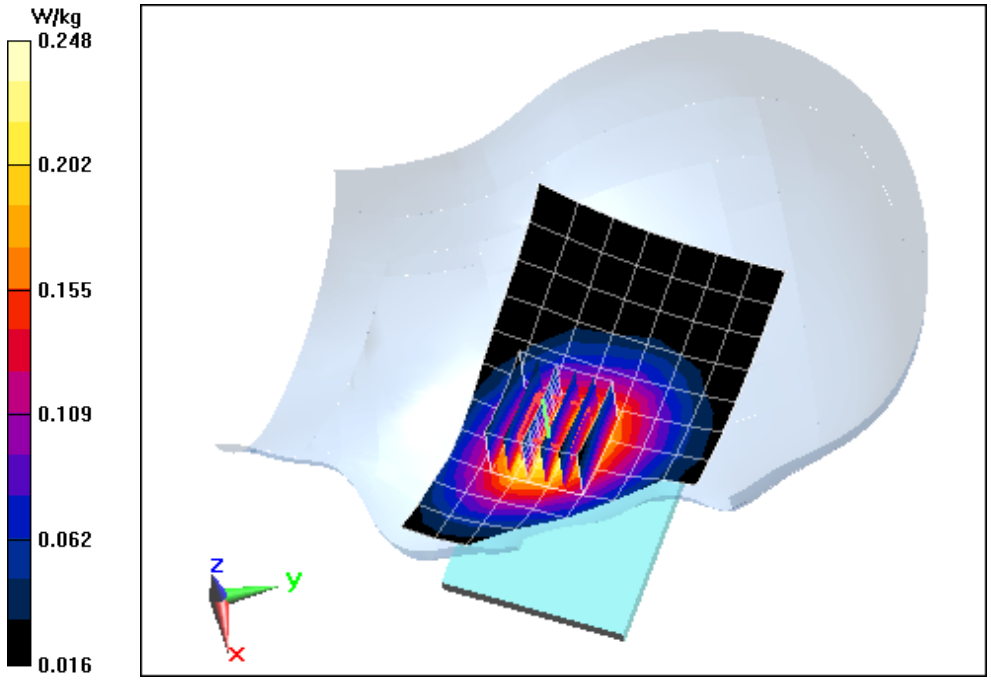
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Head, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.91 S/m; ε_r = 41.416; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 01-06-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.4°C

Probe: ES3DV2 - SN3022; ConvF(6.18, 6.18, 6.18); Calibrated: 8/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/12/2014
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.77 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.294 W/kg
SAR(1 g) = 0.225 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

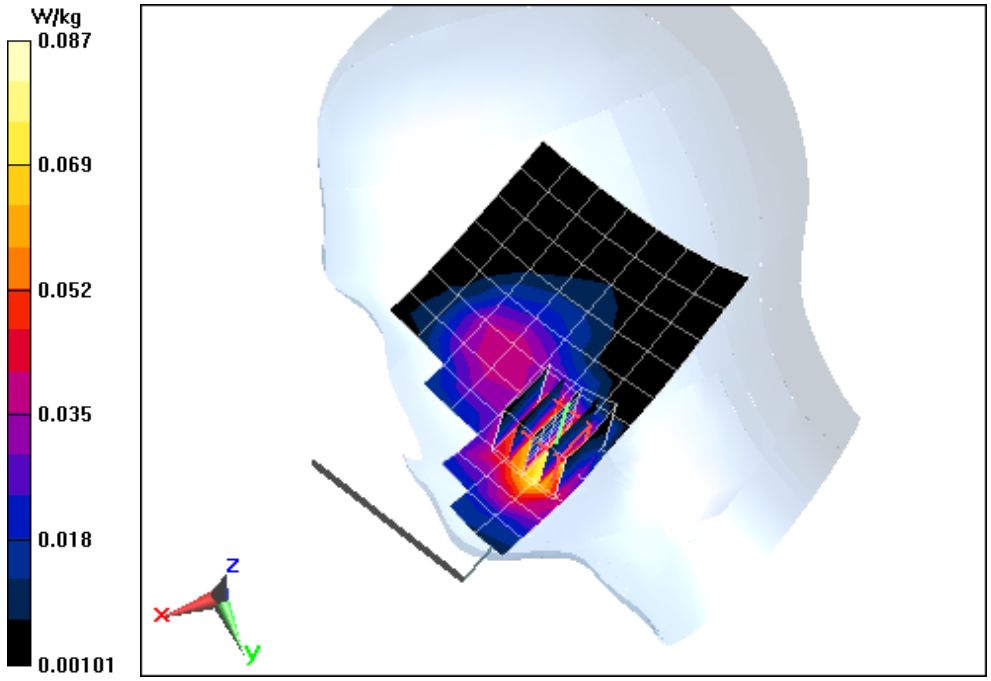
Communication System: UID 0, GSM1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 Head, Medium parameters used:
f = 1880 MHz; σ = 1.374 S/m; ε_r = 39.346; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-05-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.293 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.118 W/kg
SAR(1 g) = 0.072 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

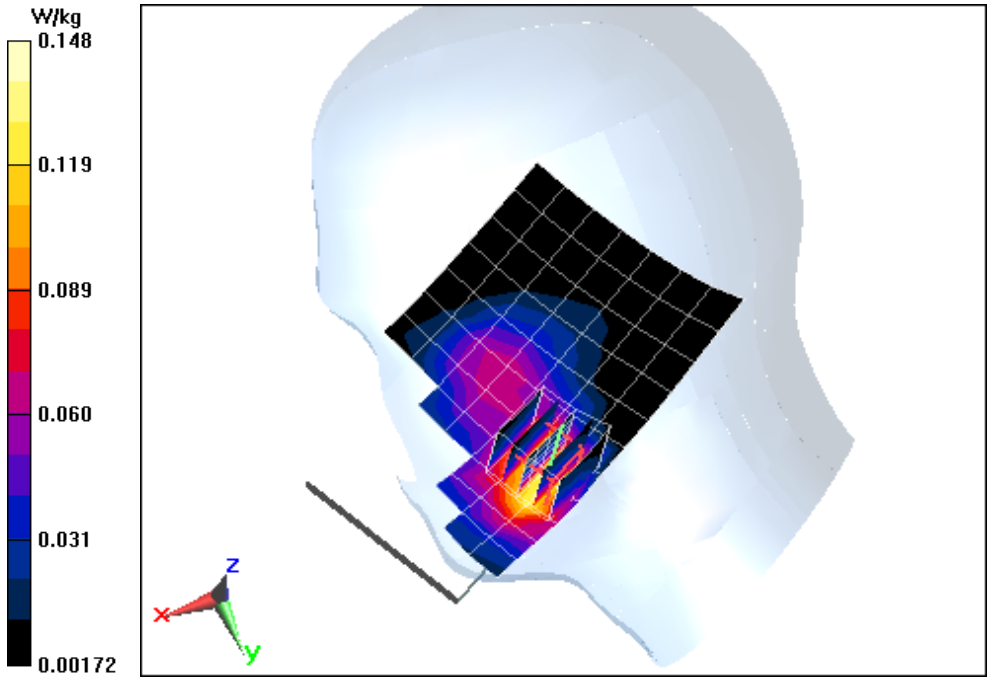
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used:
f = 1880 MHz; σ = 1.374 S/m; ε_r = 39.346; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-05-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.702 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 0.199 W/kg
SAR(1 g) = 0.125 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

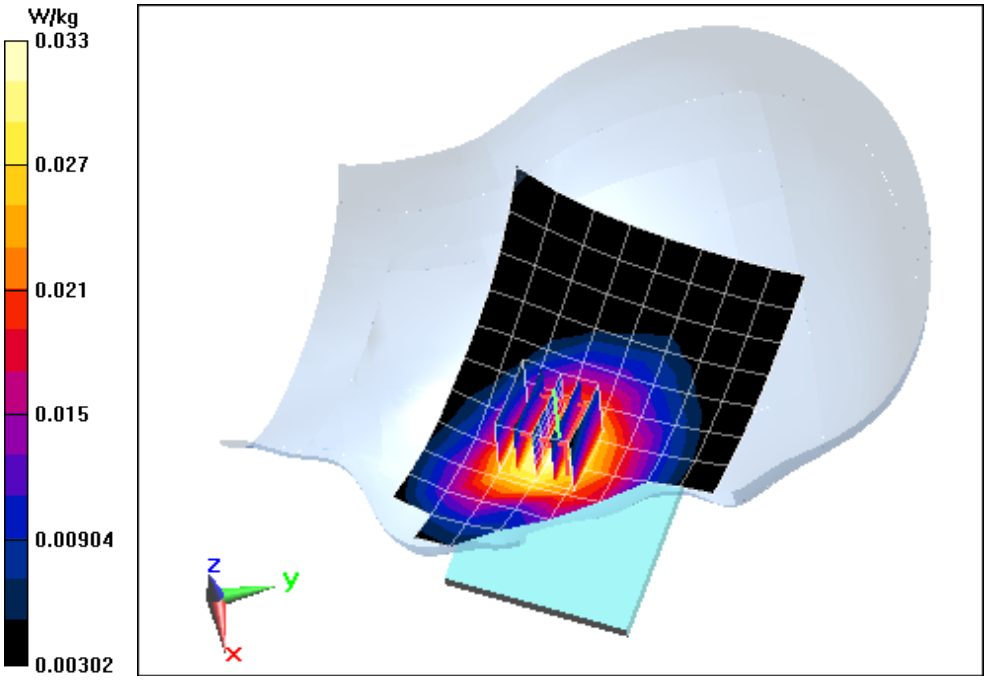
Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: 750 Head, Medium parameters used (interpolated):
f = 707.5 MHz; σ = 0.876 S/m; ε_r = 41.646; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 01-05-2015; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3263; ConvF(6.42, 6.42, 6.42); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 12, 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 = 6.342 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.0380 W/kg
SAR(1 g) = 0.031 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

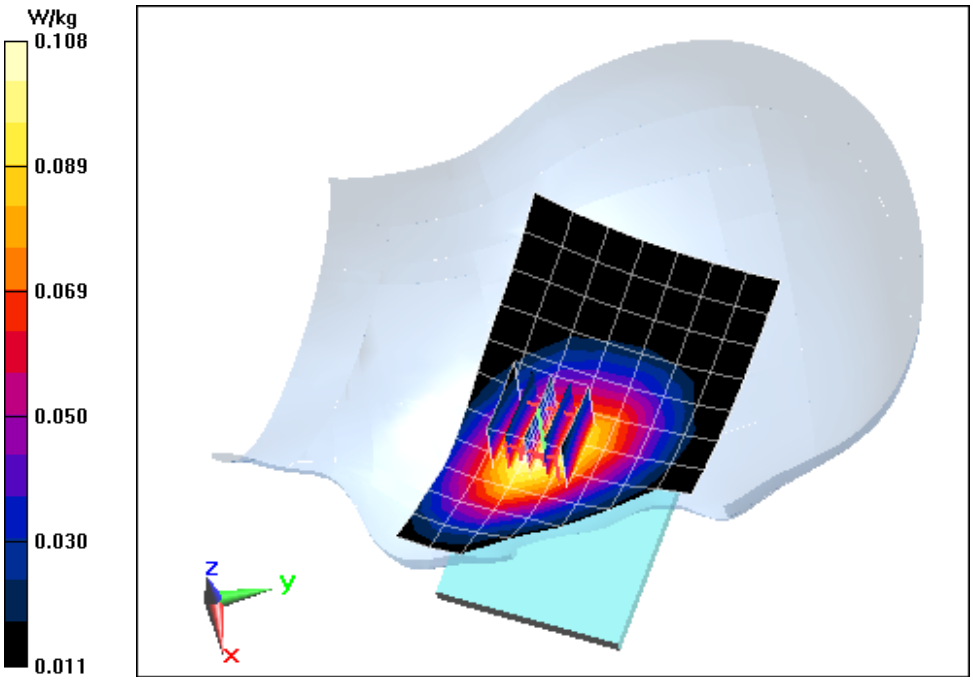
Communication System: UID 0, LTE Band 26; Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 Head, Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.91 S/m; ε_r = 41.417; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 01-06-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.4°C

Probe: ES3DV2 - SN3022; ConvF(6.18, 6.18, 6.18); Calibrated: 8/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/12/2014
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 26 (Cell), Left Head, Cheek, Mid.ch,
QPSK, 15 MHz Bandwidth, 1 RB, 0 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.18 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.129 W/kg
SAR(1 g) = 0.098 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

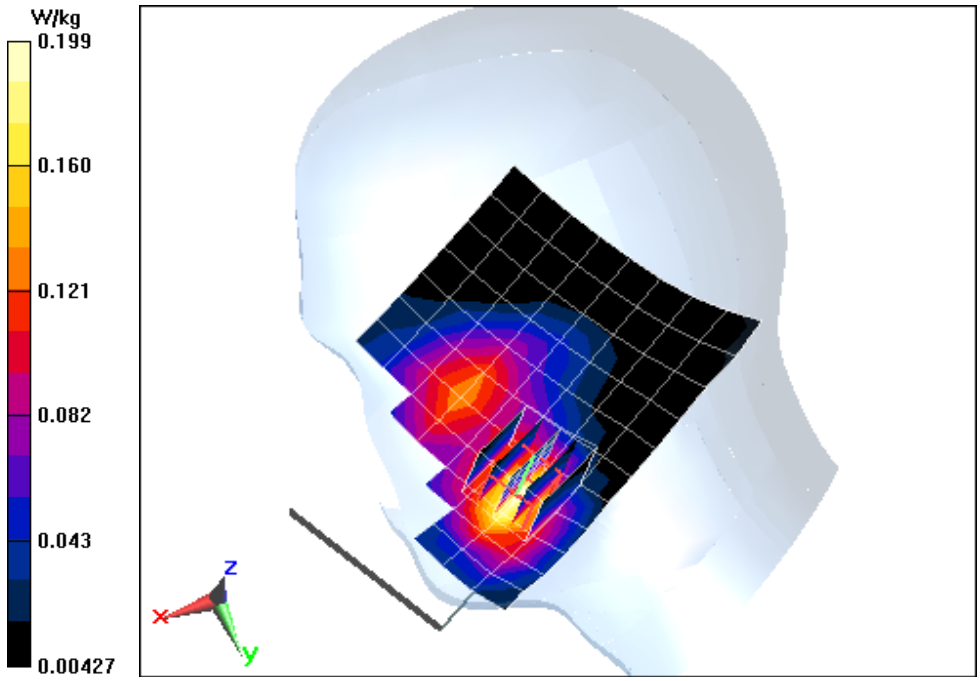
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Head, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.364 S/m; ε_r = 39.038; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-08-2015; Ambient Temp: 23.8°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(5.41, 5.41, 5.41); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Right Head, Cheek, Mid.ch,
20 MHz Bandwidth, QPSK, 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 = 12.46 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.257 W/kg
SAR(1 g) = 0.170 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

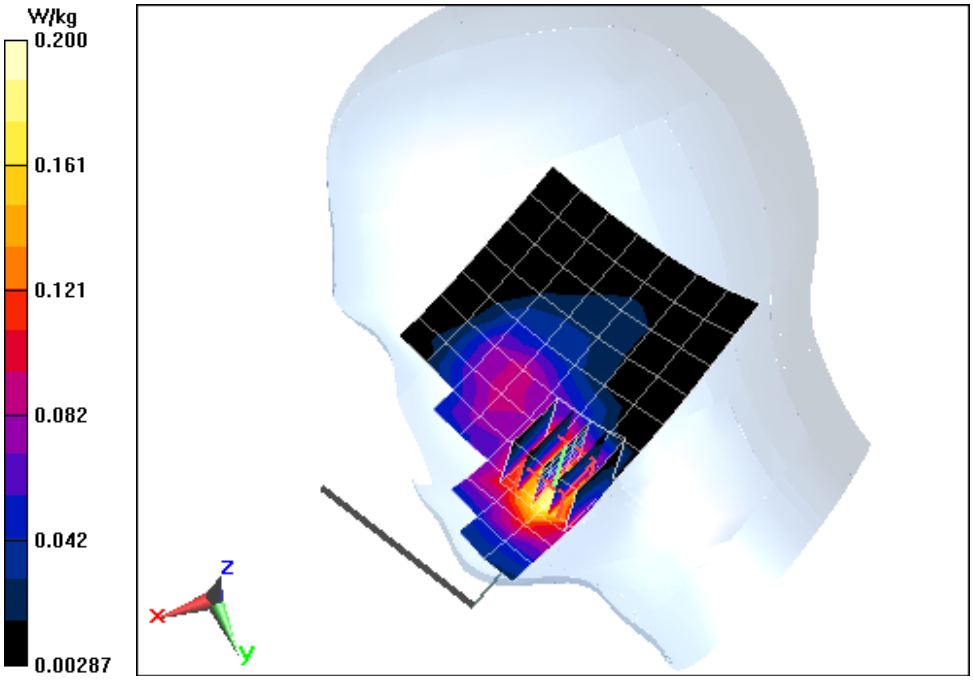
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1860 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used (interpolated):
f = 1860 MHz; σ = 1.354 S/m; ε_r = 39.409; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-05-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 2 (PCS), Right Head, Cheek, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.25 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.262 W/kg
SAR(1 g) = 0.169 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

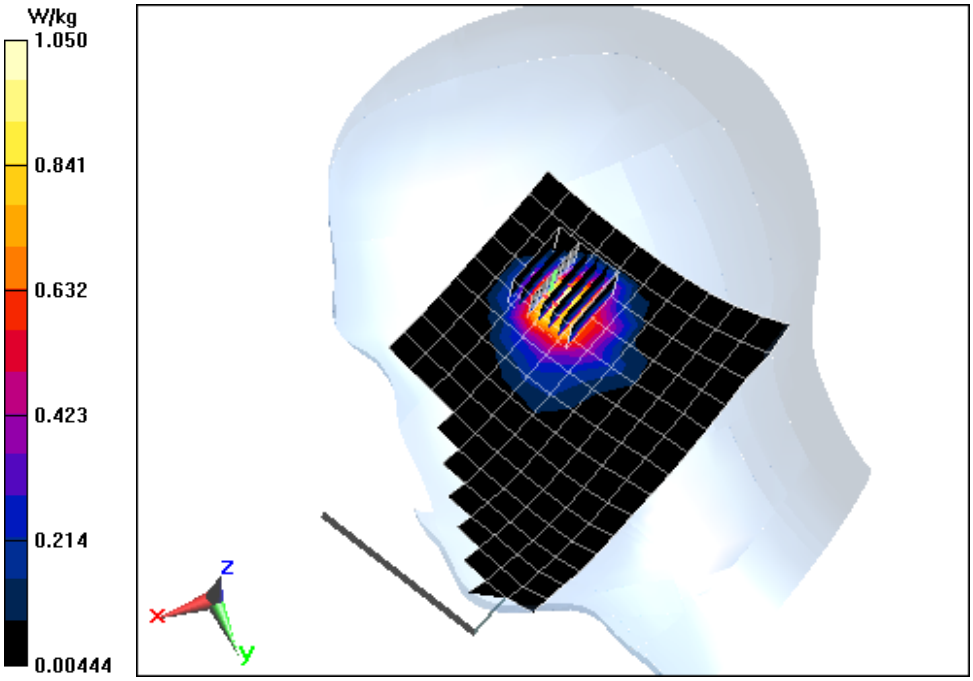
Communication System: UID 0, IEEE 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1
Medium: 2450 Head, Medium parameters used (interpolated):
f = 2462 MHz; σ = 1.832 S/m; ε_r = 37.652; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-09-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3263; ConvF(4.47, 4.47, 4.47); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.89 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 2.07 W/kg
SAR(1 g) = 0.837 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FEF

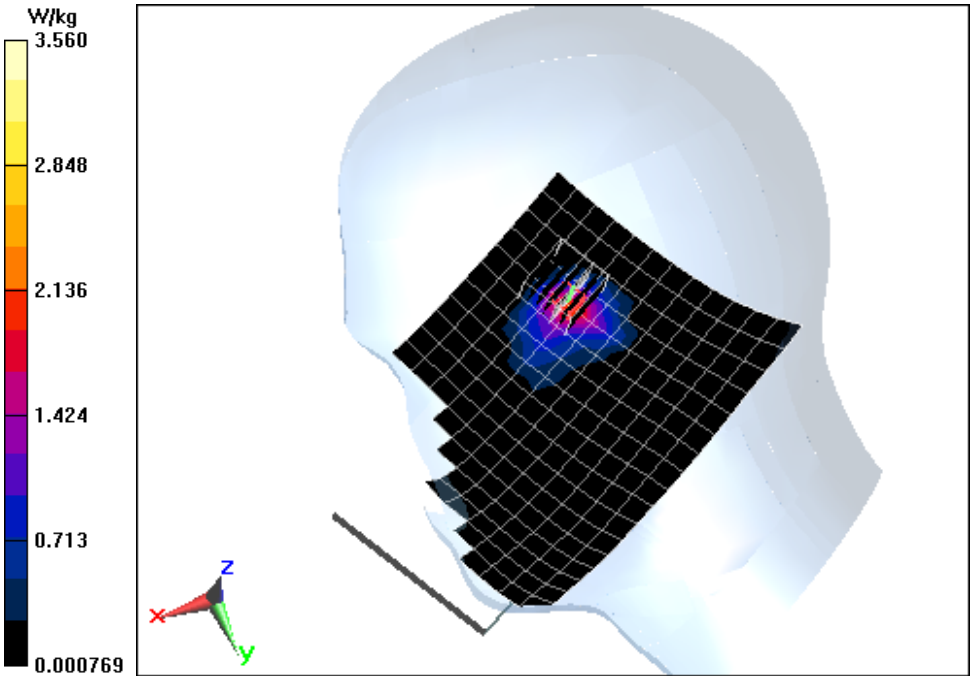
Communication System: UID 0, IEEE 802.11n 5.8 GHz Band; Frequency: 5825 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5825 MHz; σ = 5.366 S/m; ε_r = 34.923; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 01-19-2015; Ambient Temp: 22.5°C; Tissue Temp: 21.1°C

Probe: EX3DV4 - SN7308; ConvF(4.81, 4.81, 4.81); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11n, 5.8 GHz, 20 MHz Bandwidth,
Right Head, Cheek, Ch 165, 13 Mbps, MIMO

Area Scan (13x18x1): 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 = 14.81 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 6.37 W/kg
SAR(1 g) = 1.34 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

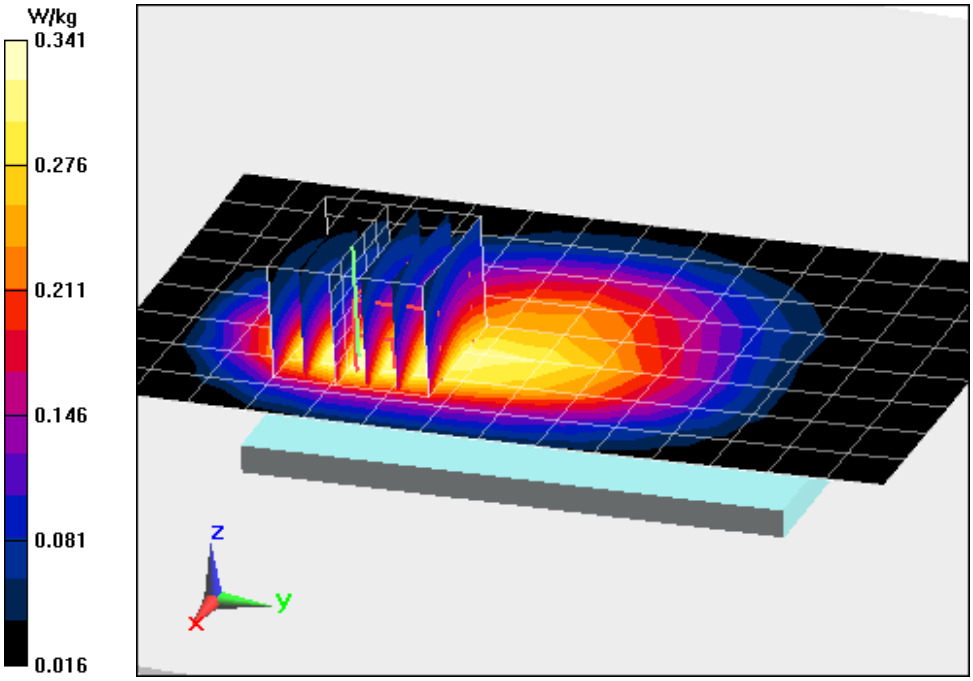
Communication System: UID 0, GSM; Frequency: 836.6 MHz; Duty Cycle: 1:8.3
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.994 S/m; ε_r = 53.11; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 21.6°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.50 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.423 W/kg
SAR(1 g) = 0.306 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

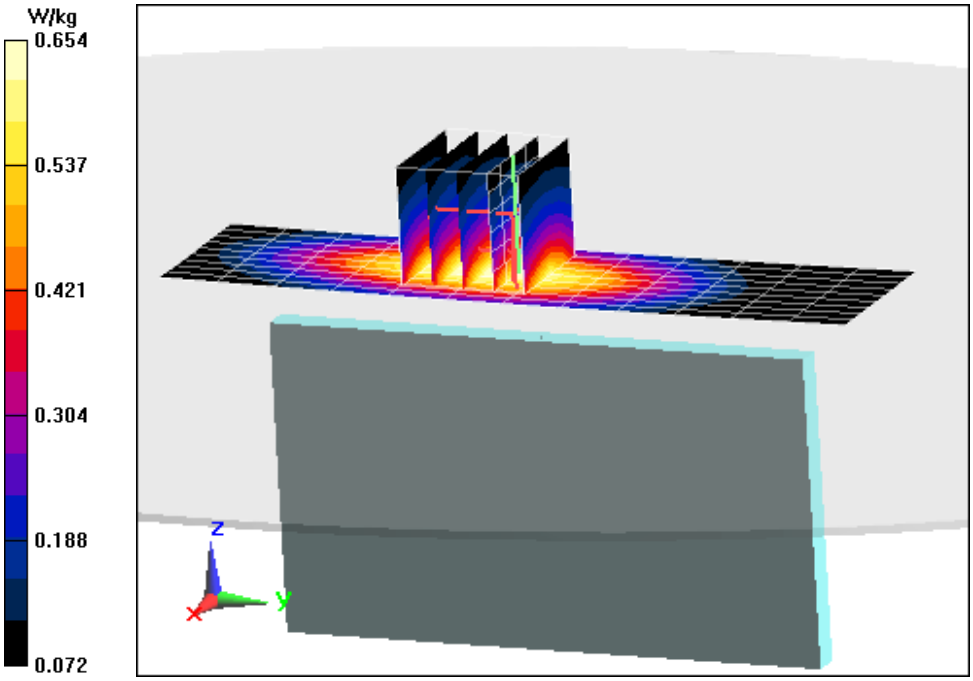
Communication System: UID 0, GSM GPRS; 2 Tx slots; Frequency: 836.6 MHz; Duty Cycle: 1:4.15
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.994 S/m; ε_r = 53.11; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 21.6°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: GPRS 850, Body SAR, Left Edge, Mid.ch, 2 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 = 24.68 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 0.824 W/kg
SAR(1 g) = 0.568 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

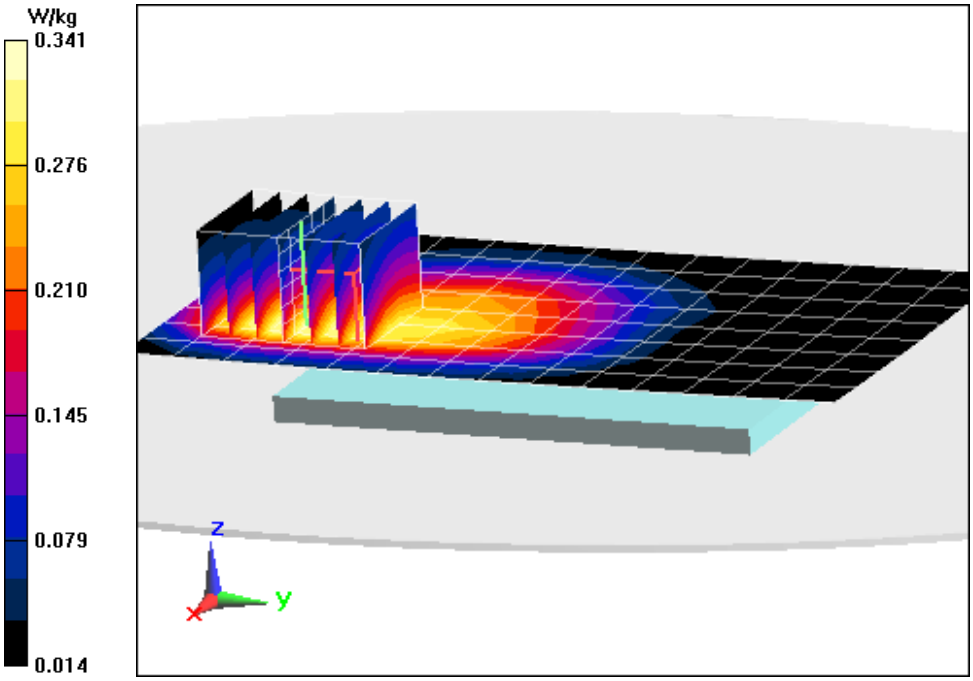
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.994 S/m; ε_r = 53.11; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 21.6°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.96 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.434 W/kg
SAR(1 g) = 0.305 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

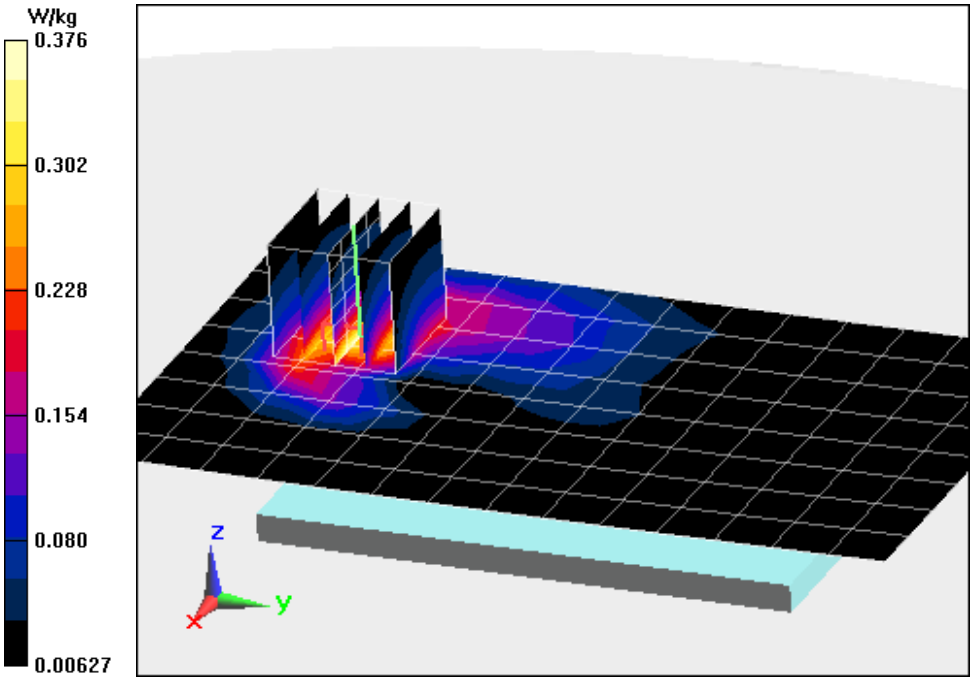
Communication System: UID 0, GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; σ = 1.49 S/m; ε_r = 52.726; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.12 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.526 W/kg
SAR(1 g) = 0.316 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

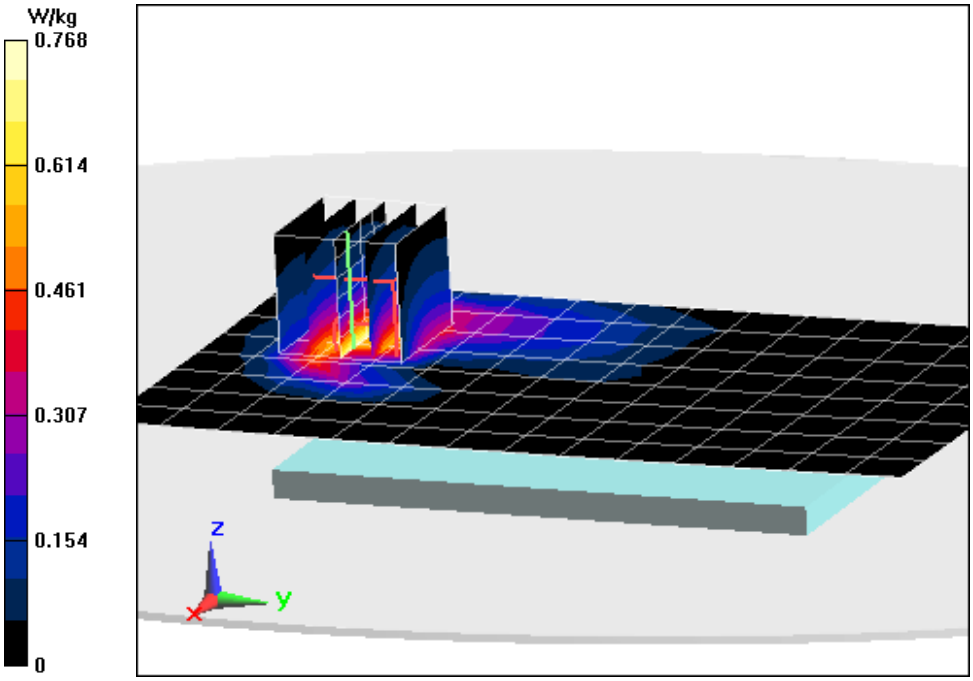
Communication System: UID 0, GSM GPRS; 2 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:4.15
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; σ = 1.49 S/m; ε_r = 52.726; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: GPRS 1900, Body SAR, Back side, Mid.ch, 2 Tx Slots

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.77 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.06 W/kg
SAR(1 g) = 0.621 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

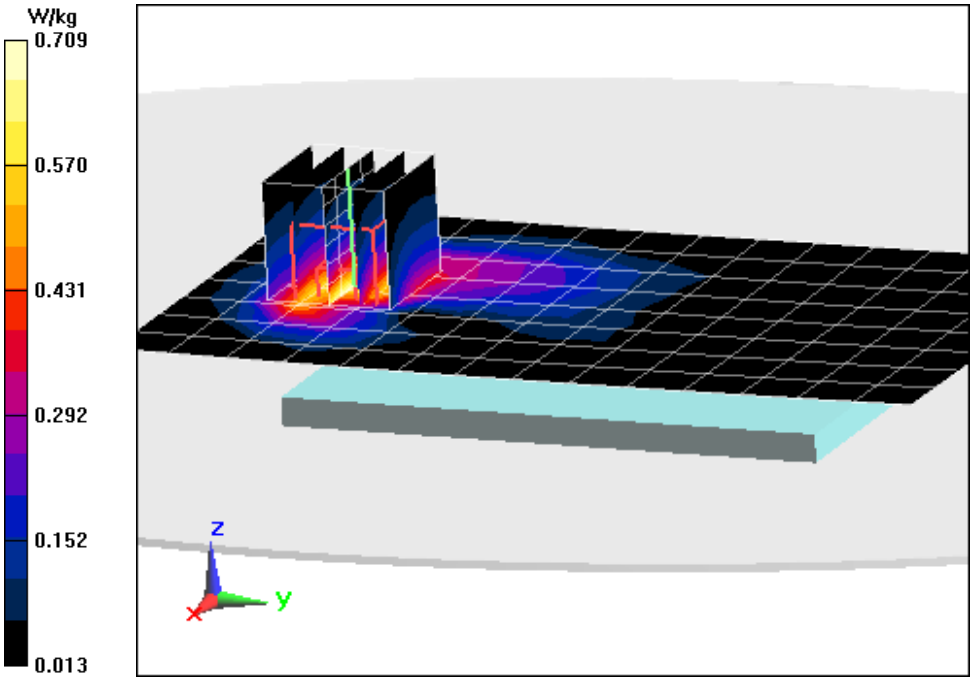
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; σ = 1.49 S/m; ε_r = 52.726; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.24 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.979 W/kg
SAR(1 g) = 0.592 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FDE

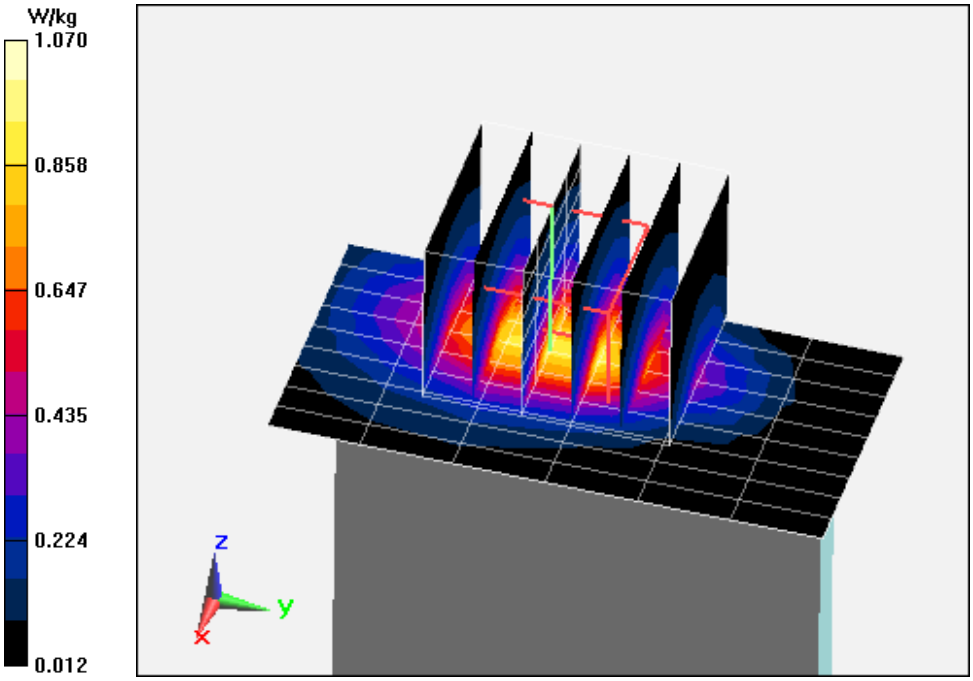
Communication System: UID 0, UMTS; Frequency: 1852.4 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1852.4 MHz; σ = 1.457 S/m; ε_r = 52.802; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (10x7x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.99 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.45 W/kg
SAR(1 g) = 0.886 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

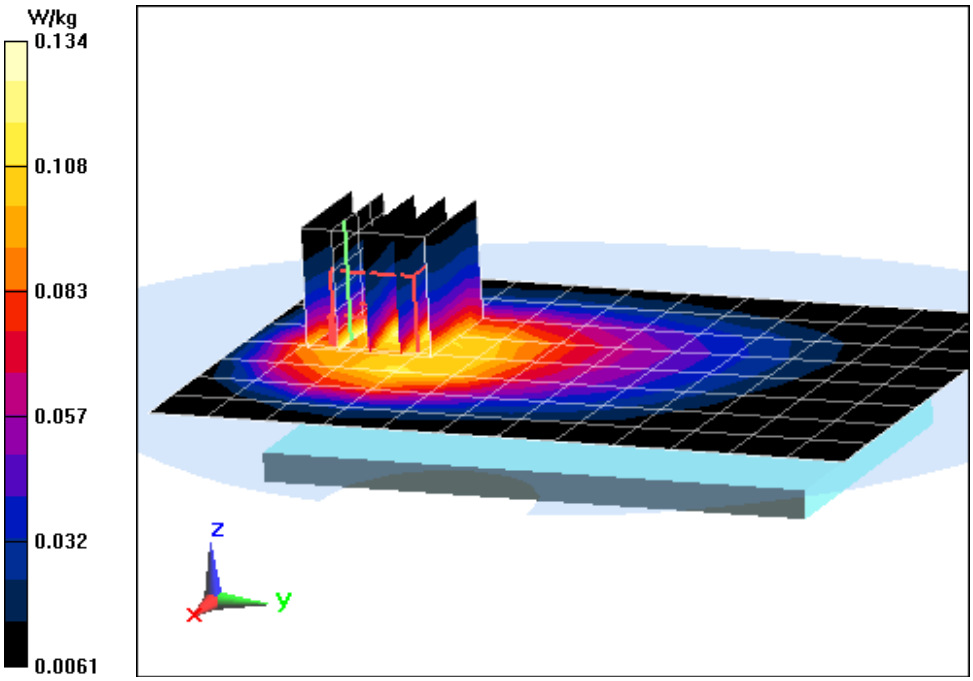
Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: 740 Body, Medium parameters used (interpolated):
f = 707.5 MHz; σ = 0.929 S/m; ε_r = 56.201; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-06-2015; Ambient Temp: 23.3°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3263; ConvF(6.19, 6.19, 6.19); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 12, Body SAR, Back side, Mid.ch, 10 MHz Bandwidth, QPSK, 1 RB, 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 = 11.10 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.196 W/kg
SAR(1 g) = 0.106 W/kg



DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

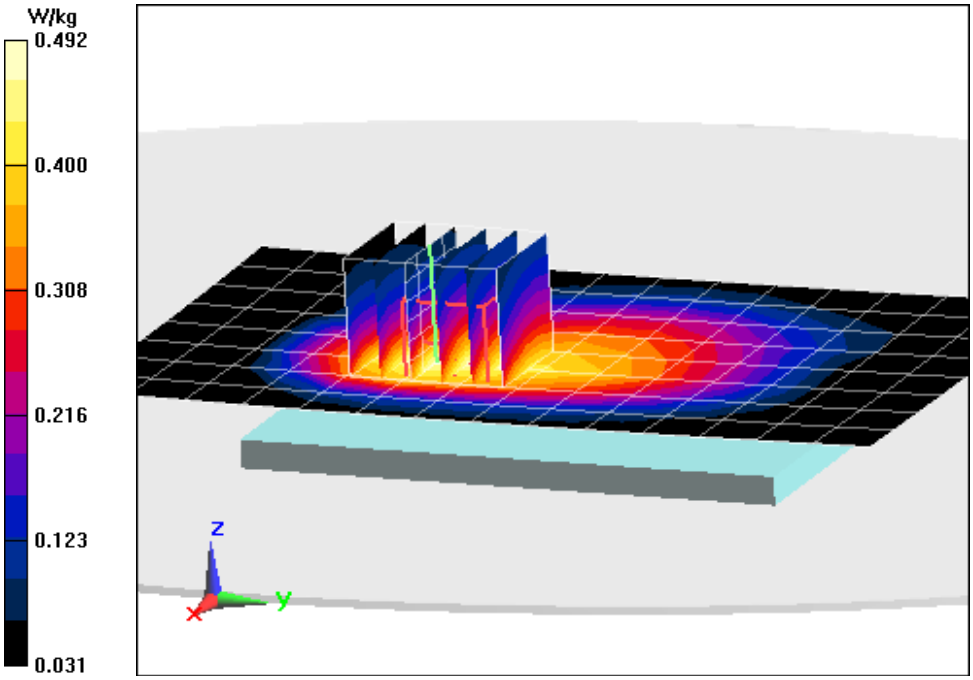
Communication System: UID 0, LTE Band 26; Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.994 S/m; ε_r = 53.111; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 21.6°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 26, Body SAR, Back side, Mid.ch, 15 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.68 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.581 W/kg
SAR(1 g) = 0.438 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FEF

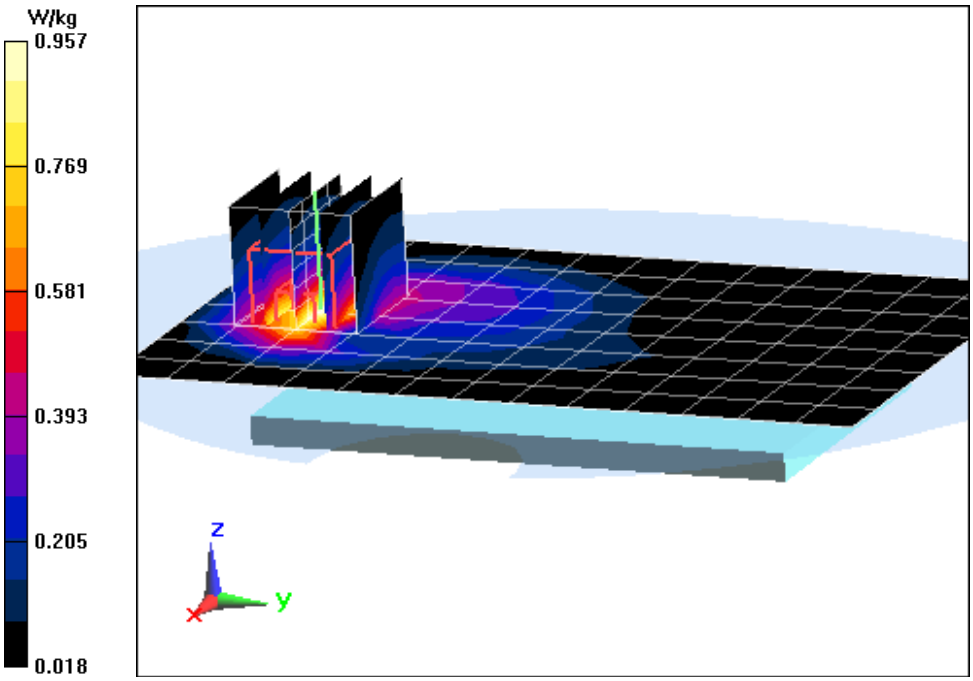
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Body, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.506 S/m; ε_r = 51.656; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2015; Ambient Temp: 23.8°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3263; ConvF(4.98, 4.98, 4.98); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Body SAR, Back side, Mid.ch, 20 MHz Bandwidth, QPSK, 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 = 25.03 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.34 W/kg
SAR(1 g) = 0.826 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FEF

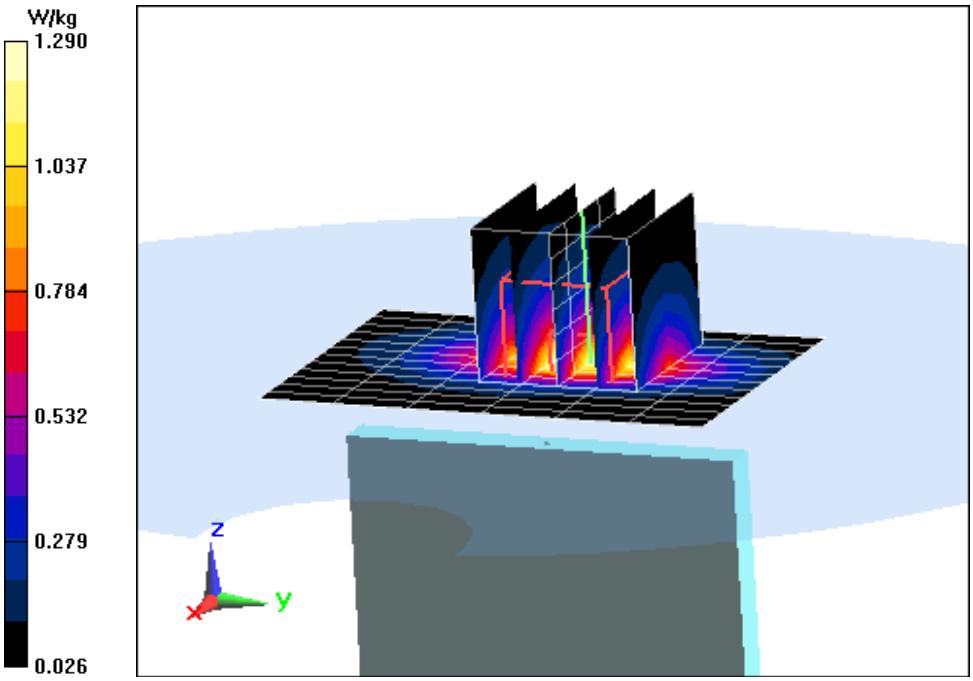
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Body, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.479 S/m; ε_r = 51.857; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.8°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(4.98, 4.98, 4.98); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (13x7x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.62 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.71 W/kg
SAR(1 g) = 1.05 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 01009

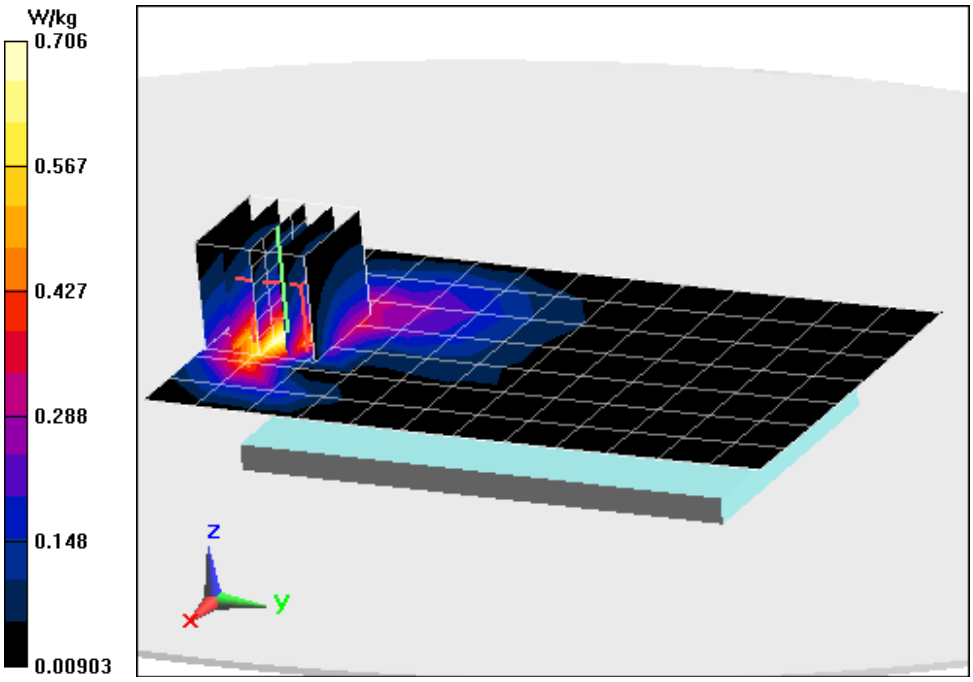
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1860 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1860 MHz; σ = 1.466 S/m; ε_r = 52.781; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 2 (PCS), Body SAR, Back side, Low.ch, 20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.40 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.986 W/kg
SAR(1 g) = 0.586 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 01009

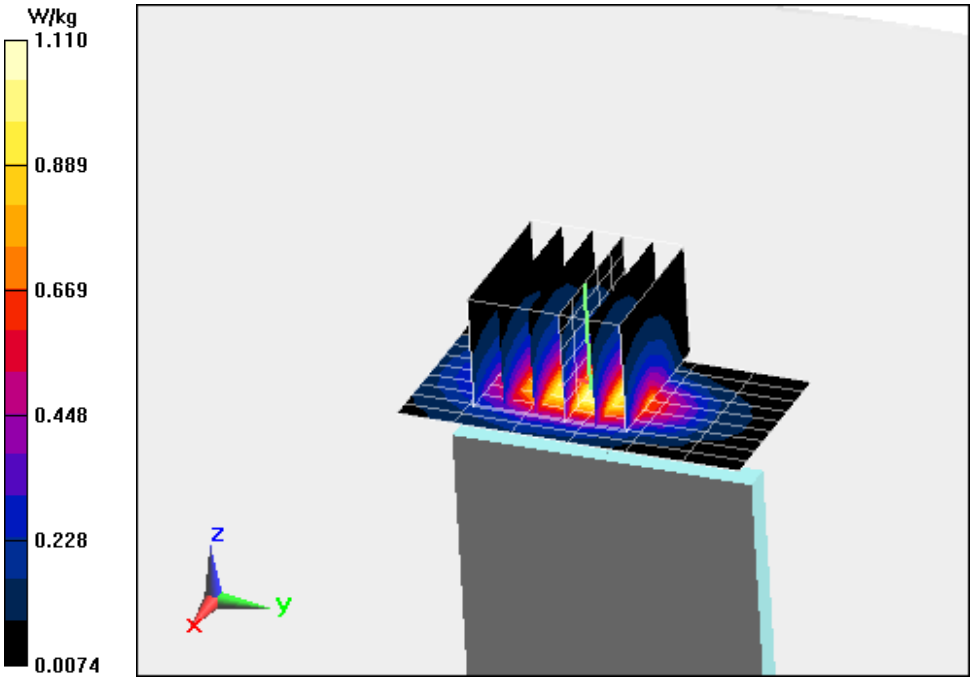
Communication System: UID 0, LTE Band 2 (PCS) ; Frequency: 1860 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1860 MHz; σ = 1.466 S/m; ε_r = 52.781; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 2 (PCS), Body SAR, Bottom Edge, Low.ch, 20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (10x7x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.01 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.53 W/kg
SAR(1 g) = 0.931 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 00FEF

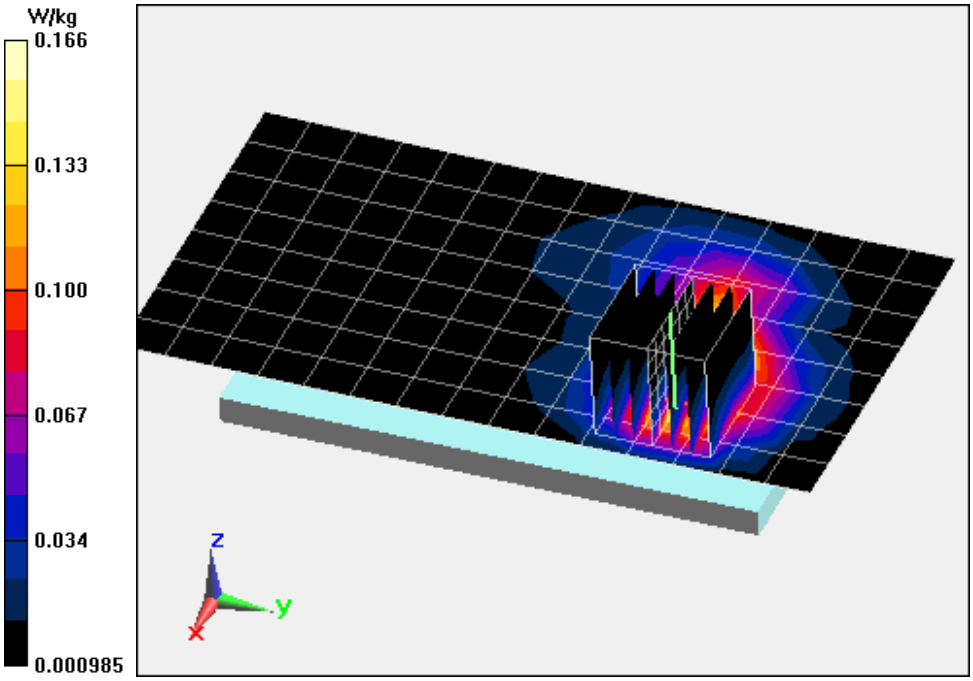
Communication System: UID 0, IEEE 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1
Medium: 2450 Body, Medium parameters used (interpolated):
f = 2462 MHz; σ = 2.007 S/m; ε_r = 51.856; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2015; Ambient Temp: 23.1°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(4.14, 4.14, 4.14); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Area Scan (9x16x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.020 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.279 W/kg
SAR(1 g) = 0.128 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

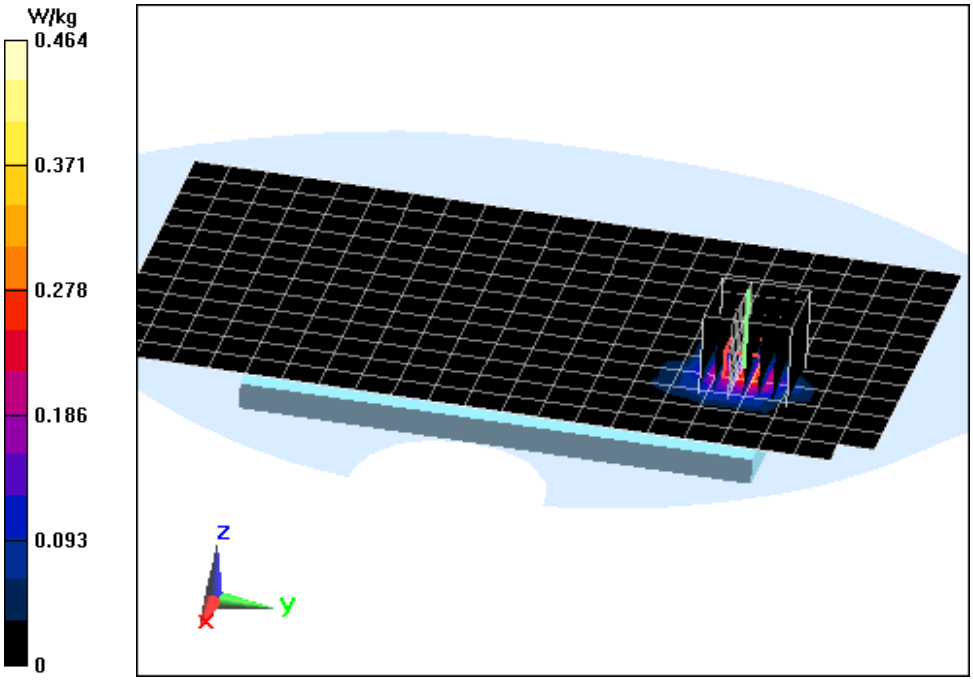
Communication System: UID 0, 802.11a 5.5 GHz Band; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5500 MHz; σ = 5.847 S/m; ε_r = 46.781; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-13-2015; Ambient Temp: 24.8°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(3.79, 3.79, 3.79); Calibrated: 12/12/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, 5.5 GHz, Body SAR, Ch 100, 6 Mbps, Back Side, Antenna 1

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio = 1.4
Reference Value = 5.457 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 0.755 W/kg
SAR(1 g) = 0.182 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG925F; Type: Portable Handset; Serial: 0100F

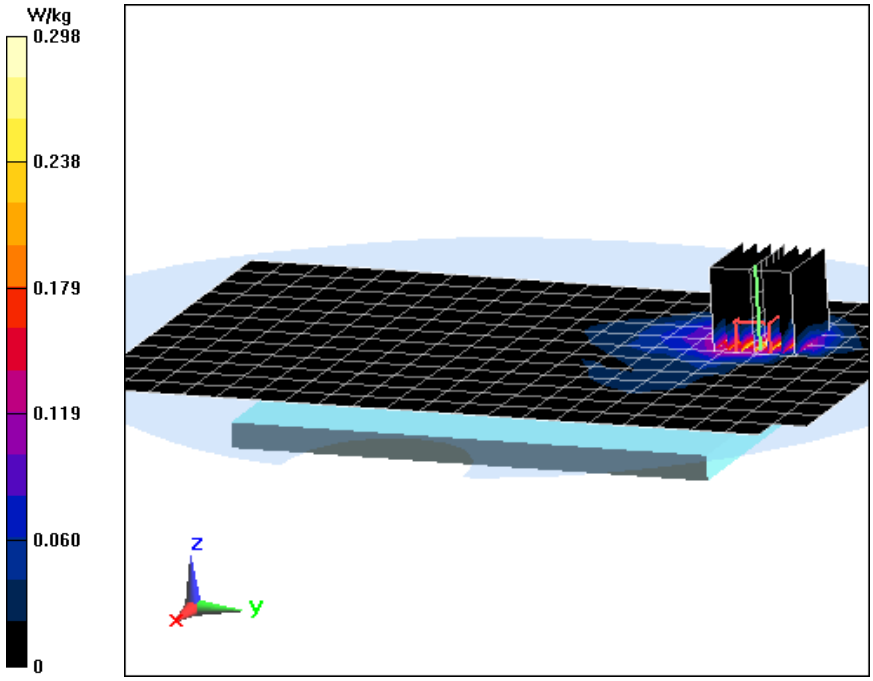
Communication System: UID 0, IEEE 802.11a; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5745 MHz; σ = 6.175 S/m; ε_r = 46.36; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-13-2015; Ambient Temp: 24.8°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(3.93, 3.93, 3.93); Calibrated: 12/12/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 149, 6 Mbps, Front Side, Antenna 1

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio = 1.4
Reference Value = 4.298 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.480 W/kg
SAR(1 g) = 0.125 W/kg



APPENDIX B: SYSTEM VERIFICATION

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PCTEST ENGINEERING LABORATORY, INC.

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

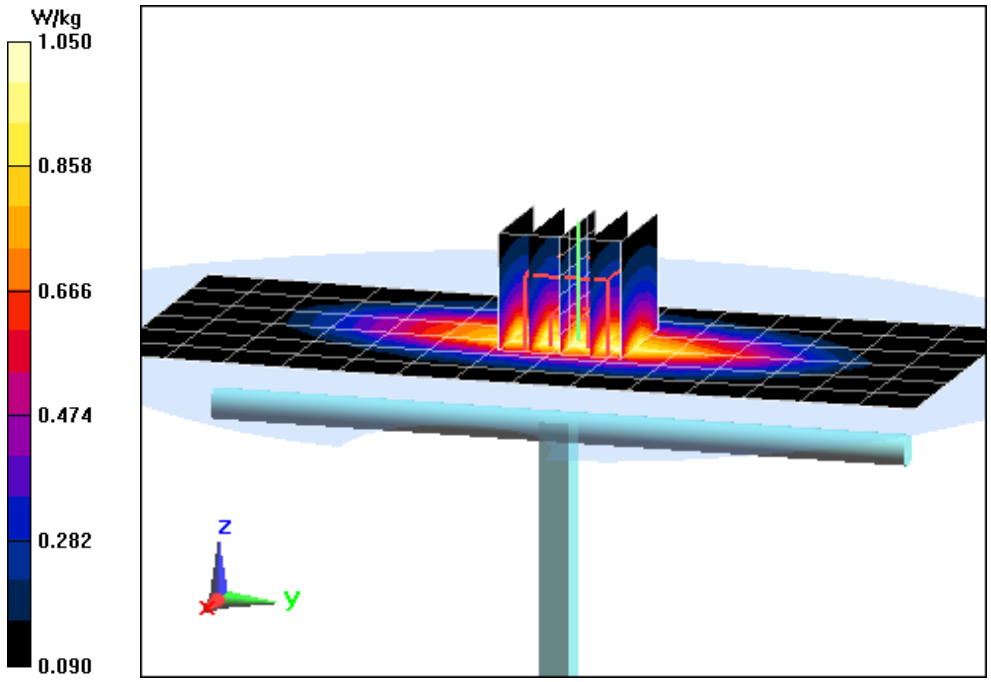
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Head, Medium parameters used (interpolated):
f = 750 MHz; σ = 0.911 S/m; ε_r = 41.114; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5cm

Test Date: 01-05-2015; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3263; ConvF(6.42, 6.42, 6.42); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.35 W/kg
SAR(1 g) = 0.888 W/kg
Deviation = 6.60%



PCTEST ENGINEERING LABORATORY, INC.

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

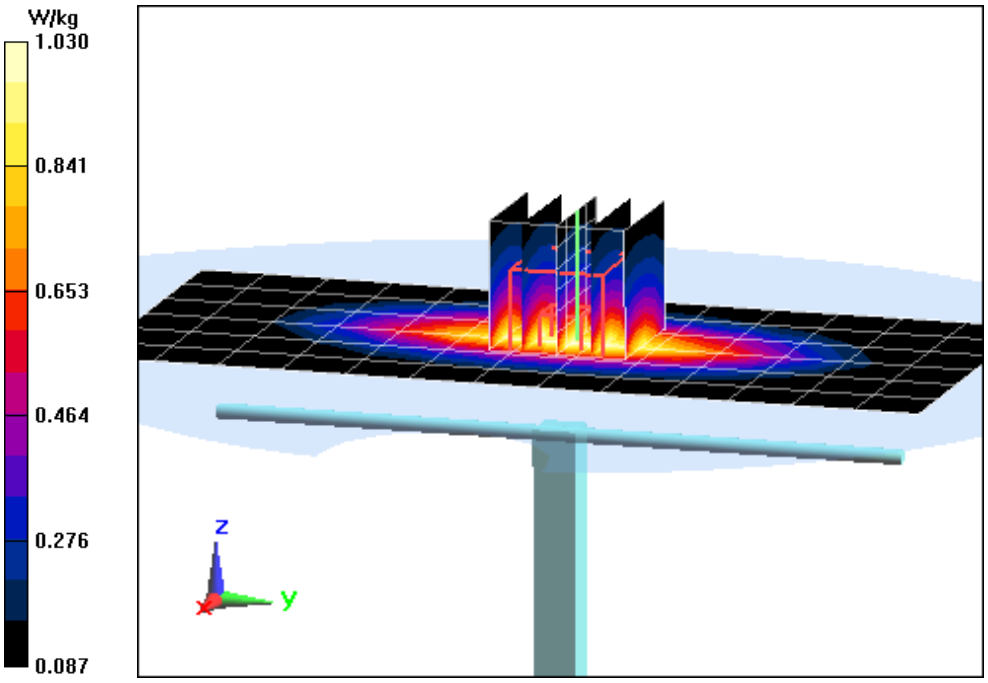
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Head, Medium parameters used:
f = 835 MHz; σ = 0.909 S/m; ε_r = 41.434; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-06-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.4°C

Probe: ES3DV2 - SN3022; ConvF(6.18, 6.18, 6.18); Calibrated: 8/19/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/12/2014
Phantom: SAM with CRP v4.0; Type: QD000P40CD; Serial: TP:1800
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.33 W/kg
SAR(1 g) = 0.896 W/kg
Deviation = -2.82%



PCTEST ENGINEERING LABORATORY, INC.

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

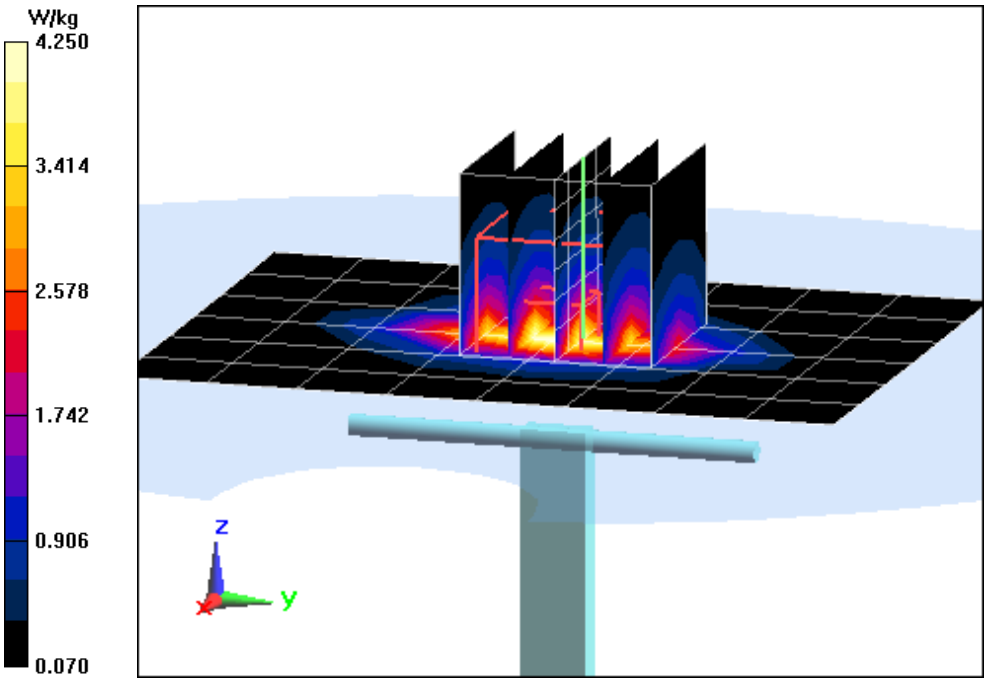
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Head, Medium parameters used:
f = 1750 MHz; σ = 1.381 S/m; ε_r = 38.933; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.8°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(5.41, 5.41, 5.41); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.16 W/kg
SAR(1 g) = 3.44 W/kg
Deviation = -6.78%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d141

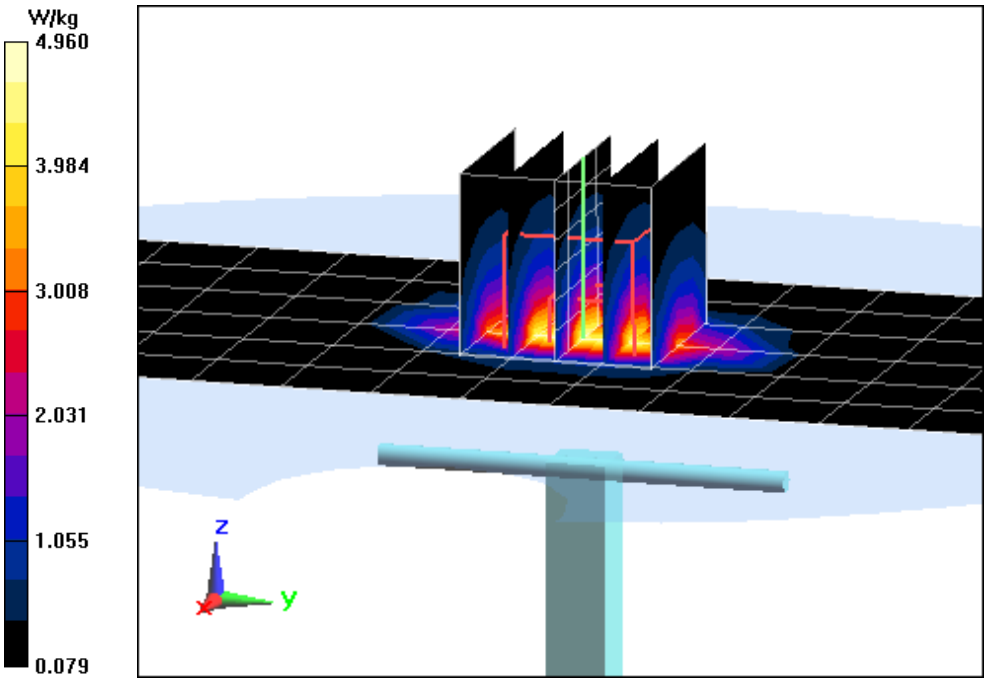
Communication System: UID 0, CW (0); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.393 S/m; ε_r = 39.274; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-05-2015; Ambient Temp: 24.0°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(5.04, 5.04, 5.04); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Validation

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 7.51 W/kg
SAR(1 g) = 4.1 W/kg
Deviation = 2.24%



PCTEST ENGINEERING LABORATORY, INC.

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

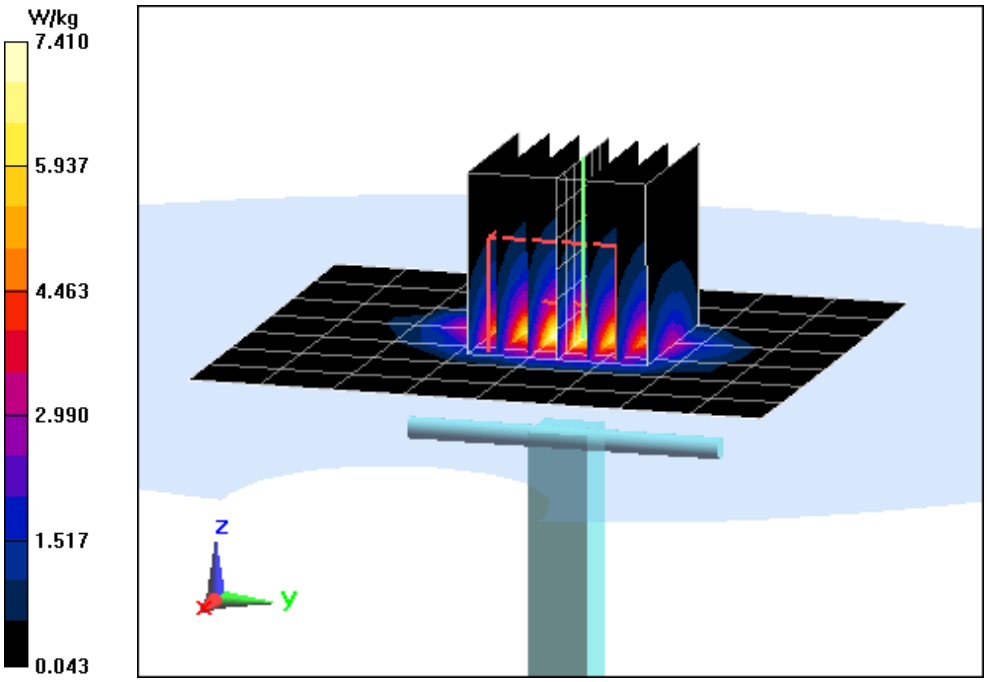
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Head, Medium parameters used:
f = 2450 MHz; σ = 1.787 S/m; ε_r = 38.287; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-15-2015; Ambient Temp: 23.9°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3263; ConvF(4.47, 4.47, 4.47); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 11.7 W/kg
SAR(1 g) = 5.66 W/kg
Deviation = 8.64%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1120

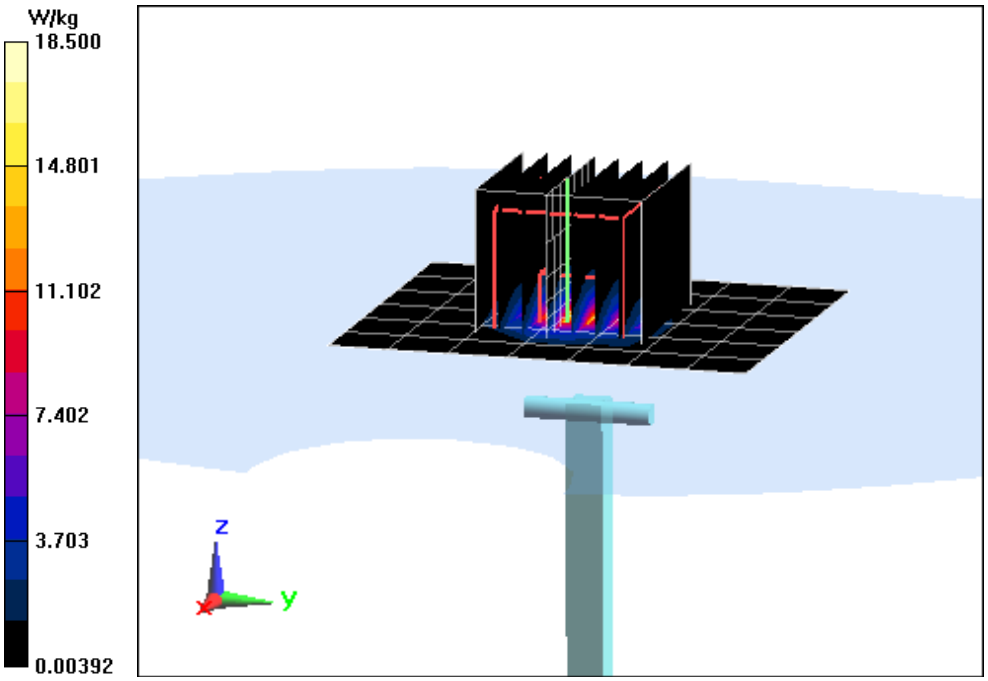
Communication System: UID 0, CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5300 MHz; σ = 4.785 S/m; ε_r = 35.717; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-19-2015; Ambient Temp: 22.4°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7308; ConvF(5.37, 5.37, 5.37); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 32.6 W/kg
SAR(1 g) = 7.7 W/kg
Deviation = -7.67%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1120

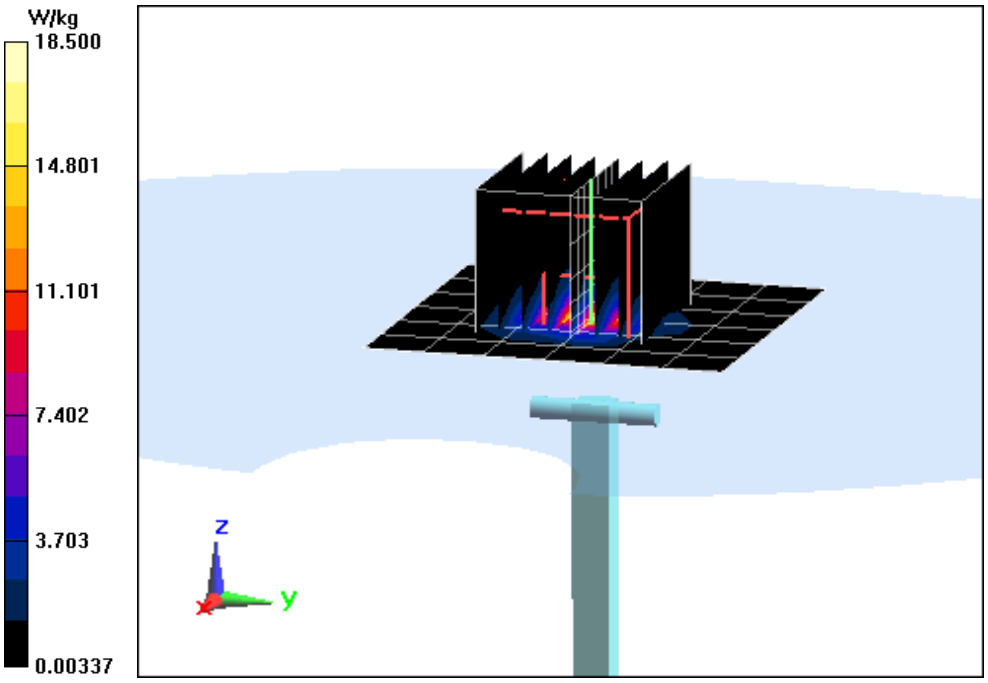
Communication System: UID 0, CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5500 MHz; σ = 4.989 S/m; ε_r = 35.418; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-19-2015; Ambient Temp: 22.5°C; Tissue Temp: 21.1°C

Probe: EX3DV4 - SN7308; ConvF(4.64, 4.64, 4.64); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5500 MHz System Verification

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
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 33.7 W/kg
SAR(1 g) = 7.84 W/kg
Deviation = -7.66%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1120

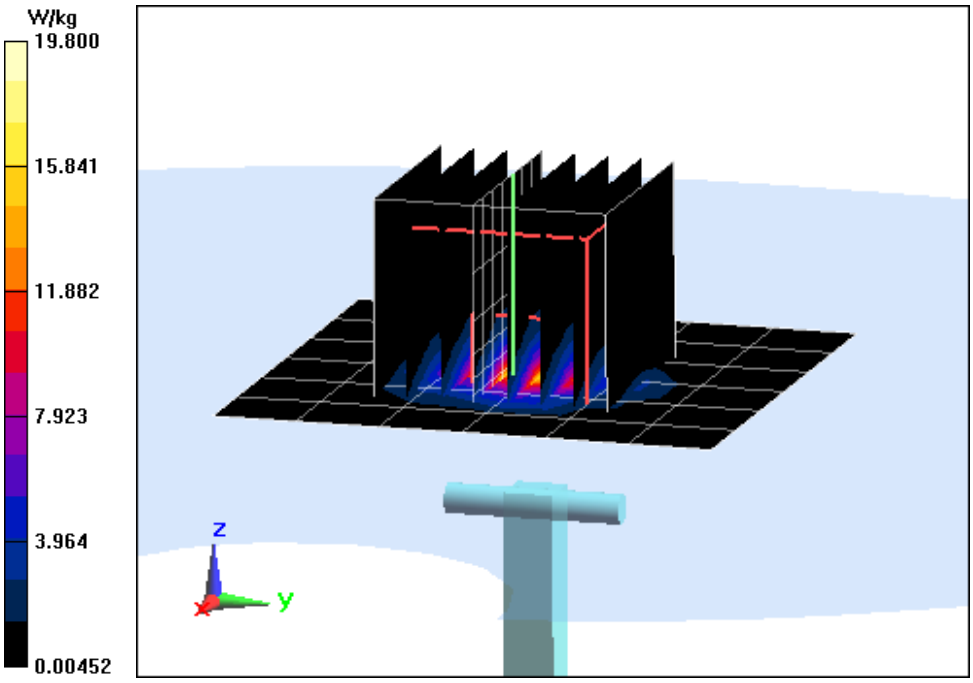
Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5600 MHz; σ = 5.119 S/m; ε_r = 35.278; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-19-2015; Ambient Temp: 22.5°C; Tissue Temp: 21.1°C

Probe: EX3DV4 - SN7308; ConvF(4.64, 4.64, 4.64); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5600 MHz System Verification

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
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 35.6 W/kg
SAR(1 g) = 8.2 W/kg
Deviation = -0.24%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1120

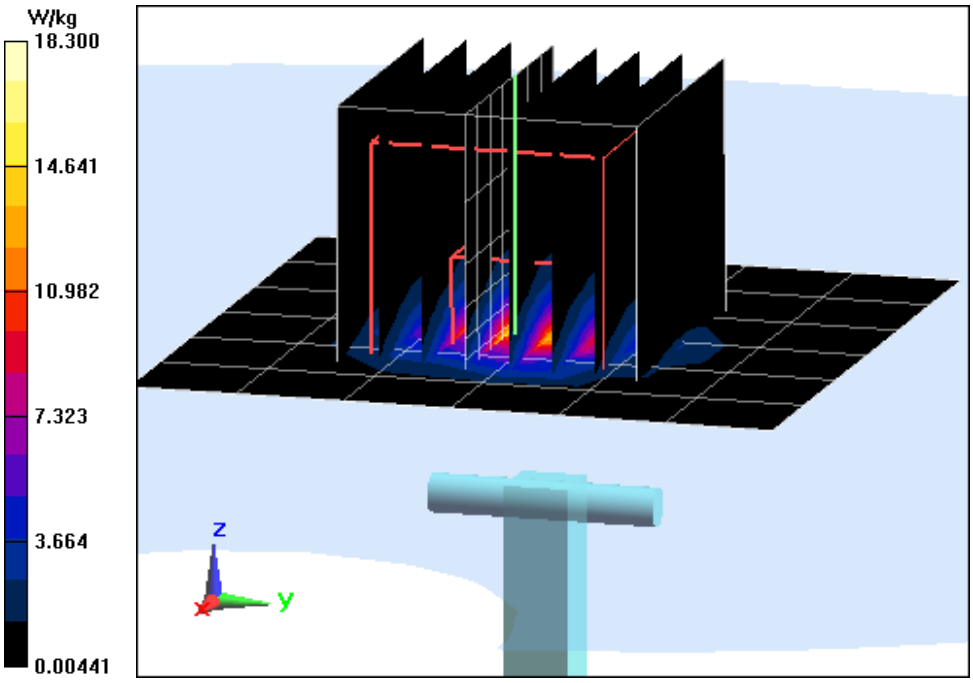
Communication System: UID 0, CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head, Medium parameters used:
f = 5800 MHz; σ = 5.332 S/m; ε_r = 34.954; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-19-2015; Ambient Temp: 22.5°C; Tissue Temp: 21.1°C

Probe: EX3DV4 - SN7308; ConvF(4.81, 4.81, 4.81); Calibrated: 7/16/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1323; Calibrated: 9/17/2014
Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5800 MHz System Verification

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
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 32.7 W/kg
SAR(1 g) = 7.37 W/kg
Deviation = -6.83%



PCTEST ENGINEERING LABORATORY, INC.

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

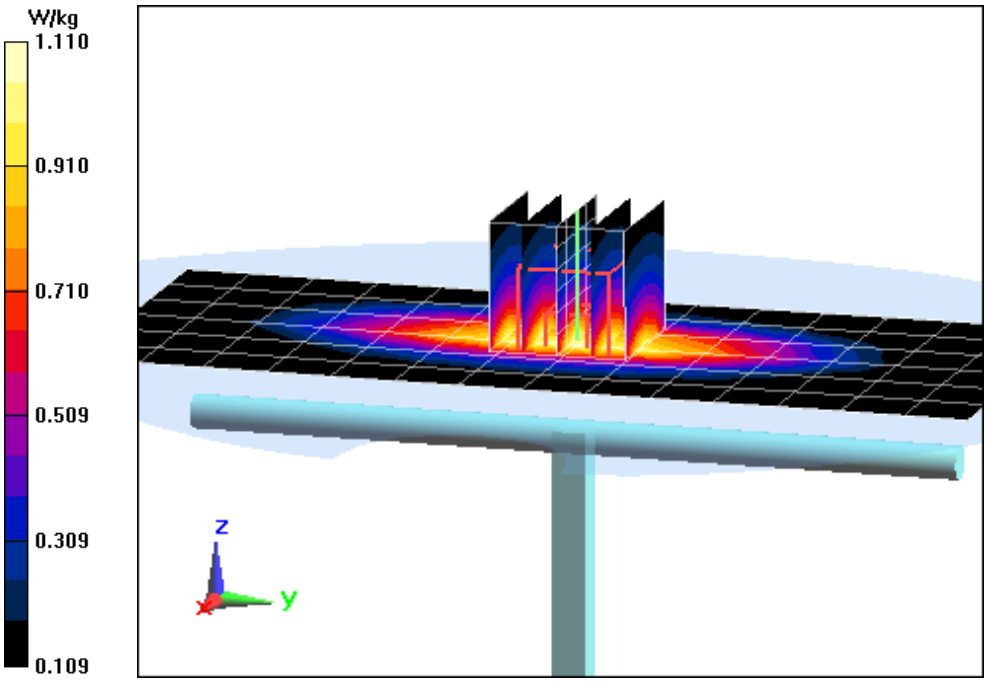
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Body, Medium parameters used (interpolated):
f = 750 MHz; σ = 0.965 S/m; ε_r = 55.717; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-06-2015; Ambient Temp: 23.3°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3263; ConvF(6.19, 6.19, 6.19); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

750 MHz System Verification

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.41 W/kg
SAR(1 g) = 0.948 W/kg
Deviation = 9.72%



PCTEST ENGINEERING LABORATORY, INC.

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

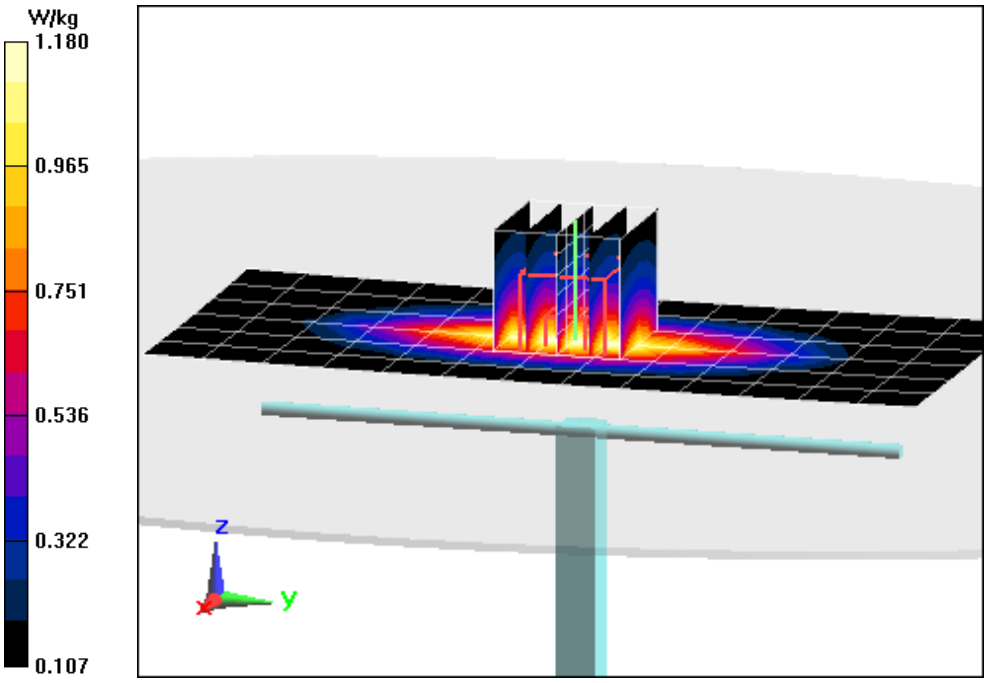
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 Body, Medium parameters used:
f = 835 MHz; σ = 0.992 S/m; ε_r = 53.127; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-08-2015; Ambient Temp: 21.6°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3288; ConvF(6.32, 6.32, 6.32); Calibrated: 9/24/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 9/18/2014
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835 MHz System Verification

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 1.01 W/kg
Deviation = 8.02%



PCTEST ENGINEERING LABORATORY, INC.

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

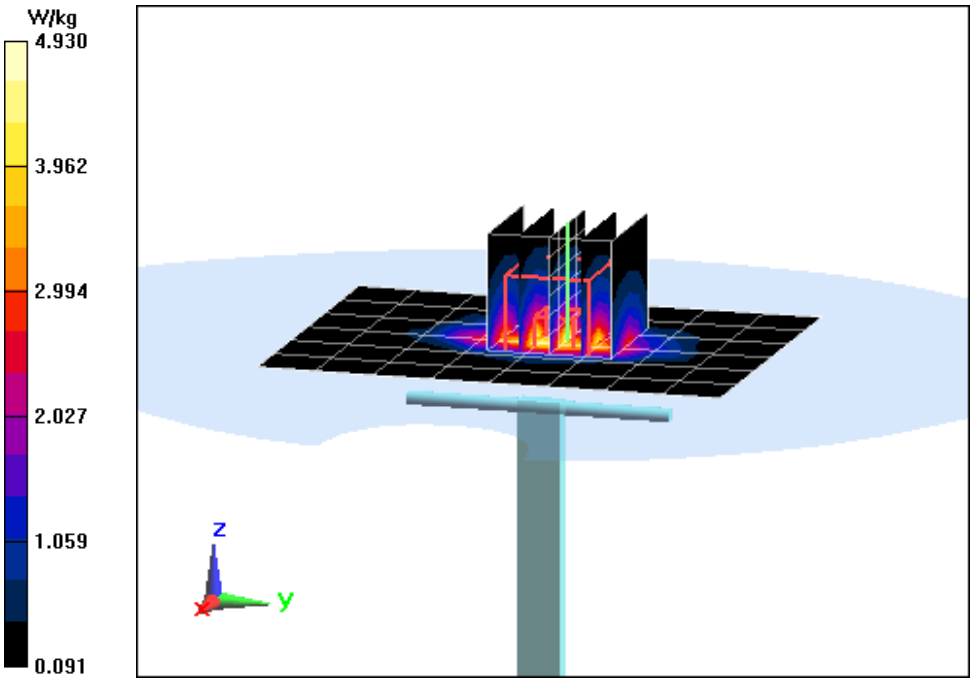
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Body, Medium parameters used:
f = 1750 MHz; σ = 1.526 S/m; ε_r = 51.581; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-12-2015; Ambient Temp: 23.8°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3263; ConvF(4.98, 4.98, 4.98); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.91 W/kg
SAR(1 g) = 3.93 W/kg
Deviation = 4.52%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d141

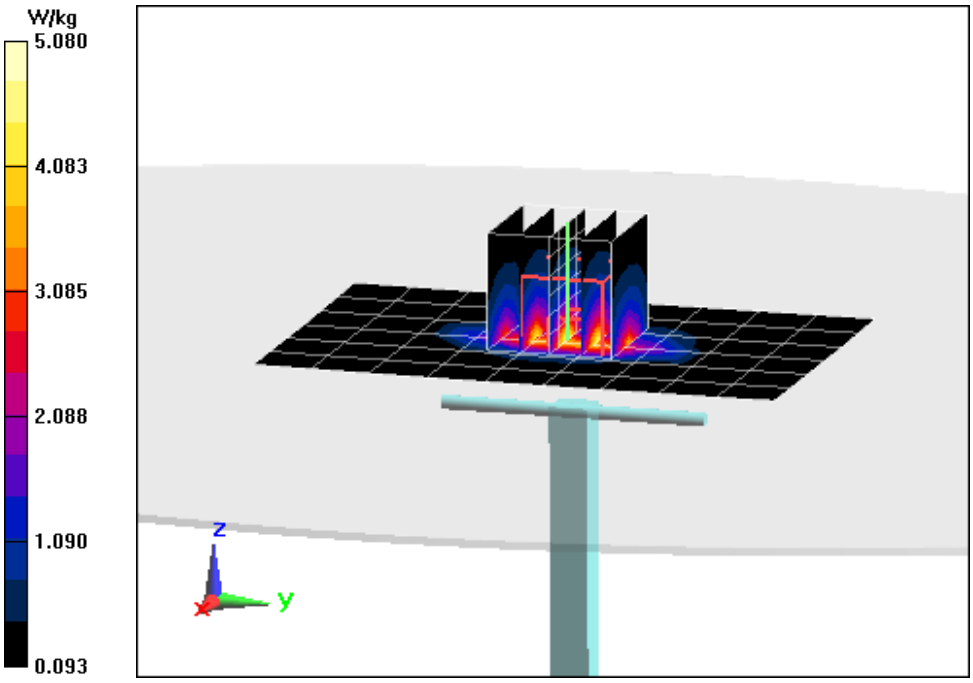
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.515 S/m; ε_r = 52.692; ρ = 1000 kg/m^3
Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-08-2015; Ambient Temp: 23.6°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.99 W/kg
SAR(1 g) = 4.05 W/kg
Deviation = -0.25%



PCTEST ENGINEERING LABORATORY, INC.

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

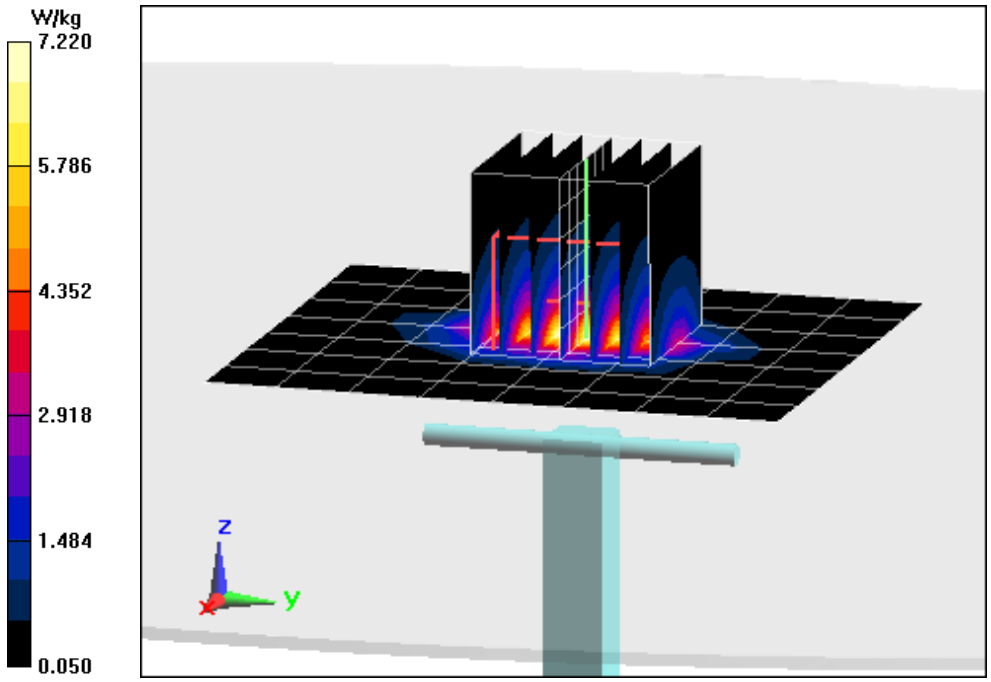
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 Body, Medium parameters used:
f = 2450 MHz; σ = 1.99 S/m; ε_r = 51.901; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2015; Ambient Temp: 23.1°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3258; ConvF(4.14, 4.14, 4.14); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

2450 MHz System Verification

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 11.5 W/kg
SAR(1 g) = 5.54 W/kg
Deviation = 6.95%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1191

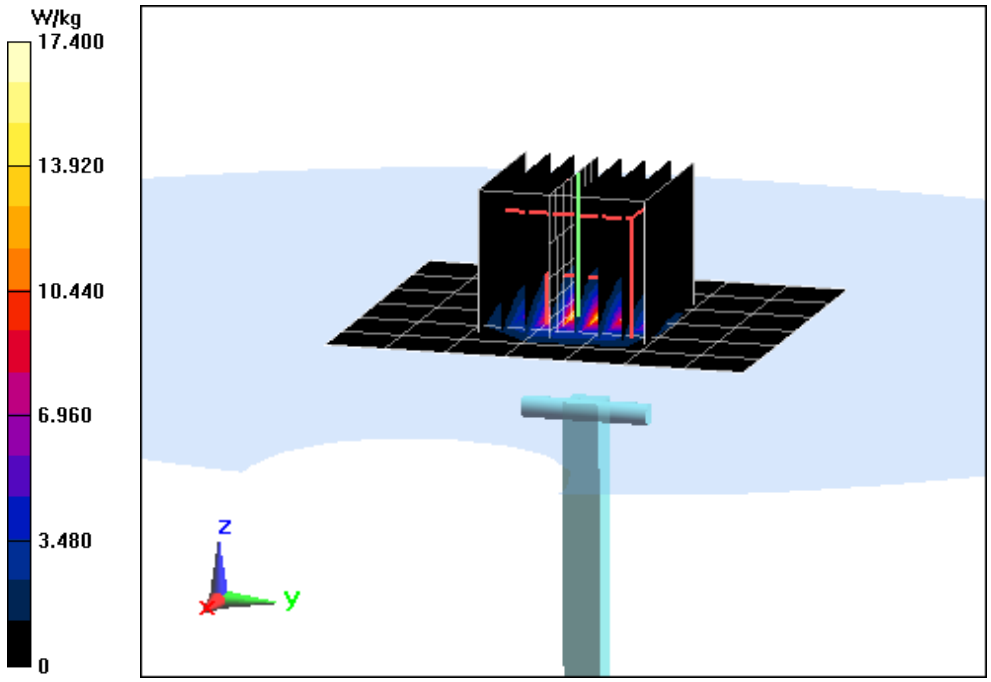
Communication System: UID 0, CW; Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5300 MHz; σ = 5.589 S/m; ε_r = 47.162; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-13-2015; Ambient Temp: 24.8°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(4.16, 4.16, 4.16); Calibrated: 12/12/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5300 MHz System Verification

Area Scan (7x8x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio = 1.4
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 30.1 W/kg
SAR(1 g) = 7.36 W/kg
Deviation = -7.88%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1191

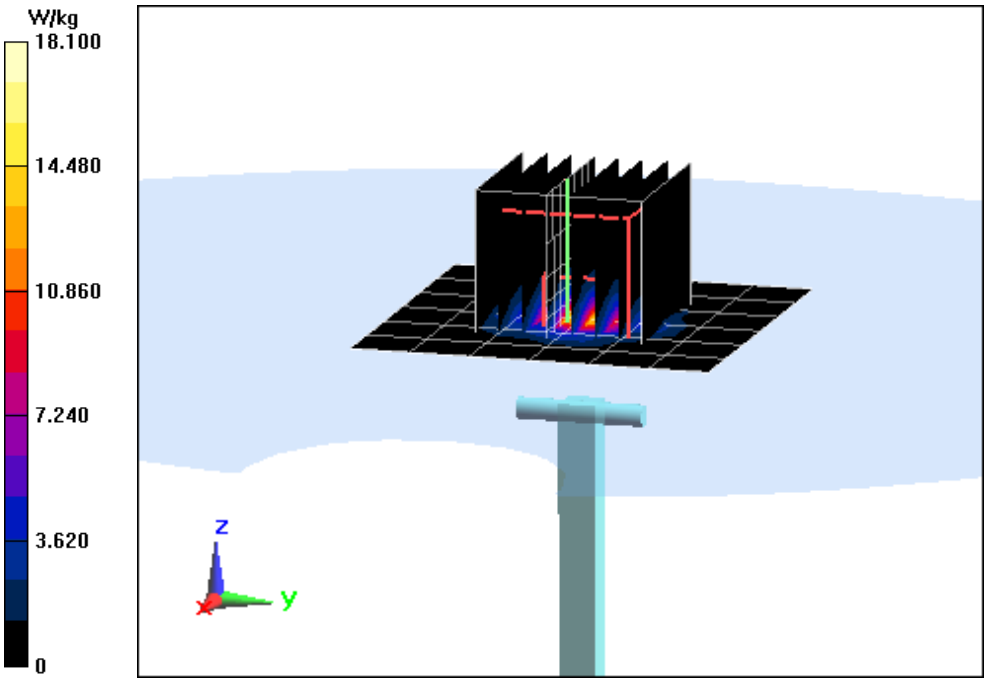
Communication System: UID 0, CW; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5500 MHz; σ = 5.847 S/m; ε_r = 46.781; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-13-2015; Ambient Temp: 24.8°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(3.79, 3.79, 3.79); Calibrated: 12/12/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5500 MHz System Verification

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
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 31.3 W/kg
SAR(1 g) = 7.5 W/kg
Deviation = -9.75%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1191

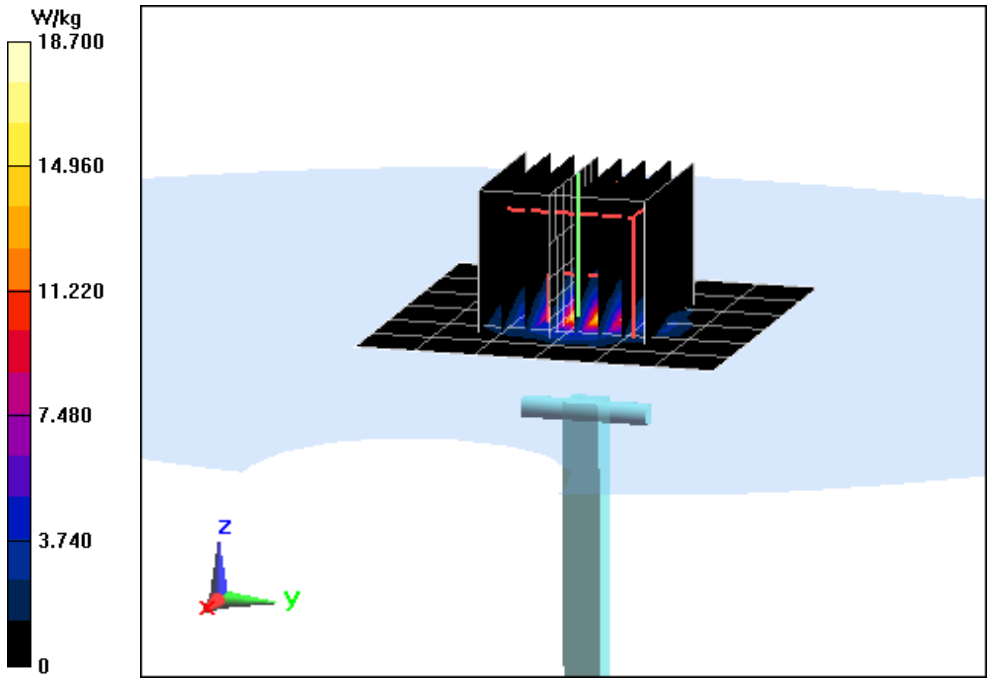
Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5600 MHz; σ = 5.996 S/m; ε_r = 46.661; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-13-2015; Ambient Temp: 24.8°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(3.66, 3.66, 3.66); Calibrated: 12/12/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5600 MHz System Verification

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
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 32.9 W/kg
SAR(1 g) = 7.74 W/kg
Deviation = -7.97%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1191

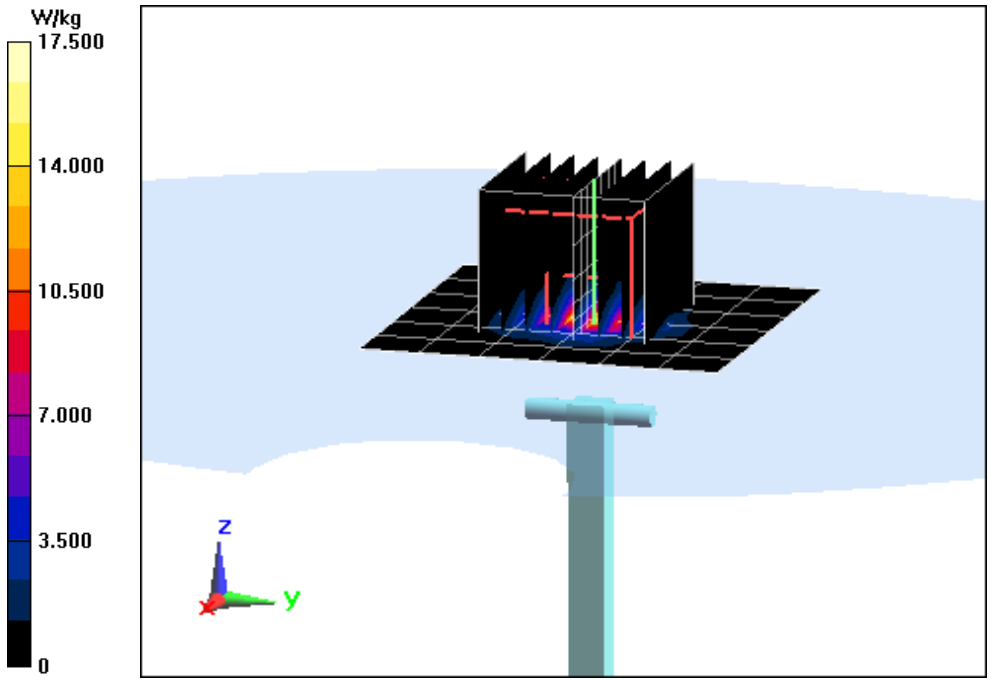
Communication System: UID 0, CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body, Medium parameters used:
f = 5800 MHz; σ = 6.263 S/m; ε_r = 46.274; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-13-2015; Ambient Temp: 24.8°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN3920; ConvF(3.93, 3.93, 3.93); Calibrated: 12/12/2014;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1368; Calibrated: 4/11/2014
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

5800 MHz System Verification

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
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 31.7 W/kg
SAR(1 g) = 7.04 W/kg
Deviation = -9.74%



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 108

Client **PC Test**

Certificate No: D750V3-1054_Mar14

CALIBRATION CERTIFICATE

Object	D750V3 - SN: 1054
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	March 17, 2014

CCV 3/28/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 17, 2014

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

PCTH 80880

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) 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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 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	40.6 ± 6 %	0.92 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	2.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.33 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.42 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	55.2 ± 6 %	1.00 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	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.64 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.69 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.1 Ω + 0.7 jΩ
Return Loss	- 26.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.5 Ω - 2.8 jΩ
Return Loss	- 29.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.035 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: 17.03.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

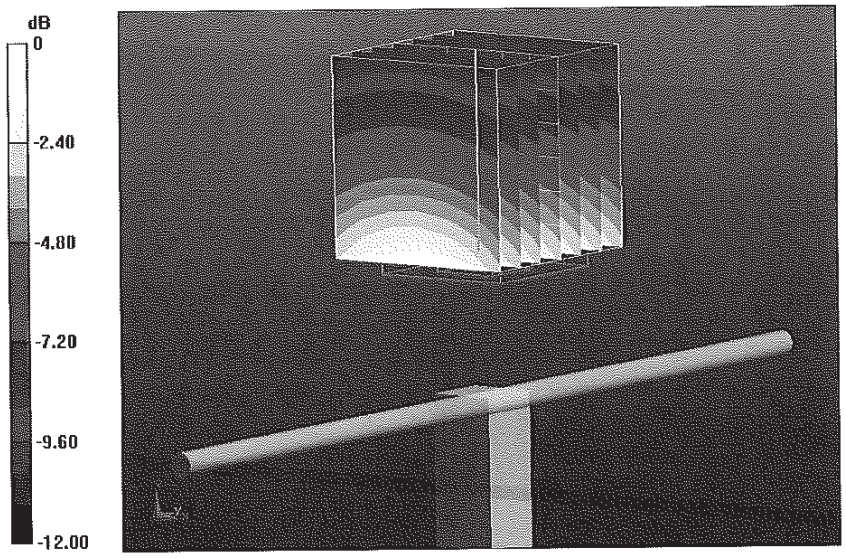
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.92 S/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

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

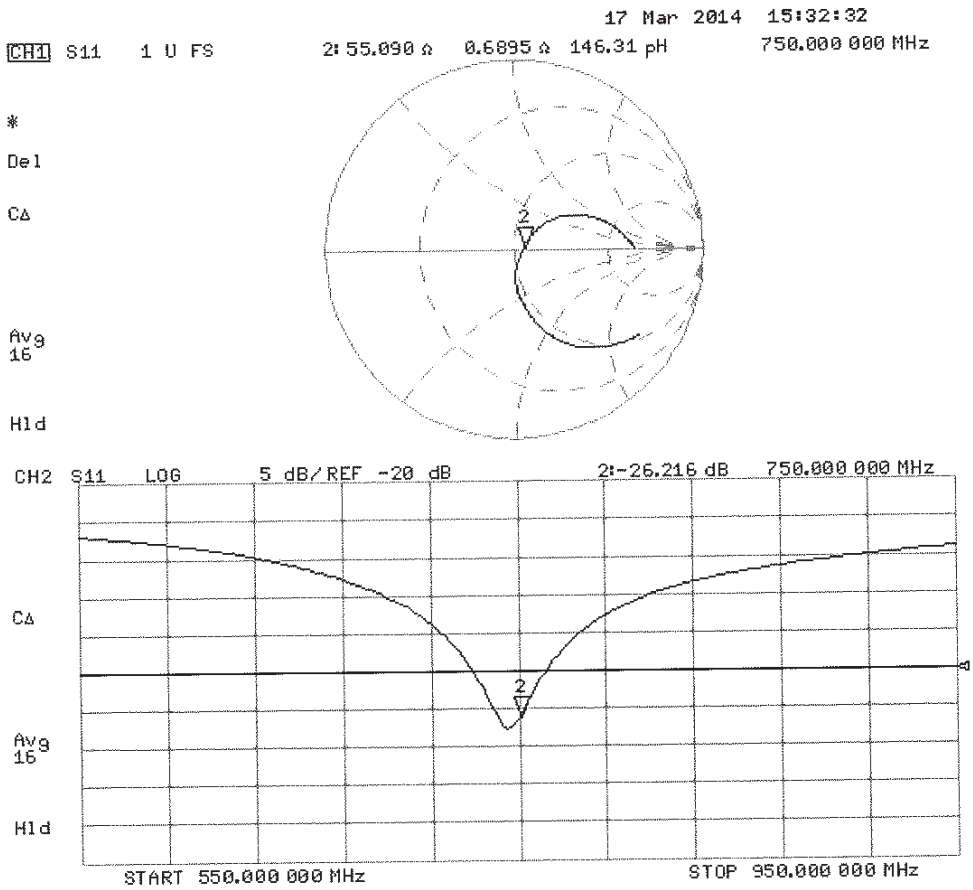
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.851 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.25 W/kg
SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.39 W/kg
Maximum value of SAR (measured) = 2.51 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.03.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

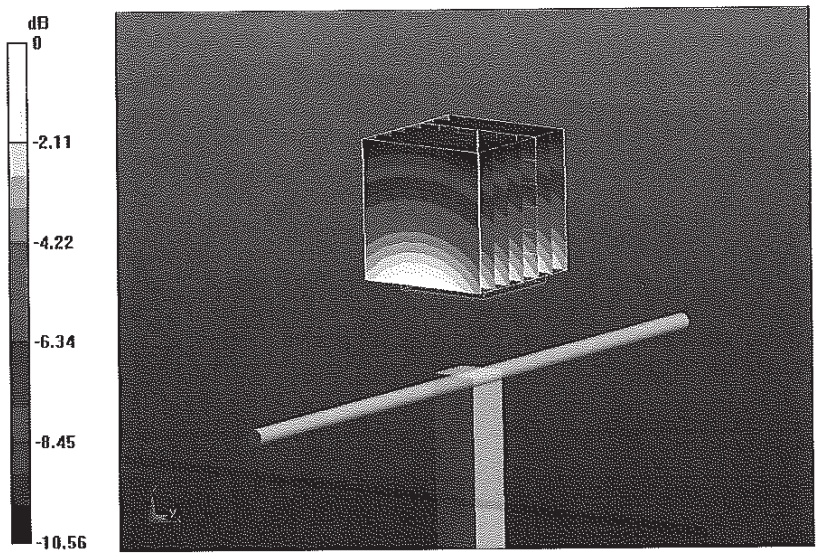
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 1 S/m; ε_r = 55.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

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

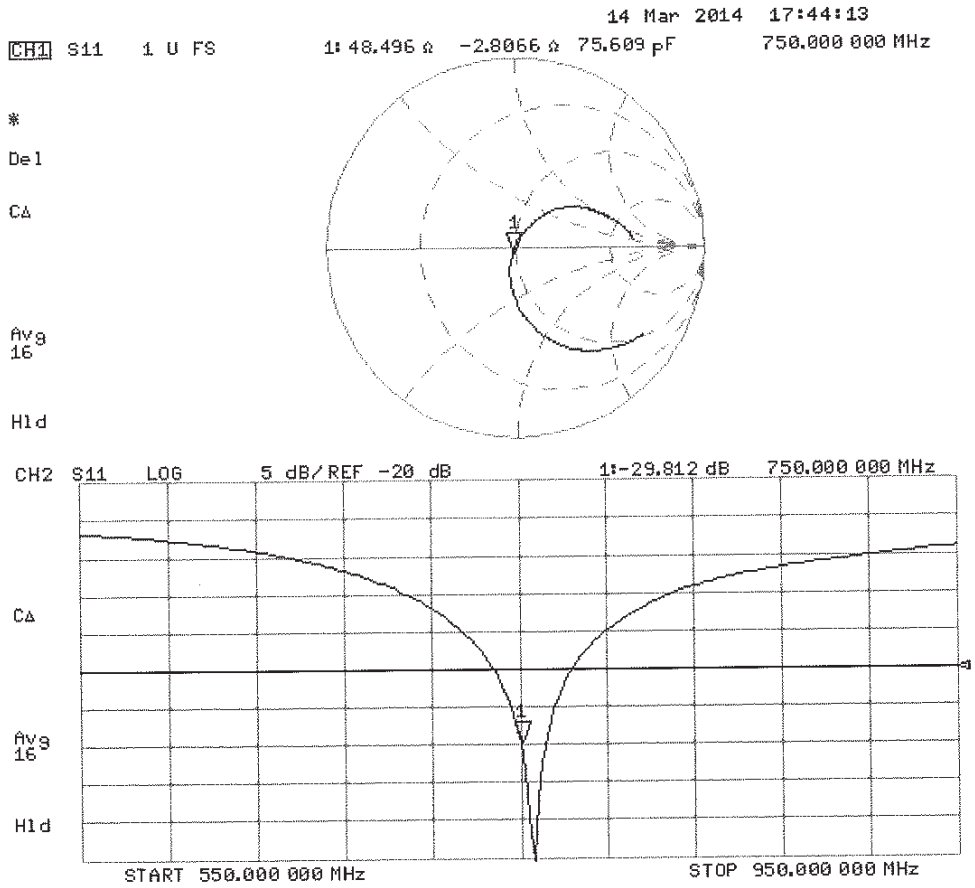
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.788 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.27 W/kg
SAR(1 g) = 2.23 W/kg; SAR(10 g) = 1.46 W/kg
Maximum value of SAR (measured) = 2.59 W/kg



0 dB = 2.59 W/kg = 4.13 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D835V2-4d119_Apr14**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d119
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 07, 2014

OCV 4/25/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Leif Klysner
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 9, 2014

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) 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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	41.6 ± 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	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.22 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.97 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	53.6 ± 6 %	1.02 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	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.34 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	**6.15 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.2 Ω - 1.6 jΩ
Return Loss	- 34.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3 Ω - 4.5 jΩ
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 29, 2010

DASY5 Validation Report for Head TSL

Date: 07.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

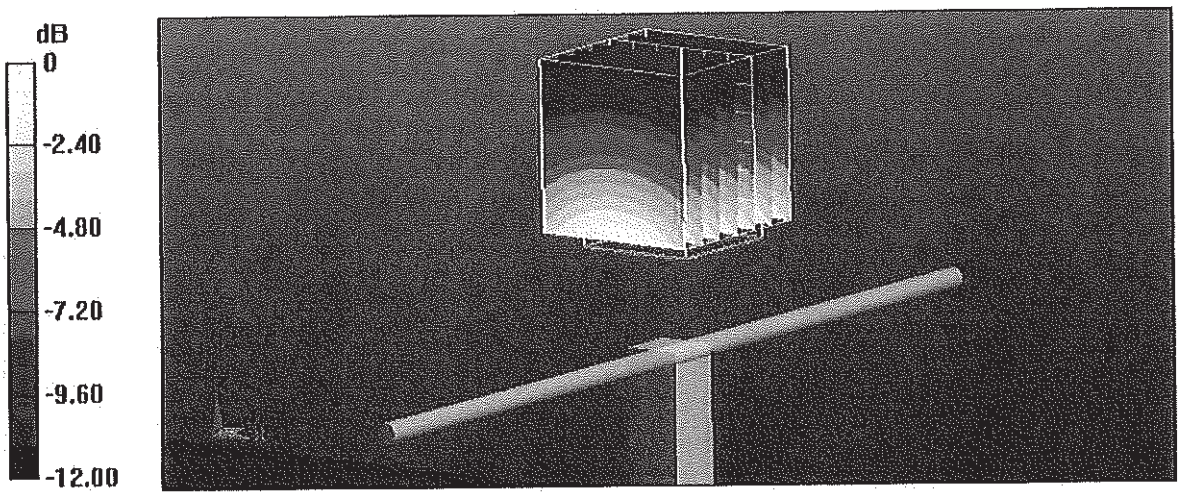
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 41.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.22, 6.22, 6.22); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

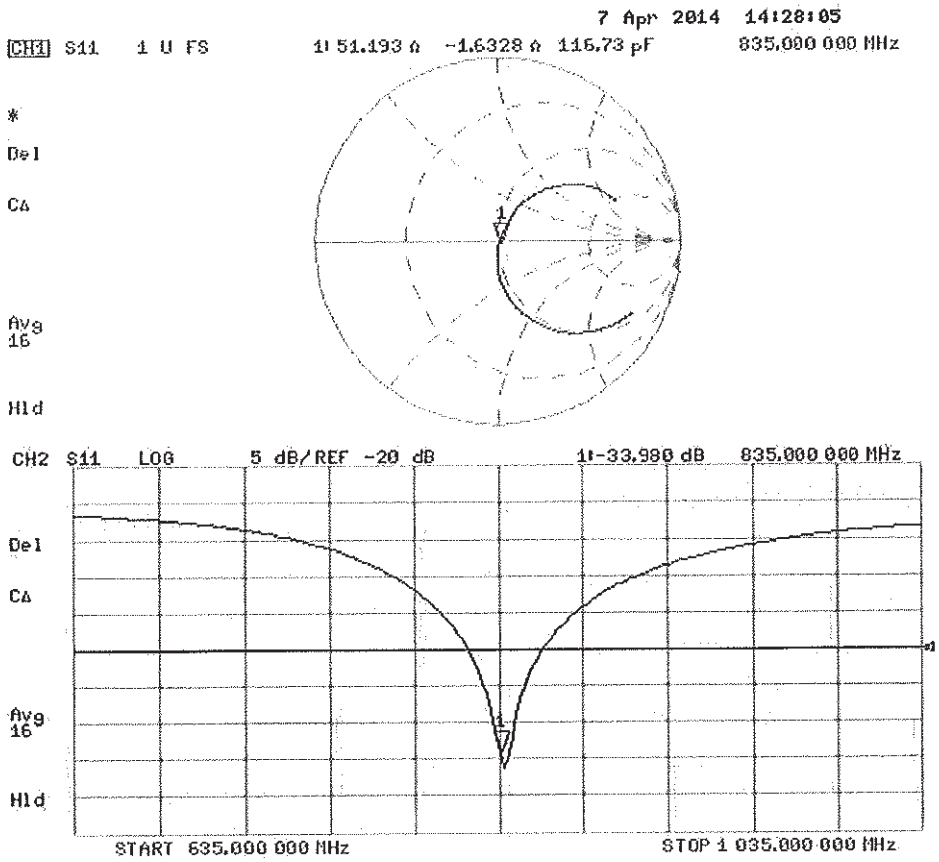
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.289 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.59 W/kg
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.53 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: 07.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

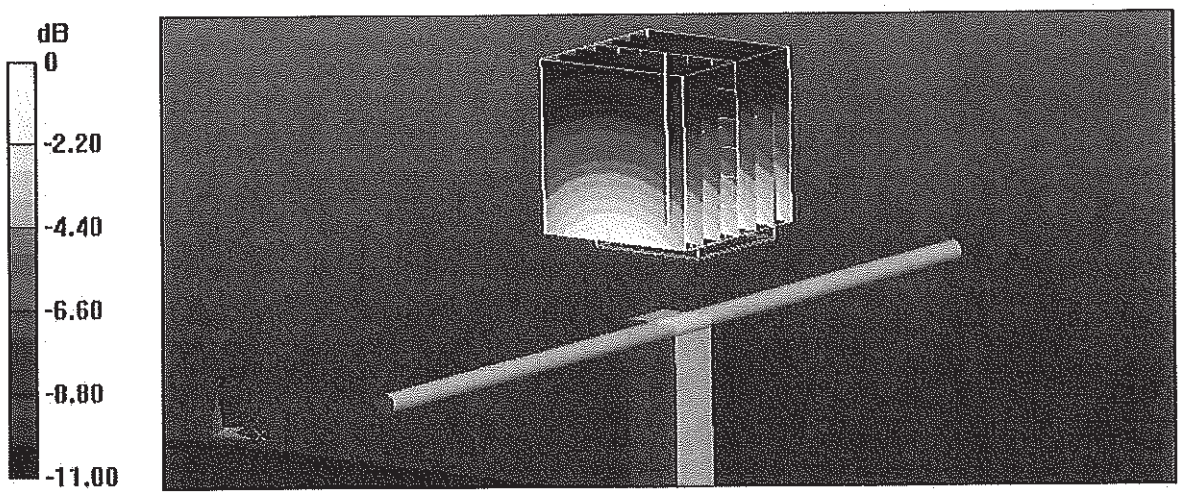
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.02 S/m; ε_r = 53.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

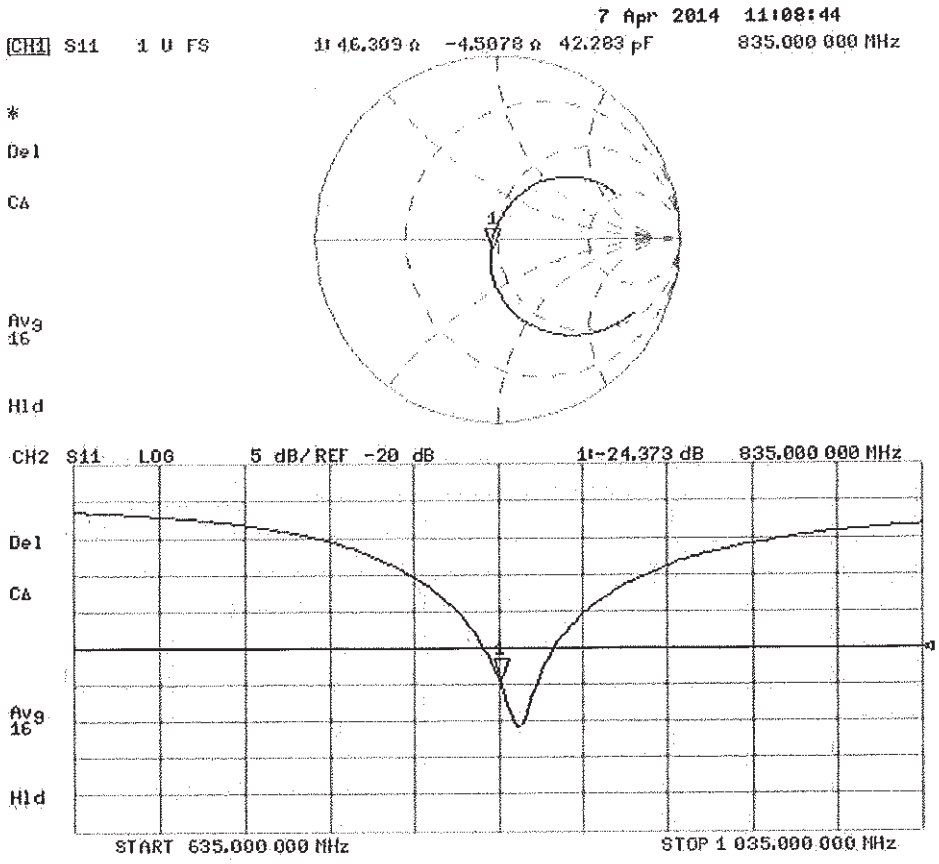
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.594 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.61 W/kg
SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.59 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 Body TSL



Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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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 108

Client PC Test

Certificate No: D1765V2-1008_May14

CALIBRATION CERTIFICATE

Object	D1765V2 - SN: 1008
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 07, 2014

CCV 6/2/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: May 12, 2014

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) 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	
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	39.0 ± 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	9.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.5 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	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.48 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	9.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.1 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.7 Ω - 6.1 jΩ
Return Loss	- 23.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.7 Ω - 6.4 jΩ
Return Loss	- 20.4 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: 07.05.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

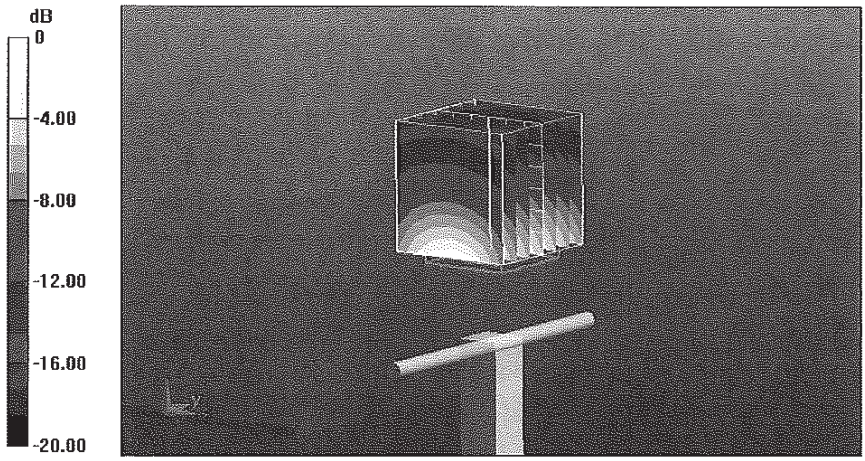
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.36 S/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.23, 5.23, 5.23); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

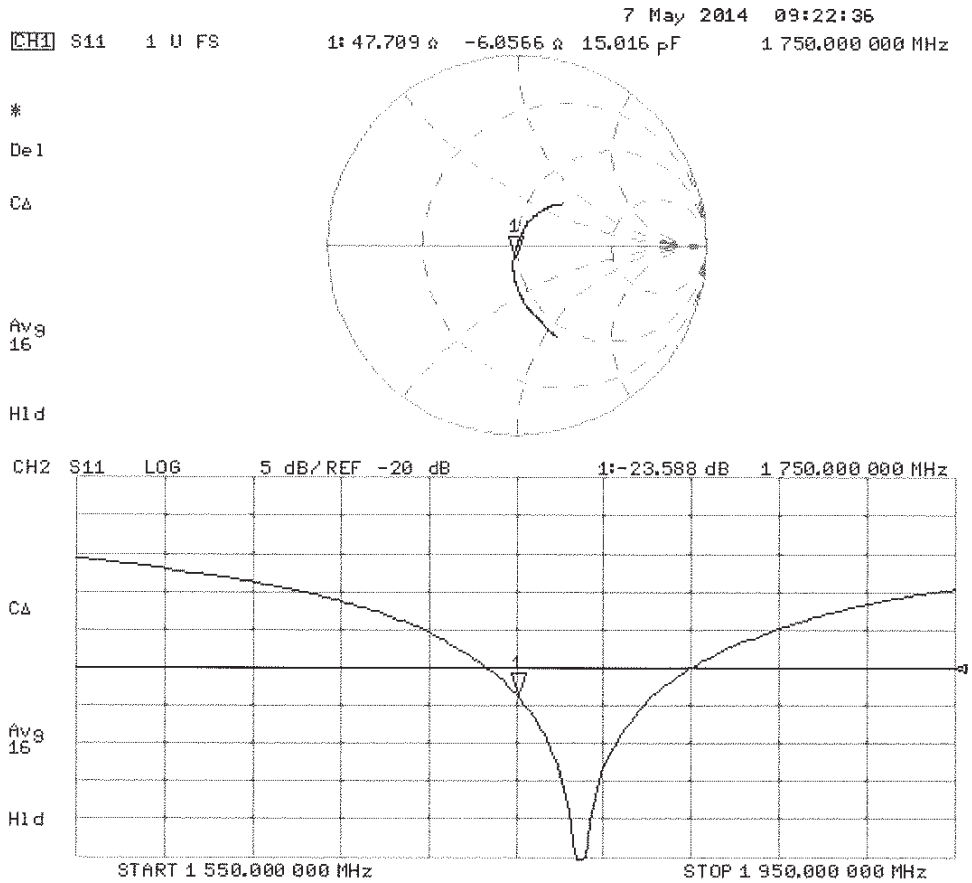
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.06 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.7 W/kg
SAR(1 g) = 9.23 W/kg; SAR(10 g) = 4.87 W/kg
Maximum value of SAR (measured) = 11.7 W/kg



0 dB = 11.7 W/kg = 10.68 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.05.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

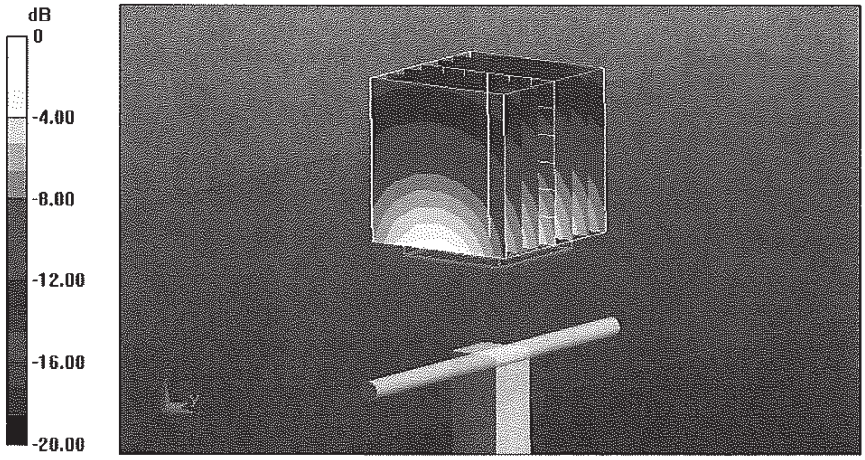
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.48 S/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.89, 4.89, 4.89); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

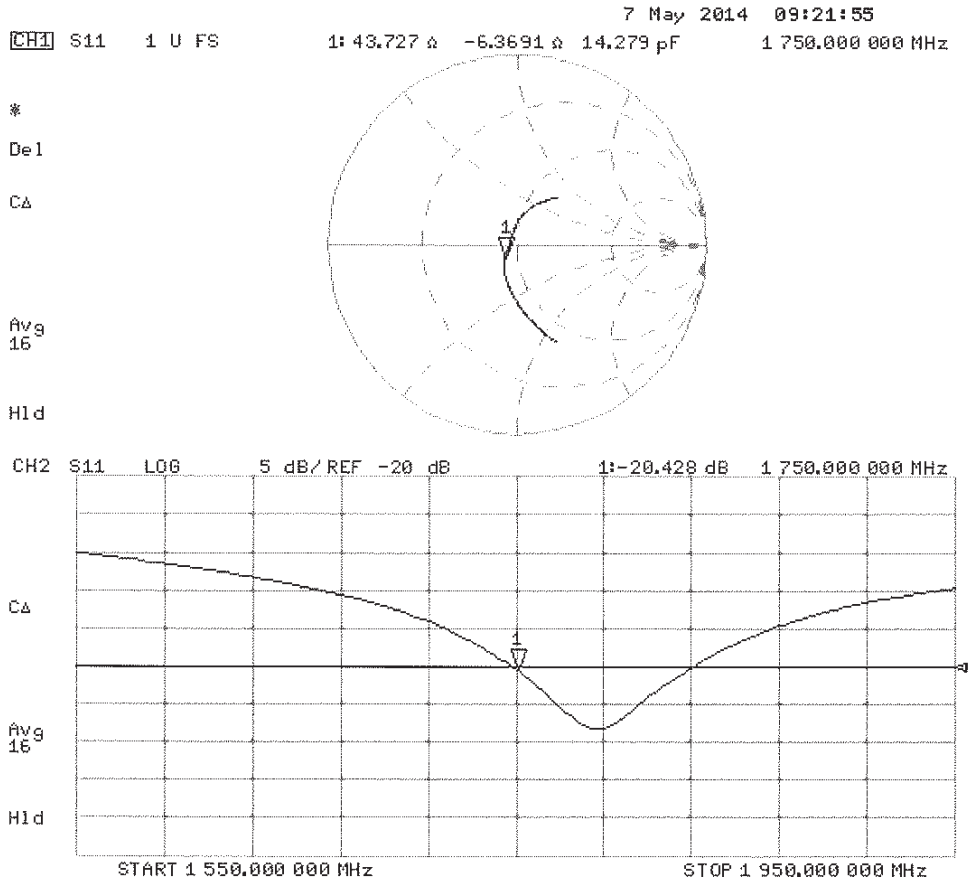
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.01 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 16.3 W/kg
SAR(1 g) = 9.41 W/kg; SAR(10 g) = 5.02 W/kg
Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 11.8 W/kg = 10.72 dBW/kg

Impedance Measurement Plot for Body TSL



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

S Schweizerischer Kalibrierdienst
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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 108**

Client **PC Test**

Certificate No: **D1900V2-5d141_Apr14**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d141
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 09, 2014

✓ KOK 5/7/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: April 9, 2014

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) 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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 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	39.1 ± 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	9.91 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	5.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.8 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	52.4 ± 6 %	1.52 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	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.6 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.8 Ω + 5.5 jΩ
Return Loss	- 24.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8 Ω + 6.3 jΩ
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 09.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d141

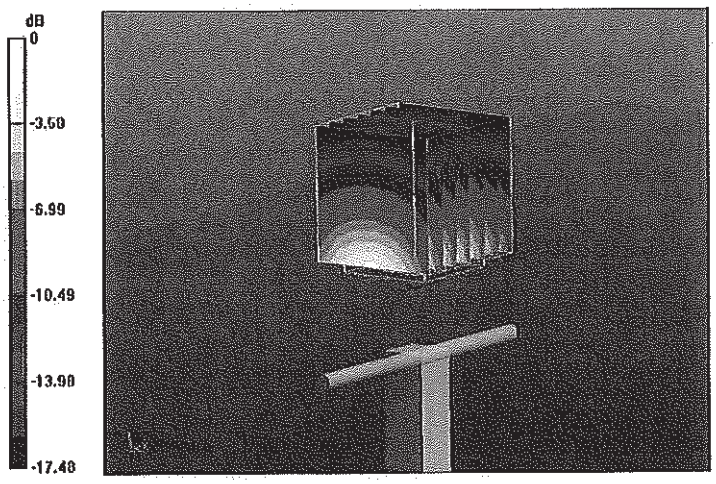
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.36 S/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

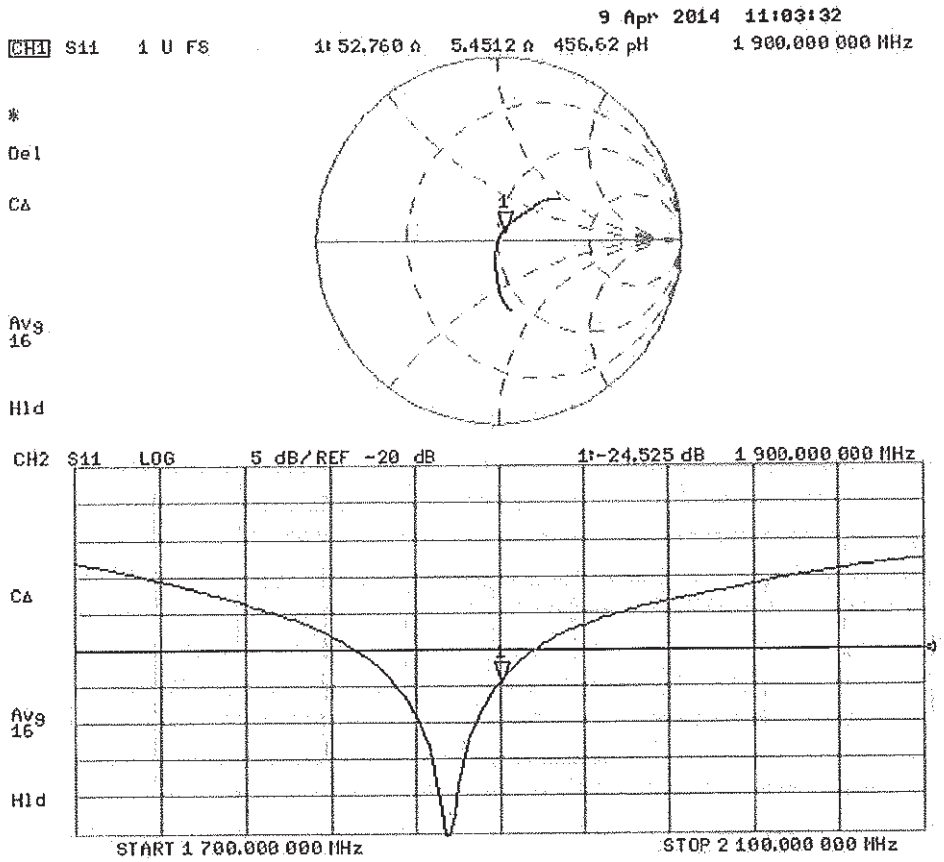
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.080 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 9.91 W/kg; SAR(10 g) = 5.17 W/kg
Maximum value of SAR (measured) = 12.5 W/kg



0 dB = 12.5 W/kg = 10.97 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 09.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d141

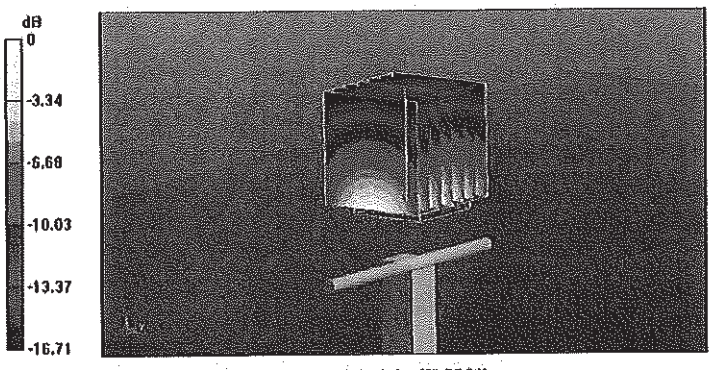
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.52 S/m; ε_r = 52.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom; Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

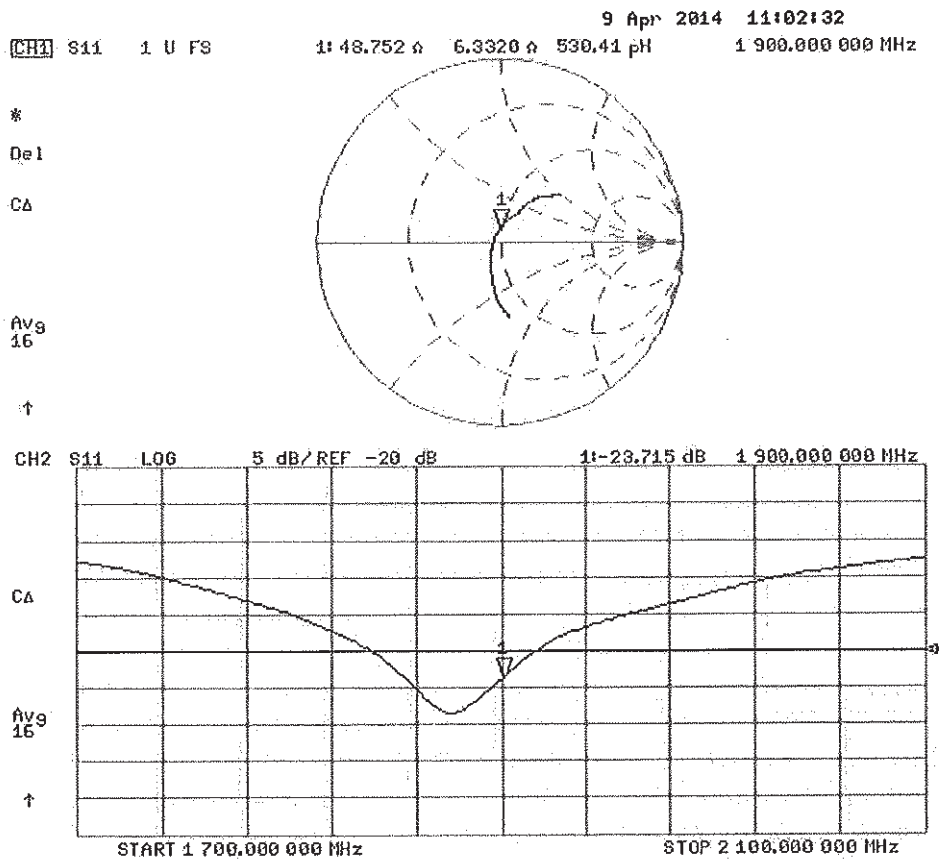
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.820 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.41 W/kg
Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Body TSL



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 108

Client **PC Test**

Certificate No: D2450V2-719_Aug14

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 719
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 11, 2014

✓ KOK 9/8/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	30-Apr-14 (No. DAE4-601_Apr14)	Apr-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: August 12, 2014

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) 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	
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	38.0 ± 6 %	1.82 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	13.2 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	6.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.2 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	50.5 ± 6 %	2.02 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	13.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.9 Ω + 3.0 jΩ
Return Loss	- 25.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.9 Ω + 5.8 jΩ
Return Loss	- 24.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

DASY5 Validation Report for Head TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

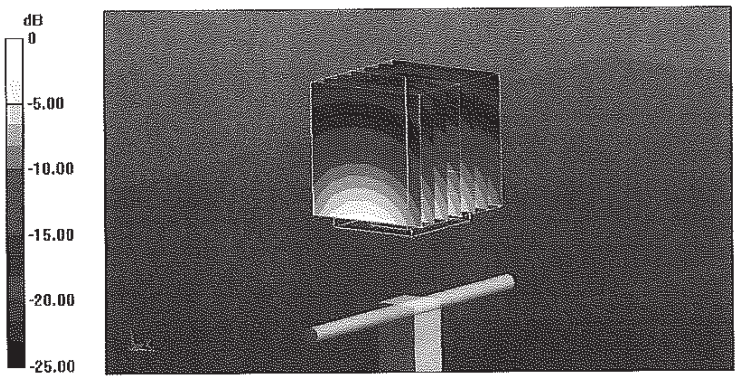
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.82 S/m; ε_r = 38; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

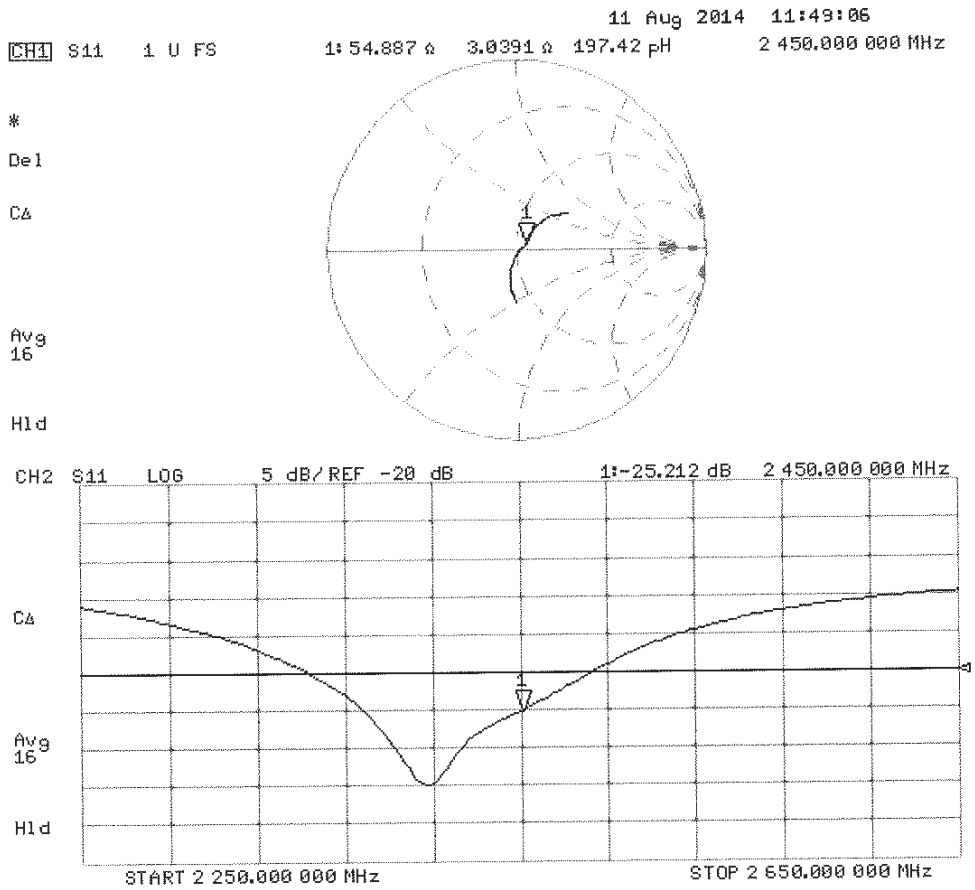
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.6 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kg
Maximum value of SAR (measured) = 17.4 W/kg



0 dB = 17.4 W/kg = 12.41 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

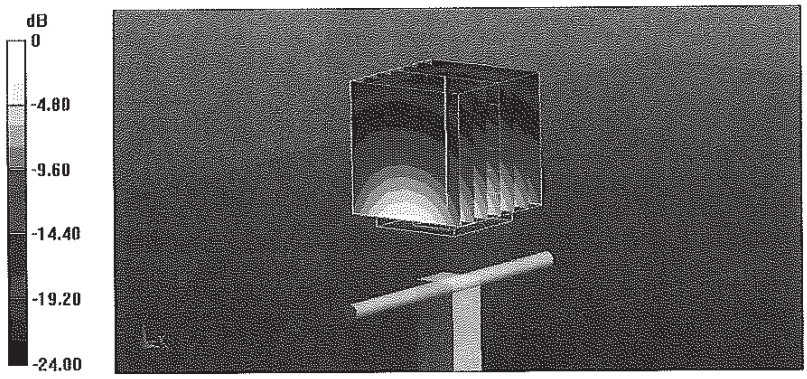
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 50.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

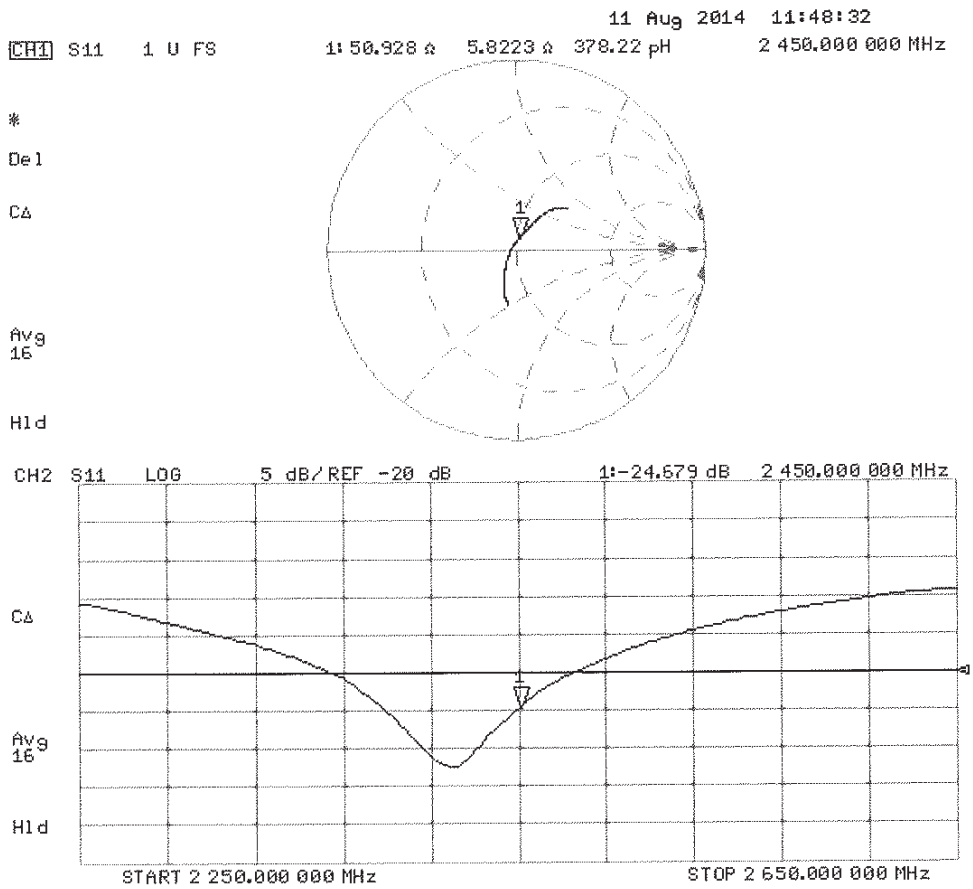
DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.08 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.1 W/kg
Maximum value of SAR (measured) = 17.6 W/kg



0 dB = 17.6 W/kg = 12.46 dBW/kg

Impedance Measurement Plot for Body TSL