SAR EVALUATION REPORT

Applicant Name:
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Date of Testing:
07/23/19 - 08/19/19
Test Site/Location:
PCTEST Lab, Morgan Hill, CA, USA
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FCC ID: A3LSMA307GN

APPLICANT: SAMSUNG ELECTRONICS CO., LTD.

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model: SM-A307GN/DS

Equipment Class	Band & Mode	Tx Frequency	SAR			
			1g Head (W/kg)	1g Body-Worn (W/kg)	1g Hotspot (W/kg)	10g Phablet (W/kg)
PCE	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	0.26	0.29	1.07	N/A
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	0.17	0.17	0.46	N/A
PCE	UMTS 850	826.40 - 846.60 MHz	0.22	0.32	0.57	N/A
PCE	UMTS 1750	1712.4 - 1752.6 MHz	0.31	0.25	0.50	N/A
PCE	UMTS 1900	1852.4 - 1907.6 MHz	0.32	0.32	0.69	1.47
PCE	LTE Band 12	699.7 - 715.3 MHz	0.18	0.34	0.41	N/A
PCE	LTE Band 17	706.5 - 713.5 MHz	N/A	N/A	N/A	N/A
PCE	LTE Band 13	779.5 - 784.5 MHz	0.11	0.27	0.28	N/A
PCE	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.29	0.45	0.69	N/A
PCE	LTE Band 66 (AWS)	1710.7 - 1779.3 MHz	0.15	0.16	0.37	N/A
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	N/A	N/A	N/A	N/A
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.37	0.17	0.38	1.90
PCE	LTE Band 41	2498.5 - 2687.5 MHz	0.45	0.46	1.06	N/A
DTS	2.4 GHz WLAN	2412 - 2472 MHz	0.10	< 0.1	0.13	N/A
NII	U-NII-1	5180 - 5240 MHz	N/A	N/A	N/A	N/A
NII	U-NII-2A	5260 - 5320 MHz	< 0.1	< 0.1	N/A	0.18
NII	U-NII-2C	5500 - 5720 MHz	< 0.1	< 0.1	N/A	0.21
NII	U-NII-3	5745 - 5825 MHz	0.22	0.16	0.26	N/A
DSS/DTS	Bluetooth	2402 - 2480 MHz	< 0.1	N/A	< 0.1	N/A
Simultaneous SAR per KDB 690783 D01v01r03:			0.69	0.80	1.33	2.12

Note: This revised Test Report (S/N: 1M1907080117-01-R1.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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 & Wireless Forum (MWF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MWF. Further details can be obtained by emailing: sartick@mwfai.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
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1750	Voice/Data	1712.4 - 1752.6 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 17	Voice/Data	706.5 - 713.5 MHz
LTE Band 13	Voice/Data	779.5 - 784.5 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Voice/Data	1710.7 - 1779.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2472 MHz
U-NII-1	Voice/Data	5180 - 5240 MHz
U-NII-2A	Voice/Data	5260 - 5320 MHz
U-NII-2C	Voice/Data	5500 - 5720 MHz
U-NII-3	Voice/Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz

1.2 Power Reduction for SAR

This device utilizes a power reduction mechanism for some wireless modes and bands for SAR compliance under portable hotspot conditions, under some conditions when the device is being used in close proximity to the user's hand, and during voice or held to ear scenarios. All hotspot SAR evaluations for this device were performed at the maximum allowed output power when hotspot is enabled. FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device when being used in phablet use conditions. Detailed descriptions of the power reduction mechanism are included in the operational description.

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

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1.3 Nominal and Maximum Output Power Specifications

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

1.3.1 Maximum 2G/3G/4G Output Power

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 850	Maximum	**33.5**	**33.5**	**31.0**	**29.5**	**28.5**	**27.5**	**25.5**	**24.5**	**23.0**
	Nominal	**32.5**	**32.5**	**30.0**	**28.5**	**27.5**	**26.5**	**24.5**	**23.5**	**22.0**
GSM/GPRS/EDGE 1900	Maximum	**30.5**	**30.5**	**28.0**	**26.5**	**25.0**	**27.0**	**25.0**	**24.0**	**22.5**
	Nominal	**29.5**	**29.5**	**27.0**	**25.5**	**24.0**	**26.0**	**24.0**	**23.0**	**21.5**

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	*3GPP HSDPA*	*3GPP HSUPA*	*3GPP DC-HSDPA*
UMTS Band 5 (850 MHz)	Maximum	**25.0**	**24.0**	**24.0**	**24.0**
	Nominal	**24.0**	**23.0**	**23.0**	**23.0**
UMTS Band 4 (1750 MHz)	Maximum	**24.5**	**24.0**	**24.0**	**24.0**
	Nominal	**23.5**	**23.0**	**23.0**	**23.0**
UMTS Band 2 (1900 MHz)	Maximum	**23.5**	**23.5**	**23.5**	**23.5**
	Nominal	**22.5**	**22.5**	**22.5**	**22.5**

Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	**24.5**
	Nominal	**23.5**
LTE Band 17	Maximum	**24.5**
	Nominal	**23.5**
LTE Band 13	Maximum	**24.5**
	Nominal	**23.5**
LTE Band 5 (Cell)	Maximum	**25.5**
	Nominal	**24.5**
LTE Band 66 (AWS)	Maximum	**24.5**
	Nominal	**23.5**
LTE Band 4 (AWS)	Maximum	**24.5**
	Nominal	**23.5**
LTE Band 2 (PCS)	Maximum	**24.5**
	Nominal	**23.5**
LTE Band 41	Maximum	**24.5**
	Nominal	**23.5**

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1.3.2 Reduced 3G/4G Output Power – Hotspot Mode Active

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	*3GPP HSDPA*	*3GPP HSUPA*	*3GPP DC-HSDPA*
UMTS Band 2 (1900 MHz)	Maximum	**20.5**	**20.5**	**20.5**	**20.5**
	Nominal	**19.5**	**19.5**	**19.5**	**19.5**

Mode / Band		Modulated Average (dBm)
LTE Band 2 (PCS)	Maximum	**21.5**
	Nominal	**20.5**

1.3.3 Reduced 3G/4G Output Power – Grip Sensor Mode Active

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	*3GPP HSDPA*	*3GPP HSUPA*	*3GPP DC-HSDPA*
UMTS Band 2 (1900 MHz)	Maximum	**20.5**	**20.5**	**20.5**	**20.5**
	Nominal	**19.5**	**19.5**	**19.5**	**19.5**

Mode / Band		Modulated Average (dBm)
LTE Band 2 (PCS)	Maximum	**21.5**
	Nominal	**20.5**

1.3.4 Reduced 4G Output Power – RCV Mode Active

Mode / Band		Modulated Average (dBm)
LTE Band 41	Maximum	**21.5**
	Nominal	**20.5**

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1.3.5 Maximum Bluetooth and WLAN Output Power

Mode / Band		Modulated Average - Single Tx Chain (dBm)		
	Channel	1-11	12	13
IEEE 802.11b (2.4 GHz)	Maximum	**19.0**	**15.5**	**14.5**
	Nominal	**18.0**	**14.5**	**13.5**
IEEE 802.11g (2.4 GHz)	Maximum	**16.0**	**11.0**	**5.0**
	Nominal	**15.0**	**10.0**	**4.0**
IEEE 802.11n (2.4 GHz)	Maximum	**16.0**	**11.0**	**5.0**
	Nominal	**15.0**	**10.0**	**4.0**

Mode / Band		Modulated Average - Single Tx Chain (dBm)											
		20 MHz Bandwidth				40 MHz Bandwidth				80 MHz Bandwidth			
	Channel	36-48	52-64	100-144	149-165	38-46	54-62	102-142	151-159	42	58	106-138	155
IEEE 802.11a (5 GHz)	Maximum	**15.5**	**15.5**	**15.0**	**15.0**								
	Nominal	**14.5**	**14.5**	**14.0**	**14.0**								
IEEE 802.11n (5 GHz)	Maximum	**15.5**	**15.5**	**15.0**	**15.0**	**14.5**	**14.5**	**14.5**	**14.0**				
	Nominal	**14.5**	**14.5**	**14.0**	**14.0**	**13.5**	**13.5**	**13.5**	**13.0**				
IEEE 802.11ac (5 GHz)	Maximum	**15.5**	**15.5**	**15.0**	**15.0**	**14.5**	**14.5**	**14.5**	**14.0**	**12.5**	**12.5**	**12.0**	**12.0**
	Nominal	**14.5**	**14.5**	**14.0**	**14.0**	**13.5**	**13.5**	**13.5**	**13.0**	**11.5**	**11.5**	**11.0**	**11.0**

Mode/Band		Modulated Average (dBm)
Bluetooth	Maximum	**11.0**
	Nominal	**10.0**
Bluetooth EDR	Maximum	**9.5**
	Nominal	**8.5**
Bluetooth LE	Maximum	**8.0**
	Nominal	**7.0**

1.3.6 Reduced WLAN Output Power

Mode / Band		Modulated Average (dBm)		
	Channel	1-11	12	13
IEEE 802.11b (2.4 GHz)	Maximum	**16.0**	**15.5**	**14.5**
	Nominal	**15.0**	**14.5**	**13.5**
IEEE 802.11g (2.4 GHz)	Maximum	**16.0**	**11.0**	**5.0**
	Nominal	**15.0**	**10.0**	**4.0**
IEEE 802.11n (2.4 GHz)	Maximum	**16.0**	**11.0**	**5.0**
	Nominal	**15.0**	**10.0**	**4.0**

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Mode / Band		Modulated Average - Single Tx Chain (dBm)											
		20 MHz Bandwidth				40 MHz Bandwidth				80 MHz Bandwidth			
	Channel	36-48	52-64	100-144	149-165	38-46	54-62	102-142	151-159	42	58	106-138	155
IEEE 802.11a (5 GHz)	Maximum	**14.0**	**14.0**	**14.0**	**14.0**								
	Nominal	**13.0**	**13.0**	**13.0**	**13.0**								
IEEE 802.11n (5 GHz)	Maximum	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**				
	Nominal	**13.0**	**13.0**	**13.0**	**13.0**	**13.0**	**13.0**	**13.0**	**13.0**				
IEEE 802.11ac (5 GHz)	Maximum	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**14.0**	**12.5**	**12.5**	**12.0**	**12.0**
	Nominal	**13.0**	**13.0**	**13.0**	**13.0**	**13.0**	**13.0**	**13.0**	**13.0**	**11.5**	**11.5**	**11.0**	**11.0**

1.4 DUT Antenna Locations

The overall dimensions of this device are > 9 x 5 cm. A diagram showing the location of the device antennas can be found in Appendix F. Since the diagonal dimension of this device is > 160 mm and <200 mm, it is considered a "phablet."

Table 1-1
Device Edges/Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	Yes	Yes
GPRS 1900	Yes	Yes	No	Yes	Yes	Yes
UMTS 850	Yes	Yes	No	Yes	Yes	Yes
UMTS 1750	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 13	Yes	Yes	No	Yes	Yes	Yes
LTE Band 5 (Cell)	Yes	Yes	No	Yes	Yes	Yes
LTE Band 66 (AWS)	Yes	Yes	No	Yes	Yes	Yes
LTE Band 2 (PCS)	Yes	Yes	No	Yes	Yes	Yes
LTE Band 41	Yes	Yes	Yes	No	No	Yes
2.4 GHz WLAN	Yes	Yes	Yes	No	Yes	No
5 GHz WLAN	Yes	Yes	Yes	No	Yes	No
Bluetooth	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for wireless router SAR or phablet SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v02r01 Section III and FCC KDB Publication 648474 D04v01r03. The distances between the transmit antennas and the edges of the device are included in the filing. When wireless router mode is enabled, U-NII-1, U-NII-2A, U-NII-2C operations are disabled.

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1.5 Near Field Communications (NFC) Antenna

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

1.6 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be operating simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

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

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Phablet	Notes
1	GSM voice + 2.4 GHz WI-FI	Yes	Yes	N/A	Yes	
2	GSM voice + 5 GHz WI-FI	Yes	Yes	N/A	Yes	
3	GSM voice + 2.4 GHz Bluetooth	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
4	GSM voice + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
5	UMTS + 2.4 GHz WI-FI	Yes	Yes	Yes	Yes	
6	UMTS + 5 GHz WI-FI	Yes	Yes	Yes	Yes	
7	UMTS + 2.4 GHz Bluetooth	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
8	UMTS + 2.4 GHz Bluetooth + 5 GHZ WI-FI	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
9	LTE + 2.4 GHz WI-FI	Yes	Yes	Yes	Yes	
10	LTE + 5 GHz WI-FI	Yes	Yes	Yes	Yes	
11	LTE + 2.4 GHz Bluetooth	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
12	LTE + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
13	GPRS/EDGE + 2.4 GHz WI-FI	N/A	N/A	Yes	Yes	
14	GPRS/EDGE + 5 GHz WI-FI	N/A	N/A	Yes	Yes	
15	GPRS/EDGE + 2.4 GHz Bluetooth	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
16	GPRS/EDGE + 2.4 GHz Bluetooth + 5GHz WI-FI	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered

1. 2.4 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 by S/W, therefore U-NII-1, U-NII2A, and U-NII2C were not evaluated for wireless router conditions.
6. This device supports VOLTE.
7. This device supports VoWIFI.
8. This device supports Bluetooth Tethering.

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1.7 Miscellaneous SAR Test Considerations

(A) WIFI/BT

Since U-NII-1 and U-NII-2A bands have the same maximum output power and the highest reported SAR for U-NII-2A is less than 1.2 W/kg, SAR is not required for U-NII-1 band according to FCC KDB Publication 248227 D01v02r02.

Since Wireless Router operations are not allowed by the chipset firmware using U-NII-1, U-NII-2A & U-NII-2C WIFI, only 2.4 GHz and U-NII-3 WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v02r01.

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

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, body-worn Bluetooth SAR was not required; [(13/15)* √2.480] = 1.4< 3.0. Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

This device supports IEEE 802.11ac with the following features:

a) Up to 80 MHz Bandwidth only
b) No aggregate channel configurations
c) 1 Tx antenna output
d) 256 QAM is supported
e) TDWR and Band gap channels are supported

Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is greater than 160mm and less than 200mm. Phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg. Because wireless router operations are not supported for U-NII-1, U-NII-2A & U-NII-2C WLAN, phablet SAR tests were performed. Phablet SAR was not evaluated for Bluetooth, 2.4 GHz and U-NII-3 WLAN operations since wireless router 1g SAR was < 1.2 W/kg.

This device supports channel 1-13 for 2.4 GHz WLAN. However, due to the reduced output power for channels 12 and 13, channels 1, 6, and 11 were considered for SAR testing per KDB 248227 D01v02r02.

(B) Licensed Transmitter(s)

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

This device is only capable of QPSK HSUPA in the uplink. Therefore, no additional SAR tests are required beyond that described for devices with HSUPA in KDB 941225 D01v03r01.

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

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

Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is greater than 160mm and less than 200mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg. Additional SAR tests for Phablet SAR were evaluated per KDB 616217 Section 6 (See Section 6.9 for more information.)

This device supports LTE capabilities with overlapping transmission frequency ranges. When the supported frequency range of an LTE Band falls completely within an LTE band with a larger transmission frequency range, both LTE bands have the same target power (or the band with the larger transmission frequency range has a higher target power), and both LTE bands share the same transmission path and signal characteristics, SAR was only assessed for the band with the larger transmission frequency range.

1.8 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01, D05v02r04, D05Av01r02, D06v02r01 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 648474 D04v01r03 (Phablet Procedures)
- FCC KDB Publication 616217 D04v01r02 (Proximity Sensor)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)
- April 2018 TCB Workshop Notes (LTE Carrier Aggregation)

1.9 Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units. The serial numbers used for each test are indicated alongside the results in Section 11.

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2 LTE INFORMATION

LTE Information					
Form Factor	Portable Handset				
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz)				
	LTE Band 17 (706.5 - 713.5 MHz)				
	LTE Band 13 (779.5 - 784.5 MHz)				
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)				
	LTE Band 66 (AWS) (1710.7 - 1779.3 MHz)				
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)				
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)				
	LTE Band 41 (2498.5 - 2687.5 MHz)				
Channel Bandwidths	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 17: 5 MHz, 10 MHz				
	LTE Band 13: 5 MHz, 10 MHz				
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 66 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 41: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
Channel Numbers and Frequencies (MHz)	Low	Low-Mid	Mid	Mid-High	High
LTE Band 12: 1.4 MHz	699.7 (23017)		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 13: 5 MHz	779.5 (23205)		782 (23230)	784.5 (23255)	
LTE Band 13: 10 MHz	N/A		782 (23230)	N/A	
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 66 (AWS): 1.4 MHz	1710.7 (131979)		1745 (132322)	1779.3 (132665)	
LTE Band 66 (AWS): 3 MHz	1711.5 (131987)		1745 (132322)	1778.5 (132657)	
LTE Band 66 (AWS): 5 MHz	1712.5 (131997)		1745 (132322)	1777.5 (132647)	
LTE Band 66 (AWS): 10 MHz	1715 (132022)		1745 (132322)	1775 (132622)	
LTE Band 66 (AWS): 15 MHz	1717.5 (132047)		1745 (132322)	1772.5 (132597)	
LTE Band 66 (AWS): 20 MHz	1720 (132072)		1745 (132322)	1770 (132572)	
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)	
LTE Band 41: 5 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
LTE Band 41: 10 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
LTE Band 41: 15 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
LTE Band 41: 20 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
UE Category	DL UE Cat 6, UL UE Cat 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	The technical description includes all the possible carrier aggregation combinations				
LTE Additional Information	This device does not support full CA features on 3GPP Release 10. It supports carrier aggregation features as shown in Appendix H. All other uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. The following LTE Release 10 Features are not supported: Relay, HetNet, Enhanced MIMO, eICIC, WIFI Offloading, eMBMS, Cross-Carrier scheduling, Enhanced SC-FDMA.				

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3 INTRODUCTION

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

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

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = Total RMS electric field strength (V/m)

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

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

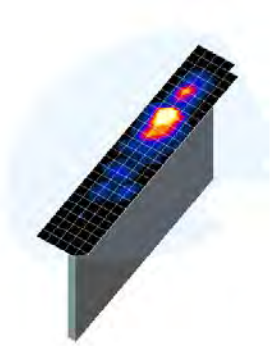

Figure 4-1
Sample SAR Area Scan

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

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

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

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

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

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

*Also compliant to IEEE 1528-2013 Table 6

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5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

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

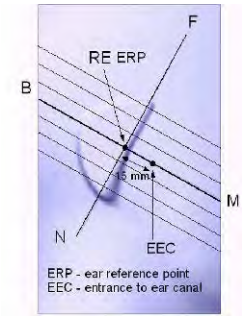

Figure 5-1
Close-Up Side view of ERP

5.2 HANDSET REFERENCE POINTS

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

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

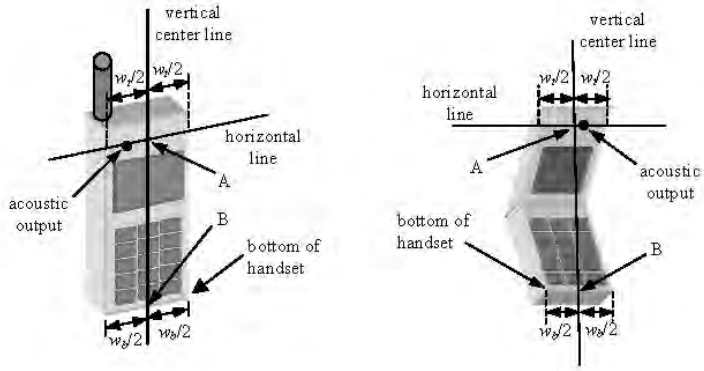

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS

6.1 Device Holder

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

6.2 Positioning for Cheek

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

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

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

6.3 Positioning for Ear / 15º Tilt

With the test device aligned in the "Cheek Position":

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

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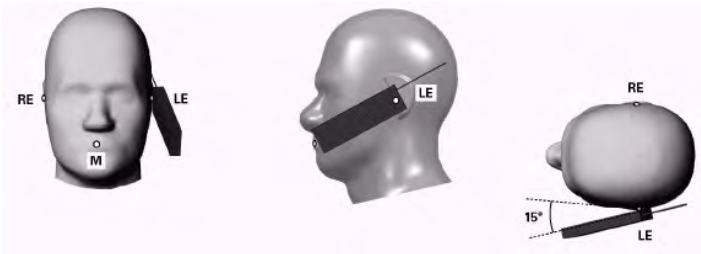

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

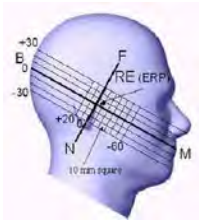

Figure 6-3
Side view w/ relevant markings

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

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

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

6.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-4). Per FCC KDB Publication 648474 D04v01r03, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

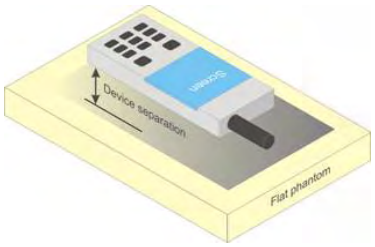

Figure 6-4
Sample Body-Worn Diagram

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

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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 1g body and 10g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v06 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v06, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

6.7 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

6.8 Phablet Configurations

For smart phones with a display diagonal dimension > 150 mm or an overall diagonal dimension > 160 mm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that

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support voice calls next to the ear, the phablets procedures outlined in KDB Publication 648474 D04v01r03 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance. In addition to the normally required head and body-worn accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna <=25 mm from that surface or edge, in direct contact with the phantom, for 10g SAR. The UMPC mini-tablet 1g SAR at 5 mm is not required. When hotspot mode applies, 10g SAR is required only for the surfaces and edges with hotspot mode 1g SAR > 1.2 W/kg.

6.9 Proximity Sensor Considerations

This device uses a power reduction mechanism to reduce output powers in certain use conditions when the device is used close the user's body. When the device's antenna is within a certain distance of the user, the sensor activates and reduces the maximum allowed output power. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, additional evaluation is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a nonreduced output power level. FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional test positions. Sensor triggering distance summary data is included in Appendix G.

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

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7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

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

Table 7-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

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

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

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8 FCC MEASUREMENT PROCEDURES

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

8.1 Measured and Reported SAR

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

8.2 3G SAR Test Reduction Procedure

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

8.3 Procedures Used to Establish RF Signal for SAR

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

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

8.4 SAR Measurement Conditions for UMTS

8.4.1 Output Power Verification

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

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8.4.2 Head SAR Measurements

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all “1’s”. The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest reported SAR configuration in 12.2 kbps RMC for head exposure.

8.4.3 Body SAR Measurements

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

8.4.4 SAR Measurements with Rel 5 HSDPA

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

8.4.5 SAR Measurements with Rel 6 HSUPA

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

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

8.4.6 SAR Measurement Conditions for DC-HSDPA

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

8.5 SAR Measurement Conditions for LTE

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

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8.5.1 Spectrum Plots for RB Configurations

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

8.5.2 MPR

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

8.5.3 A-MPR

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

8.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r04:

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

8.5.5 TDD

LTE TDD testing is performed using the SAR test guidance provided in FCC KDB 941225 D05v02r04. TDD is tested at the highest duty factor using UL-DL configuration 0 with special subframe configuration 6 and applying the FDD LTE procedures in KDB 941225 D05v02r04. SAR testing is performed using the extended cyclic prefix listed in 3GPP TS 36.211 Section 4.

8.5.6 Downlink Only Carrier Aggregation

Conducted power measurements with LTE Carrier Aggregation (CA) (downlink only) active are made in accordance to KDB Publication 941225 D05Av01r02. The RRC connection is only handled by one cell, the primary component carrier (PCC) for downlink and uplink communications. After making a data connection to the PCC, the UE device adds secondary component carrier(s) (SCC) on the downlink only. All uplink communications and acknowledgements remain identical to specifications when downlink

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carrier aggregation is inactive on the PCC. Additional conducted output powers are measured with the downlink carrier aggregation active for the configuration with highest measured maximum conducted power with downlink carrier aggregation inactive measured among the channel bandwidth, modulation, and RB combinations in each frequency band. Per FCC KDB Publication 941225 D05Av01r02, no SAR measurements are required for downlink only carrier aggregation configurations when the average output power with downlink only carrier aggregation active is not more than 0.25 dB higher than the average output power with downlink only carrier aggregation inactive.

8.6 SAR Testing with 802.11 Transmitters

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

8.6.1 General Device Setup

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

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

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

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers are specified for the bands, SAR measurement for the U-NII band with the lower maximum output power is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

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

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification. Unless band gap channels are permanently disabled, SAR must be considered for these channels. Each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

8.6.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission

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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. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

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. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.6.6 OFDM Transmission Mode and SAR Test Channel Selection

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

8.6.7 Initial Test Configuration Procedure

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

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 8.6.6). When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

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8.6.8 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

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9 RF CONDUCTED POWERS

9.1 GSM Conducted Powers

Table 9-1
Maximum Conducted Power

Maximum Burst-Averaged Output Power										
		Voice	*GPRS/EDGE Data (GMSK)*				*EDGE Data (8-PSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**	**EDGE [dBm] 3 Tx Slot**	**EDGE [dBm] 4 Tx Slot**
GSM 850	128	32.13	32.18	29.72	28.38	**26.97**	26.07	24.37	23.29	21.88
	190	32.34	32.51	29.96	28.82	**27.27**	26.36	24.54	23.52	22.04
	251	32.71	32.79	30.44	29.14	**27.88**	26.72	24.93	23.85	22.33
GSM 1900	512	29.70	29.60	26.93	**25.26**	23.70	26.17	24.06	22.78	21.78
	661	29.75	29.67	27.50	**25.33**	23.79	26.28	24.13	22.91	21.80
	810	29.93	29.82	27.19	**25.46**	24.06	26.06	24.32	23.10	22.01

Calculated Maximum Frame-Averaged Output Power										
		Voice	*GPRS/EDGE Data (GMSK)*				*EDGE Data (8-PSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**	**EDGE [dBm] 3 Tx Slot**	**EDGE [dBm] 4 Tx Slot**
GSM 850	128	23.10	23.15	23.70	24.12	**23.96**	17.04	18.35	19.03	18.87
	190	23.31	23.48	23.94	24.56	**24.26**	17.33	18.52	19.26	19.03
	251	23.68	23.76	24.42	24.88	**24.87**	17.69	18.91	19.59	19.32
GSM 1900	512	20.67	20.57	20.91	**21.00**	20.69	17.14	18.04	18.52	18.77
	661	20.72	20.64	21.48	**21.07**	20.78	17.25	18.11	18.65	18.79
	810	20.90	20.79	21.17	**21.20**	21.05	17.03	18.30	18.84	19.00

GSM 850	**Frame Avg.Targets:**	23.47	23.47	23.98	24.24	**24.49**	17.47	18.48	19.24	18.99
GSM 1900		20.47	20.47	20.98	**21.24**	20.99	16.97	17.98	18.74	18.49

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Note:

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

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

Figure 9-1
Power Measurement Setup

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9.2 UMTS Conducted Powers

Table 9-2
Maximum Conducted Power

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	24.50	24.35	24.42	24.07	23.79	24.22	22.86	22.65	22.98	-
99		12.2 kbps AMR	24.25	24.38	24.15	24.07	23.78	24.21	22.82	22.46	22.96	-
6	HSDPA	Subtest 1	23.47	23.32	23.26	23.72	23.50	23.87	23.21	22.87	23.33	0
6		Subtest 2	22.56	22.41	22.30	22.31	22.09	22.47	22.36	22.07	22.55	0
6		Subtest 3	22.62	22.40	22.31	22.86	22.56	23.05	22.84	22.55	22.98	0.5
6		Subtest 4	21.48	21.30	21.17	21.95	21.67	22.07	21.96	21.64	22.14	0.5
6	HSUPA	Subtest 1	22.51	22.39	22.28	21.35	21.12	21.54	22.39	22.11	22.60	0
6		Subtest 2	20.51	20.37	20.23	19.40	19.17	19.58	20.34	20.05	20.52	2
6		Subtest 3	22.58	22.40	22.27	22.32	22.12	22.33	22.44	22.20	22.40	1
6		Subtest 4	20.53	20.36	20.26	19.42	19.18	19.56	19.37	19.08	19.55	2
6		Subtest 5	22.55	22.37	22.30	22.23	22.02	22.39	23.20	22.87	23.34	0
8	DC-HSDPA	Subtest 1	23.47	23.34	23.23	23.66	23.62	23.82	23.21	22.88	23.36	0
8		Subtest 2	22.54	22.95	22.85	22.44	22.32	22.51	22.66	22.48	22.74	0
8		Subtest 3	21.39	21.44	21.82	21.77	21.72	21.86	22.06	21.79	22.12	0.5
8		Subtest 4	21.40	21.21	21.16	21.77	21.68	21.92	21.83	21.58	22.11	0.5

Table 9-3
Reduced Conducted Power – Hotspot and Proximity Sensor Mode Active

3GPP Release Version	Mode	3GPP 34.121 Subtest	PCS Band [dBm]			3GPP MPR [dB]
			9262	9400	9538	
99	WCDMA	12.2 kbps RMC	19.79	19.50	19.86	-
99		12.2 kbps AMR	19.76	19.35	19.84	-
6	HSDPA	Subtest 1	19.78	19.44	19.83	0
6		Subtest 2	19.75	19.51	19.86	0
6		Subtest 3	19.76	19.46	19.86	0.5
6		Subtest 4	19.79	19.52	19.85	0.5
6	HSUPA	Subtest 1	19.11	19.00	19.19	0
6		Subtest 2	19.17	18.79	19.24	2
6		Subtest 3	19.12	18.90	19.34	1
6		Subtest 4	19.15	18.77	19.38	2
6		Subtest 5	19.93	19.70	20.16	0
8	DC-HSDPA	Subtest 1	19.97	19.64	20.23	0
8		Subtest 2	20.03	19.80	20.25	0
8		Subtest 3	20.10	19.77	20.26	0.5
8		Subtest 4	20.09	19.78	20.24	0.5

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DC-HSDPA considerations

- 3GPP Specification 34.121-1 Release 8 Ver 8.10.0 was used for DC-HSDPA guidance
- H-Set 12 (QPSK) was confirmed to be used during DC-HSDPA measurements
- The DUT supports UE category 24 for HSDPA

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

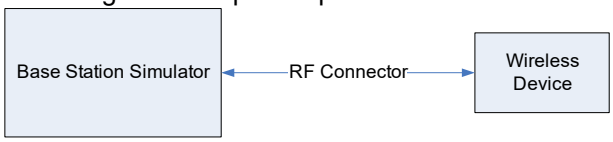

Figure 9-2
Power Measurement Setup

9.3 LTE Conducted Powers

9.3.1 LTE Band 12

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

LTE Band 12 10 MHz Bandwidth				
Modulation	**RB Size**	**RB Offset**	**Mid Channel 23095 (707.5 MHz) Conducted Power [dBm]**	**Designed MPR [dB]**
QPSK	1	0	**23.67**	0
	1	25	23.59	0
	1	49	23.55	0
	25	0	**22.07**	2
	25	12	22.04	2
	25	25	22.03	2
	50	0	22.00	2
16QAM	1	0	21.58	2
	1	25	21.53	2
	1	49	21.52	2
	25	0	20.87	3
	25	12	20.82	3
	25	25	20.79	3
	50	0	20.78	3

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.

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

LTE Band 12 5 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 23035 (701.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23155 (713.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.77	23.67	23.50	0
	1	12	23.74	23.65	23.46	0
	1	24	23.73	23.67	23.46	0
	12	0	22.12	22.10	22.05	2
	12	6	22.13	22.04	22.04	2
	12	13	22.12	22.09	22.06	2
	25	0	22.14	22.09	22.06	2
16QAM	1	0	22.10	21.83	21.87	2
	1	12	22.08	21.80	21.83	2
	1	24	22.02	21.70	21.75	2
	12	0	20.90	20.81	20.87	3
	12	6	20.97	20.77	20.78	3
	12	13	20.86	20.74	20.76	3
	25	0	20.87	20.84	20.79	3

Table 9-6
LTE Band 12 Conducted Powers - 3 MHz Bandwidth

LTE Band 12 3 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 23025 (700.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23165 (714.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.71	23.62	23.59	0
	1	7	23.70	23.64	23.56	0
	1	14	23.63	23.66	23.53	0
	8	0	22.17	22.13	22.08	2
	8	4	22.16	22.10	22.04	2
	8	7	22.15	22.07	22.03	2
	15	0	22.12	22.10	22.05	2
16QAM	1	0	22.06	21.94	21.81	2
	1	7	22.13	21.90	21.85	2
	1	14	22.01	21.79	21.80	2
	8	0	20.85	20.72	20.71	3
	8	4	20.83	20.73	20.73	3
	8	7	20.82	20.71	20.77	3
	15	0	20.79	20.83	20.87	3

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Table 9-7
LTE Band 12 Conducted Powers -1.4 MHz Bandwidth

LTE Band 12 1.4 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 23017 (699.7 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23173 (715.3 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.65	23.59	23.71	0
	1	2	23.62	23.54	23.68	0
	1	5	23.63	23.56	23.73	0
	3	0	23.67	23.63	23.59	0
	3	2	23.69	23.69	23.60	0
	3	3	23.67	23.68	23.63	0
	6	0	22.17	22.08	22.03	2
16QAM	1	0	22.01	21.97	21.95	2
	1	2	22.00	21.86	21.99	2
	1	5	22.16	21.88	21.88	2
	3	0	22.14	22.06	22.05	2
	3	2	22.15	22.15	22.04	2
	3	3	22.15	22.17	22.13	2
	6	0	20.76	20.82	20.92	3

9.3.2 LTE Band 13

Table 9-8
LTE Band 13 Conducted Powers - 10 MHz Bandwidth

LTE Band 13 10 MHz Bandwidth				
Modulation	RB Size	RB Offset	Mid Channel 23230 (782.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]	
QPSK	1	0	**23.69**	0
	1	25	23.67	0
	1	49	23.61	0
	25	0	**22.22**	2
	25	12	22.21	2
	25	25	22.18	2
	50	0	22.18	2
16QAM	1	0	21.97	2
	1	25	21.84	2
	1	49	21.71	2
	25	0	20.80	3
	25	12	20.77	3
	25	25	20.74	3
	50	0	20.78	3

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

LTE Band 13 5 MHz Bandwidth				
Modulation	RB Size	RB Offset	Mid Channel 23230 (782.0 MHz) Conducted Power [dBm]	Designed MPR [dB]
QPSK	1	0	23.78	0
	1	12	23.75	0
	1	24	23.71	0
	12	0	22.18	2
	12	6	22.19	2
	12	13	22.17	2
	25	0	22.17	2
16QAM	1	0	21.82	2
	1	12	21.83	2
	1	24	21.73	2
	12	0	20.95	3
	12	6	20.95	3
	12	13	20.94	3
	25	0	21.01	3

Note: LTE Band 13 at 5 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

9.3.3 LTE Band 5 (Cell)

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

LTE Band 5 (Cell) 10 MHz Bandwidth				
Modulation	RB Size	RB Offset	Mid Channel 20525 (836.5 MHz) Conducted Power [dBm]	Designed MPR [dB]
QPSK	1	0	**24.77**	0
	1	25	24.72	0
	1	49	24.69	0
	25	0	**22.65**	2
	25	12	22.62	2
	25	25	22.59	2
	50	0	22.62	2
16QAM	1	0	22.57	2
	1	25	22.51	2
	1	49	22.47	2
	25	0	21.64	3
	25	12	21.62	3
	25	25	21.60	3
	50	0	21.65	3

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

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Table 9-11
LTE Band 5 (Cell) Conducted Powers - 5 MHz Bandwidth

LTE Band 5 (Cell) 5 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 20425 (826.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20625 (846.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	24.76	24.60	24.61	0
	1	12	24.75	24.62	24.45	0
	1	24	24.69	24.58	24.42	0
	12	0	22.67	22.55	22.34	2
	12	6	22.67	22.53	22.32	2
	12	13	22.67	22.53	22.31	2
	25	0	22.65	22.53	22.35	2
16QAM	1	0	22.71	22.11	22.24	2
	1	12	22.45	22.10	21.85	2
	1	24	22.70	22.36	21.79	2
	12	0	21.71	21.46	21.29	3
	12	6	21.67	21.49	21.29	3
	12	13	21.70	21.53	21.30	3
	25	0	21.67	21.52	21.37	3

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

LTE Band 5 (Cell) 3 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 20415 (825.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20635 (847.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	24.73	24.58	24.25	0
	1	7	24.76	24.62	24.28	0
	1	14	24.74	24.53	24.25	0
	8	0	22.68	22.55	22.35	2
	8	4	22.71	22.52	22.38	2
	8	7	22.67	22.52	22.35	2
	15	0	22.65	22.51	22.34	2
16QAM	1	0	22.62	22.35	22.04	2
	1	7	22.54	22.36	21.99	2
	1	14	22.39	22.29	22.13	2
	8	0	21.52	21.49	21.31	3
	8	4	21.63	21.53	21.26	3
	8	7	21.65	21.50	21.32	3
	15	0	21.61	21.49	21.30	3

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Table 9-13
LTE Band 5 (Cell) Conducted Powers -1.4 MHz Bandwidth

LTE Band 5 (Cell) 1.4 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 20407 (824.7 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20643 (848.3 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	24.71	24.53	24.50	0
	1	2	24.74	24.50	24.50	0
	1	5	24.73	24.52	24.47	0
	3	0	24.72	24.52	24.30	0
	3	2	24.68	24.53	24.32	0
	3	3	24.70	24.51	24.32	0
	6	0	22.67	22.51	22.35	2
16QAM	1	0	22.65	22.36	21.87	2
	1	2	22.67	21.99	21.70	2
	1	5	22.53	22.34	21.86	2
	3	0	22.36	22.41	22.11	2
	3	2	22.36	22.27	22.11	2
	3	3	22.36	22.47	22.10	2
	6	0	21.61	21.42	21.28	3

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9.3.4 LTE Band 66 (AWS)

Table 9-14
LTE Band 66 (AWS) Conducted Powers - 20 MHz Bandwidth

LTE Band 66 (AWS) 20 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 132072 (1720.0 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132572 (1770.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	**24.34**	24.07	23.87	0
	1	50	24.30	23.99	23.79	0
	1	99	24.32	23.96	23.72	0
	50	0	**22.50**	22.49	22.37	2
	50	25	22.48	22.48	22.30	2
	50	50	22.47	22.47	22.24	2
	100	0	22.49	22.48	22.32	2
16QAM	1	0	22.37	22.33	22.26	2
	1	50	22.30	22.28	22.16	2
	1	99	22.34	22.24	22.11	2
	50	0	21.50	21.50	21.34	3
	50	25	21.50	21.48	21.27	3
	50	50	21.48	21.46	21.22	3
	100	0	21.49	21.47	21.31	3

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

LTE Band 66 (AWS) 15 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 132047 (1717.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132597 (1772.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.58	23.69	23.80	0
	1	36	23.66	23.77	23.82	0
	1	74	23.60	23.69	23.67	0
	36	0	22.12	22.31	22.37	2
	36	18	22.15	22.34	22.35	2
	36	37	22.13	22.29	22.28	2
	75	0	22.10	22.29	22.34	2
16QAM	1	0	21.96	22.19	22.27	2
	1	36	22.01	22.22	22.27	2
	1	74	21.95	22.16	22.14	2
	36	0	21.20	21.35	21.43	3
	36	18	21.22	21.38	21.41	3
	36	37	21.19	21.34	21.36	3
	75	0	21.15	21.38	21.40	3

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Table 9-16
LTE Band 66 (AWS) Conducted Powers - 10 MHz Bandwidth

LTE Band 66 (AWS) 10 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 132022 (1715.0 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132622 (1775.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.73	23.76	23.87	0
	1	25	23.63	23.76	23.82	0
	1	49	23.64	23.75	23.79	0
	25	0	22.09	22.29	22.29	2
	25	12	22.08	22.27	22.27	2
	25	25	22.11	22.26	22.25	2
	50	0	22.08	22.24	22.26	2
16QAM	1	0	22.10	22.17	22.10	2
	1	25	22.03	22.30	22.05	2
	1	49	22.02	22.15	22.25	2
	25	0	21.13	21.31	21.33	3
	25	12	21.13	21.32	21.35	3
	25	25	21.13	21.29	21.33	3
	50	0	21.13	21.30	21.31	3

Table 9-17
LTE Band 66 (AWS) Conducted Powers - 5 MHz Bandwidth

LTE Band 66 (AWS) 5 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 131997 (1712.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132647 (1777.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.65	23.81	23.85	0
	1	12	23.63	23.79	23.82	0
	1	24	23.67	23.75	23.79	0
	12	0	22.16	22.27	22.25	2
	12	6	22.16	22.27	22.26	2
	12	13	22.17	22.27	22.23	2
	25	0	22.13	22.27	22.21	2
16QAM	1	0	22.12	21.99	22.11	2
	1	12	22.10	21.97	22.13	2
	1	24	22.12	21.96	22.12	2
	12	0	21.22	21.33	21.33	3
	12	6	21.19	21.31	21.30	3
	12	13	21.22	21.33	21.31	3
	25	0	21.17	21.33	21.26	3

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Table 9-18
LTE Band 66 (AWS) Conducted Powers - 3 MHz Bandwidth

LTE Band 66 (AWS) 3 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 131987 (1711.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132657 (1778.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.71	23.76	23.82	0
	1	7	23.72	23.74	23.80	0
	1	14	23.73	23.77	23.77	0
	8	0	22.19	22.29	22.25	2
	8	4	22.17	22.28	22.26	2
	8	7	22.19	22.28	22.26	2
	15	0	22.17	22.28	22.23	2
16QAM	1	0	22.30	22.20	22.37	2
	1	7	22.35	22.17	22.35	2
	1	14	22.34	22.24	22.36	2
	8	0	21.22	21.30	21.34	3
	8	4	21.25	21.28	21.35	3
	8	7	21.22	21.30	21.34	3
	15	0	21.22	21.31	21.27	3

Table 9-19
LTE Band 66 (AWS) Conducted Powers -1.4 MHz Bandwidth

LTE Band 66 (AWS) 1.4 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 131979 (1710.7 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132665 (1779.3 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.89	23.95	23.99	0
	1	2	23.88	23.96	23.96	0
	1	5	23.87	23.98	24.00	0
	3	0	23.61	23.70	23.73	0
	3	2	23.62	23.71	23.72	0
	3	3	23.60	23.71	23.71	0
	6	0	22.24	22.39	22.38	2
16QAM	1	0	22.40	22.40	22.43	2
	1	2	22.43	22.49	22.40	2
	1	5	22.45	22.48	22.42	2
	3	0	22.20	22.24	22.31	2
	3	2	22.16	22.21	22.30	2
	3	3	22.18	22.31	22.29	2
	6	0	21.27	21.41	21.46	3

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9.3.5 LTE Band 2 (PCS)

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

LTE Band 2 (PCS) 20 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.84	23.63	23.76	0
	1	50	23.86	23.69	23.80	0
	1	99	**23.93**	23.80	23.85	0
	50	0	22.34	22.16	22.27	2
	50	25	22.36	22.20	22.29	2
	50	50	**22.40**	22.23	22.34	2
	100	0	22.37	22.20	22.31	2
16QAM	1	0	22.14	21.97	22.00	2
	1	50	22.17	21.99	22.07	2
	1	99	22.21	22.09	22.13	2
	50	0	21.36	21.12	21.25	3
	50	25	21.35	21.15	21.25	3
	50	50	21.37	21.17	21.27	3
	100	0	21.38	21.16	21.26	3

Table 9-21
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

LTE Band 2 (PCS) 15 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.90	23.59	23.57	0
	1	36	23.92	23.69	23.65	0
	1	74	23.90	23.64	23.62	0
	36	0	22.40	22.07	22.11	2
	36	18	22.41	22.12	22.15	2
	36	37	22.40	22.13	22.14	2
	75	0	22.39	22.11	22.12	2
16QAM	1	0	22.29	21.93	22.09	2
	1	36	22.38	22.07	22.21	2
	1	74	22.33	22.03	22.15	2
	36	0	21.39	21.03	21.12	3
	36	18	21.42	21.09	21.19	3
	36	37	21.41	21.10	21.14	3
	75	0	21.39	21.09	21.14	3

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Table 9-22
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

LTE Band 2 (PCS) 10 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.90	23.52	23.64	0
	1	25	23.90	23.56	23.64	0
	1	49	23.92	23.58	23.66	0
	25	0	22.41	22.05	22.12	2
	25	12	22.39	22.06	22.13	2
	25	25	22.41	22.08	22.11	2
	50	0	22.39	22.07	22.12	2
16QAM	1	0	22.18	21.84	22.12	2
	1	25	22.20	21.80	22.00	2
	1	49	22.17	21.84	22.13	2
	25	0	21.41	21.07	21.09	3
	25	12	21.42	21.09	21.09	3
	25	25	21.43	21.11	21.10	3
	50	0	21.45	21.08	21.10	3

Table 9-23
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth

LTE Band 2 (PCS) 5 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.91	23.60	23.57	0
	1	12	23.91	23.59	23.57	0
	1	24	23.92	23.67	23.61	0
	12	0	22.43	22.04	22.13	2
	12	6	22.43	22.06	22.13	2
	12	13	22.43	22.06	22.14	2
	25	0	22.43	22.05	22.15	2
16QAM	1	0	22.27	21.73	21.88	2
	1	12	22.19	21.86	21.99	2
	1	24	22.38	21.85	22.01	2
	12	0	21.49	21.01	21.08	3
	12	6	21.48	21.02	21.09	3
	12	13	21.46	21.06	21.11	3
	25	0	21.47	21.02	21.08	3

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Table 9-24
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

LTE Band 2 (PCS) 3 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 18615 (1851.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19185 (1908.5 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.95	23.63	23.68	0
	1	7	23.92	23.57	23.68	0
	1	14	23.93	23.60	23.71	0
	8	0	22.45	22.05	22.10	2
	8	4	22.45	22.04	22.13	2
	8	7	22.46	22.04	22.15	2
	15	0	22.48	22.09	22.16	2
16QAM	1	0	22.49	21.93	22.27	2
	1	7	22.47	21.95	22.10	2
	1	14	22.48	21.93	22.28	2
	8	0	21.49	21.07	20.99	3
	8	4	21.46	21.05	21.02	3
	8	7	21.47	21.08	21.01	3
	15	0	21.49	21.09	21.10	3

Table 9-25
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth

LTE Band 2 (PCS) 1.4 MHz Bandwidth						
Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19193 (1909.3 MHz)	Designed MPR [dB]
			Conducted Power [dBm]			
QPSK	1	0	23.91	23.56	23.80	0
	1	2	23.89	23.50	23.76	0
	1	5	23.90	23.54	23.81	0
	3	0	23.79	23.57	23.65	0
	3	2	23.85	23.60	23.67	0
	3	3	23.86	23.59	23.67	0
	6	0	22.49	22.06	22.13	2
16QAM	1	0	22.15	21.64	21.86	2
	1	2	22.22	21.63	21.84	2
	1	5	22.27	21.66	21.87	2
	3	0	22.46	22.04	22.08	2
	3	2	22.48	22.08	22.09	2
	3	3	22.43	22.05	22.05	2
	6	0	21.48	21.07	21.10	3

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Table 9-26
LTE Band 2 (PCS) Reduced Conducted Powers - 20 MHz Bandwidth – Hotspot and Proximity Sensor Mode Active

LTE Band 2 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.53	20.14	20.55	0	0
	1	50	20.45	20.15	20.57		0
	1	99	20.46	20.16	**20.64**		0
	50	0	20.48	20.13	20.52	0-1	0
	50	25	20.45	20.14	20.56		0
	50	50	20.42	20.16	**20.60**		0
	100	0	20.44	20.15	20.56		0
16QAM	1	0	20.22	20.07	20.32	0-1	0
	1	50	20.13	20.09	20.33		0
	1	99	20.11	20.11	20.47		0
	50	0	20.44	20.16	20.57	0-2	0
	50	25	20.42	20.15	20.58		0
	50	50	20.40	20.15	20.60		0
	100	0	20.43	20.16	20.55		0

Table 9-27
LTE Band 2 (PCS) Reduced Conducted Powers - 15 MHz Bandwidth – Hotspot and Proximity Sensor Mode Active

LTE Band 2 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.65	20.36	20.79	0	0
	1	36	20.71	20.48	20.90		0
	1	74	20.65	20.44	20.86		0
	36	0	20.69	20.45	20.88	0-1	0
	36	18	20.70	20.51	20.90		0
	36	37	20.68	20.50	20.89		0
	75	0	20.68	20.47	20.85		0
16QAM	1	0	20.67	20.35	20.88	0-1	0
	1	36	20.73	20.44	20.90		0
	1	74	20.69	20.44	20.85		0
	36	0	20.77	20.42	20.93	0-2	0
	36	18	20.79	20.44	20.97		0
	36	37	20.76	20.44	20.98		0
	75	0	20.71	20.50	20.93		0

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Table 9-28
LTE Band 2 (PCS) Reduced Conducted Powers - 10 MHz Bandwidth – Hotspot and Proximity Sensor Mode Active

LTE Band 2 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.76	20.36	20.84	0	0
	1	25	20.78	20.42	20.87		0
	1	49	20.70	20.42	20.89		0
	25	0	20.68	20.42	20.87	0-1	0
	25	12	20.68	20.43	20.87		0
	25	25	20.68	20.45	20.86		0
	50	0	20.68	20.43	20.87		0
16QAM	1	0	20.74	20.25	20.89	0-1	0
	1	25	20.76	20.24	20.83		0
	1	49	20.66	20.26	20.88		0
	25	0	20.74	20.40	20.86	0-2	0
	25	12	20.68	20.41	20.88		0
	25	25	20.75	20.43	20.88		0
	50	0	20.73	20.44	20.87		0

Table 9-29
LTE Band 2 (PCS) Reduced Conducted Powers - 5 MHz Bandwidth – Hotspot and Proximity Sensor Mode Active

LTE Band 2 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.72	20.44	20.88	0	0
	1	12	20.72	20.45	20.87		0
	1	24	20.71	20.44	20.92		0
	12	0	20.71	20.45	20.81	0-1	0
	12	6	20.74	20.46	20.83		0
	12	13	20.74	20.49	20.83		0
	25	0	20.74	20.46	20.84		0
16QAM	1	0	20.73	20.45	20.88	0-1	0
	1	12	20.85	20.44	20.88		0
	1	24	20.80	20.48	20.89		0
	12	0	20.72	20.40	20.82	0-2	0
	12	6	20.70	20.41	20.82		0
	12	13	20.74	20.46	20.83		0
	25	0	20.71	20.41	20.79		0

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Table 9-30
LTE Band 2 (PCS) Reduced Conducted Powers - 3 MHz Bandwidth – Hotspot and Proximity Sensor Mode Active

LTE Band 2 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18615 (1851.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19185 (1908.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.65	20.46	20.89	0	0
	1	7	20.68	20.41	20.86		0
	1	14	20.68	20.47	20.87		0
	8	0	20.67	20.49	20.76	0-1	0
	8	4	20.66	20.46	20.77		0
	8	7	20.70	20.46	20.79		0
	15	0	20.66	20.46	20.75		0
16QAM	1	0	20.60	20.52	20.90	0-1	0
	1	7	20.71	20.54	20.85		0
	1	14	20.67	20.57	20.86		0
	8	0	20.74	20.41	20.76	0-2	0
	8	4	20.75	20.41	20.74		0
	8	7	20.73	20.43	20.79		0
	15	0	20.76	20.39	20.75		0

Table 9-31
LTE Band 2 (PCS) Reduced Conducted Powers -1.4 MHz Bandwidth – Hotspot and Proximity Sensor Mode Active

LTE Band 2 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19193 (1909.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	20.84	20.52	20.91	0	0
	1	2	20.82	20.54	20.89		0
	1	5	20.81	20.53	20.88		0
	3	0	20.80	20.40	20.85		0
	3	2	20.78	20.39	20.83		0
	3	3	20.79	20.41	20.81		0
	6	0	20.84	20.48	20.79	0-1	0
16QAM	1	0	20.76	20.54	20.87	0-1	0
	1	2	20.77	20.53	20.88		0
	1	5	20.75	20.56	20.94		0
	3	0	20.86	20.43	20.90		0
	3	2	20.88	20.41	20.88		0
	3	3	20.87	20.38	20.89		0
	6	0	20.82	20.40	20.88	0-2	0

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9.3.6 LTE Band 41

Table 9-32
LTE Band 41 Conducted Powers - 20 MHz Bandwidth

LTE Band 41 20 MHz Bandwidth								
Modulation	RB Size	RB Offset	Low Channel 39750 (2506.0 MHz)	Low-Mid Channel 40185 (2549.5 MHz)	Mid Channel 40620 (2593.0 MHz)	Mid-High Channel 41055 (2636.5 MHz)	High Channel 41490 (2680.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]					
QPSK	1	0	23.82	23.81	**23.93**	23.40	23.36	0
	1	50	23.70	23.82	23.69	23.37	23.34	0
	1	99	23.67	23.86	23.54	23.39	23.33	0
	50	0	22.10	21.99	**22.11**	21.33	21.19	2
	50	25	22.08	21.98	22.01	21.36	21.17	2
	50	50	22.07	21.97	21.90	21.34	21.18	2
	100	0	22.06	21.95	21.97	21.68	21.55	2
16QAM	1	0	21.98	21.71	21.91	21.56	21.47	2
	1	50	21.84	21.74	21.71	21.55	21.48	2
	1	99	21.80	21.73	21.52	21.52	21.50	2
	50	0	21.05	20.91	21.05	20.65	20.41	3
	50	25	21.04	20.90	20.97	20.63	20.44	3
	50	50	20.97	20.88	20.86	20.62	20.47	3
	100	0	21.03	20.91	20.91	20.61	20.49	3

Table 9-33
LTE Band 41 Conducted Powers - 15 MHz Bandwidth

LTE Band 41 15 MHz Bandwidth								
Modulation	RB Size	RB Offset	Low Channel 39750 (2506.0 MHz)	Low-Mid Channel 40185 (2549.5 MHz)	Mid Channel 40620 (2593.0 MHz)	Mid-High Channel 41055 (2636.5 MHz)	High Channel 41490 (2680.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]					
QPSK	1	0	23.78	23.47	23.72	23.21	23.04	0
	1	36	23.74	23.42	23.62	23.26	23.14	0
	1	74	23.58	23.36	23.42	23.19	23.08	0
	36	0	22.10	21.78	21.99	21.59	21.35	2
	36	18	22.05	21.78	21.93	21.61	21.37	2
	36	37	22.01	21.79	21.84	21.56	21.36	2
	75	0	22.03	21.76	21.92	21.59	21.37	2
16QAM	1	0	21.74	21.44	21.76	21.05	21.03	2
	1	36	21.95	21.17	21.75	21.50	21.06	2
	1	74	21.52	21.42	21.52	21.25	21.01	2
	36	0	21.01	20.69	21.01	20.55	20.34	3
	36	18	21.01	20.69	20.90	20.56	20.35	3
	36	37	21.00	20.68	20.83	20.55	20.32	3
	75	0	20.96	20.72	20.93	20.55	20.37	3

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Table 9-34
LTE Band 41 Conducted Powers - 10 MHz Bandwidth

LTE Band 41 10 MHz Bandwidth								
Modulation	RB Size	RB Offset	Low Channel 39750 (2506.0 MHz)	Low-Mid Channel 40185 (2549.5 MHz)	Mid Channel 40620 (2593.0 MHz)	Mid-High Channel 41055 (2636.5 MHz)	High Channel 41490 (2680.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]					
QPSK	1	0	23.73	23.41	23.79	23.31	23.02	0
	1	25	23.62	23.38	23.57	23.31	23.07	0
	1	49	23.60	23.35	23.49	23.28	23.04	0
	25	0	22.01	21.73	21.95	21.54	21.30	2
	25	12	21.96	21.72	21.89	21.54	21.30	2
	25	25	21.93	21.73	21.86	21.53	21.30	2
	50	0	21.97	21.71	21.89	21.54	21.27	2
16QAM	1	0	21.59	21.35	21.68	21.52	20.86	2
	1	25	21.86	21.37	21.54	21.60	20.87	2
	1	49	21.56	21.33	21.43	21.52	20.90	2
	25	0	20.93	20.62	20.90	20.48	20.22	3
	25	12	20.91	20.64	20.84	20.45	20.21	3
	25	25	20.89	20.62	20.79	20.45	20.22	3
	50	0	20.90	20.65	20.83	20.48	20.17	3

Table 9-35
LTE Band 41 Conducted Powers - 5 MHz Bandwidth

LTE Band 41 5 MHz Bandwidth								
Modulation	RB Size	RB Offset	Low Channel 39750 (2506.0 MHz)	Low-Mid Channel 40185 (2549.5 MHz)	Mid Channel 40620 (2593.0 MHz)	Mid-High Channel 41055 (2636.5 MHz)	High Channel 41490 (2680.0 MHz)	Designed MPR [dB]
			Conducted Power [dBm]					
QPSK	1	0	23.55	23.46	23.57	23.31	22.86	0
	1	12	23.50	23.45	23.47	23.29	22.88	0
	1	24	23.46	23.43	23.43	23.32	22.87	0
	12	0	21.95	21.67	21.89	21.52	21.26	2
	12	6	21.92	21.67	21.88	21.52	21.26	2
	12	13	21.91	21.64	21.85	21.51	21.28	2
	25	0	21.93	21.67	21.90	21.52	21.28	2
16QAM	1	0	21.53	21.07	21.46	20.92	20.95	2
	1	12	21.35	21.14	21.08	21.08	21.00	2
	1	24	21.34	21.08	21.03	20.89	20.98	2
	12	0	20.90	20.65	20.94	20.42	20.22	3
	12	6	20.92	20.66	20.94	20.38	20.26	3
	12	13	20.92	20.64	20.87	20.37	20.24	3
	25	0	20.90	20.63	20.88	20.48	20.22	3

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Table 9-36
LTE Band 41 Reduced Conducted Powers - 20 MHz Bandwidth – RCV Mode Active

LTE Band 41 20 MHz Bandwidth									
Modulation	RB Size	RB Offset	Low Channel 39750 (2506.0 MHz)	Low-Mid Channel 40185 (2549.5 MHz)	Mid Channel 40620 (2593.0 MHz)	Mid-High Channel 41055 (2636.5 MHz)	High Channel 41490 (2680.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]						
QPSK	1	0	20.83	**21.16**	20.61	20.63	20.20	0	0
	1	50	20.72	20.93	20.40	20.53	20.14		0
	1	99	20.69	20.98	20.23	20.52	20.16		0
	50	0	21.02	21.17	20.83	20.79	20.60	0-1	0
	50	25	20.99	**21.20**	20.77	20.76	20.59		0
	50	50	20.94	21.18	20.66	20.73	20.61		0
	100	0	20.96	21.15	20.74	20.77	20.60		0
16QAM	1	0	20.60	20.54	20.46	20.57	19.89	0-1	0
	1	50	20.48	20.50	20.25	20.48	19.85		0
	1	99	20.44	20.52	20.07	20.47	19.88		0
	50	0	21.02	21.10	20.73	20.78	20.60	0-2	0
	50	25	21.00	21.12	20.81	20.74	20.58		0
	50	50	20.96	21.15	20.76	20.70	20.59		0
	100	0	20.96	21.15	20.74	20.76	20.59		0

Table 9-37
LTE Band 41 Reduced Conducted Powers - 15 MHz Bandwidth – RCV Mode Active

LTE Band 41 15 MHz Bandwidth									
Modulation	RB Size	RB Offset	Low Channel 39750 (2506.0 MHz)	Low-Mid Channel 40185 (2549.5 MHz)	Mid Channel 40620 (2593.0 MHz)	Mid-High Channel 41055 (2636.5 MHz)	High Channel 41490 (2680.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]						
QPSK	1	0	20.62	20.84	20.49	20.39	20.18	0	0
	1	36	20.60	20.82	20.37	20.42	20.24		0
	1	74	20.42	20.73	20.15	20.25	20.14		0
	36	0	21.11	21.20	20.80	20.83	20.67	0-1	0
	36	18	21.10	21.22	20.75	20.84	20.72		0
	36	37	20.98	21.19	20.76	20.81	20.69		0
	75	0	21.07	21.20	20.71	20.84	20.72		0
16QAM	1	0	20.42	20.48	20.10	20.48	19.89	0-1	0
	1	36	20.27	20.67	19.85	20.56	20.01		0
	1	74	20.23	20.77	19.91	20.13	19.96		0
	36	0	21.18	21.13	20.73	20.81	20.77	0-2	0
	36	18	21.16	21.16	20.69	20.84	20.74		0
	36	37	21.03	21.16	20.75	20.78	20.70		0
	75	0	21.02	21.22	20.76	20.86	20.65		0

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Table 9-38
LTE Band 41 Reduced Conducted Powers - 10 MHz Bandwidth – RCV Mode Active

LTE Band 41 10 MHz Bandwidth									
Modulation	RB Size	RB Offset	Low Channel 39750 (2506.0 MHz)	Low-Mid Channel 40185 (2549.5 MHz)	Mid Channel 40620 (2593.0 MHz)	Mid-High Channel 41055 (2636.5 MHz)	High Channel 41490 (2680.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]						
QPSK	1	0	20.68	20.77	20.47	20.42	20.26	0	0
	1	25	20.60	20.74	20.43	20.32	20.21		0
	1	49	20.50	20.74	20.29	20.30	20.25		0
	25	0	21.00	21.13	20.80	20.79	20.61	0-1	0
	25	12	20.99	21.12	20.75	20.75	20.62		0
	25	25	20.98	21.13	20.68	20.76	20.60		0
	50	0	21.01	21.12	20.76	20.77	20.60		0
16QAM	1	0	20.32	20.40	20.18	20.23	20.20	0-1	0
	1	25	20.37	20.44	20.26	20.15	19.91		0
	1	49	20.30	20.43	20.39	20.14	19.97		0
	25	0	21.10	21.16	20.87	20.81	20.67	0-2	0
	25	12	21.06	21.16	20.83	20.78	20.68		0
	25	25	21.06	21.12	20.73	20.77	20.70		0
	50	0	21.09	21.11	20.79	20.78	20.68		0

Table 9-39
LTE Band 41 Reduced Conducted Powers - 5 MHz Bandwidth – RCV Mode Active

LTE Band 41 5 MHz Bandwidth									
Modulation	RB Size	RB Offset	Low Channel 39750 (2506.0 MHz)	Low-Mid Channel 40185 (2549.5 MHz)	Mid Channel 40620 (2593.0 MHz)	Mid-High Channel 41055 (2636.5 MHz)	High Channel 41490 (2680.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]						
QPSK	1	0	20.70	21.11	20.47	20.34	20.64	0	0
	1	12	20.64	20.77	20.34	20.28	20.28		0
	1	24	20.67	20.79	20.37	20.31	20.30		0
	12	0	21.03	21.12	20.78	20.78	20.61	0-1	0
	12	6	21.02	21.10	20.74	20.75	20.61		0
	12	13	20.99	21.12	20.70	20.75	20.62		0
	25	0	21.00	21.13	20.77	20.77	20.62		0
16QAM	1	0	20.42	21.15	20.16	20.07	20.61	0-1	0
	1	12	20.53	20.36	20.06	19.97	19.93		0
	1	24	20.39	20.30	20.08	20.00	19.90		0
	12	0	21.16	21.15	20.88	20.70	20.61	0-2	0
	12	6	21.15	21.18	20.82	20.74	20.60		0
	12	13	21.14	21.14	20.82	20.72	20.64		0
	25	0	21.07	21.15	20.75	20.82	20.60		0

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9.4 WLAN Conducted Powers

Table 9-40
2.4 GHz WLAN Maximum Average RF Power

2.4GHz Conducted Power [dBm]				
Freq [MHz]	Channel	IEEE Transmission Mode		
		802.11b	802.11g	802.11n
		Average	Average	Average
2412	1	18.99	15.61	15.22
2437	6	18.81	15.22	15.05
2462	11	18.96	15.94	15.67

Table 9-41
5 GHz WLAN Maximum Average RF Power

5GHz (20MHz) Conducted Power [dBm]				
Freq [MHz]	Channel	IEEE Transmission Mode		
		802.11a	802.11n	802.11ac
		Average	Average	Average
5180	36	14.97	14.79	14.80
5200	40	14.98	14.64	14.59
5220	44	15.28	15.21	15.04
5240	48	14.94	14.82	14.58
5260	52	14.92	14.98	15.24
5280	56	15.01	15.22	15.21
5300	60	15.29	15.05	15.02
5320	64	14.89	14.86	14.84
5500	100	14.98	14.99	14.99
5600	120	14.69	14.62	14.56
5620	124	14.65	14.37	14.52
5720	144	14.61	14.41	14.61
5745	149	14.54	14.77	14.64
5785	157	14.48	14.48	14.44
5825	165	14.53	14.36	14.43

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Table 9-42
2.4 GHz WLAN Reduced Average RF Power

2.4GHz Conducted Power [dBm]				
Freq [MHz]	Channel	IEEE Transmission Mode		
		802.11b	802.11g	802.11n
		Average	Average	Average
2412	1	15.57	15.61	15.22
2437	6	15.12	15.22	15.05
2462	11	15.43	15.94	15.67

Table 9-43
5 GHz WLAN Reduced Average RF Power

5GHz (40MHz) Conducted Power [dBm]			
Freq [MHz]	Channel	IEEE Transmission Mode	
		802.11n	802.11ac
		Average	Average
5190	38	13.98	13.71
5230	46	13.23	13.50
5270	54	13.64	13.44
5310	62	13.56	13.80
5510	102	13.95	13.85
5590	118	13.53	13.37
5630	126	13.40	13.14
5710	142	13.76	13.90
5755	151	13.86	13.82
5795	159	13.56	13.59

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

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

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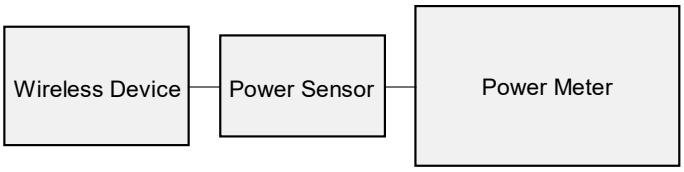

Figure 9-3
Power Measurement Setup

9.5 Bluetooth Conducted Powers

Table 9-44
Bluetooth Average RF Power

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1.0	0	8.92	7.790
2441	1.0	39	10.74	11.855
2480	1.0	78	8.78	7.547
2402	2.0	0	7.50	5.628
2441	2.0	39	9.21	8.336
2480	2.0	78	7.43	5.539
2402	3.0	0	7.51	5.641
2441	3.0	39	9.27	8.451
2480	3.0	78	7.47	5.589

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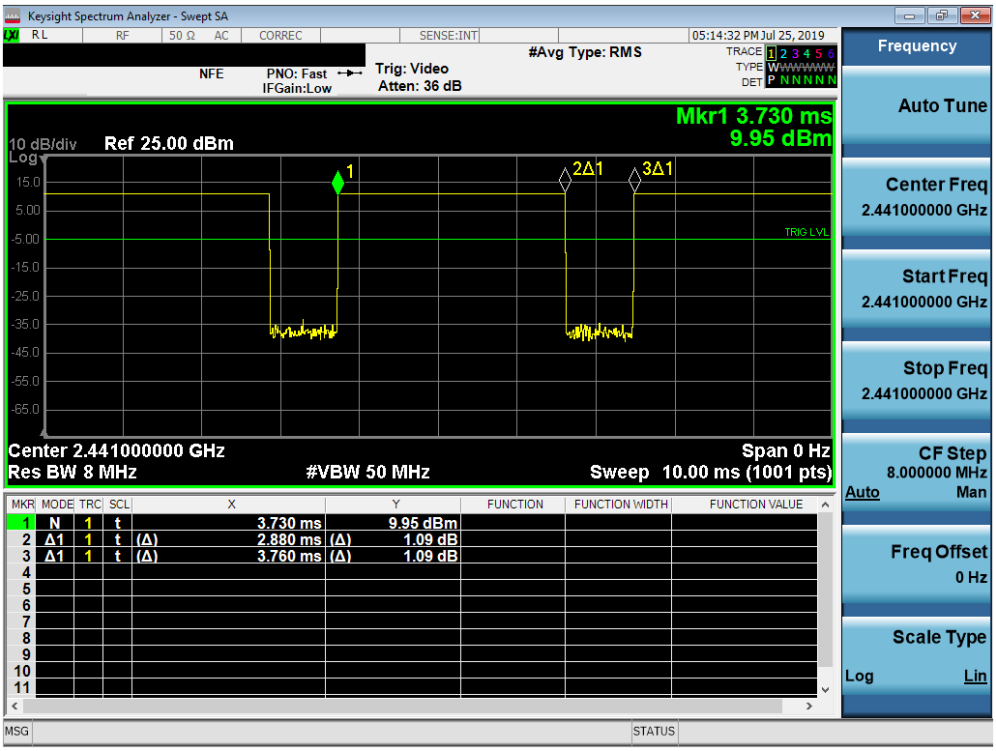

Figure 9-4
Bluetooth Transmission Plot

Equation 9-1
Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.88ms}{3.76ms} * 100\% = 76.6\%$$

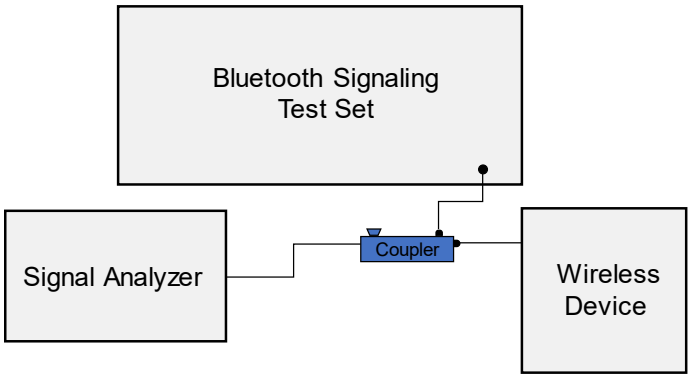

Figure 9-5
Power Measurement Setup

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10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Head 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
7/26/2019	750H	21.0	680	0.862	41.121	0.888	42.305	-2.93%	-2.80%
			695	0.867	41.075	0.889	42.227	-2.47%	-2.73%
			700	0.869	41.063	0.889	42.201	-2.25%	-2.70%
			710	0.872	41.031	0.890	42.149	-2.02%	-2.65%
			720	0.876	40.998	0.891	42.097	-1.68%	-2.61%
			725	0.878	40.983	0.891	42.071	-1.46%	-2.59%
			740	0.883	40.936	0.893	41.994	-1.12%	-2.52%
			755	0.889	40.894	0.894	41.916	-0.56%	-2.44%
			770	0.895	40.847	0.895	41.838	0.00%	-2.37%
			785	0.900	40.805	0.896	41.760	0.45%	-2.29%
			800	0.905	40.765	0.897	41.682	0.89%	-2.20%
7/24/2019	835H	20.9	820	0.928	43.568	0.899	41.578	3.23%	4.79%
			835	0.933	43.504	0.900	41.500	3.67%	4.83%
			850	0.939	43.444	0.916	41.500	2.51%	4.68%
7/23/2019	1750H	22.3	1710	1.342	38.669	1.348	40.142	-0.45%	-3.67%
			1750	1.365	38.630	1.371	40.079	-0.44%	-3.62%
			1790	1.386	38.590	1.394	40.016	-0.57%	-3.56%
8/1/2019	1750H	21.1	1710	1.357	41.577	1.348	40.142	0.67%	3.57%
			1750	1.381	41.516	1.371	40.079	0.73%	3.59%
			1790	1.405	41.444	1.394	40.016	0.79%	3.57%
8/1/2019	1900H	20.8	1850	1.408	41.069	1.400	40.000	0.57%	2.67%
			1880	1.425	41.016	1.400	40.000	1.79%	2.54%
			1910	1.442	40.966	1.400	40.000	3.00%	2.42%
7/26/2019	2450H	23.7	2400	1.806	39.157	1.756	39.289	2.85%	-0.34%
			2450	1.865	38.965	1.800	39.200	3.61%	-0.60%
			2500	1.923	38.751	1.855	39.136	3.67%	-0.98%
7/29/2019	2450H	22.4	2400	1.828	38.842	1.756	39.289	4.10%	-1.14%
			2450	1.881	38.662	1.800	39.200	4.50%	-1.37%
			2500	1.936	38.472	1.855	39.136	4.37%	-1.70%
8/2/2019	2450H-2600H	21.0	2400	1.789	39.955	1.756	39.289	1.88%	1.70%
			2450	1.830	39.885	1.800	39.200	1.67%	1.75%
			2500	1.870	39.791	1.855	39.136	0.81%	1.67%
			2550	1.912	39.715	1.909	39.073	0.16%	1.64%
			2600	1.954	39.611	1.964	39.009	-0.51%	1.54%
			2650	1.996	39.534	2.018	38.945	-1.09%	1.51%
			2700	2.035	39.428	2.073	38.882	-1.83%	1.40%
07/29/2019	5200H-5800H	21.7	5180	4.527	36.400	4.635	36.009	-2.33%	1.09%
			5200	4.551	36.343	4.655	35.986	-2.23%	0.99%
			5220	4.581	36.315	4.676	35.963	-2.03%	0.98%
			5240	4.604	36.312	4.696	35.940	-1.96%	1.04%
			5260	4.620	36.273	4.717	35.917	-2.06%	0.99%
			5280	4.639	36.206	4.737	35.894	-2.07%	0.87%
			5300	4.664	36.171	4.758	35.871	-1.98%	0.84%
			5320	4.687	36.147	4.778	35.849	-1.90%	0.83%
			5500	4.880	35.849	4.963	35.643	-1.67%	0.58%
			5520	4.899	35.815	4.983	35.620	-1.69%	0.55%
			5540	4.919	35.783	5.004	35.597	-1.70%	0.52%
			5560	4.950	35.733	5.024	35.574	-1.47%	0.45%
			5580	4.978	35.688	5.045	35.551	-1.33%	0.39%
			5600	4.998	35.678	5.065	35.529	-1.32%	0.42%
			5620	5.019	35.647	5.086	35.506	-1.32%	0.40%
			5640	5.035	35.615	5.106	35.483	-1.39%	0.37%
			5660	5.060	35.559	5.127	35.460	-1.31%	0.28%
			5680	5.090	35.510	5.147	35.437	-1.11%	0.21%
			5700	5.117	35.485	5.168	35.414	-0.99%	0.20%
			5745	5.157	35.430	5.214	35.363	-1.09%	0.19%
			5765	5.177	35.390	5.234	35.340	-1.09%	0.14%
			5785	5.207	35.330	5.255	35.317	-0.91%	0.04%
			5800	5.228	35.298	5.270	35.300	-0.80%	-0.01%
			5805	5.236	35.289	5.275	35.294	-0.74%	-0.01%
			5825	5.260	35.291	5.296	35.271	-0.68%	0.06%

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Table 10-2
Body 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
7/25/2019	750B	21.6	680	0.926	54.253	0.958	55.804	-3.34%	-2.78%
			695	0.931	54.214	0.959	55.745	-2.92%	-2.75%
			700	0.933	54.204	0.959	55.726	-2.71%	-2.73%
			710	0.937	54.179	0.960	55.687	-2.40%	-2.71%
			720	0.941	54.148	0.961	55.648	-2.08%	-2.70%
			725	0.943	54.136	0.961	55.629	-1.87%	-2.68%
			740	0.949	54.089	0.963	55.570	-1.45%	-2.67%
			755	0.955	54.044	0.964	55.512	-0.93%	-2.64%
			770	0.961	54.001	0.965	55.453	-0.41%	-2.62%
			785	0.967	53.958	0.966	55.395	0.10%	-2.59%
			800	0.973	53.918	0.967	55.336	0.62%	-2.56%
7/25/2019	835B	21.6	820	0.981	53.860	0.969	55.258	1.24%	-2.53%
			835	0.987	53.806	0.970	55.200	1.75%	-2.53%
			850	0.994	53.755	0.988	55.154	0.61%	-2.54%
8/1/2019	1750B	21.6	1710	1.410	51.622	1.463	53.537	-3.62%	-3.58%
			1750	1.437	51.566	1.488	53.432	-3.43%	-3.49%
			1790	1.464	51.503	1.514	53.326	-3.30%	-3.42%
8/1/2019	1900B	21.6	1850	1.504	51.414	1.520	53.300	-1.05%	-3.54%
			1880	1.524	51.365	1.520	53.300	0.26%	-3.63%
			1910	1.545	51.320	1.520	53.300	1.64%	-3.71%
8/5/2019	1900B	21.2	1850	1.515	52.602	1.520	53.300	-0.33%	-1.31%
			1880	1.538	52.542	1.520	53.300	1.18%	-1.42%
			1910	1.562	52.488	1.520	53.300	2.76%	-1.52%
8/19/2019	1900B	20.9	1850	1.460	52.238	1.520	53.300	-3.95%	-1.99%
			1880	1.482	52.228	1.520	53.300	-2.50%	-2.01%
			1910	1.500	52.192	1.520	53.300	-1.32%	-2.08%
7/29/2019	2450B	21.4	2400	1.928	51.244	1.902	52.767	1.37%	-2.89%
			2450	1.973	51.173	1.950	52.700	1.18%	-2.90%
			2500	2.019	51.077	2.021	52.636	-0.10%	-2.96%
8/6/2019	2450B-2600B	21.3	2400	1.944	51.384	1.902	52.767	2.21%	-2.62%
			2450	1.989	51.300	1.950	52.700	2.00%	-2.66%
			2500	2.035	51.210	2.021	52.636	0.69%	-2.71%
			2550	2.080	51.130	2.092	52.573	-0.57%	-2.74%
			2600	2.128	51.030	2.163	52.509	-1.62%	-2.82%
			2650	2.176	50.962	2.234	52.445	-2.60%	-2.83%
			2700	2.224	50.852	2.305	52.382	-3.51%	-2.92%
			2750	2.272	50.774	2.375	52.320	-4.34%	-2.95%
8/19/2019	2450B	21.3	2400	1.925	50.990	1.902	52.767	1.21%	-3.37%
			2450	1.967	50.939	1.950	52.700	0.87%	-3.34%
			2500	2.016	50.838	2.021	52.636	-0.25%	-3.42%
07/29/2019	5200B-5800B	21.2	5180	5.250	47.300	5.276	49.041	-0.49%	-3.55%
			5200	5.285	47.245	5.299	49.014	-0.26%	-3.61%
			5220	5.313	47.212	5.323	48.987	-0.19%	-3.62%
			5240	5.339	47.191	5.346	48.960	-0.13%	-3.61%
			5260	5.369	47.145	5.369	48.933	0.00%	-3.65%
			5280	5.396	47.103	5.393	48.906	0.06%	-3.69%
			5300	5.421	47.051	5.416	48.879	0.09%	-3.74%
			5320	5.451	47.018	5.439	48.851	0.22%	-3.75%
			5500	5.696	46.669	5.650	48.607	0.81%	-3.99%
			5520	5.723	46.635	5.673	48.580	0.88%	-4.00%
			5540	5.751	46.594	5.696	48.553	0.97%	-4.03%
			5560	5.784	46.529	5.720	48.526	1.12%	-4.12%
			5580	5.813	46.492	5.743	48.499	1.22%	-4.14%
			5600	5.843	46.482	5.766	48.471	1.34%	-4.10%
			5620	5.874	46.443	5.790	48.444	1.45%	-4.13%
			5640	5.898	46.402	5.813	48.417	1.46%	-4.16%
			5660	5.927	46.343	5.837	48.390	1.54%	-4.23%
			5680	5.957	46.291	5.860	48.363	1.66%	-4.28%
			5700	5.989	46.279	5.883	48.336	1.80%	-4.26%
			5745	6.049	46.215	5.936	48.275	1.90%	-4.27%
			5765	6.076	46.153	5.959	48.248	1.96%	-4.34%
			5785	6.113	46.104	5.982	48.220	2.19%	-4.39%
			5800	6.135	46.077	6.000	48.200	2.25%	-4.40%
			5805	6.143	46.068	6.006	48.193	2.28%	-4.41%
			5825	6.171	46.054	6.029	48.166	2.36%	-4.38%

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

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10.2 Test System Verification

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

Table 10-3
System Verification Results – 1g

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Source SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
AM6	750	HEAD	07/26/2019	22.4	20.3	0.200	1034	7427	1.580	8.320	7.900	-5.05%
AM3	835	HEAD	07/24/2019	22.5	22.3	0.200	4d040	7420	2.040	9.500	10.200	7.37%
AM6	1750	HEAD	07/23/2019	21.3	20.5	0.100	1083	7427	3.580	36.100	35.800	-0.83%
AM2	1750	HEAD	08/01/2019	21.1	21.1	0.100	1092	7490	3.690	36.100	36.900	2.22%
AM8	1900	HEAD	08/01/2019	22.5	20.8	0.100	5d181	7416	3.970	39.500	39.700	0.51%
AM2	1900	HEAD	08/01/2019	22.1	20.8	0.100	5d181	7490	4.120	39.500	41.200	4.30%
AM5	2450	HEAD	07/26/2019	21.6	21.8	0.100	750	3318	5.220	53.100	52.200	-1.69%
AM5	2450	HEAD	07/29/2019	22.5	20.9	0.100	750	3318	5.340	53.100	53.400	0.56%
AM2	2450	HEAD	08/02/2019	22.1	21.0	0.100	921	7490	5.530	53.100	55.300	4.14%
AM2	2600	HEAD	08/02/2019	22.1	21.0	0.100	1069	7490	6.000	56.900	60.000	5.45%
AM2	5250	HEAD	07/29/2019	22.7	21.7	0.050	1123	7490	3.940	81.600	78.800	-3.43%
AM2	5600	HEAD	07/29/2019	22.7	21.7	0.050	1123	7490	4.270	85.100	85.400	0.35%
AM2	5750	HEAD	07/29/2019	22.7	21.7	0.050	1123	7490	3.850	80.600	77.000	-4.47%
AM4	750	BODY	07/25/2019	23.6	21.6	0.200	1097	7532	1.660	8.560	8.300	-3.04%
AM4	835	BODY	07/25/2019	22.3	21.6	0.200	4d040	7532	2.040	9.530	10.200	7.03%
AM4	1750	BODY	08/01/2019	22.8	21.2	0.100	1083	7532	3.480	37.100	34.800	-6.20%
AM4	1900	BODY	08/01/2019	22.8	21.2	0.100	5d030	7532	3.960	39.900	39.600	-0.75%
AM4	1900	BODY	08/19/2019	21.5	20.7	0.100	5d030	7532	4.290	39.900	42.900	7.52%
AM4	2450	BODY	07/29/2019	22.6	21.4	0.100	921	7532	5.290	50.800	52.900	4.13%
AM4	2450	BODY	08/06/2019	21.2	21.0	0.100	921	7532	5.390	50.800	53.900	6.10%
AM2	2450	BODY	08/19/2019	21.5	20.7	0.100	921	7490	5.190	50.800	51.900	2.17%
AM4	2600	BODY	08/06/2019	21.2	21.0	0.100	1069	7532	5.570	55.300	55.700	0.72%
AM3	5250	BODY	07/29/2019	22.1	21.6	0.050	1163	7420	3.590	77.700	71.800	-7.59%
AM3	5600	BODY	07/29/2019	22.1	21.6	0.050	1163	7420	3.990	80.100	79.800	-0.37%
AM3	5750	BODY	07/29/2019	22.1	21.6	0.050	1163	7420	3.760	77.800	75.200	-3.34%

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Table 10-4
System Verification Results – 10g

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Source SN	Probe SN	Measured SAR_{10g} (W/kg)	1 W Target SAR_{10g} (W/kg)	1 W Normalized SAR_{10g} (W/kg)	$Deviation_{10g}$ (%)
AM2	1900	BODY	08/05/2019	21.7	21.2	0.100	5d181	7490	2.130	20.900	21.300	1.91%
AM3	5250	BODY	07/29/2019	22.1	21.6	0.050	1163	7420	0.997	21.500	19.940	-7.26%
AM3	5600	BODY	07/29/2019	22.1	21.6	0.050	1163	7420	1.090	22.300	21.800	-2.24%
AM3	5750	BODY	07/29/2019	22.1	21.6	0.050	1163	7420	1.050	21.500	21.000	-2.33%

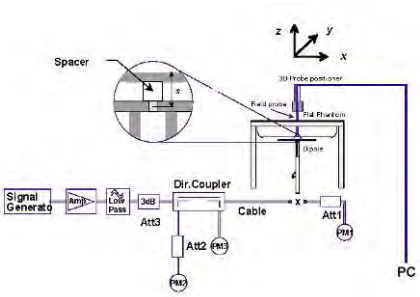

Figure 10-1
System Verification Setup Diagram

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	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	# of Time Slots	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
848.80	251	GSM 850	GSM	33.5	32.71	-0.04	Right	Cheek	02547	1	1:8.3	0.218	1.199	0.261	A1
848.80	251	GSM 850	GSM	33.5	32.71	-0.03	Right	Tilt	02547	1	1:8.3	0.099	1.199	0.119	
848.80	251	GSM 850	GSM	33.5	32.71	0.12	Left	Cheek	02547	1	1:8.3	0.167	1.199	0.200	
848.80	251	GSM 850	GSM	33.5	32.71	-0.08	Left	Tilt	02547	1	1:8.3	0.099	1.199	0.119	
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
GSM 1900 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.										(W/kg)		(W/kg)		
1880.00	661	GSM 1900	GSM	30.5	29.75	0.03	Right	Cheek	05995	1:8.3	0.108	1.189	0.128		
1880.00	661	GSM 1900	GSM	30.5	29.75	0.00	Right	Tilt	05995	1:8.3	0.093	1.189	0.111		
1880.00	661	GSM 1900	GSM	30.5	29.75	0.09	Left	Cheek	05995	1:8.3	0.146	1.189	0.174	A2	
1880.00	661	GSM 1900	GSM	30.5	29.75	0.08	Left	Tilt	05995	1:8.3	0.106	1.189	0.126		
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

Table 11-3
UMTS 850 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.										(W/kg)		(W/kg)		
836.60	4183	UMTS 850	RMC	25.0	24.35	0.05	Right	Cheek	02547	1:1	0.193	1.161	0.224	A3	
836.60	4183	UMTS 850	RMC	25.0	24.35	0.03	Right	Tilt	02547	1:1	0.094	1.161	0.109		
836.60	4183	UMTS 850	RMC	25.0	24.35	-0.02	Left	Cheek	02547	1:1	0.175	1.161	0.203		
836.60	4183	UMTS 850	RMC	25.0	24.35	0.07	Left	Tilt	02547	1:1	0.090	1.161	0.104		
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 1750 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1732.40	1412	UMTS 1750	RMC	24.5	23.79	0.05	Right	Cheek	02513	1:1	0.168	1.178	0.198	
1732.40	1412	UMTS 1750	RMC	24.5	23.79	0.04	Right	Tilt	02513	1:1	0.169	1.178	0.199	
1732.40	1412	UMTS 1750	RMC	24.5	23.79	0.04	Left	Cheek	02513	1:1	0.261	1.178	0.307	A4
1732.40	1412	UMTS 1750	RMC	24.5	23.79	0.06	Left	Tilt	02513	1:1	0.232	1.178	0.273	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-5
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	23.5	22.65	0.07	Right	Cheek	05995	1:1	0.175	1.216	0.213	
1880.00	9400	UMTS 1900	RMC	23.5	22.65	0.08	Right	Tilt	05995	1:1	0.146	1.216	0.178	
1880.00	9400	UMTS 1900	RMC	23.5	22.65	0.02	Left	Cheek	05995	1:1	0.261	1.216	0.317	A5
1880.00	9400	UMTS 1900	RMC	23.5	22.65	0.02	Left	Tilt	05995	1:1	0.202	1.216	0.246	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram							

Table 11-6
LTE Band 12 Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	0.00	0	Right	Cheek	QPSK	1	0	02513	1:1	0.150	1.211	0.182	A6
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	0.03	2	Right	Cheek	QPSK	25	0	02513	1:1	0.101	1.104	0.112	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	-0.14	0	Right	Tilt	QPSK	1	0	02513	1:1	0.076	1.211	0.092	
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	-0.05	2	Right	Tilt	QPSK	25	0	02513	1:1	0.049	1.104	0.054	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	0.07	0	Left	Cheek	QPSK	1	0	02513	1:1	0.124	1.211	0.150	
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	-0.16	2	Left	Cheek	QPSK	25	0	02513	1:1	0.086	1.104	0.095	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	0.21	0	Left	Tilt	QPSK	1	0	02513	1:1	0.064	1.211	0.078	
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	-0.21	2	Left	Tilt	QPSK	25	0	02513	1:1	0.046	1.104	0.051	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

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Table 11-7
LTE Band 13 Head SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	-0.15	0	Right	Cheek	QPSK	1	0	02497	1:1	0.094	1.205	0.113	A7
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	0.00	2	Right	Cheek	QPSK	25	0	02497	1:1	0.061	1.067	0.065	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	-0.16	0	Right	Tilt	QPSK	1	0	02497	1:1	0.058	1.205	0.070	
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	0.12	2	Right	Tilt	QPSK	25	0	02497	1:1	0.033	1.067	0.035	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	0.01	0	Left	Cheek	QPSK	1	0	02497	1:1	0.085	1.205	0.102	
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	0.21	2	Left	Cheek	QPSK	25	0	02497	1:1	0.058	1.067	0.062	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	-0.21	0	Left	Tilt	QPSK	1	0	02497	1:1	0.056	1.205	0.067	
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	-0.03	2	Left	Tilt	QPSK	25	0	02497	1:1	0.037	1.067	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 11-8
LTE Band 5 (Cell) Head SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	0.01	0	Right	Cheek	QPSK	1	0	02513	1:1	0.245	1.183	0.290	A8
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	0.01	2	Right	Cheek	QPSK	25	0	02513	1:1	0.150	1.216	0.182	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	0.01	0	Right	Tilt	QPSK	1	0	02513	1:1	0.123	1.183	0.146	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	0.04	2	Right	Tilt	QPSK	25	0	02513	1:1	0.069	1.216	0.084	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	0.02	0	Left	Cheek	QPSK	1	0	02513	1:1	0.194	1.183	0.230	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	0.04	2	Left	Cheek	QPSK	25	0	02513	1:1	0.126	1.216	0.153	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	0.06	0	Left	Tilt	QPSK	1	0	02513	1:1	0.124	1.183	0.147	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	0.03	2	Left	Tilt	QPSK	25	0	02513	1:1	0.075	1.216	0.091	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-9
LTE Band 66 (AWS) Head SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.21	0	Right	Cheek	QPSK	1	0	05995	1:1	0.093	1.038	0.097	
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	-0.07	2	Right	Cheek	QPSK	50	0	05995	1:1	0.073	1.000	0.073	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.04	0	Right	Tilt	QPSK	1	0	05995	1:1	0.103	1.038	0.107	
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	0.07	2	Right	Tilt	QPSK	50	0	05995	1:1	0.071	1.000	0.071	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.13	0	Left	Cheek	QPSK	1	0	05995	1:1	0.140	1.038	0.145	A9
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	0.09	2	Left	Cheek	QPSK	50	0	05995	1:1	0.102	1.000	0.102	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.17	0	Left	Tilt	QPSK	1	0	05995	1:1	0.103	1.038	0.107	
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	0.09	2	Left	Tilt	QPSK	50	0	05995	1:1	0.075	1.000	0.075	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

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Table 11-10
LTE Band 2 (PCS) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	-0.10	0	Right	Cheek	QPSK	1	99	05995	1:1	0.211	1.140	0.241	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	0.06	2	Right	Cheek	QPSK	50	50	05995	1:1	0.141	1.023	0.144	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	0.12	0	Right	Tilt	QPSK	1	99	05995	1:1	0.213	1.140	0.243	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	0.11	2	Right	Tilt	QPSK	50	50	05995	1:1	0.142	1.023	0.145	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	0.08	0	Left	Cheek	QPSK	1	99	05995	1:1	0.327	1.140	0.373	A10
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	0.02	2	Left	Cheek	QPSK	50	50	05995	1:1	0.219	1.023	0.224	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	-0.02	0	Left	Tilt	QPSK	1	99	05995	1:1	0.265	1.140	0.302	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	0.04	2	Left	Tilt	QPSK	50	50	05995	1:1	0.185	1.023	0.189	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-11
LTE Band 41 Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
2549.50	40185	Low-Mid	LTE Band 41	20	21.5	21.16	-0.02	0	Right	Cheek	QPSK	1	0	05995	1:1.58	0.415	1.081	**0.449**	A11
2549.50	40185	Low-Mid	LTE Band 41	20	21.5	21.20	0.01	0	Right	Cheek	QPSK	50	25	05995	1:1.58	0.415	1.072	**0.445**	
2549.50	40185	Low-Mid	LTE Band 41	20	21.5	21.16	0.13	0	Right	Tilt	QPSK	1	0	05995	1:1.58	0.191	1.081	0.206	
2549.50	40185	Low-Mid	LTE Band 41	20	21.5	21.20	0.14	0	Right	Tilt	QPSK	50	25	05995	1:1.58	0.188	1.072	0.202	
2549.50	40185	Low-Mid	LTE Band 41	20	21.5	21.16	0.05	0	Left	Cheek	QPSK	1	0	05995	1:1.58	0.142	1.081	0.154	
2549.50	40185	Low-Mid	LTE Band 41	20	21.5	21.20	-0.13	0	Left	Cheek	QPSK	50	25	05995	1:1.58	0.142	1.072	0.152	
2549.50	40185	Low-Mid	LTE Band 41	20	21.5	21.16	-0.03	0	Left	Tilt	QPSK	1	0	05995	1:1.58	0.102	1.081	0.110	
2549.50	40185	Low-Mid	LTE Band 41	20	21.5	21.20	0.16	0	Left	Tilt	QPSK	50	25	05995	1:1.58	0.092	1.072	0.099	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-12
DTS Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	16.0	15.57	0.06	Right	Cheek	02547	1	99.7	0.049	-	1.104	1.003	-	
2412	1	802.11b	DSSS	22	16.0	15.57	0.07	Right	Tilt	02547	1	99.7	0.044	-	1.104	1.003	-	
2412	1	802.11b	DSSS	22	16.0	15.57	-0.06	Left	Cheek	02547	1	99.7	0.101	0.091	1.104	1.003	**0.101**	A12
2412	1	802.11b	DSSS	22	16.0	15.57	0.01	Left	Tilt	02547	1	99.7	0.092	-	1.104	1.003	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram									

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Table 11-13
NII Head SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
5270	54	802.11n	OFDM	40	14.0	13.64	0.03	Right	Cheek	02547	13.5	92.9	0.062	0.015	1.086	1.076	0.018	
5270	54	802.11n	OFDM	40	14.0	13.64	0.03	Right	Tilt	02547	13.5	92.9	0.054	-	1.086	1.076	-	
5270	54	802.11n	OFDM	40	14.0	13.64	0.00	Left	Cheek	02547	13.5	92.9	0.051	-	1.086	1.076	-	
5270	54	802.11n	OFDM	40	14.0	13.64	0.21	Left	Tilt	02547	13.5	92.9	0.055	-	1.086	1.076	-	
5510	102	802.11n	OFDM	40	14.0	13.95	0.03	Right	Cheek	02547	13.5	92.9	0.135	-	1.012	1.076	-	
5510	102	802.11n	OFDM	40	14.0	13.95	0.10	Right	Tilt	02547	13.5	92.9	0.159	-	1.012	1.076	-	
5510	102	802.11n	OFDM	40	14.0	13.95	0.20	Left	Cheek	02547	13.5	92.9	0.165	-	1.012	1.076	-	
5510	102	802.11n	OFDM	40	14.0	13.95	0.06	Left	Tilt	02547	13.5	92.9	0.178	0.059	1.012	1.076	0.064	
5755	151	802.11n	OFDM	40	14.0	13.86	-0.15	Right	Cheek	02513	13.5	92.9	0.371	-	1.033	1.076	-	
5755	151	802.11n	OFDM	40	14.0	13.86	-0.06	Right	Tilt	02513	13.5	92.9	0.502	0.198	1.033	1.076	**0.220**	A13
5755	151	802.11n	OFDM	40	14.0	13.86	0.05	Left	Cheek	02513	13.5	92.9	0.367	-	1.033	1.076	-	
5755	151	802.11n	OFDM	40	14.0	13.86	0.08	Left	Tilt	02513	13.5	92.9	0.398	-	1.033	1.076	-	
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 11-14
DSS Head SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	SAR (1g)	Scaling Factor (Cond Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)			(W/kg)	
2441.00	39	Bluetooth	FHSS	11.0	10.74	0.16	Right	Cheek	02448	1	76.6	0.005	1.062	1.305	0.007	
2441.00	39	Bluetooth	FHSS	11.0	10.74	-0.05	Right	Tilt	02448	1	76.6	0.007	1.062	1.305	0.010	
2441.00	39	Bluetooth	FHSS	11.0	10.74	0.20	Left	Cheek	02448	1	76.6	0.012	1.062	1.305	**0.017**	A14
2441.00	39	Bluetooth	FHSS	11.0	10.74	0.21	Left	Tilt	02448	1	76.6	0.011	1.062	1.305	**0.015**	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								**Head 1.6 W/kg (mW/g)** averaged over 1 gram								

11.2 Standalone Body-Worn SAR Data

Table 11-15
GSM/UMTS Body-Worn SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
848.80	251	GSM 850	GSM	33.5	32.71	-0.05	15 mm	02448	1	1:8.3	back	0.245	1.199	0.294	A15
1880.00	661	GSM 1900	GSM	30.5	29.75	0.04	15 mm	05763	1	1:8.3	back	0.144	1.189	0.171	A17
836.60	4183	UMTS 850	RMC	25.0	24.35	-0.02	15 mm	02497	N/A	1:1	back	0.272	1.161	0.316	A19
1732.40	1412	UMTS 1750	RMC	24.5	23.79	0.04	15 mm	05763	N/A	1:1	back	0.215	1.178	0.253	A21
1880.00	9400	UMTS 1900	RMC	23.5	22.65	-0.04	15 mm	05763	N/A	1:1	back	0.262	1.216	0.319	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								

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Table 11-16
LTE Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	0.09	0	02497	QPSK	1	0	15 mm	back	1:1	0.279	1.211	0.338	A25
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	-0.01	2	02497	QPSK	25	0	15 mm	back	1:1	0.198	1.104	0.219	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	0.00	0	02513	QPSK	1	0	15 mm	back	1:1	0.222	1.205	0.268	A27
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	-0.01	2	02513	QPSK	25	0	15 mm	back	1:1	0.143	1.067	0.153	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	-0.04	0	02448	QPSK	1	0	15 mm	back	1:1	0.382	1.183	0.452	A29
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	0.00	2	02448	QPSK	25	0	15 mm	back	1:1	0.222	1.216	0.270	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.02	0	05763	QPSK	1	0	15 mm	back	1:1	0.157	1.038	0.163	A31
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	-0.01	2	05763	QPSK	50	0	15 mm	back	1:1	0.111	1.000	0.111	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	-0.01	0	05763	QPSK	1	99	15 mm	back	1:1	0.145	1.140	0.165	A33
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	0.05	2	05763	QPSK	50	50	15 mm	back	1:1	0.104	1.023	0.106	
2593.00	40620	Mid	LTE Band 41	20	24.5	23.93	0.05	0	05995	QPSK	1	0	15 mm	back	1:1.58	0.399	1.140	**0.455**	A35
2593.00	40620	Mid	LTE Band 41	20	22.5	22.11	0.03	2	05995	QPSK	50	0	15 mm	back	1:1.58	0.256	1.094	0.280	
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
DTS Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	19.0	18.99	0.04	15 mm	02448	1	back	99.7	0.084	0.053	1.002	1.003	**0.053**	A37
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
NII Body-Worn SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
5300	60	802.11a	OFDM	20	15.5	15.29	-0.21	15 mm	02497	6	back	97.3	0.023	0.010	1.050	1.028	0.011	
5500	100	802.11a	OFDM	20	15.0	14.98	0.06	15 mm	02497	6	back	97.3	0.068	0.021	1.005	1.028	0.022	
5745	149	802.11a	OFDM	20	15.0	14.54	0.21	15 mm	02497	6	back	97.3	0.368	0.140	1.112	1.028	**0.160**	A39
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram										

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11.3 Standalone Hotspot SAR Data

Table 11-19
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 Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
824.20	128	GSM 850	GPRS	28.5	26.97	-0.10	10 mm	02448	4	1:2.076	back	0.586	1.422	0.833	
836.60	190	GSM 850	GPRS	28.5	27.27	-0.06	10 mm	02448	4	1:2.076	back	0.805	1.327	**1.068**	
848.80	251	GSM 850	GPRS	28.5	27.88	-0.09	10 mm	02448	4	1:2.076	back	0.837	1.153	0.965	A16
848.80	251	GSM 850	GPRS	28.5	27.88	-0.09	10 mm	02448	4	1:2.076	front	0.304	1.153	0.351	
848.80	251	GSM 850	GPRS	28.5	27.88	0.02	10 mm	02448	4	1:2.076	bottom	0.365	1.153	0.421	
848.80	251	GSM 850	GPRS	28.5	27.88	-0.06	10 mm	02448	4	1:2.076	right	0.458	1.153	0.528	
848.80	251	GSM 850	GPRS	28.5	27.88	0.21	10 mm	02448	4	1:2.076	left	0.191	1.153	0.220	
848.80	251	GSM 850	GPRS	28.5	27.88	-0.09	10 mm	02448	4	1:2.076	back	0.765	1.153	0.882	
1880.00	661	GSM 1900	GPRS	26.5	25.33	0.01	10 mm	05763	3	1:2.76	back	0.351	1.309	0.459	A18
1880.00	661	GSM 1900	GPRS	26.5	25.33	-0.20	10 mm	05763	3	1:2.76	front	0.174	1.309	0.228	
1880.00	661	GSM 1900	GPRS	26.5	25.33	0.06	10 mm	05763	3	1:2.76	bottom	0.237	1.309	0.310	
1880.00	661	GSM 1900	GPRS	26.5	25.33	0.10	10 mm	05763	3	1:2.76	right	0.071	1.309	0.093	
1880.00	661	GSM 1900	GPRS	26.5	25.33	0.11	10 mm	05763	3	1:2.76	left	0.196	1.309	0.257	
836.60	4183	UMTS 850	RMC	25.0	24.35	-0.04	10 mm	02497	N/A	1:1	back	0.494	1.161	0.574	A20
836.60	4183	UMTS 850	RMC	25.0	24.35	-0.04	10 mm	02497	N/A	1:1	front	0.194	1.161	0.225	
836.60	4183	UMTS 850	RMC	25.0	24.35	0.02	10 mm	02497	N/A	1:1	bottom	0.233	1.161	0.271	
836.60	4183	UMTS 850	RMC	25.0	24.35	0.03	10 mm	02497	N/A	1:1	right	0.341	1.161	0.396	
836.60	4183	UMTS 850	RMC	25.0	24.35	0.02	10 mm	02497	N/A	1:1	left	0.147	1.161	0.171	
1732.40	1412	UMTS 1750	RMC	24.5	23.79	-0.03	10 mm	05763	N/A	1:1	back	0.415	1.178	0.489	
1732.40	1412	UMTS 1750	RMC	24.5	23.79	-0.01	10 mm	05763	N/A	1:1	front	0.425	1.178	0.501	A22
1732.40	1412	UMTS 1750	RMC	24.5	23.79	-0.06	10 mm	05763	N/A	1:1	bottom	0.333	1.178	0.392	
1732.40	1412	UMTS 1750	RMC	24.5	23.79	0.04	10 mm	05763	N/A	1:1	right	0.102	1.178	0.120	
1732.40	1412	UMTS 1750	RMC	24.5	23.79	0.00	10 mm	05763	N/A	1:1	left	0.287	1.178	0.338	
1852.40	9262	UMTS 1900	RMC	20.5	19.79	-0.04	10 mm	05763	N/A	1:1	back	0.300	1.178	0.353	
1880.00	9400	UMTS 1900	RMC	20.5	19.50	-0.01	10 mm	05763	N/A	1:1	back	0.545	1.259	0.686	A24
1907.60	9538	UMTS 1900	RMC	20.5	19.86	0.02	10 mm	05763	N/A	1:1	back	0.294	1.159	0.341	
1880.00	9400	UMTS 1900	RMC	20.5	19.50	-0.03	10 mm	05763	N/A	1:1	front	0.149	1.259	0.188	
1880.00	9400	UMTS 1900	RMC	20.5	19.50	-0.01	10 mm	05763	N/A	1:1	bottom	0.221	1.259	0.278	
1880.00	9400	UMTS 1900	RMC	20.5	19.50	-0.04	10 mm	05763	N/A	1:1	right	0.065	1.259	0.082	
1880.00	9400	UMTS 1900	RMC	20.5	19.50	0.02	10 mm	05763	N/A	1:1	left	0.192	1.259	0.242	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							**Body 1.6 W/kg (mW/g) averaged over 1 gram**								

Note: Blue entry represents variability measurement.

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Table 11-20
LTE Band 12 Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	-0.06	0	02497	QPSK	1	0	10 mm	back	1:1	0.340	1.211	0.412	A26
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	0.03	2	02497	QPSK	25	0	10 mm	back	1:1	0.239	1.104	0.264	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	0.01	0	02497	QPSK	1	0	10 mm	front	1:1	0.185	1.211	0.224	
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	-0.02	2	02497	QPSK	25	0	10 mm	front	1:1	0.129	1.104	0.142	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	0.05	0	02497	QPSK	1	0	10 mm	bottom	1:1	0.078	1.211	0.094	
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	0.01	2	02497	QPSK	25	0	10 mm	bottom	1:1	0.057	1.104	0.063	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	0.01	0	02497	QPSK	1	0	10 mm	right	1:1	0.271	1.211	0.328	
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	0.02	2	02497	QPSK	25	0	10 mm	right	1:1	0.193	1.104	0.213	
707.50	23095	Mid	LTE Band 12	10	24.5	23.67	-0.02	0	02497	QPSK	1	0	10 mm	left	1:1	0.126	1.211	0.153	
707.50	23095	Mid	LTE Band 12	10	22.5	22.07	0.03	2	02497	QPSK	25	0	10 mm	left	1:1	0.179	1.104	0.198	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram													

Table 11-21
LTE Band 13 Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	-0.04	0	02513	QPSK	1	0	10 mm	back	1:1	0.236	1.205	0.284	A28
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	0.03	2	02513	QPSK	25	0	10 mm	back	1:1	0.161	1.067	0.172	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	-0.04	0	02513	QPSK	1	0	10 mm	front	1:1	0.120	1.205	0.145	
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	0.03	2	02513	QPSK	25	0	10 mm	front	1:1	0.079	1.067	0.084	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	0.02	0	02513	QPSK	1	0	10 mm	bottom	1:1	0.095	1.205	0.114	
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	-0.08	2	02513	QPSK	25	0	10 mm	bottom	1:1	0.064	1.067	0.068	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	0.01	0	02513	QPSK	1	0	10 mm	right	1:1	0.231	1.205	0.278	
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	0.05	2	02513	QPSK	25	0	10 mm	right	1:1	0.149	1.067	0.159	
782.00	23230	Mid	LTE Band 13	10	24.5	23.69	-0.20	0	02513	QPSK	1	0	10 mm	left	1:1	0.128	1.205	0.154	
782.00	23230	Mid	LTE Band 13	10	22.5	22.22	-0.01	2	02513	QPSK	25	0	10 mm	left	1:1	0.079	1.067	0.084	
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 11-22
LTE Band 5 (Cell) Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	-0.05	0	02448	QPSK	1	0	10 mm	back	1:1	0.584	1.183	0.691	A30
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	-0.02	2	02448	QPSK	25	0	10 mm	back	1:1	0.352	1.216	0.428	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	-0.02	0	02448	QPSK	1	0	10 mm	front	1:1	0.233	1.183	0.276	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	0.10	2	02448	QPSK	25	0	10 mm	front	1:1	0.137	1.216	0.167	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	0.07	0	02448	QPSK	1	0	10 mm	bottom	1:1	0.245	1.183	0.290	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	-0.01	2	02448	QPSK	25	0	10 mm	bottom	1:1	0.146	1.216	0.178	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	-0.05	0	02448	QPSK	1	0	10 mm	right	1:1	0.397	1.183	0.470	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	-0.08	2	02448	QPSK	25	0	10 mm	right	1:1	0.243	1.216	0.295	
836.50	20525	Mid	LTE Band 5 (Cell)	10	25.5	24.77	-0.09	0	02448	QPSK	1	0	10 mm	left	1:1	0.197	1.183	0.233	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.65	-0.10	2	02448	QPSK	25	0	10 mm	left	1:1	0.115	1.216	0.140	
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 11-23
LTE Band 66 (AWS) Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.00	0	05763	QPSK	1	0	10 mm	back	1:1	0.355	1.038	0.368	A32
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	-0.03	2	05763	QPSK	50	0	10 mm	back	1:1	0.252	1.000	0.252	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.01	0	05763	QPSK	1	0	10 mm	front	1:1	0.327	1.038	0.339	
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	-0.01	2	05763	QPSK	50	0	10 mm	front	1:1	0.238	1.000	0.238	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	-0.05	0	05763	QPSK	1	0	10 mm	bottom	1:1	0.228	1.038	0.237	
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	-0.01	2	05763	QPSK	50	0	10 mm	bottom	1:1	0.165	1.000	0.165	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.03	0	05763	QPSK	1	0	10 mm	right	1:1	0.074	1.038	0.077	
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	-0.01	2	05763	QPSK	50	0	10 mm	right	1:1	0.054	1.000	0.054	
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.5	24.34	0.09	0	05763	QPSK	1	0	10 mm	left	1:1	0.187	1.038	0.194	
1720.00	132072	Low	LTE Band 66 (AWS)	20	22.5	22.50	0.02	2	05763	QPSK	50	0	10 mm	left	1:1	0.144	1.000	0.144	
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 11-24
LTE Band 2 (PCS) Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.64	-0.01	0	05763	QPSK	1	99	10 mm	back	1:1	0.306	1.219	0.373	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.60	0.01	0	05763	QPSK	50	50	10 mm	back	1:1	0.311	1.230	0.383	A34
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.64	0.03	0	05763	QPSK	1	99	10 mm	front	1:1	0.109	1.219	0.133	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.60	0.05	0	05763	QPSK	50	50	10 mm	front	1:1	0.111	1.230	0.137	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.64	-0.02	0	05763	QPSK	1	99	10 mm	bottom	1:1	0.258	1.219	0.315	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.60	0.02	0	05763	QPSK	50	50	10 mm	bottom	1:1	0.254	1.230	0.312	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.64	0.00	0	05763	QPSK	1	99	10 mm	right	1:1	0.066	1.219	0.080	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.60	0.05	0	05763	QPSK	50	50	10 mm	right	1:1	0.069	1.230	0.085	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.64	-0.01	0	05763	QPSK	1	99	10 mm	left	1:1	0.176	1.219	0.215	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.60	0.02	0	05763	QPSK	50	50	10 mm	left	1:1	0.180	1.230	0.221	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

Table 11-25
LTE Band 41 Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
2506.00	39750	Low	LTE Band 41	20	24.5	23.82	-0.08	0	05995	QPSK	1	0	10 mm	back	1:1.58	0.865	1.169	1.011	A36
2549.50	40185	Low-Mid	LTE Band 41	20	24.5	23.86	-0.04	0	05995	QPSK	1	99	10 mm	back	1:1.58	0.749	1.159	0.868	
2593.00	40620	Mid	LTE Band 41	20	24.5	23.93	-0.04	0	05995	QPSK	1	0	10 mm	back	1:1.58	0.862	1.140	0.983	
2636.50	41055	Mid-High	LTE Band 41	20	24.5	23.40	-0.06	0	05995	QPSK	1	0	10 mm	back	1:1.58	0.826	1.288	1.064	
2680.00	41490	High	LTE Band 41	20	24.5	23.36	-0.05	0	05995	QPSK	1	0	10 mm	back	1:1.58	0.552	1.300	0.718	
2506.00	39750	Low	LTE Band 41	20	22.5	22.10	-0.07	2	05995	QPSK	50	0	10 mm	back	1:1.58	0.561	1.096	0.615	
2549.50	40185	Low-Mid	LTE Band 41	20	22.5	21.99	-0.03	2	05995	QPSK	50	0	10 mm	back	1:1.58	0.501	1.125	0.564	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.11	0.03	2	05995	QPSK	50	0	10 mm	back	1:1.58	0.563	1.094	0.616	
2636.50	41055	Mid-High	LTE Band 41	20	22.5	21.36	-0.01	2	05995	QPSK	50	25	10 mm	back	1:1.58	0.516	1.300	0.671	
2680.00	41490	High	LTE Band 41	20	22.5	21.19	0.00	2	05995	QPSK	50	0	10 mm	back	1:1.58	0.372	1.352	0.503	
2506.00	39750	Low	LTE Band 41	20	22.5	22.06	-0.05	2	05995	QPSK	100	0	10 mm	back	1:1.58	0.547	1.107	0.606	
2593.00	40620	Mid	LTE Band 41	20	24.5	23.93	0.03	0	05995	QPSK	1	0	10 mm	front	1:1.58	0.201	1.140	0.229	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.11	0.06	2	05995	QPSK	50	0	10 mm	front	1:1.58	0.128	1.094	0.140	
2593.00	40620	Mid	LTE Band 41	20	24.5	23.93	0.10	0	05995	QPSK	1	0	10 mm	top	1:1.58	0.120	1.140	0.137	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.11	0.09	2	05995	QPSK	50	0	10 mm	top	1:1.58	0.080	1.094	0.088	
2593.00	40620	Mid	LTE Band 41	20	24.5	23.93	0.00	0	05995	QPSK	1	0	10 mm	left	1:1.58	0.429	1.140	0.489	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.11	-0.02	2	05995	QPSK	50	0	10 mm	left	1:1.58	0.286	1.094	0.313	
2506.00	39750	Low	LTE Band 41	20	24.5	23.82	-0.16	0	05995	QPSK	1	0	10 mm	back	1:1.58	0.845	1.169	0.988	
2593.00	40620	Mid	LTE Band 41	20	24.5	23.93	-0.05	0	05995	QPSK	1	0	10 mm	back	1:1.58	0.788	1.140	0.898	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

Note: Blue entry represents variability measurement.

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Table 11-26
WLAN Hotspot SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	19.0	18.99	0.03	10 mm	02448	1	back	99.7	0.192	0.133	1.002	1.003	**0.134**	A38
2412	1	802.11b	DSSS	22	19.0	18.99	0.12	10 mm	02448	1	front	99.7	0.047	-	1.002	1.003	-	
2412	1	802.11b	DSSS	22	19.0	18.99	-0.01	10 mm	02448	1	top	99.7	0.078	-	1.002	1.003	-	
2412	1	802.11b	DSSS	22	19.0	18.99	0.01	10 mm	02448	1	right	99.7	0.044	-	1.002	1.003	-	
5745	149	802.11a	OFDM	20	15.0	14.54	0.02	10 mm	02497	6	back	97.3	0.518	0.223	1.112	1.028	**0.255**	A40
5745	149	802.11a	OFDM	20	15.0	14.54	0.00	10 mm	02497	6	front	97.3	0.072	-	1.112	1.028	-	
5745	149	802.11a	OFDM	20	15.0	14.54	0.00	10 mm	02497	6	top	97.3	0.448	-	1.112	1.028	-	
5745	149	802.11a	OFDM	20	15.0	14.54	0.20	10 mm	02497	6	right	97.3	0.028	-	1.112	1.028	-	
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 11-27
DSS Hotspot SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Cond Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)			(W/kg)	
2441	39	Bluetooth	FHSS	11.0	10.74	0.20	10 mm	05995	1	back	76.6	0.003	1.062	1.305	**0.004**	A41
2441	39	Bluetooth	FHSS	11.0	10.74	0.14	10 mm	05995	1	front	76.6	0.000	1.062	1.305	0.000	
2441	39	Bluetooth	FHSS	11.0	10.74	0.20	10 mm	05995	1	top	76.6	0.001	1.062	1.305	0.001	
2441	39	Bluetooth	FHSS	11.0	10.74	0.20	10 mm	05995	1	right	76.6	0.001	1.062	1.305	0.001	
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 Standalone Phablet SAR Data

Table 11-28
UMTS Phablet SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (10g)	Scaling Factor	Reported SAR (10g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	23.5	22.65	-0.02	11 mm	05763	1:1	back	0.289	1.216	0.351	
1880.00	9400	UMTS 1900	RMC	23.5	22.65	0.13	0 mm	05763	1:1	front	1.170	1.216	1.423	
1880.00	9400	UMTS 1900	RMC	23.5	22.65	-0.11	5 mm	05763	1:1	bottom	0.539	1.216	0.655	
1880.00	9400	UMTS 1900	RMC	23.5	22.65	0.05	0 mm	05763	1:1	right	0.104	1.216	0.126	
1880.00	9400	UMTS 1900	RMC	23.5	22.65	-0.05	0 mm	05763	1:1	left	1.210	1.216	1.471	A42
1880.00	9400	UMTS 1900	RMC	20.5	19.50	0.20	0 mm	05763	1:1	back	0.717	1.259	0.903	
1880.00	9400	UMTS 1900	RMC	20.5	19.50	-0.20	0 mm	05763	1:1	bottom	0.613	1.259	0.772	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Phablet 4.0 W/kg (mW/g) averaged over 10 grams							

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Table 11-29
LTE Phablet SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (10g)	Scaling Factor	Reported SAR (10g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	0.03	0	05763	QPSK	1	99	11 mm	back	1:1	0.362	1.140	0.413	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	-0.05	2	05763	QPSK	50	50	11 mm	back	1:1	0.227	1.023	0.232	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	-0.04	0	05763	QPSK	1	99	0 mm	front	1:1	1.670	1.140	**1.904**	A43
1880.00	18900	Mid	LTE Band 2 (PCS)	20	24.5	23.80	0.07	0	05763	QPSK	1	99	0 mm	front	1:1	1.410	1.175	1.657	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.5	23.85	0.08	0	05763	QPSK	1	99	0 mm	front	1:1	1.360	1.161	1.579	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	0.08	2	05763	QPSK	50	50	0 mm	front	1:1	1.210	1.023	1.238	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	0.00	0	05763	QPSK	1	99	5 mm	bottom	1:1	0.686	1.140	0.782	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	-0.02	2	05763	QPSK	50	50	5 mm	bottom	1:1	0.465	1.023	0.476	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	0.01	0	05763	QPSK	1	99	0 mm	right	1:1	0.136	1.140	0.155	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	0.05	2	05763	QPSK	50	50	0 mm	right	1:1	0.094	1.023	0.096	
1860.00	18700	Low	LTE Band 2 (PCS)	20	24.5	23.93	-0.10	0	05763	QPSK	1	99	0 mm	left	1:1	1.610	1.140	1.835	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.40	-0.05	2	05763	QPSK	50	50	0 mm	left	1:1	1.150	1.023	1.176	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.64	-0.13	0	05763	QPSK	1	99	0 mm	back	1:1	1.040	1.219	1.268	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.60	-0.21	0	05763	QPSK	50	50	0 mm	back	1:1	0.979	1.230	1.204	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.64	-0.09	0	05763	QPSK	1	99	0 mm	bottom	1:1	0.732	1.219	0.892	
1900.00	19100	High	LTE Band 2 (PCS)	20	21.5	20.60	-0.18	0	05763	QPSK	50	50	0 mm	bottom	1:1	0.734	1.230	0.903	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Phablet 4.0 W/kg (mW/g) averaged over 10 grams											

Table 11-30
WLAN Phablet SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (10g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (10g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
5300	60	802.11a	OFDM	20	15.5	15.29	0.20	0 mm	02497	6	back	97.3	1.799	0.169	1.050	1.028	0.182	
5300	60	802.11a	OFDM	20	15.5	15.29	0.21	0 mm	02497	6	front	97.3	0.179	-	1.050	1.028	-	
5300	60	802.11a	OFDM	20	15.5	15.29	0.00	0 mm	02497	6	top	97.3	0.284	-	1.050	1.028	-	
5300	60	802.11a	OFDM	20	15.5	15.29	0.00	0 mm	02497	6	right	97.3	0.022	-	1.050	1.028	-	
5500	100	802.11a	OFDM	20	15.0	14.98	0.20	0 mm	02497	6	back	97.3	1.585	0.207	1.005	1.028	0.214	A44
5500	100	802.11a	OFDM	20	15.0	14.98	0.05	0 mm	02497	6	front	97.3	0.406	-	1.005	1.028	-	
5500	100	802.11a	OFDM	20	15.0	14.98	0.20	0 mm	02497	6	top	97.3	0.806	-	1.005	1.028	-	
5500	100	802.11a	OFDM	20	15.0	14.98	0.00	0 mm	02497	6	right	97.3	0.010	-	1.005	1.028	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Phablet 4.0 W/kg (mW/g) averaged over 10 grams										

11.5 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.

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4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 15 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01r03, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg and 2.0 W/kg for 10g SAR. 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 D06v02r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).
10. Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is > 160 mm and < 200 mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.
11. This device utilizes power reduction for some wireless modes and technologies, as outlined in Section 1.3. The maximum output power allowed for each transmitter and exposure condition was evaluated for SAR compliance based on expected use conditions and simultaneous transmission scenarios.
12. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds below.
13. Additional SAR tests for phablet SAR were evaluated per KDB 616217 Section 6 (See Section 6.9 for more information).

GSM Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. Justification for reduced test configurations per KDB Publication 941225 D01v03r01 and October 2013 TCB Workshop Notes: The source-based frame-averaged output power was evaluated for all GPRS/EDGE slot configurations. The configuration with the highest target frame averaged output power was evaluated for hotspot SAR. When the maximum frame-averaged powers are equivalent across two or more slots (within 0.25 dB), the configuration with the most number of time slots was tested.
3. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg for 1g evaluations then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

UMTS Notes:

1. UMTS mode in was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01v03r01. AMR and HSPA SAR was not required per the 3G Test Reduction Procedure in KDB Publication 941225 D01v03r01.
2. Per FCC KDB Publication 447498 D01v06, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg for 1g evaluations then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

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LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r04. The general test procedures used for testing can be found in Section 8.5.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).
4. Per FCC KDB Publication 447498 D01v06, when the reported LTE Band 41 SAR measured at the highest output power channel in a given a test configuration was > 0.6 W/kg for 1g evaluations, testing at the other channels was required for such test configurations.
5. TDD LTE was tested per the guidance provided in FCC KDB Publication 941225 D05v02r04. Testing was performed using UL-DL configuration 0 with 6 UL subframes and 2 S subframes using extended cyclic prefix only and special subframe configuration 6. SAR tests were performed at maximum output power and worst-case transmission duty factor in extended cyclic prefix. Per 3GPP 36.211 Section 4, the duty factor for special subframe configuration 6 using extended cyclic prefix is 0.633.
6. Per KDB Publication 941225 D05Av01r02, SAR for downlink only LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

WLAN Notes:

1. For held-to-ear, hotspot, and phablet 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 for 1g evaluations, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 8.6.5 for more information.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg for 1g evaluations. See Section 8.6.6 for more information.
4. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg for 1g evaluations or all test channels were measured.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.
6. When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

Bluetooth Notes

1. Bluetooth SAR was measured with the device connected to a call box with hopping disabled with DH5 operation and Tx Tests test mode type. Per October 2016 TCB Workshop Notes, the reported SAR was scaled to the 100% transmission duty factor to determine compliance. See Section 9.5 for the time domain plot and calculation for the duty factor of the device.
2. Head and Hotspot Bluetooth SAR were evaluated for BT BDR tethering applications.

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12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

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

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1g or 10g SAR.

When standalone SAR is not required to be measured, per FCC KDB 447498 D01v06 4.3.2 b), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

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

Table 12-1
1g Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2480	11.00	15	0.182

Note: Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

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12.3 Head SAR Simultaneous Transmission Analysis

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	GSM 850	0.261	0.101	0.362
	GSM 1900	0.174	0.101	0.275
	UMTS 850	0.224	0.101	0.325
	UMTS 1750	0.307	0.101	0.408
	UMTS 1900	0.317	0.101	0.418
	LTE Band 12	0.182	0.101	0.283
	LTE Band 13	0.113	0.101	0.214
	LTE Band 5 (Cell)	0.290	0.101	0.391
	LTE Band 66 (AWS)	0.145	0.101	0.246
	LTE Band 2 (PCS)	0.373	0.101	0.474
	LTE Band 41	0.449	0.101	**0.550**

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	GSM 850	0.261	0.220	0.481
	GSM 1900	0.174	0.220	0.394
	UMTS 850	0.224	0.220	0.444
	UMTS 1750	0.307	0.220	0.527
	UMTS 1900	0.317	0.220	0.537
	LTE Band 12	0.182	0.220	0.402
	LTE Band 13	0.113	0.220	0.333
	LTE Band 5 (Cell)	0.290	0.220	0.510
	LTE Band 66 (AWS)	0.145	0.220	0.365
	LTE Band 2 (PCS)	0.373	0.220	0.593
	LTE Band 41	0.449	0.220	**0.669**

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Table 12-4
Simultaneous Transmission Scenario with Bluetooth (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	GSM 850	0.261	0.017	0.278
	GSM 1900	0.174	0.017	0.191
	UMTS 850	0.224	0.017	0.241
	UMTS 1750	0.307	0.017	0.324
	UMTS 1900	0.317	0.017	0.334
	LTE Band 12	0.182	0.017	0.199
	LTE Band 13	0.113	0.017	0.130
	LTE Band 5 (Cell)	0.290	0.017	0.307
	LTE Band 66 (AWS)	0.145	0.017	0.162
	LTE Band 2 (PCS)	0.373	0.017	0.390
	LTE Band 41	0.449	0.017	**0.466**

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	GSM 850	0.261	0.017	0.220	0.498
	GSM 1900	0.174	0.017	0.220	0.411
	UMTS 850	0.224	0.017	0.220	0.461
	UMTS 1750	0.307	0.017	0.220	0.544
	UMTS 1900	0.317	0.017	0.220	0.554
	LTE Band 12	0.182	0.017	0.220	0.419
	LTE Band 13	0.113	0.017	0.220	0.350
	LTE Band 5 (Cell)	0.290	0.017	0.220	0.527
	LTE Band 66 (AWS)	0.145	0.017	0.220	0.382
	LTE Band 2 (PCS)	0.373	0.017	0.220	0.610
	LTE Band 41	0.449	0.017	0.220	**0.686**

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12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-6
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn	GSM 850	0.294	0.053	0.347
	GSM 1900	0.171	0.053	0.224
	UMTS 850	0.316	0.053	0.369
	UMTS 1750	0.253	0.053	0.306
	UMTS 1900	0.319	0.053	0.372
	LTE Band 12	0.338	0.053	0.391
	LTE Band 13	0.268	0.053	0.321
	LTE Band 5 (Cell)	0.452	0.053	0.505
	LTE Band 66 (AWS)	0.163	0.053	0.216
	LTE Band 2 (PCS)	0.165	0.053	0.218
	LTE Band 41	0.455	0.053	**0.508**

Table 12-7
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn	GSM 850	0.294	0.160	0.454
	GSM 1900	0.171	0.160	0.331
	UMTS 850	0.316	0.160	0.476
	UMTS 1750	0.253	0.160	0.413
	UMTS 1900	0.319	0.160	0.479
	LTE Band 12	0.338	0.160	0.498
	LTE Band 13	0.268	0.160	0.428
	LTE Band 5 (Cell)	0.452	0.160	0.612
	LTE Band 66 (AWS)	0.163	0.160	0.323
	LTE Band 2 (PCS)	0.165	0.160	0.325
	LTE Band 41	0.455	0.160	**0.615**

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Table 12-8
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn	GSM 850	0.294	0.182	0.476
	GSM 1900	0.171	0.182	0.353
	UMTS 850	0.316	0.182	0.498
	UMTS 1750	0.253	0.182	0.435
	UMTS 1900	0.319	0.182	0.501
	LTE Band 12	0.338	0.182	0.520
	LTE Band 13	0.268	0.182	0.450
	LTE Band 5 (Cell)	0.452	0.182	0.634
	LTE Band 66 (AWS)	0.163	0.182	0.345
	LTE Band 2 (PCS)	0.165	0.182	0.347
	LTE Band 41	0.455	0.182	**0.637**

Note: Bluetooth SAR was not required to be measured per FCC KDB Publication 447498 D01v06. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

Table 12-9
Simultaneous Transmission Scenario with Bluetooth and 5 GHz WLAN (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body-Worn	GSM 850	0.294	0.182	0.160	0.636
	GSM 1900	0.171	0.182	0.160	0.513
	UMTS 850	0.316	0.182	0.160	0.658
	UMTS 1750	0.253	0.182	0.160	0.595
	UMTS 1900	0.319	0.182	0.160	0.661
	LTE Band 12	0.338	0.182	0.160	0.680
	LTE Band 13	0.268	0.182	0.160	0.610
	LTE Band 5 (Cell)	0.452	0.182	0.160	0.794
	LTE Band 66 (AWS)	0.163	0.182	0.160	0.505
	LTE Band 2 (PCS)	0.165	0.182	0.160	0.507
	LTE Band 41	0.455	0.182	0.160	**0.797**

Note: Bluetooth SAR was not required to be measured per FCC KDB Publication 447498 D01v06. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

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12.5 Hotspot SAR Simultaneous Transmission Analysis

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	GPRS 850	1.068	0.134	**1.202**
	GPRS 1900	0.459	0.134	0.593
	UMTS 850	0.574	0.134	0.708
	UMTS 1750	0.501	0.134	0.635
	UMTS 1900	0.686	0.134	0.820
	LTE Band 12	0.412	0.134	0.546
	LTE Band 13	0.284	0.134	0.418
	LTE Band 5 (Cell)	0.691	0.134	0.825
	LTE Band 66 (AWS)	0.368	0.134	0.502
	LTE Band 2 (PCS)	0.383	0.134	0.517
	LTE Band 41	1.064	0.134	1.198

Table 12-11
Simultaneous Transmission Scenario with 5 GHz WLAN (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	GPRS 850	1.068	0.255	**1.323**
	GPRS 1900	0.459	0.255	0.714
	UMTS 850	0.574	0.255	0.829
	UMTS 1750	0.501	0.255	0.756
	UMTS 1900	0.686	0.255	0.941
	LTE Band 12	0.412	0.255	0.667
	LTE Band 13	0.284	0.255	0.539
	LTE Band 5 (Cell)	0.691	0.255	0.946
	LTE Band 66 (AWS)	0.368	0.255	0.623
	LTE Band 2 (PCS)	0.383	0.255	0.638
	LTE Band 41	1.064	0.255	1.319

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Table 12-12
Simultaneous Transmission Scenario with Bluetooth (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	GPRS 850	1.068	0.004	**1.072**
	GPRS 1900	0.459	0.004	0.463
	UMTS 850	0.574	0.004	0.578
	UMTS 1750	0.501	0.004	0.505
	UMTS 1900	0.686	0.004	0.690
	LTE Band 12	0.412	0.004	0.416
	LTE Band 13	0.284	0.004	0.288
	LTE Band 5 (Cell)	0.691	0.004	0.695
	LTE Band 66 (AWS)	0.368	0.004	0.372
	LTE Band 2 (PCS)	0.383	0.004	0.387
	LTE Band 41	1.064	0.004	1.068

Table 12-13
Simultaneous Transmission Scenario with Bluetooth and 5 GHz WLAN (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Hotspot SAR	GPRS 850	1.068	0.004	0.255	**1.327**
	GPRS 1900	0.459	0.004	0.255	0.718
	UMTS 850	0.574	0.004	0.255	0.833
	UMTS 1750	0.501	0.004	0.255	0.760
	UMTS 1900	0.686	0.004	0.255	0.945
	LTE Band 12	0.412	0.004	0.255	0.671
	LTE Band 13	0.284	0.004	0.255	0.543
	LTE Band 5 (Cell)	0.691	0.004	0.255	0.950
	LTE Band 66 (AWS)	0.368	0.004	0.255	0.627
	LTE Band 2 (PCS)	0.383	0.004	0.255	0.642
	LTE Band 41	1.064	0.004	0.255	1.323

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12.6 Phablet Simultaneous Transmission Analysis

Per FCC KDB Publication 648474 D04 Handset SAR, Phablet SAR tests were not required if wireless router 1g SAR (scaled to the maximum output power, including tolerance) < 1.2 W/kg. Therefore, no further analysis beyond the tables included in this section was required to determine that possible simultaneous transmission scenarios would not exceed the SAR limit.

For SAR summation, the highest reported SAR across all test distances was used as the most conservative evaluation for simultaneous transmission analysis for each device edge.

Table 12-14
Simultaneous Transmission Scenario with 5 GHz WLAN (Phablet)

Exposure Condition	Mode	3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Phablet SAR	UMTS 1900	1.471	0.214	1.685
	LTE Band 2 (PCS)	1.904	0.214	**2.118**

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 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

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13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1g 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
5) When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

Table 13-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS															
Band	FREQUENCY		Mode	Service	# of Time Slots	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.						(W/kg)	(W/kg)		(W/kg)		(W/kg)	
835	848.80	251	GSM 850	GPRS	4	back	10 mm	0.837	0.765	1.09	N/A	N/A	N/A	N/A
2450	2506.00	39750	LTE Band 41, 20 MHz Bandwidth	QPSK, 1 RB, 0 RB Offset	N/A	back	10 mm	0.865	0.845	1.02	N/A	N/A	N/A	N/A
2600	2593.00	40620	LTE Band 41, 20 MHz Bandwidth	QPSK, 1 RB, 0 RB Offset	N/A	back	10 mm	0.862	0.788	1.09	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 1g and <3.75 W/kg for 10g for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

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14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	Network Analyzer	3/19/2019	Annual	3/19/2020	MY40001472
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	E4438C	ESG Vector Signal Generator	6/27/2019	Annual	6/27/2020	MY45093852
Agilent	E4440A	PSA Series Spectrum Analyzer	11/14/2018	Annual	11/14/2019	MY46186272
Agilent	E5515C	Wireless Communications Test Set	2/28/2018	Biennial	2/28/2020	GB41450275
Agilent	N4010A	Wireless Connectivity Test Set	CBT	N/A	CBT	GB46170464
Agilent	N5182A	MXG Vector Signal Generator	6/27/2019	Annual	6/27/2020	US46240505
Agilent	N9020A	MXA Signal Analyzer	4/20/2019	Annual	4/20/2020	US46470561
Amplifier Research	150A100C	Amplifier	CBT	N/A	CBT	350132
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343971
Anritsu	MA24106A	USB Power Sensor	6/21/2019	Annual	6/21/2020	1244515
Anritsu	MA24106A	USB Power Sensor	7/8/2019	Annual	7/8/2020	1248508
Anritsu	MA24106A	USB Power Sensor	1/31/2019	Annual	1/31/2020	1520503
Anritsu	MA24106A	USB Power Sensor	1/31/2019	Annual	1/31/2020	1520501
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	ML2495A	Power Meter	11/20/2018	Annual	11/20/2019	1039008
Anritsu	ML2496A	Power Meter	10/21/2018	Annual	10/21/2019	1138001
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330158
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181292054
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181292061
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181334698
Control Company	4352	Ultra Long Stem Thermometer	8/2/2018	Biennial	8/2/2020	181292000
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	AT/N6705B	DC Power Supply	CBT	N/A	CBT	MY53001315
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	NC-100	Torque Wrench	11/1/2017	Biennial	11/1/2019	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	6/24/2019	Annual	6/24/2020	101699
Rohde & Schwarz	CMW500	Radio Communication Tester	6/26/2019	Annual	6/26/2020	108843
Rohde & Schwarz	CMW500	Radio Communication Tester	4/15/2019	Annual	4/15/2020	167284
Rohde & Schwarz	CMW500	Radio Communication Tester	4/17/2019	Annual	4/17/2020	167285
Seekonk	NC-100	Torque Wrench	11/1/2017	Biennial	11/1/2019	22313
Seekonk	NC-100	Torque Wrench	5/23/2018	Biennial	5/23/2020	N/A
Seekonk	NC-100	Torque Wrench	4/18/2018	Biennial	4/18/2020	N/A
SPEAG	D750V3	750 MHz SAR Dipole	5/18/2018	Biennial	5/18/2020	1034
SPEAG	D750V3	750 MHz SAR Dipole	9/8/2017	Biennial	9/8/2019	1097
SPEAG	D835V2	835 MHz SAR Dipole	6/20/2019	Annual	6/20/2020	4d040
SPEAG	D1750V2	1750 MHz SAR Dipole	6/19/2019	Annual	6/19/2020	1083
SPEAG	D1750V2	1750 MHz SAR Dipole	5/15/2018	Biennial	5/15/2020	1092
SPEAG	D1900V2	1900 MHz SAR Dipole	9/7/2017	Biennial	9/7/2019	5d181
SPEAG	D1900V2	1900 MHz SAR Dipole	6/19/2019	Annual	6/19/2020	5d030
SPEAG	D2450V2	2450 MHz SAR Dipole	6/14/2019	Annual	6/14/2020	750
SPEAG	D2450V2	2450 MHz SAR Dipole	11/12/2018	Annual	11/12/2019	921
SPEAG	D2600V2	2600 MHz SAR Dipole	9/11/2017	Biennial	9/11/2019	1069
SPEAG	D5GHzV2	5 GHz SAR Dipole	3/13/2018	Biennial	3/13/2020	1123
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/13/2018	Annual	9/13/2019	1163
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/18/2018	Annual	10/18/2019	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/14/2018	Annual	8/14/2019	1408
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/17/2019	Annual	4/17/2020	501
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/13/2019	Annual	2/13/2020	1403
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/14/2019	Annual	6/14/2020	701
SPEAG	DAE4	Data Acquisition Electronics	1/15/2019	Annual	1/15/2020	1532
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/7/2019	Annual	5/7/2020	1070
SPEAG	ES3DV3	SAR Probe	11/19/2018	Annual	11/19/2019	3318
SPEAG	EX3DV4	SAR Probe	6/19/2019	Annual	6/19/2020	7416
SPEAG	EX3DV4	SAR Probe	9/18/2018	Annual	9/18/2019	7420
SPEAG	EX3DV4	SAR Probe	1/24/2019	Annual	1/24/2020	7490
SPEAG	EX3DV4	SAR Probe	2/19/2019	Annual	2/19/2020	7427
SPEAG	EX3DV4	SAR Probe	4/12/2019	Annual	4/12/2020	7532

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.

Note: All equipment used within its calibration period.

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15 MEASUREMENT UNCERTAINTIES

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

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16 CONCLUSION

16.1 Measurement Conclusion

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

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

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

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APPENDIX A: SAR TEST DATA

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PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02547

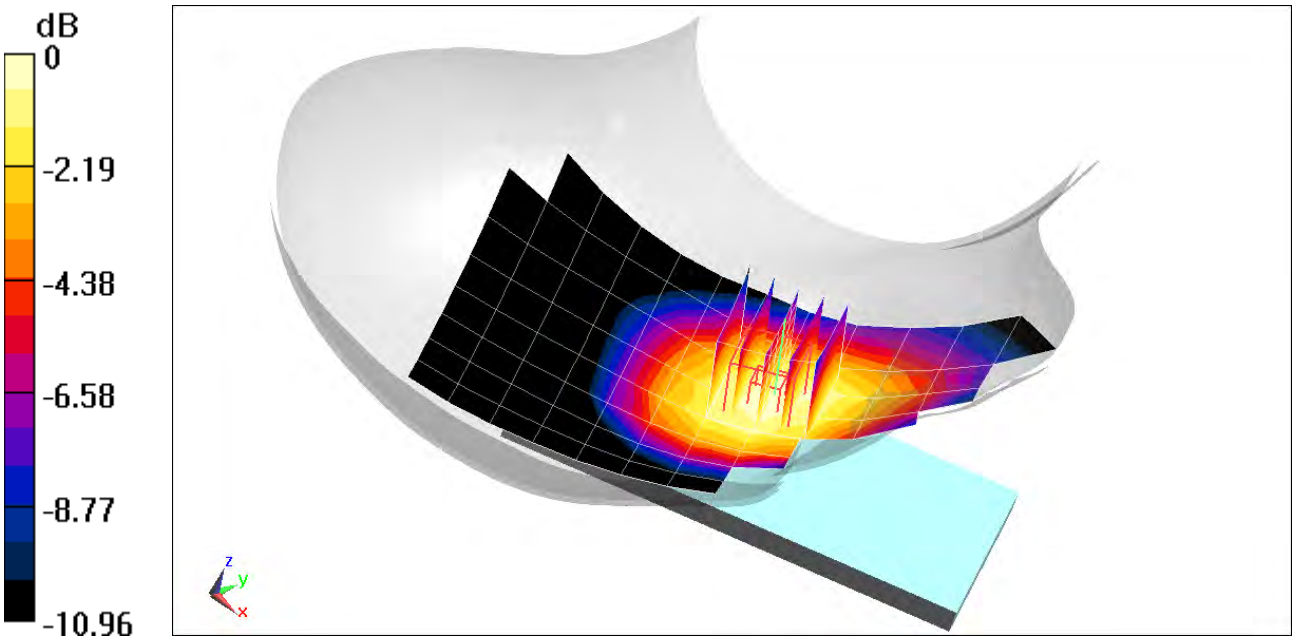
Communication System: UID 0, GSM; Frequency: 848.8 MHz; Duty Cycle: 1:8.3
Medium: 835 MHz Head; Medium parameters used (interpolated):
f = 848.8 MHz; σ = 0.939 S/m; ε_r = 43.449; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-24-2019; Ambient Temp: 22.5°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7420; ConvF(9.68, 9.68, 9.68) @ 848.8 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.64 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.282 W/kg
SAR(1 g) = 0.218 W/kg



0 dB = 0.260 W/kg = -5.85 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05995

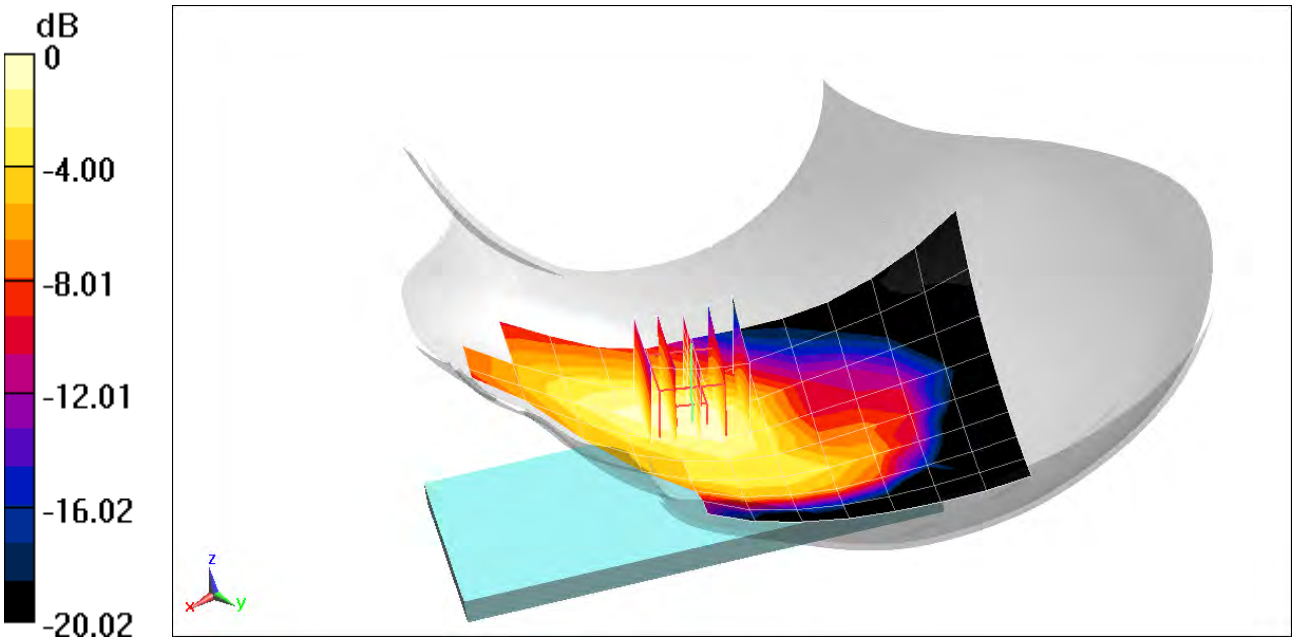
Communication System: UID 0, GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 MHz Head; Medium parameters used:
f = 1880 MHz; σ = 1.425 S/m; ε_r = 41.016; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-01-2019; Ambient Temp: 22.1°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN7490; ConvF(8.27, 8.27, 8.27) @ 1880 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.54 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.225 W/kg
SAR(1 g) = 0.146 W/kg



0 dB = 0.190 W/kg = -7.21 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02547

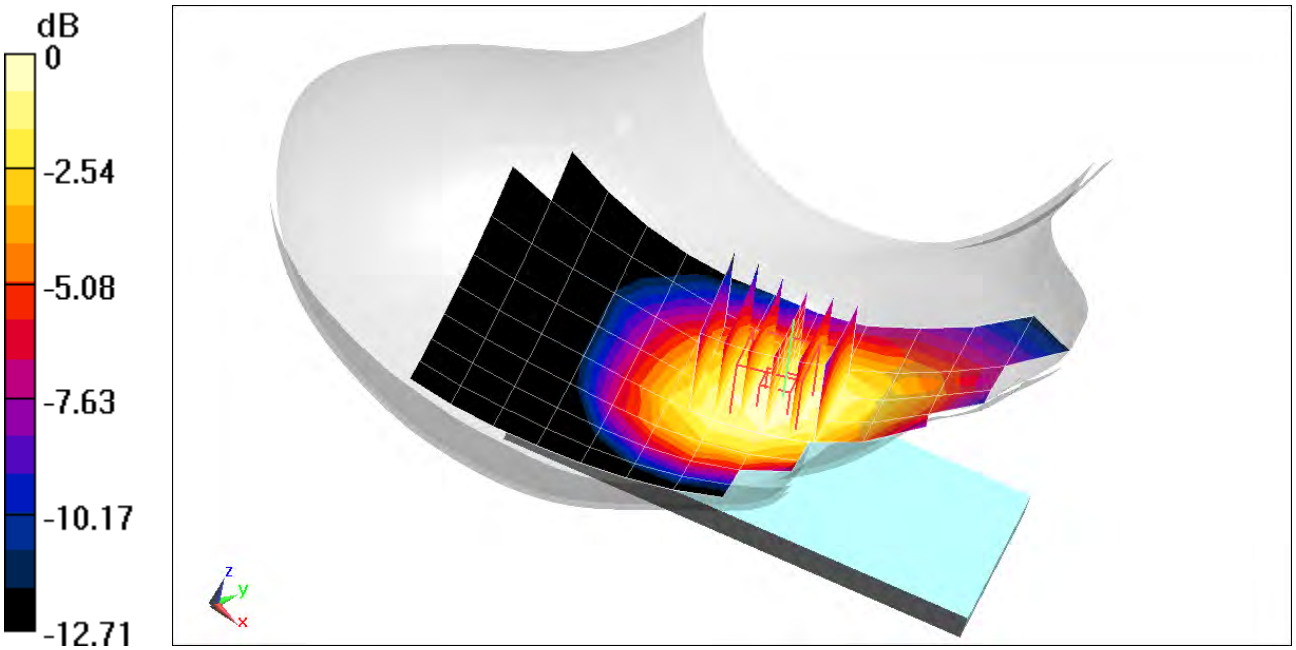
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 MHz Head; Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.934 S/m; ε_r = 43.498; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-24-2019; Ambient Temp: 22.5°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7420; ConvF(9.68, 9.68, 9.68) @ 836.6 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: UMTS 850, Right Head, Cheek, 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 = 14.63 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.248 W/kg
SAR(1 g) = 0.193 W/kg



0 dB = 0.229 W/kg = -6.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02513

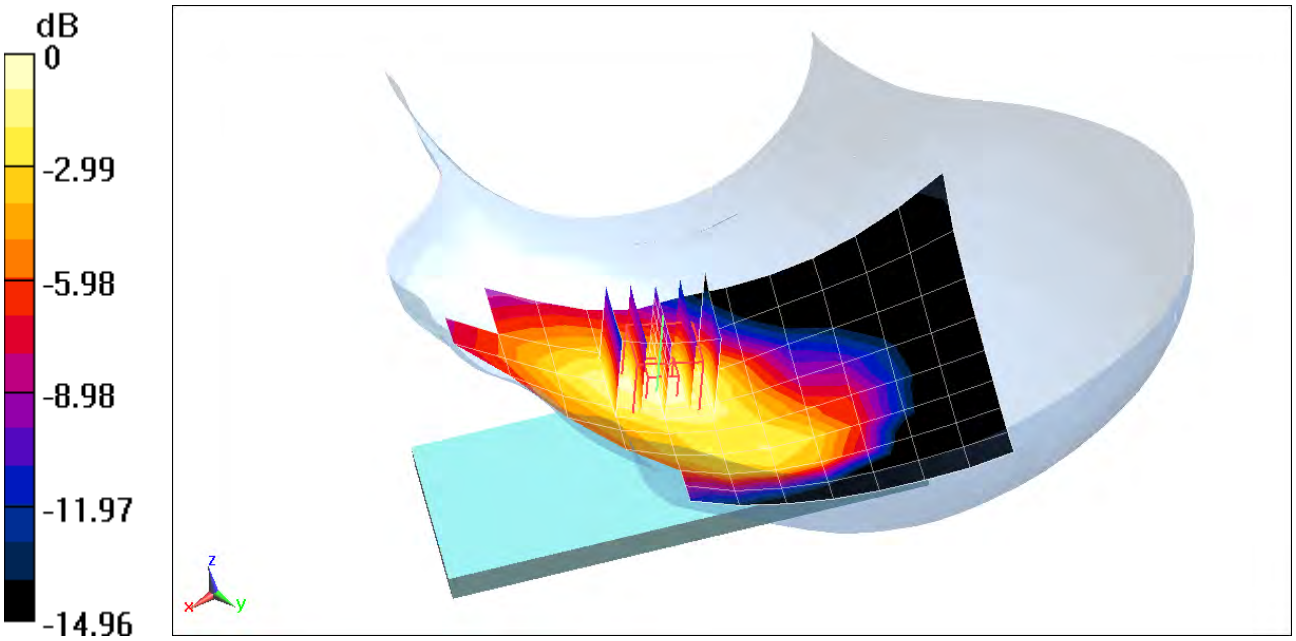
Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Head; Medium parameters used (interpolated):
f = 1732.4 MHz; σ = 1.355 S/m; ε_r = 38.647; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 07-23-2019; Ambient Temp: 21.3°C; Tissue Temp: 20.5°C

Probe: EX3DV4 - SN7427; ConvF(8.58, 8.58, 8.58) @ 1732.4 MHz; Calibrated: 2/19/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1403; Calibrated: 2/13/2019
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: UMTS 1750, Left Head, Cheek, Mid.ch

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.39 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.396 W/kg
SAR(1 g) = 0.261 W/kg



0 dB = 0.345 W/kg = -4.62 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05995

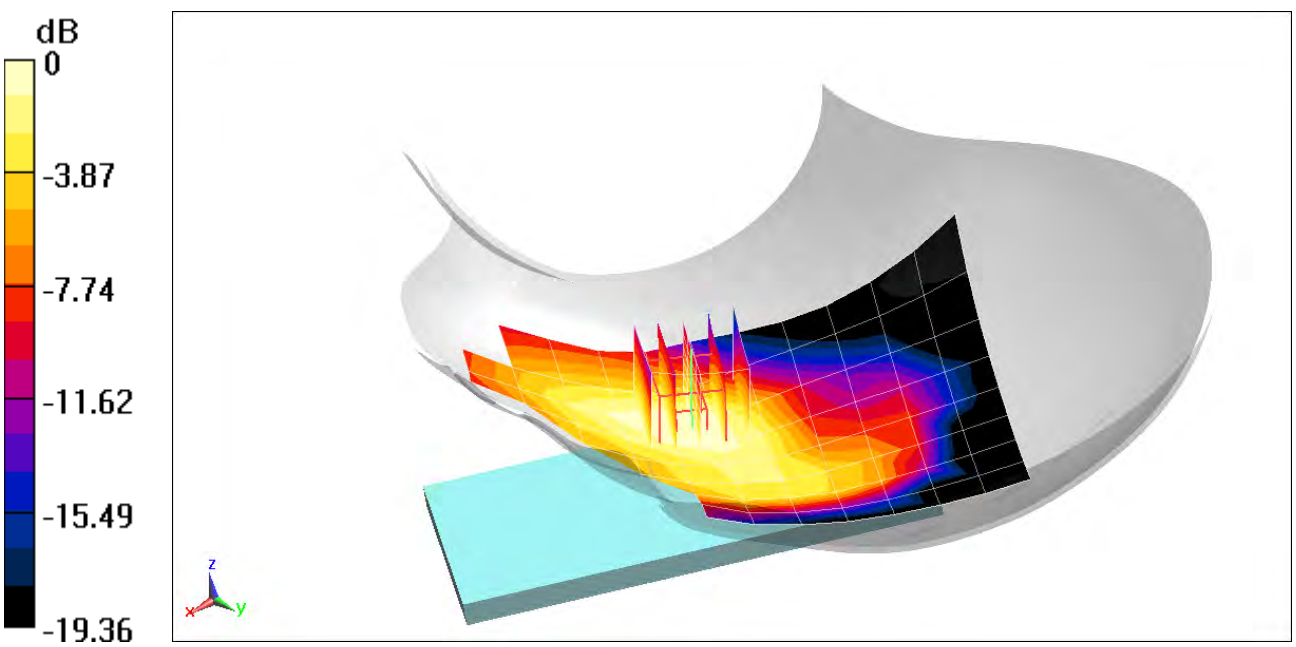
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Head; Medium parameters used:
f = 1880 MHz; σ = 1.425 S/m; ε_r = 41.016; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-01-2019; Ambient Temp: 22.1°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN7490; ConvF(8.27, 8.27, 8.27) @ 1880 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.14 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.401 W/kg
SAR(1 g) = 0.261 W/kg



0 dB = 0.337 W/kg = -4.72 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02513

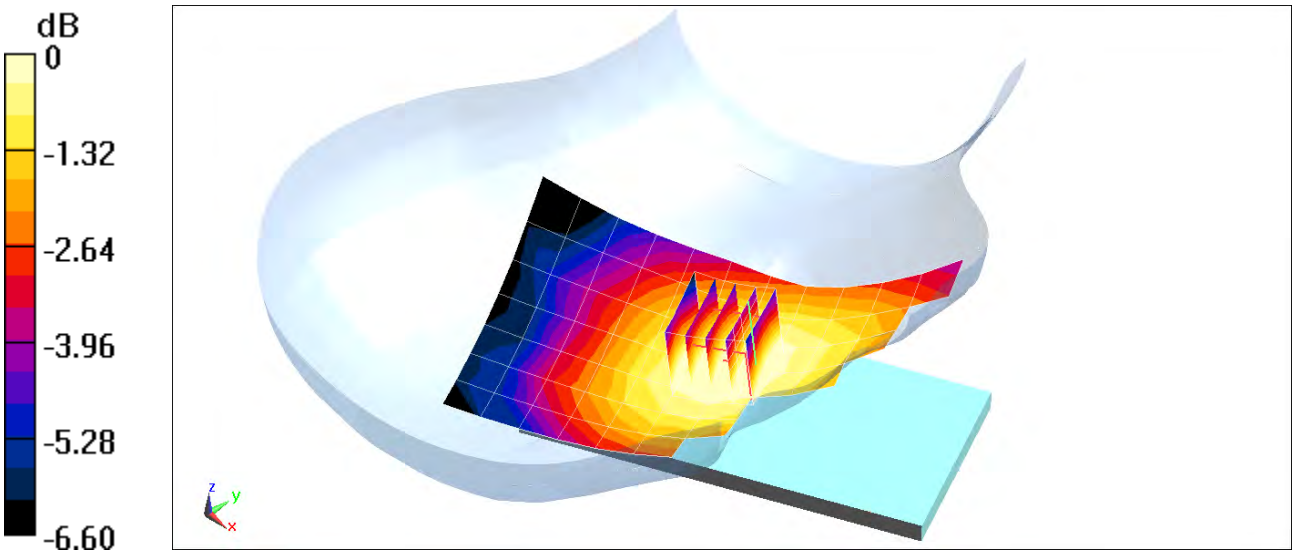
Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: 750 MHz Head; Medium parameters used (interpolated):
f = 707.5 MHz; σ = 0.871 S/m; ε_r = 41.039; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-26-2019; Ambient Temp: 22.4 C; Tissue Temp: 20.3C

Probe: EX3DV4 - SN7427; ConvF(10.11, 10.11, 10.11) @ 707.5 MHz; Calibrated: 2/19/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1403; Calibrated: 2/13/2019
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 12, Right Head, Cheek, 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 = 13.83 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.183 W/kg
SAR(1 g) = 0.150 W/kg



0 dB = 0.117 W/kg = -9.32 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02497

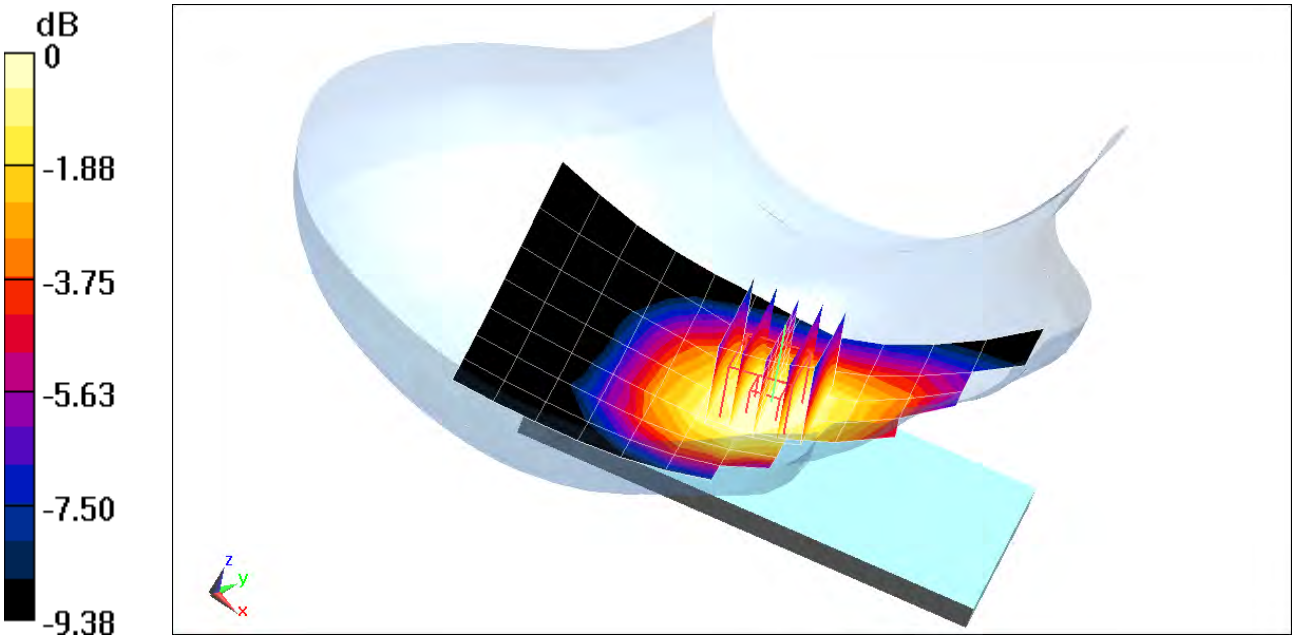
Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1
Medium: 750 MHz Head; Medium parameters used (interpolated):
f = 782 MHz; σ = 0.899 S/m; ε_r = 40.813; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-26-2019; Ambient Temp: 22.4 C; Tissue Temp: 20.3C

Probe: EX3DV4 - SN7427; ConvF(10.11, 10.11, 10.11) @ 782 MHz; Calibrated: 2/19/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1403; Calibrated: 2/13/2019
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.11 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.116 W/kg
SAR(1 g) = 0.094 W/kg



0 dB = 0.110 W/kg = -9.59 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02513

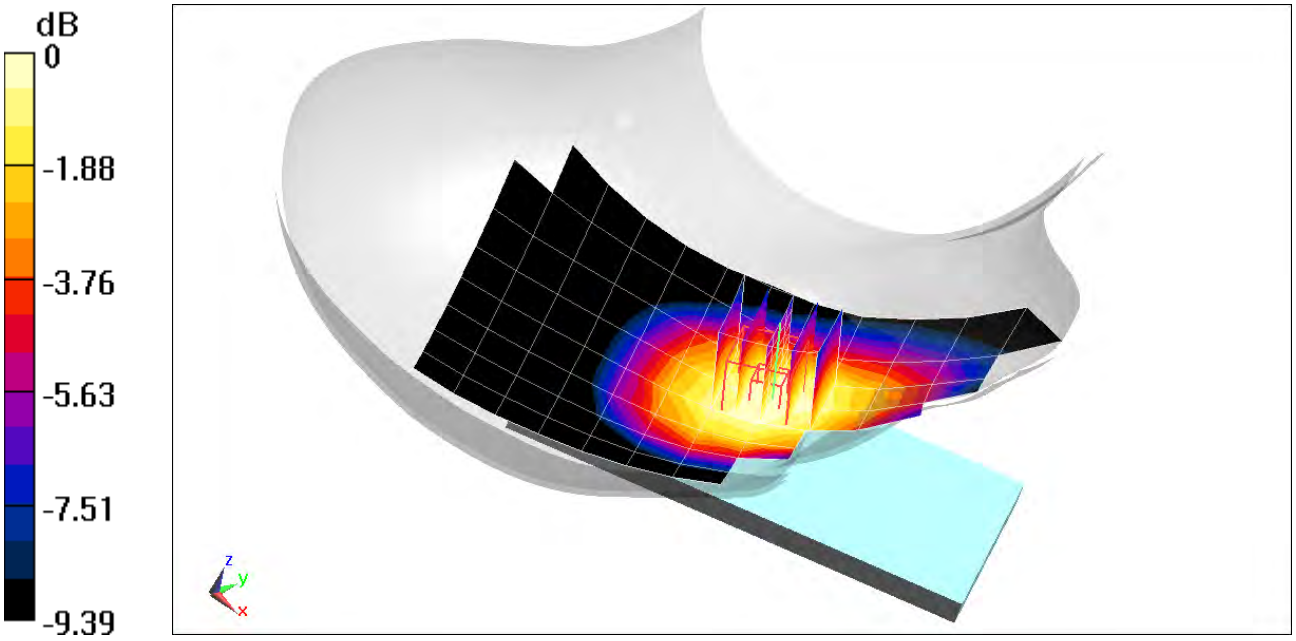
Communication System: UID 0, LTE Band 5 (Cell.); Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 MHz Head; Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.934 S/m; ε_r = 43.498; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-24-2019; Ambient Temp: 22.5°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7420; ConvF(9.68, 9.68, 9.68) @ 836.5 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.04 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.319 W/kg
SAR(1 g) = 0.245 W/kg



0 dB = 0.292 W/kg = -5.35 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05995

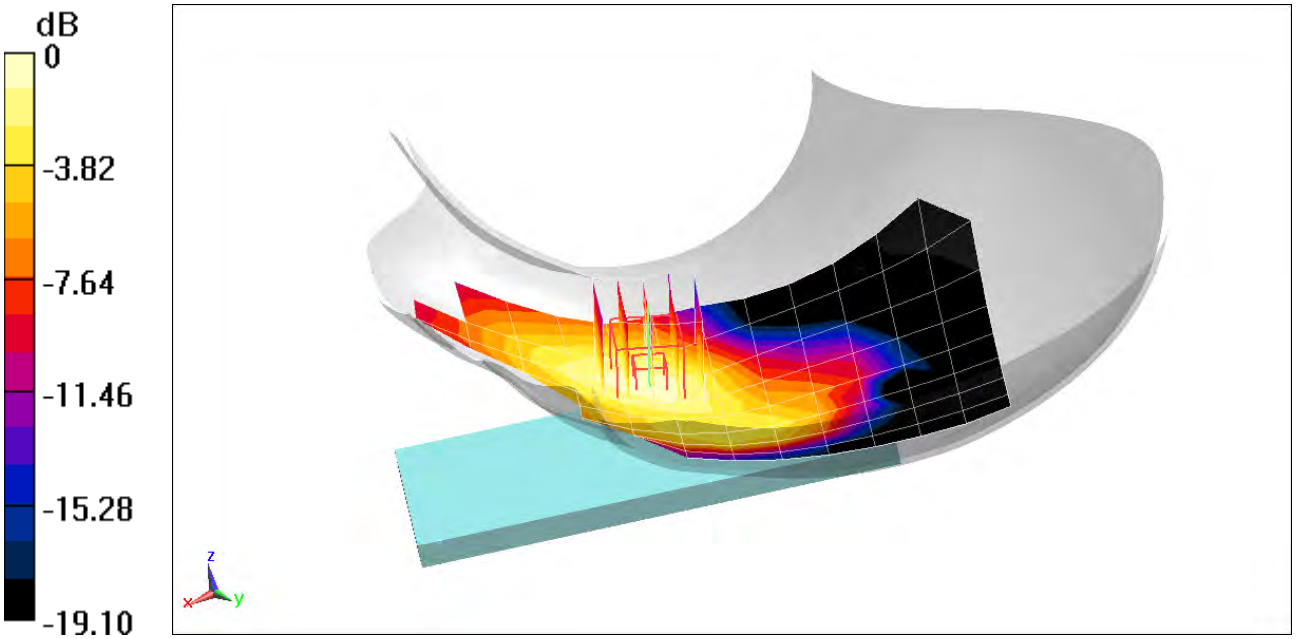
Communication System: UID 0, LTE Band 66 (AWS); Frequency: 1720 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Head; Medium parameters used (interpolated):
f = 1720 MHz; σ = 1.363 S/m; ε_r = 41.562; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-01-2019; Ambient Temp: 21.1°C; Tissue Temp: 21.1°C

Probe: EX3DV4 - SN7490; ConvF(8.79, 8.79, 8.79) @ 1720 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 66 (AWS), Left Head, Cheek, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.91 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.214 W/kg
SAR(1 g) = 0.140 W/kg



0 dB = 0.184 W/kg = -7.35 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05995

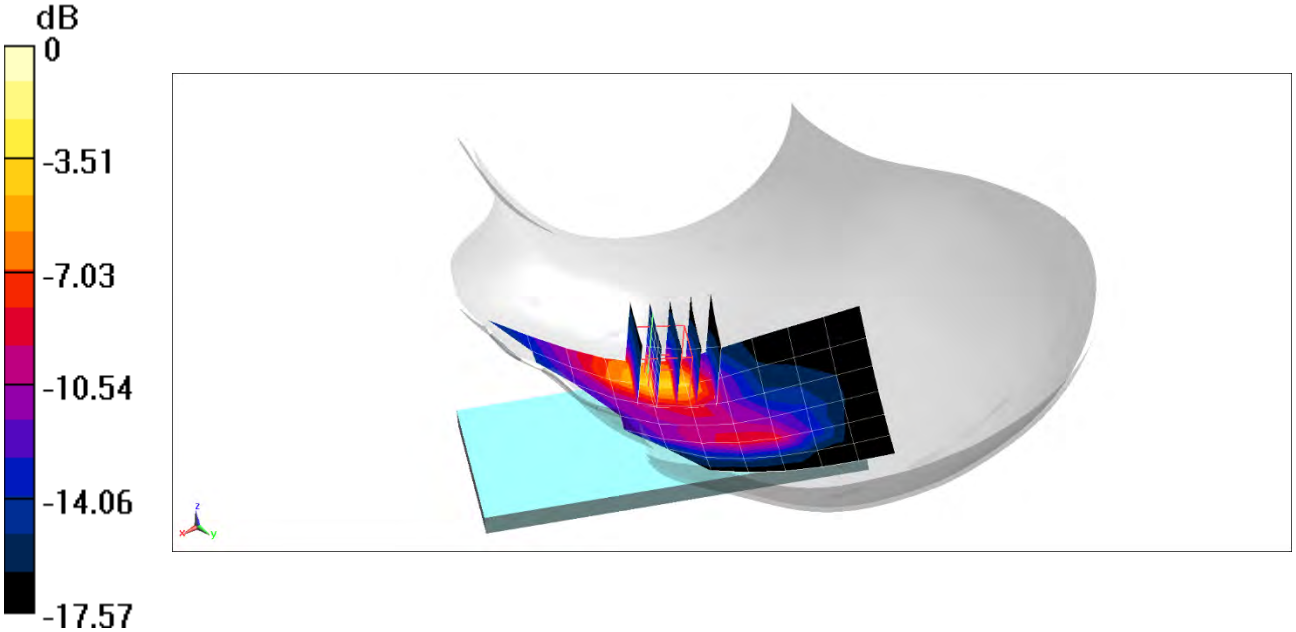
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1860 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Head; Medium parameters used (interpolated):
f = 1860 MHz; σ = 1.414 S/m; ε_r = 41.051; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-01-2019; Ambient Temp: 22.5°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN7416; ConvF(8.05, 8.05, 8.05) @ 1860 MHz; Calibrated: 6/19/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn701; Calibrated: 6/14/2019
Phantom: Twin-SAM V8.0_Left; Type: QD 000 P41 AA; Serial: 1935
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (7x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.20 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.504 W/kg
SAR(1 g) = 0.327 W/kg



0 dB = 0.430 W/kg = -3.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05995

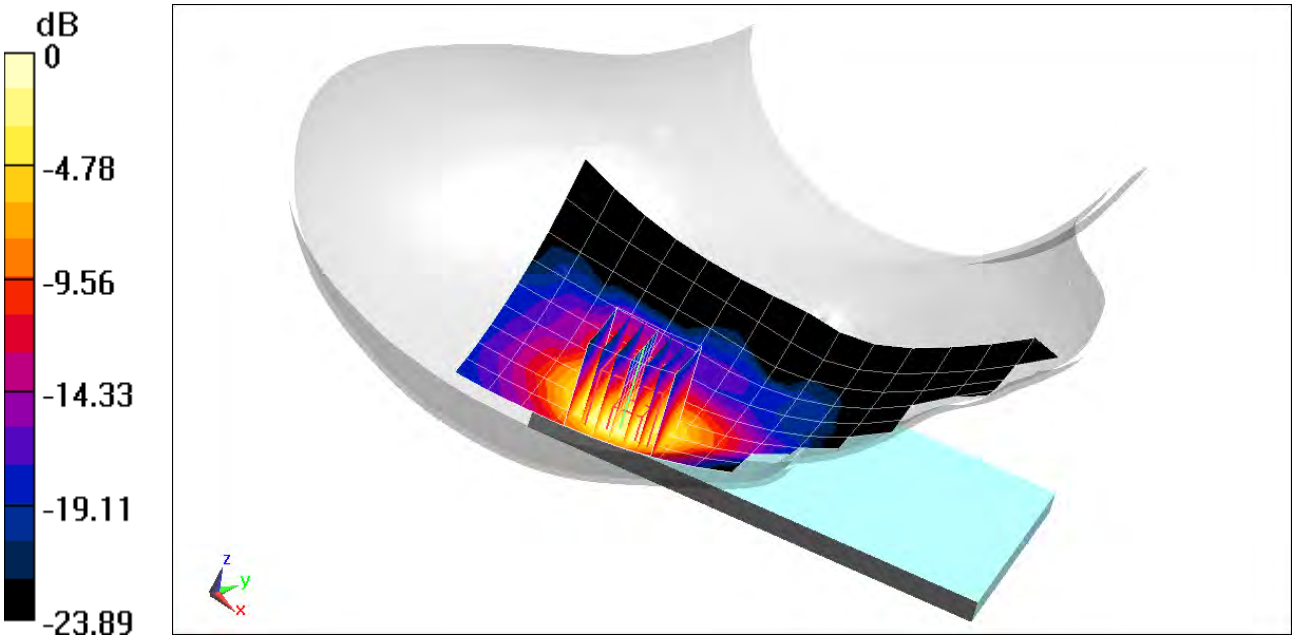
Communication System: UID 0, LTE Band 41; Frequency: 2549.5 MHz; Duty Cycle: 1:1.58
Medium: 2450-2600 MHz Head; Medium parameters used:
f = 2550 MHz; σ = 1.912 S/m; ε_r = 39.715; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 08-02-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7490; ConvF(7.48, 7.48, 7.48) @ 2549.5 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 41, Right Head, Cheek, Low-Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (10x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.41 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.972 W/kg
SAR(1 g) = 0.415 W/kg



0 dB = 0.748 W/kg = -1.26 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02547

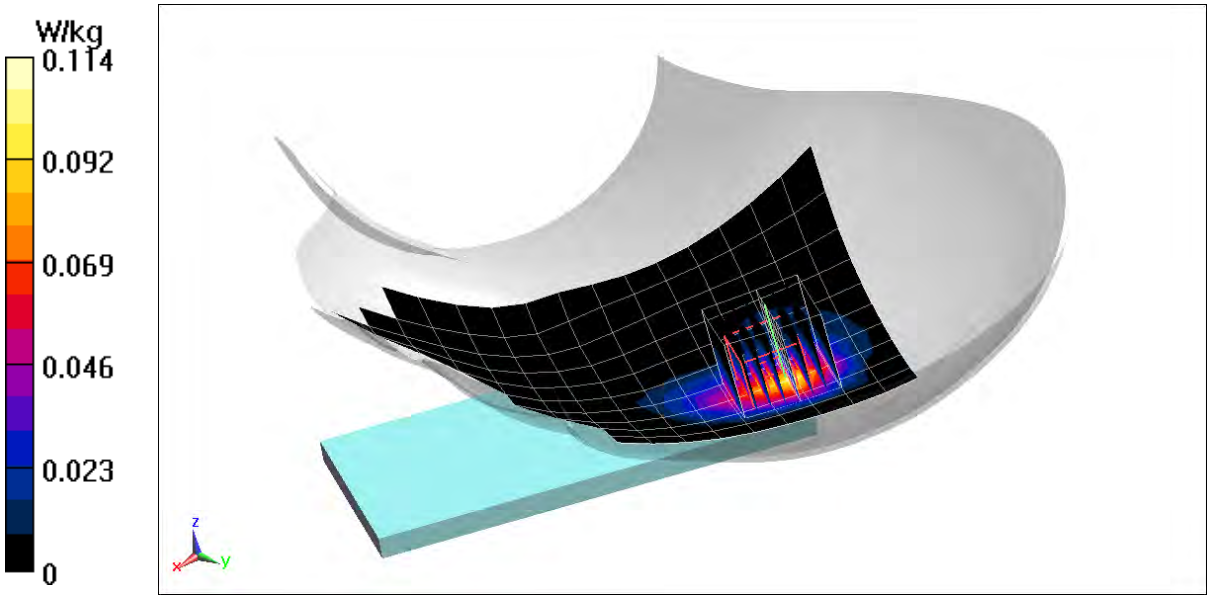
Communication System: UID 0, IEEE 802.11b; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Head; Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.82 S/m; ε_r = 39.111; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 07-26-2019; Ambient Temp: 21.6°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3318; ConvF(4.59, 4.59, 4.59) @ 2412 MHz; Calibrated: 11/19/2018
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 8/14/2018
Phantom: Twin-SAM V8.0; Type: QD 000 P41 Ax; Serial: 1936
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: IEEE 802.11b, 22 MHz Bandwidth,
Left Head, Cheek, Ch 01, 1 Mbps

Area Scan (11x18x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.501 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.196 W/kg
SAR(1 g) = 0.091 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02513

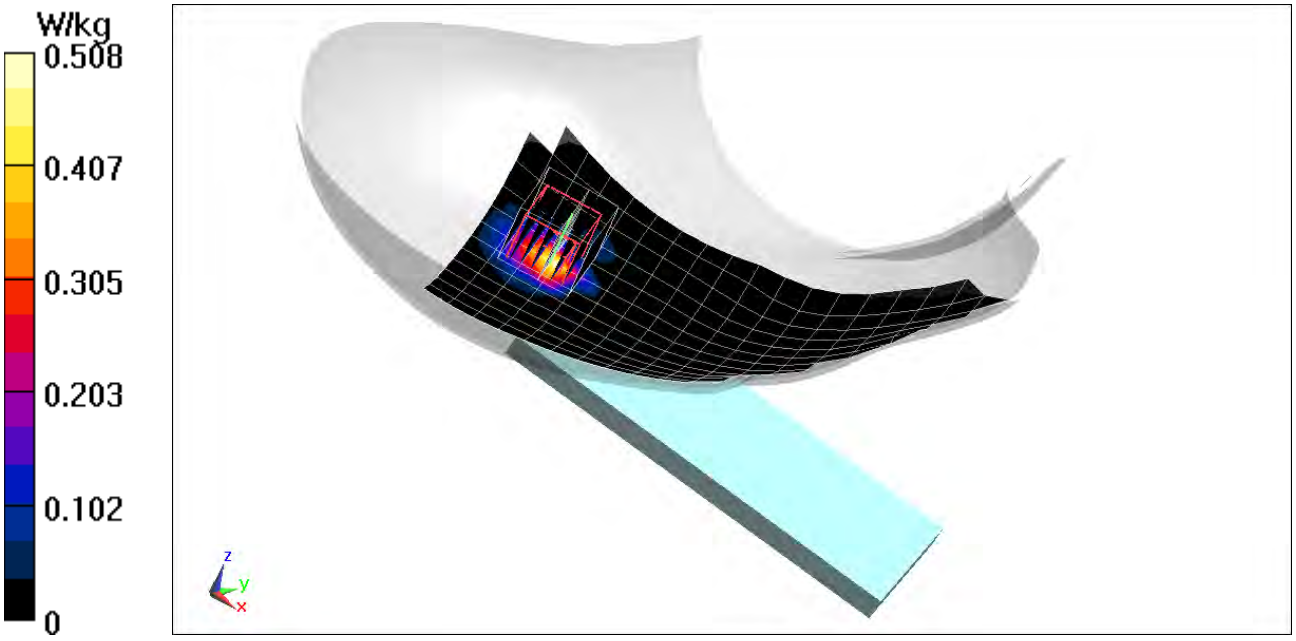
Communication System: UID 0, _IEEE 802.11n; Frequency: 5755 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head; Medium parameters used (interpolated):
f = 5755 MHz; σ = 5.167 S/m; ε_r = 35.41; ρ = 1000 kg/m^3
Phantom section: Right Section

Test Date: 07-29-2019; Ambient Temp: 22.7°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7490; ConvF(4.85, 4.85, 4.85) @ 5755 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: IEEE 802.11n, U-NII-3, 40 MHz Bandwidth, Right Head, Tilt, Ch 151, 13.5 Mbps

Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 2.878 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.830 W/kg
SAR(1 g) = 0.198 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02448

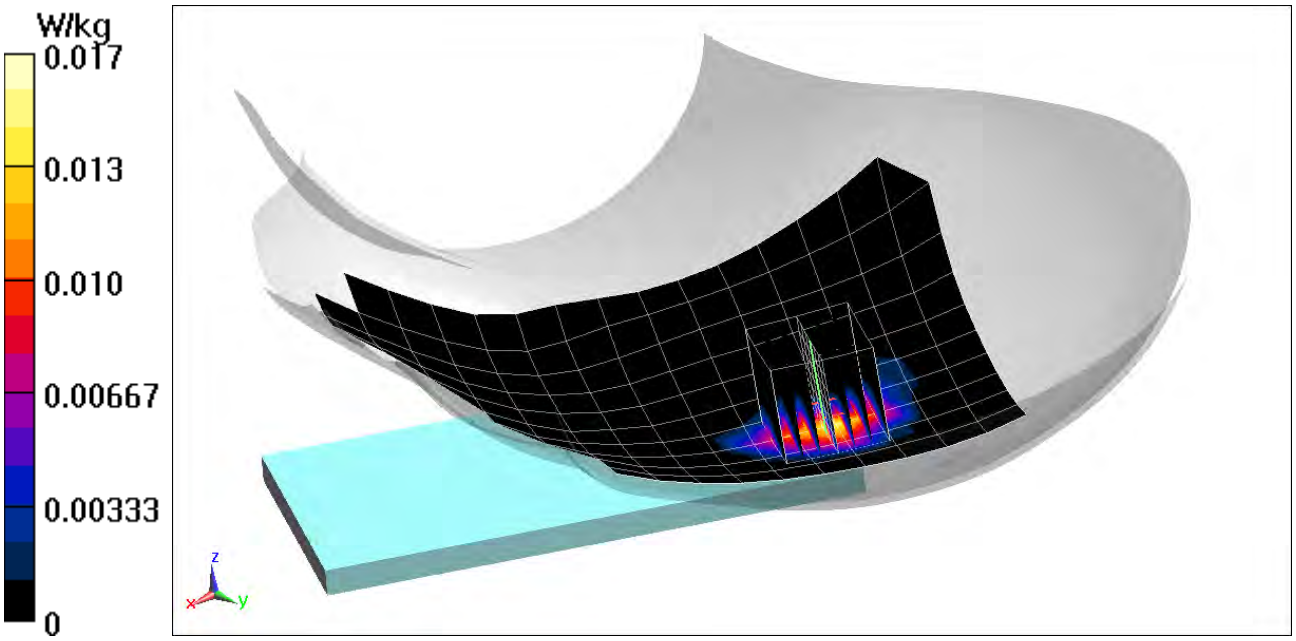
Communication System: UID 0, Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1.305
Medium: 2450 MHz Head; Medium parameters used (interpolated):
f = 2441 MHz; σ = 1.871 S/m; ε_r = 38.694; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 07-29-2019; Ambient Temp: 22.5°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3318; ConvF(4.59, 4.59, 4.59) @ 2441 MHz; Calibrated: 11/19/2018
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 8/14/2018
Phantom: Twin-SAM V8.0; Type: QD 000 P41 Ax; Serial: 1936
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: Bluetooth, Left Head, Cheek, Ch 39, 1 Mbps

Area Scan (11x19x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.870 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 0.0240 W/kg
SAR(1 g) = 0.012 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02448

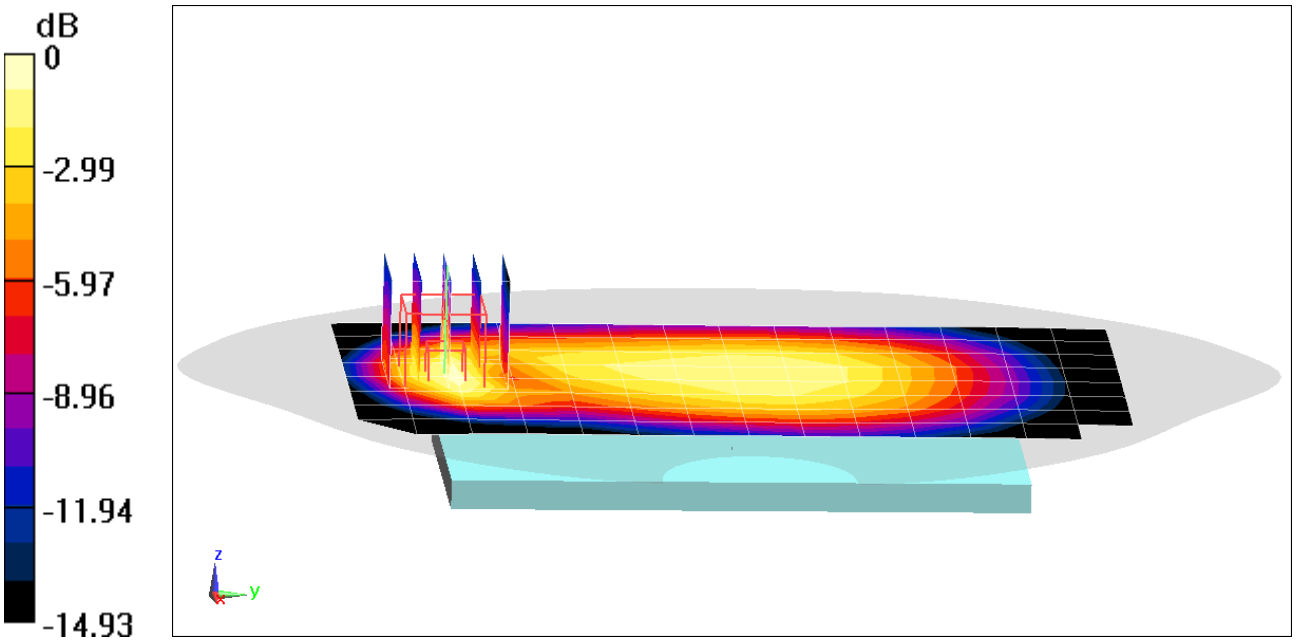
Communication System: UID 0, GSM; Frequency: 848.8 MHz; Duty Cycle: 1:8.3
Medium: 835 MHz Body; Medium parameters used (interpolated):
f = 848.8 MHz; σ = 0.993 S/m; ε_r = 53.759; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-25-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.14, 10.14, 10.14) @ 848.8 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: GSM 850, Body SAR, Back side, High.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 = 16.45 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.427 W/kg
SAR(1 g) = 0.245 W/kg



0 dB = 0.363 W/kg = -4.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02448

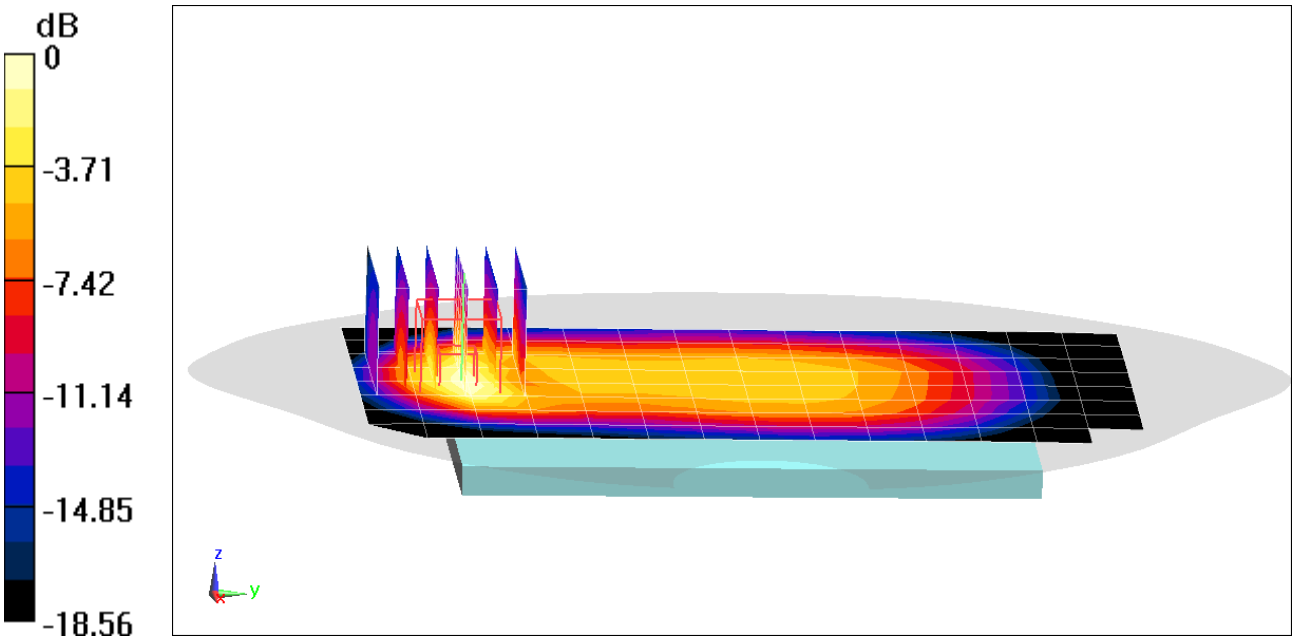
Communication System: UID 0, GSM GPRS; 4 Tx slots; Frequency: 848.8 MHz; Duty Cycle: 1:2.076
Medium: 835 MHz Body; Medium parameters used (interpolated):
f = 848.8 MHz; σ = 0.993 S/m; ε_r = 53.759; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.14, 10.14, 10.14) @ 848.8 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: GPRS 850, Body SAR, Back side, High.ch, 4 Tx Slots

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 30.97 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.57 W/kg
SAR(1 g) = 0.837 W/kg



0 dB = 1.31 W/kg = 1.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

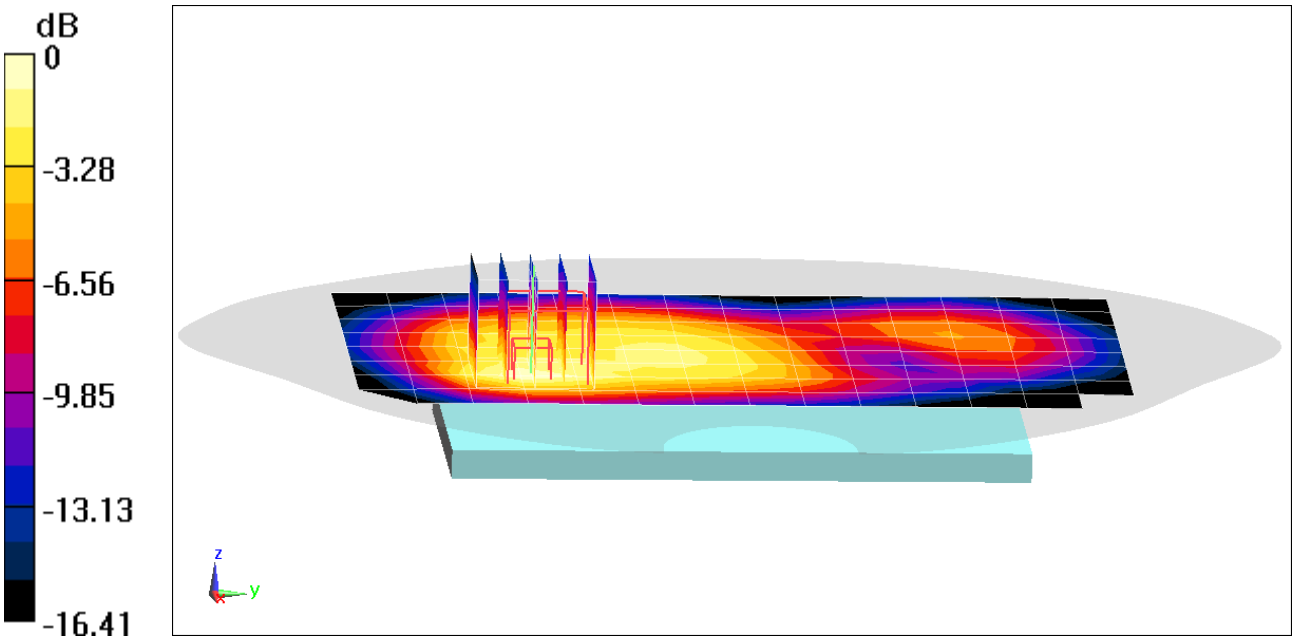
Communication System: UID 0, GSM; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Medium: 1900 MHz Body; Medium parameters used:
f = 1880 MHz; σ = 1.524 S/m; ε_r = 51.365; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date:08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.03, 8.03, 8.03) @ 1880 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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 = 10.20 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.243 W/kg
SAR(1 g) = 0.144 W/kg



0 dB = 0.208 W/kg = -6.82 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

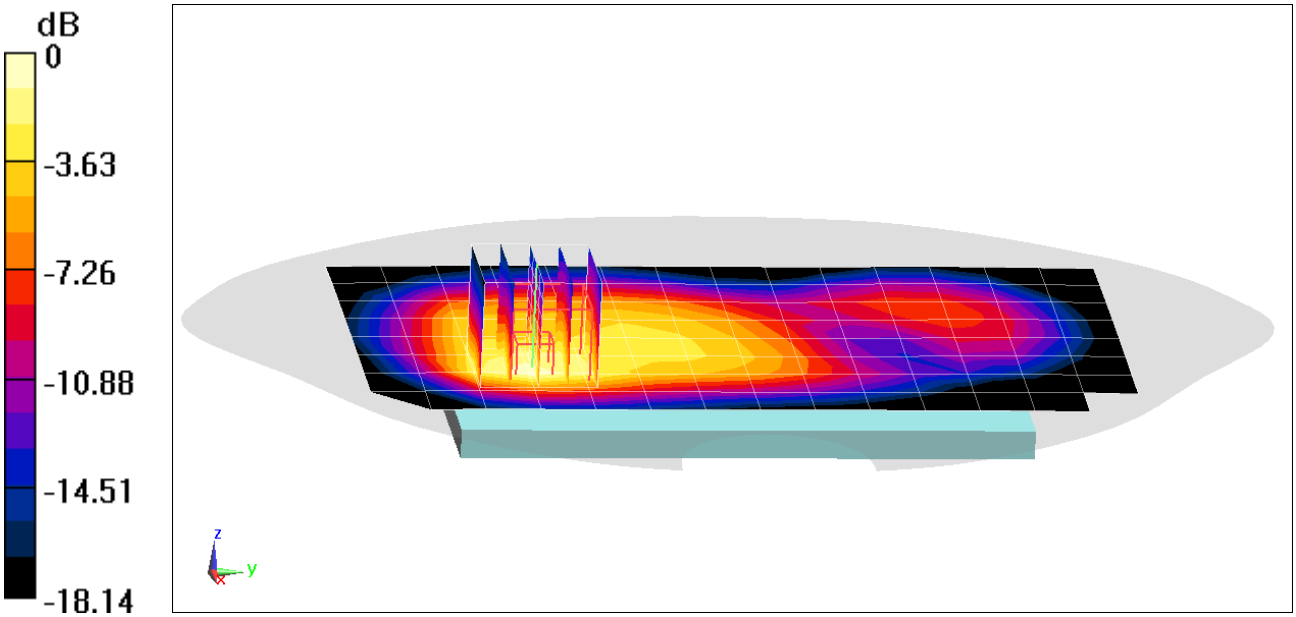
Communication System: UID 0, _GSM GPRS; 3 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:2.76
Medium: 1900 MHz Body; Medium parameters used:
f = 1880 MHz; σ = 1.524 S/m; ε_r = 51.365; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date:08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.03, 8.03, 8.03) @ 1880 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: GPRS 1900, Body SAR, Back side, Mid.ch, 3 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 = 16.15 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.625 W/kg
SAR(1 g) = 0.351 W/kg



0 dB = 0.523 W/kg = -2.81 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02497

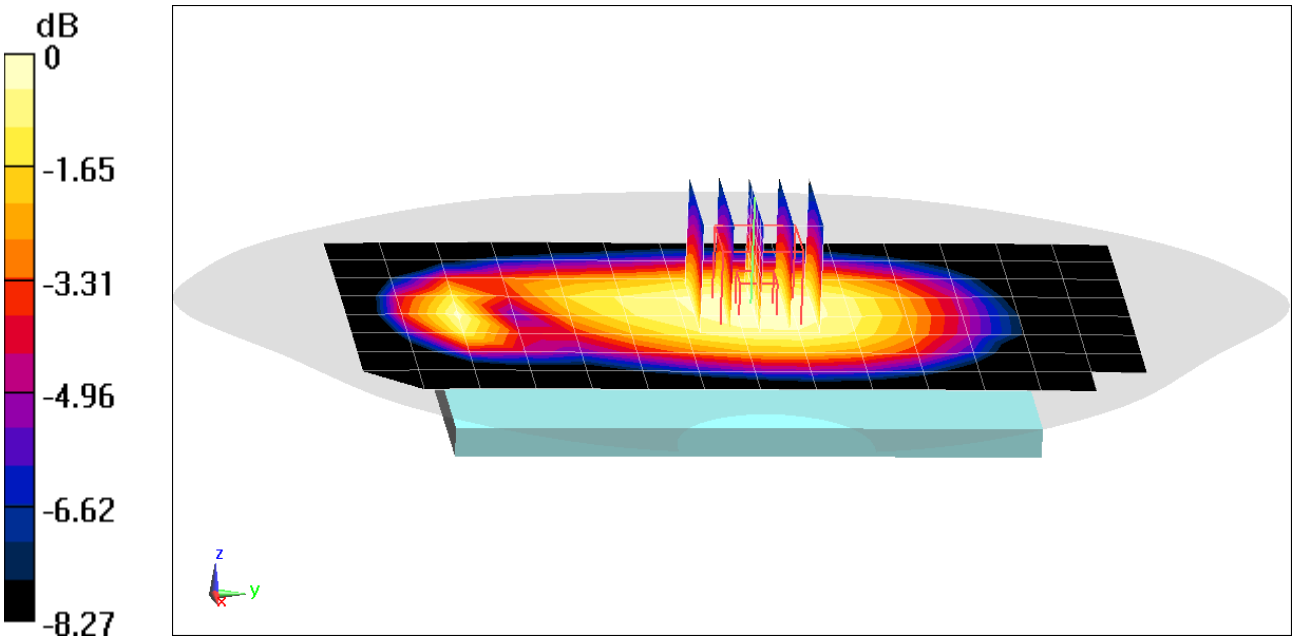
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 MHz Body; Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.988 S/m; ε_r = 53.801; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-25-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.14, 10.14, 10.14) @ 836.6 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.78 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.366 W/kg
SAR(1 g) = 0.272 W/kg



0 dB = 0.330 W/kg = -4.81 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02497

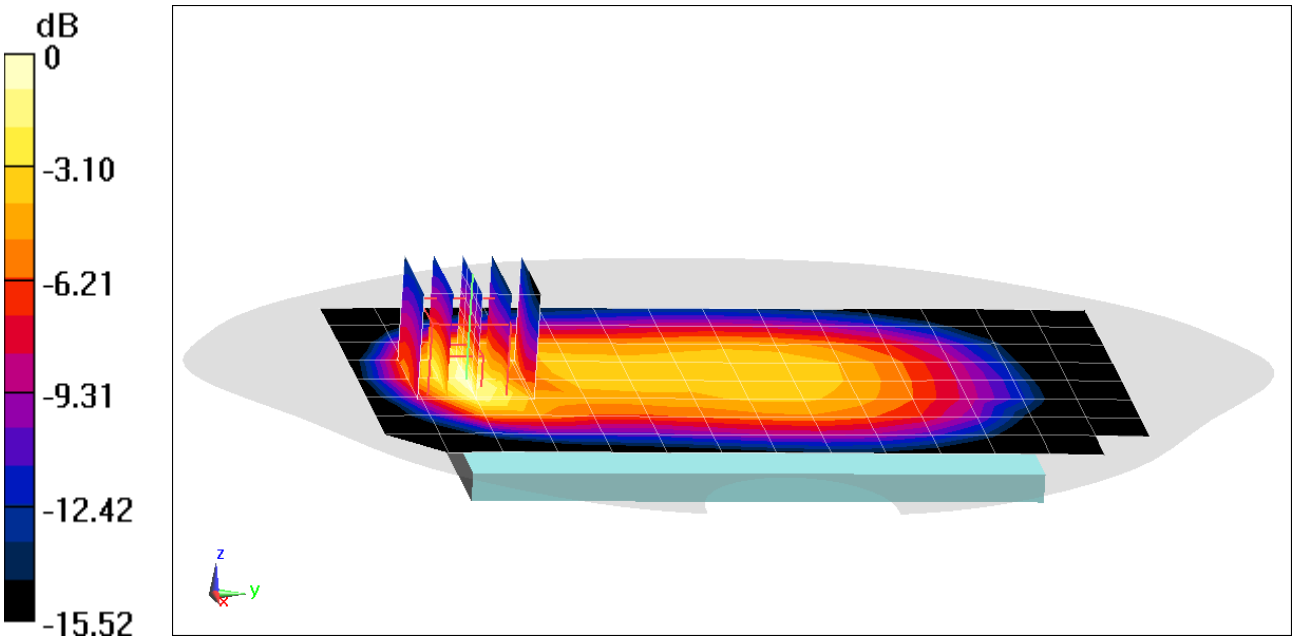
Communication System: UID 0, UMTS; Frequency: 836.6 MHz; Duty Cycle: 1:1
Medium: 835 MHz Body; Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.988 S/m; ε_r = 53.801; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.14, 10.14, 10.14) @ 836.6 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.47 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.938 W/kg
SAR(1 g) = 0.494 W/kg



0 dB = 0.768 W/kg = -1.15 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

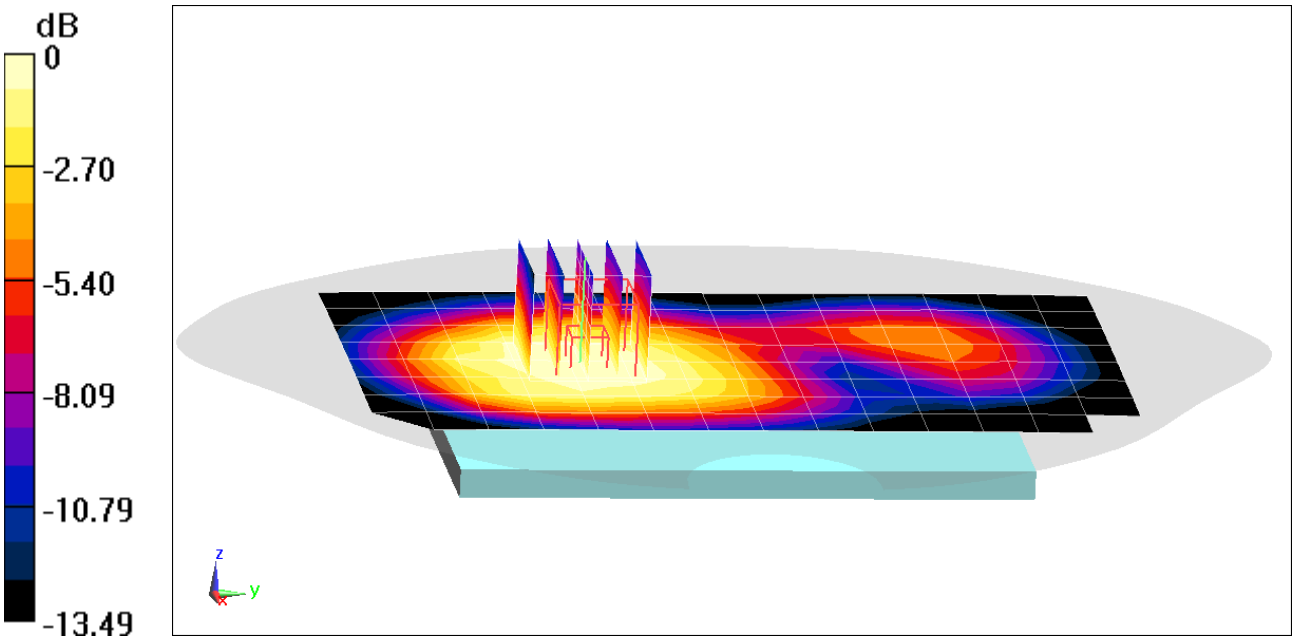
Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Body; Medium parameters used (interpolated):
f = 1732.4 MHz; σ = 1.425 S/m; ε_r = 51.591; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date:08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.44, 8.44, 8.44) @ 1732.4 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: UMTS 1750, Body SAR, Back side, Mid.ch

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.44 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.322 W/kg
SAR(1 g) = 0.215 W/kg



0 dB = 0.285 W/kg = -5.45 dBW/kg

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

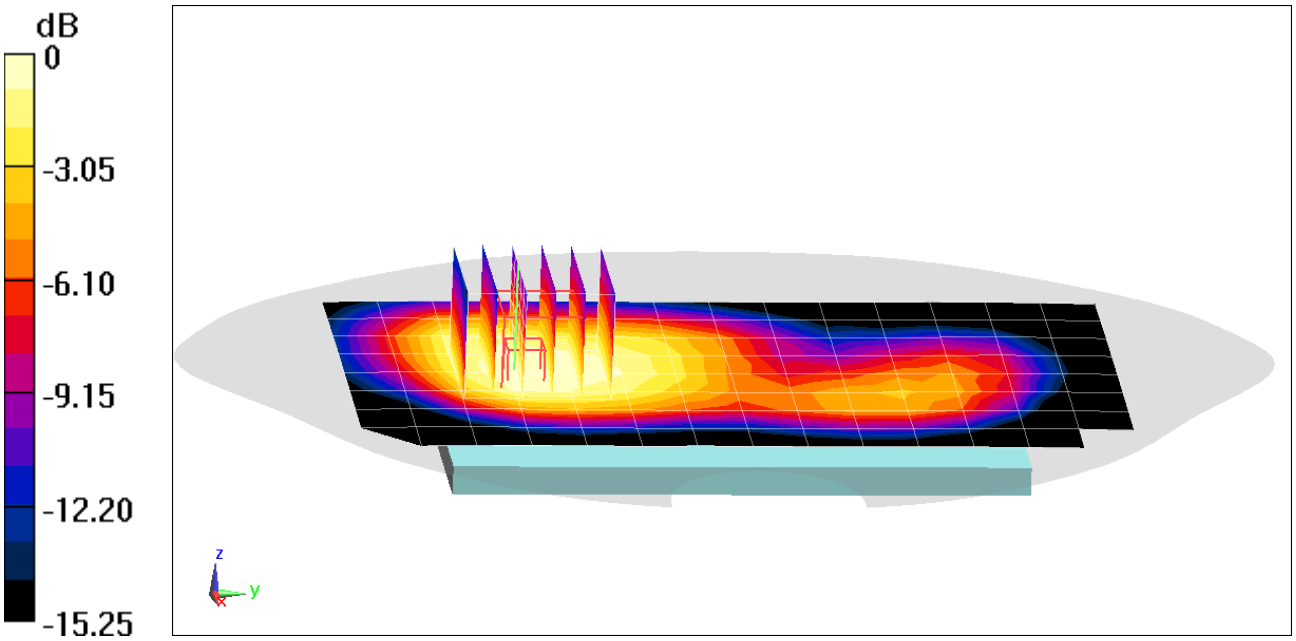
Communication System: UID 0, UMTS; Frequency: 1732.4 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Body; Medium parameters used (interpolated):
f = 1732.4 MHz; σ = 1.425 S/m; ε_r = 51.591; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date:08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.44, 8.44, 8.44) @ 1732.4 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: UMTS 1750, Body SAR, Front 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 = 17.89 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.628 W/kg
SAR(1 g) = 0.425 W/kg



0 dB = 0.553 W/kg = -2.57 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

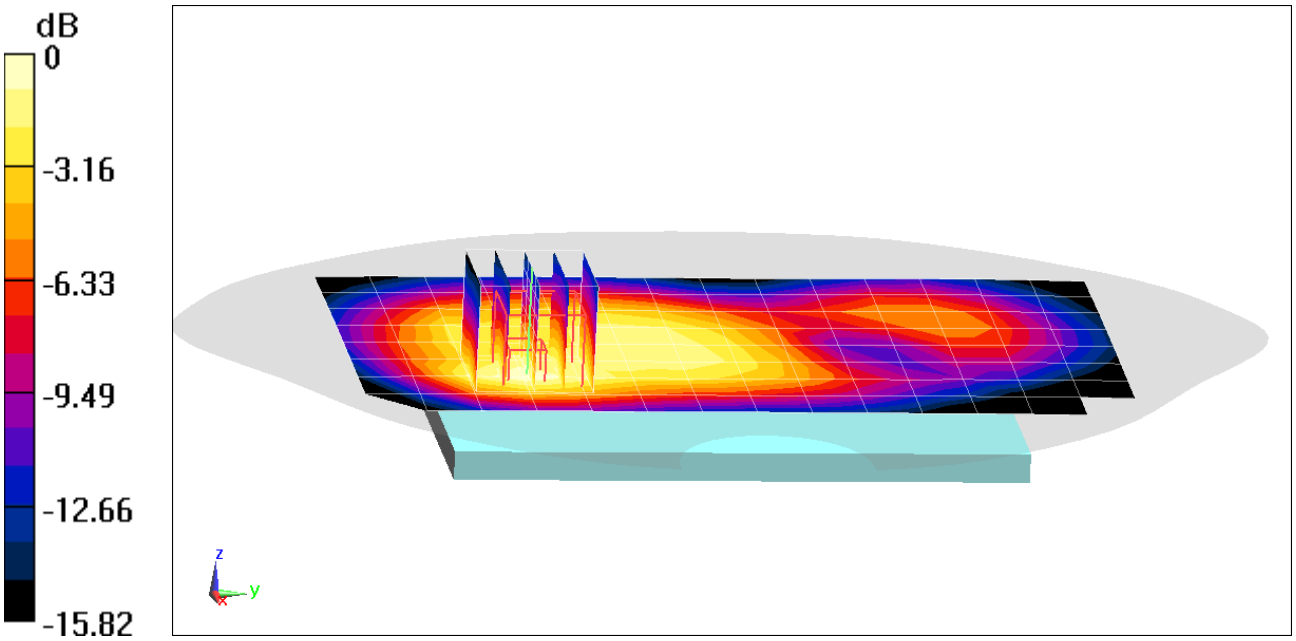
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Body; Medium parameters used:
f = 1880 MHz; σ = 1.524 S/m; ε_r = 51.365; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date:08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.03, 8.03, 8.03) @ 1880 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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 = 13.78 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.441 W/kg
SAR(1 g) = 0.262 W/kg



0 dB = 0.373 W/kg = -4.28 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

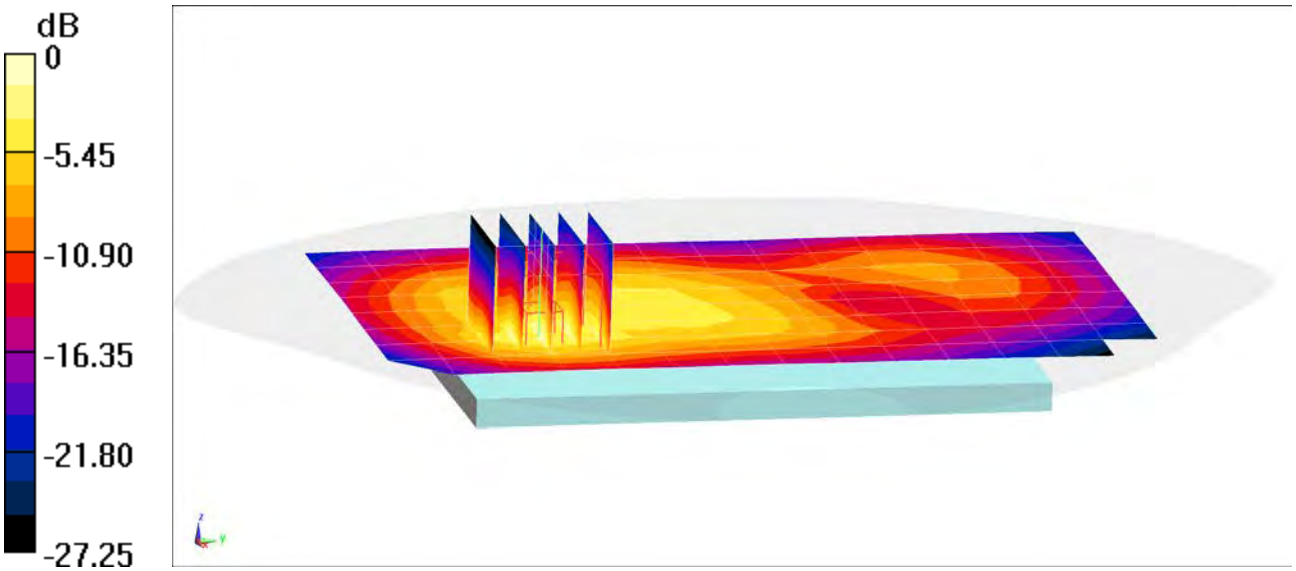
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Body; Medium parameters used:
f = 1880 MHz; σ = 1.524 S/m; ε_r = 51.365; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date:08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.03, 8.03, 8.03) @ 1880 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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 = 20.05 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.958 W/kg
SAR(1 g) = 0.545 W/kg



0 dB = 0.807 W/kg = -0.93 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02497

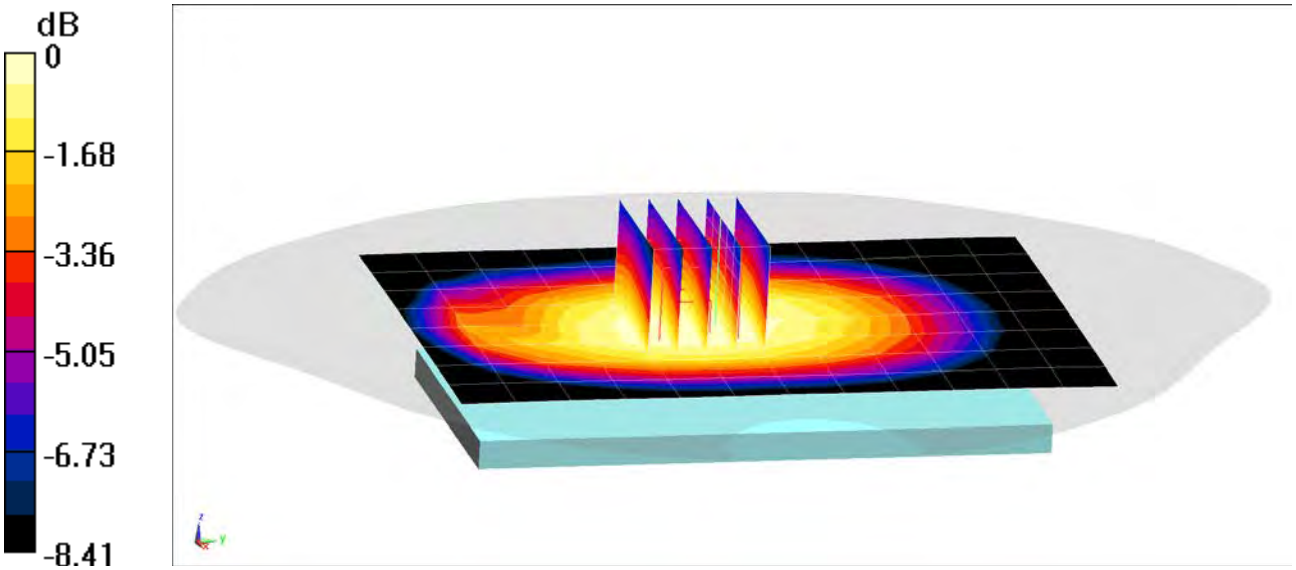
Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: 750 Body; Medium parameters used (interpolated):
f = 707.5 MHz; σ = 0.936 S/m; ε_r = 54.185; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-25-2019; Ambient Temp: 23.6°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.6, 10.6, 10.6) @ 707.5 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 12, Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.44 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.362 W/kg
SAR(1 g) = 0.279 W/kg



0 dB = 0.334 W/kg = -4.76 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02497

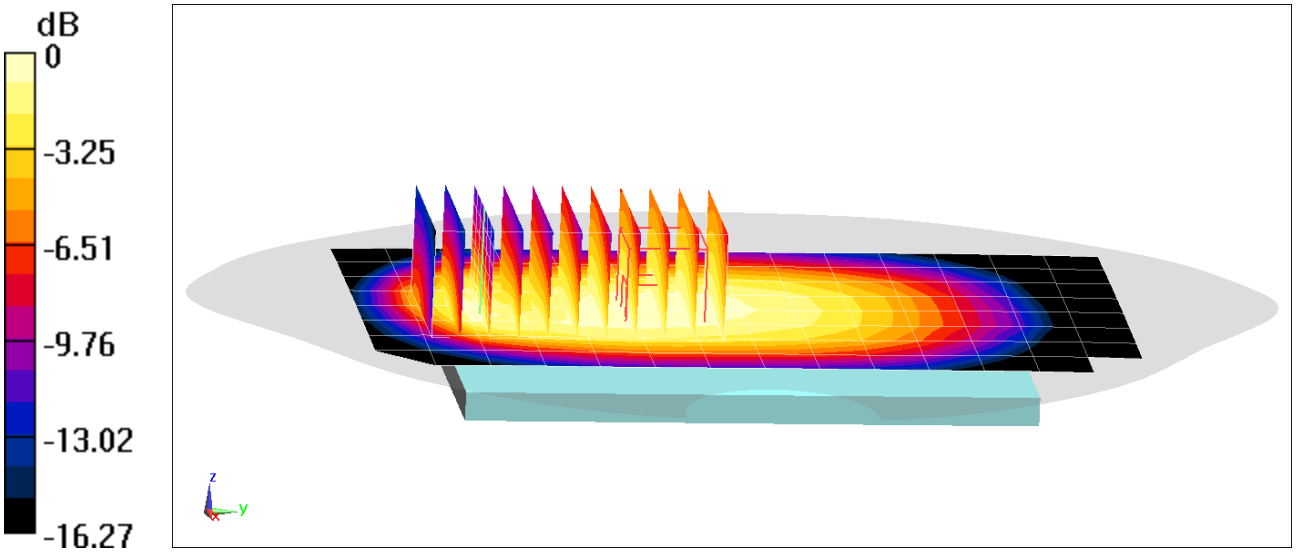
Communication System: UID 0, LTE Band 12; Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: 750 Body; Medium parameters used (interpolated):
f = 707.5 MHz; σ = 0.936 S/m; ε_r = 54.185; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2019; Ambient Temp: 23.6°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.6, 10.6, 10.6) @ 707.5 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 12, Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x11x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.31 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.496 W/kg
SAR(1 g) = 0.340 W/kg



0 dB = 0.411 W/kg = -3.86 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02513

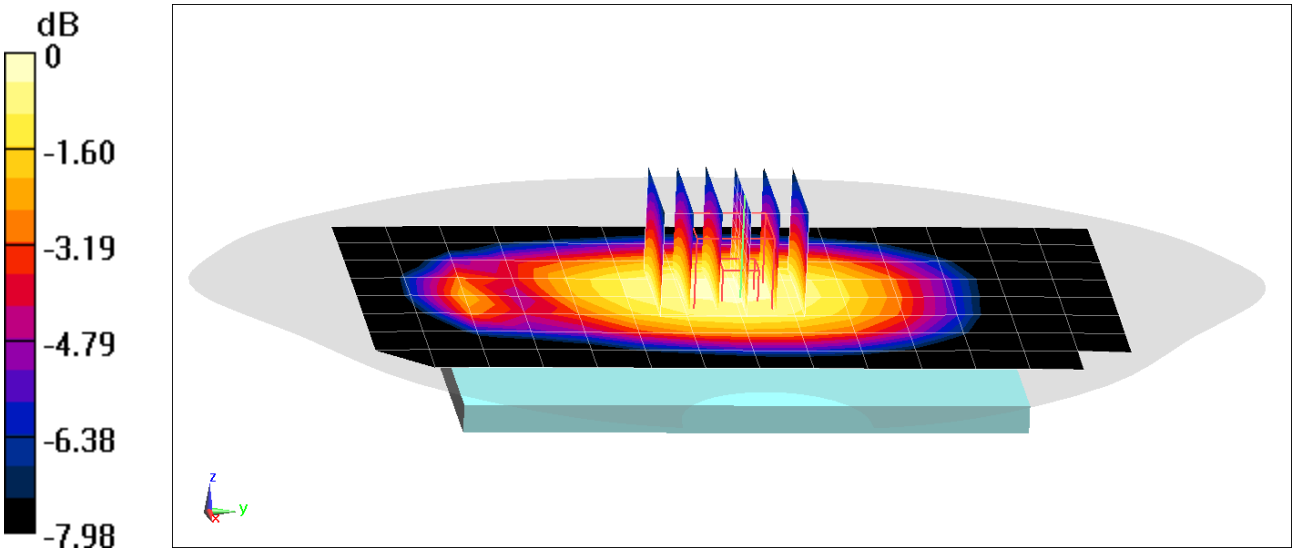
Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1
Medium: 750 Body; Medium parameters used (interpolated):
f = 782 MHz; σ = 0.966 S/m; ε_r = 53.967; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-25-2019; Ambient Temp: 23.6°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.6, 10.6, 10.6) @ 782 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.44 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.290 W/kg
SAR(1 g) = 0.222 W/kg



0 dB = 0.267 W/kg = -5.73 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02513

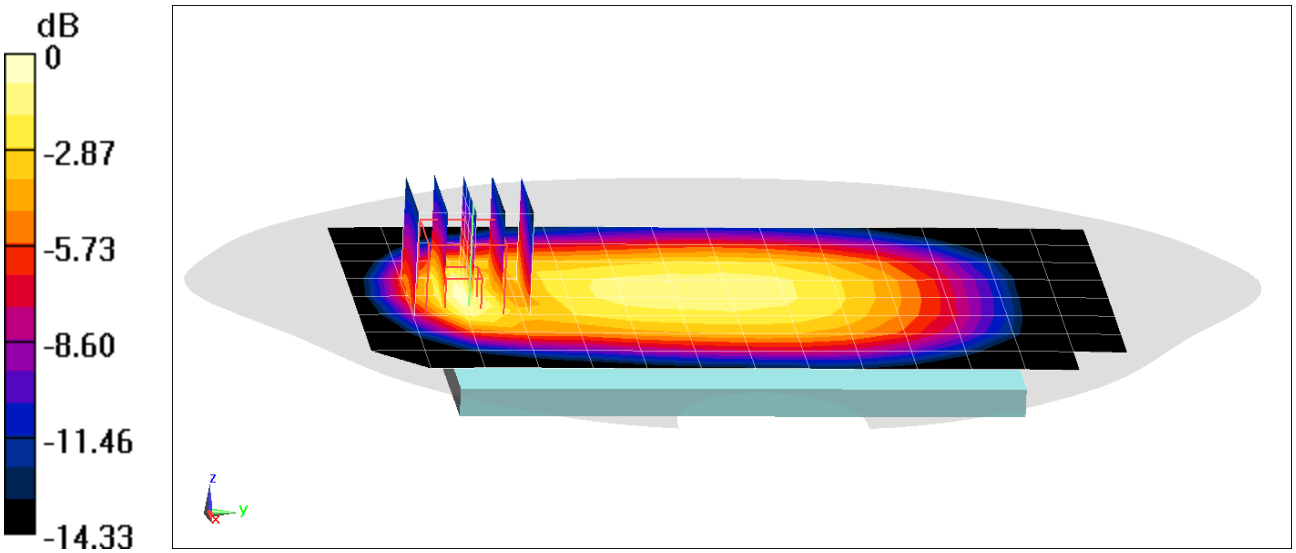
Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1
Medium: 750 Body; Medium parameters used (interpolated):
f = 782 MHz; σ = 0.966 S/m; ε_r = 53.967; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2019; Ambient Temp: 23.6°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.6, 10.6, 10.6) @ 782 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.01 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.432 W/kg
SAR(1 g) = 0.236 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02448

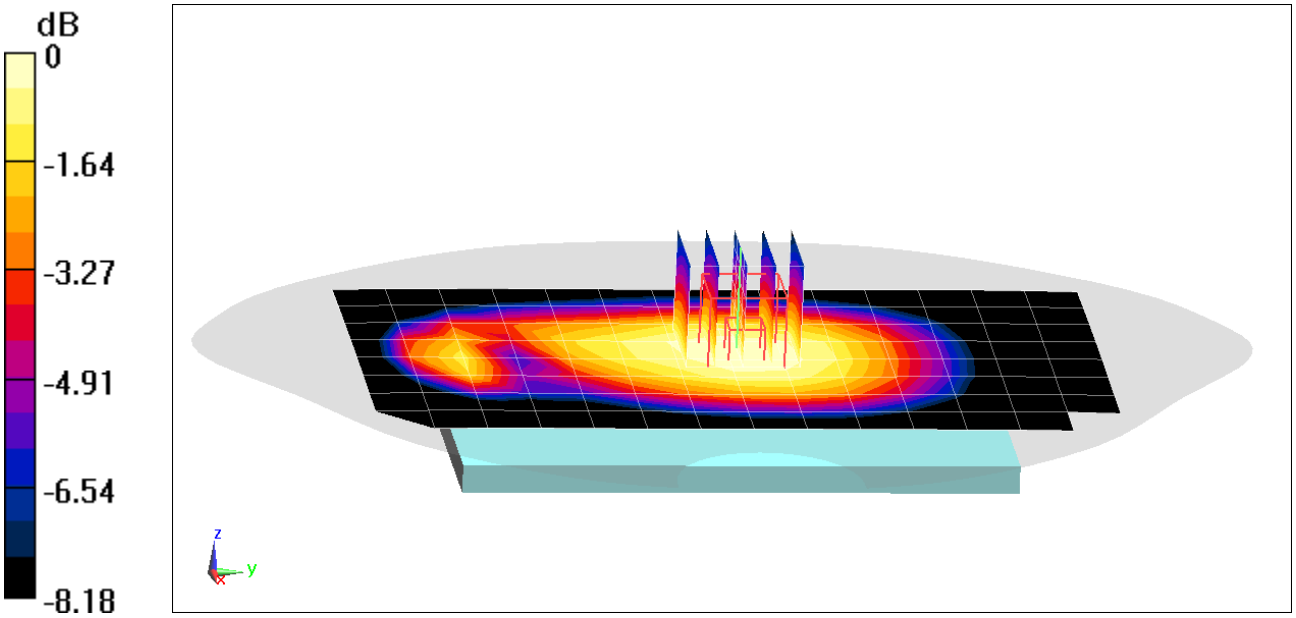
Communication System: UID 0, LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 MHz Body; Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.988 S/m; ε_r = 53.801; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-25-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.14, 10.14, 10.14) @ 836.5 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.86 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.514 W/kg
SAR(1 g) = 0.382 W/kg



0 dB = 0.467 W/kg = -3.31 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02448

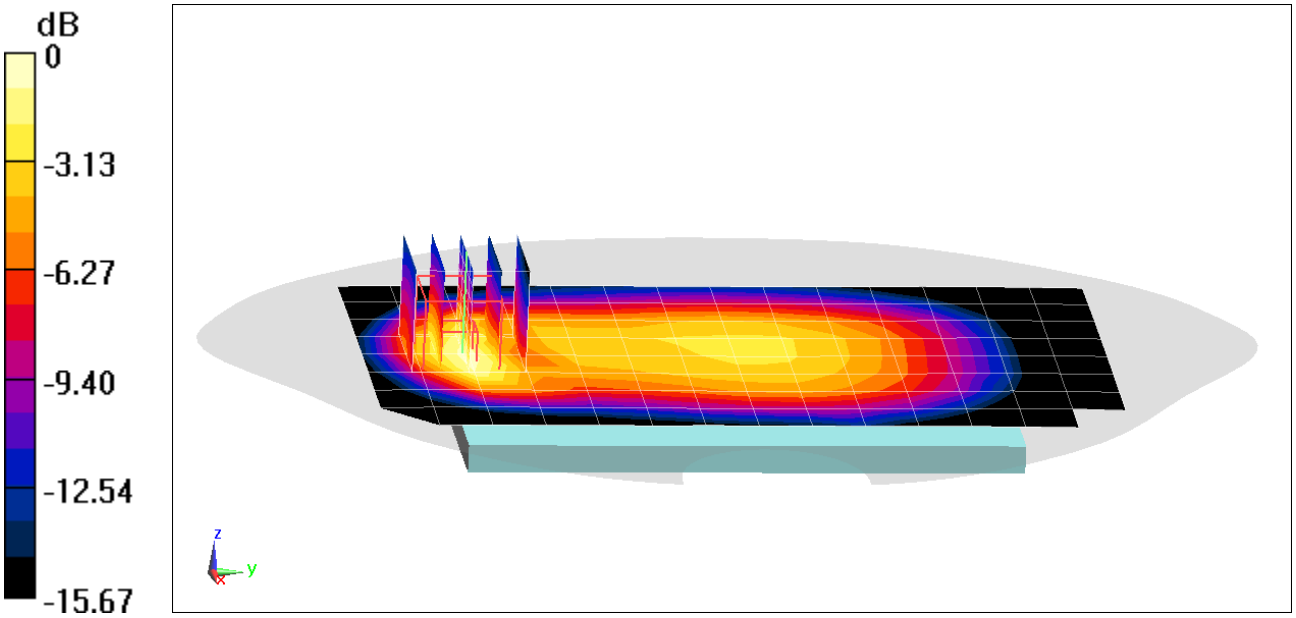
Communication System: UID 0, LTE Band 5; Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: 835 MHz Body; Medium parameters used (interpolated):
f = 836.5 MHz; σ = 0.988 S/m; ε_r = 53.801; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-25-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.14, 10.14, 10.14) @ 836.5 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.49 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.10 W/kg
SAR(1 g) = 0.584 W/kg



0 dB = 0.898 W/kg = -0.47 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

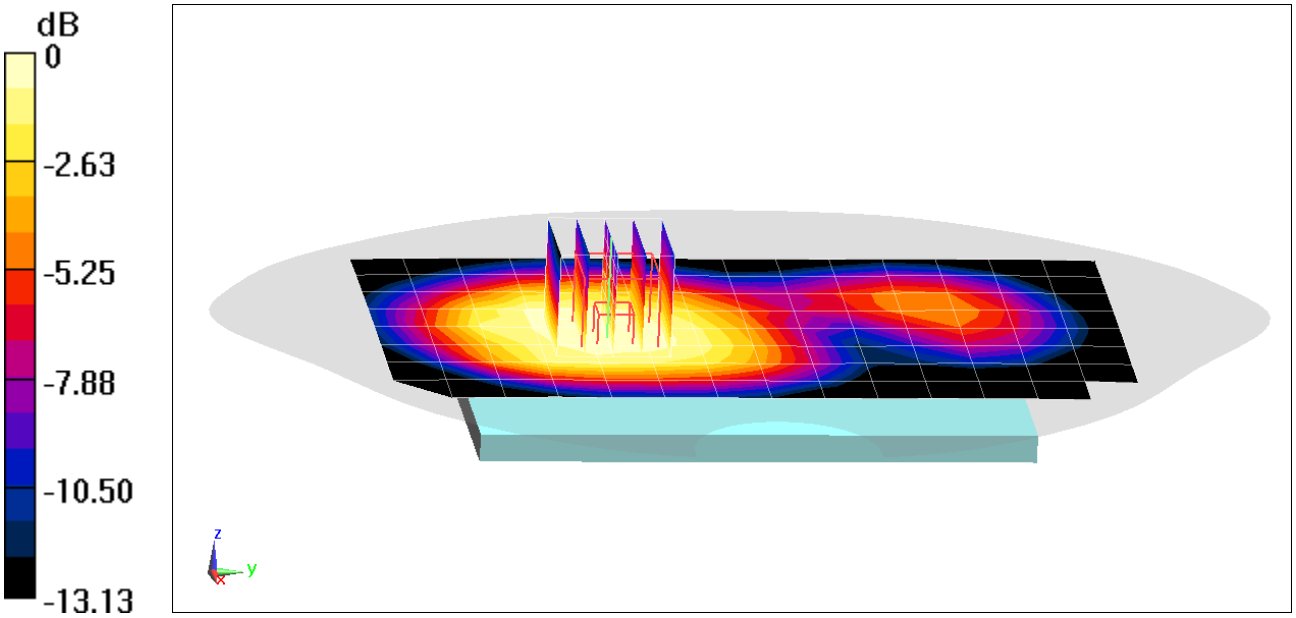
Communication System: UID 0, LTE Band 66 (AWS); Frequency: 1720 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Body; Medium parameters used (interpolated):
f = 1720 MHz; σ = 1.417 S/m; ε_r = 51.608; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.44, 8.44, 8.44) @ 1720 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 66 (AWS), Body SAR, Back side, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.71 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.232 W/kg
SAR(1 g) = 0.157 W/kg



0 dB = 0.206 W/kg = -6.86 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

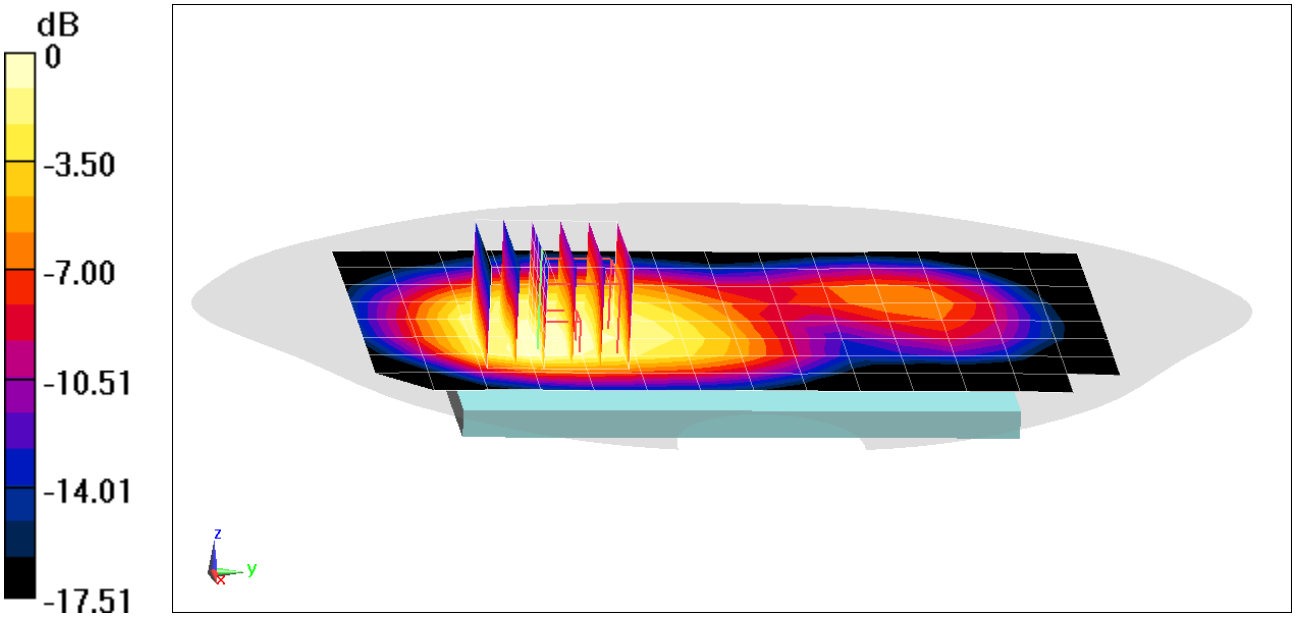
Communication System: UID 0, LTE Band 66 (AWS); Frequency: 1720 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Body; Medium parameters used (interpolated):
f = 1720 MHz; σ = 1.417 S/m; ε_r = 51.608; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.44, 8.44, 8.44) @ 1720 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 66 (AWS), Body SAR, Back side, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.18 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.575 W/kg
SAR(1 g) = 0.355 W/kg



0 dB = 0.485 W/kg = -3.14 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

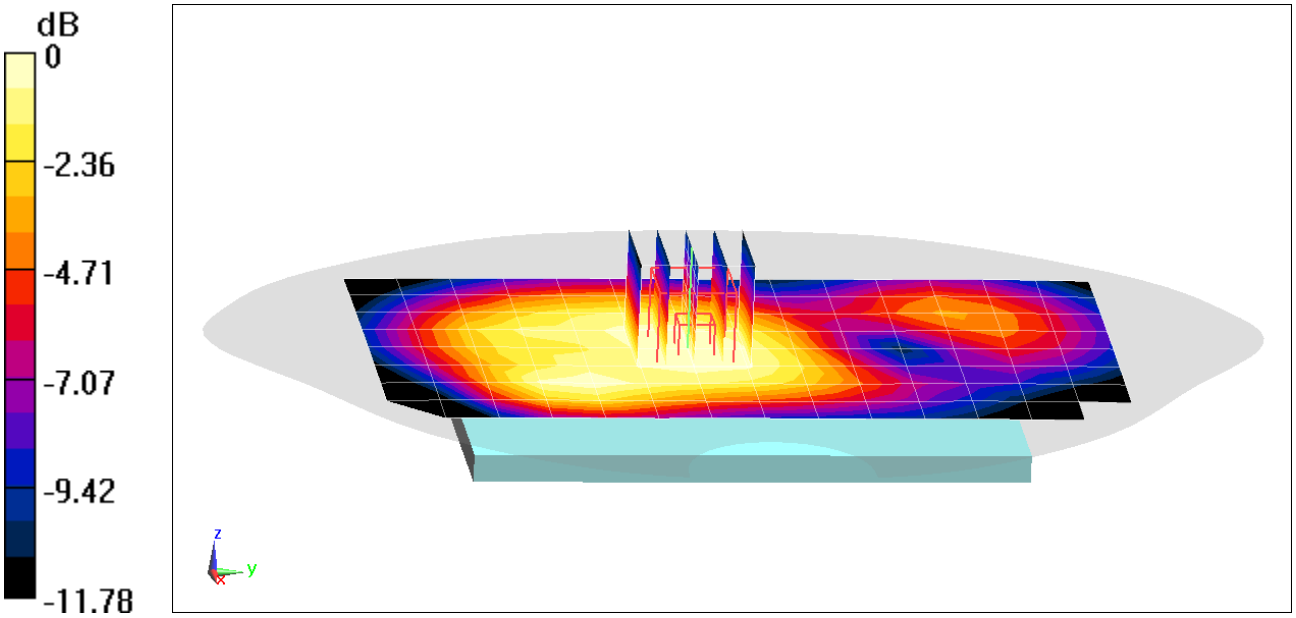
Communication System: UID 0, _LTE Band 2 (PCS); Frequency: 1860 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Body; Medium parameters used (interpolated):
f = 1860 MHz; σ = 1.511 S/m; ε_r = 51.398; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.03, 8.03, 8.03) @ 1860 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.12 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.219 W/kg
SAR(1 g) = 0.145 W/kg



0 dB = 0.193 W/kg = -7.14 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

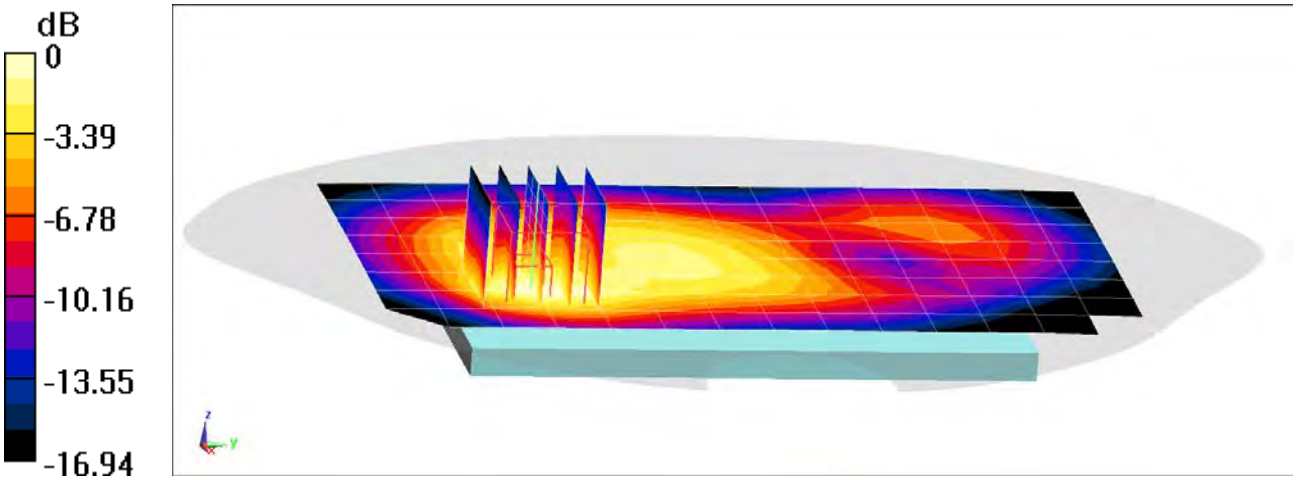
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.494 S/m; ε_r = 52.204; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2019; Ambient Temp: 21.5°C; Tissue Temp: 20.7°C

Probe: EX3DV4 - SN7532; ConvF(8.03, 8.03, 8.03) @ 1900 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.22 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.557 W/kg
SAR(1 g) = 0.311 W/kg



0 dB = 0.462 W/kg = -3.35 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05995

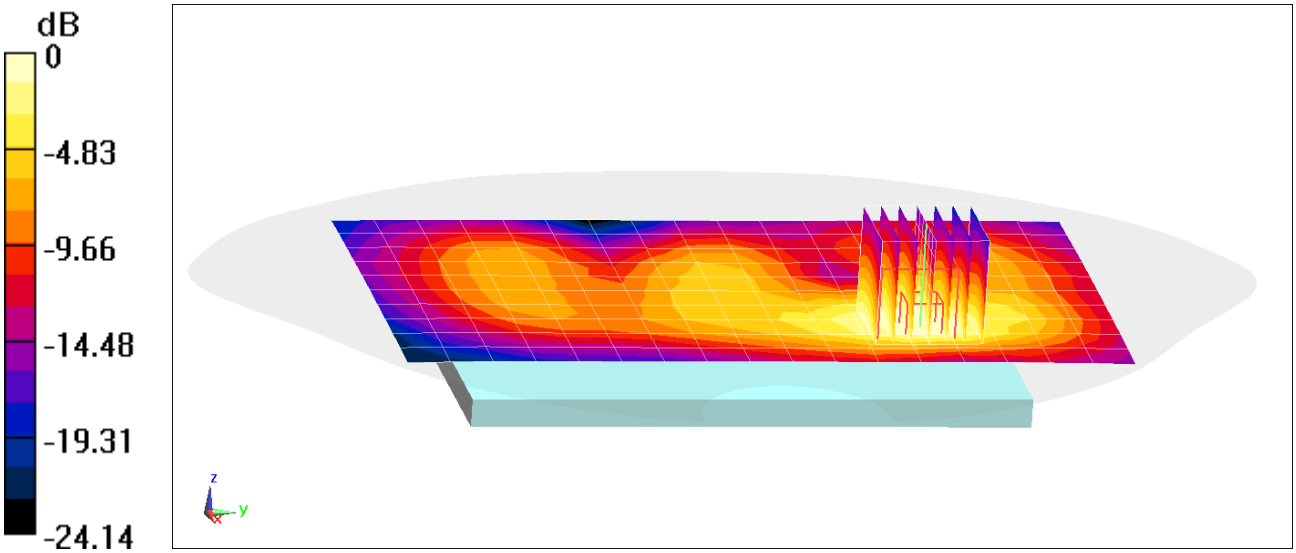
Communication System: UID 0, LTE Band 41; Frequency: 2593 MHz; Duty Cycle: 1:1.58
Medium: 2450-2600 MHz Body; Medium parameters used (interpolated):
f = 2593 MHz; σ = 2.121 S/m; ε_r = 51.044; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-06-2019; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7532; ConvF(7.47, 7.47, 7.47) @ 2593 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 41, Body SAR, Back side, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (11x18x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.36 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.804 W/kg
SAR(1 g) = 0.399 W/kg



0 dB = 0.451 W/kg = -3.46 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05995

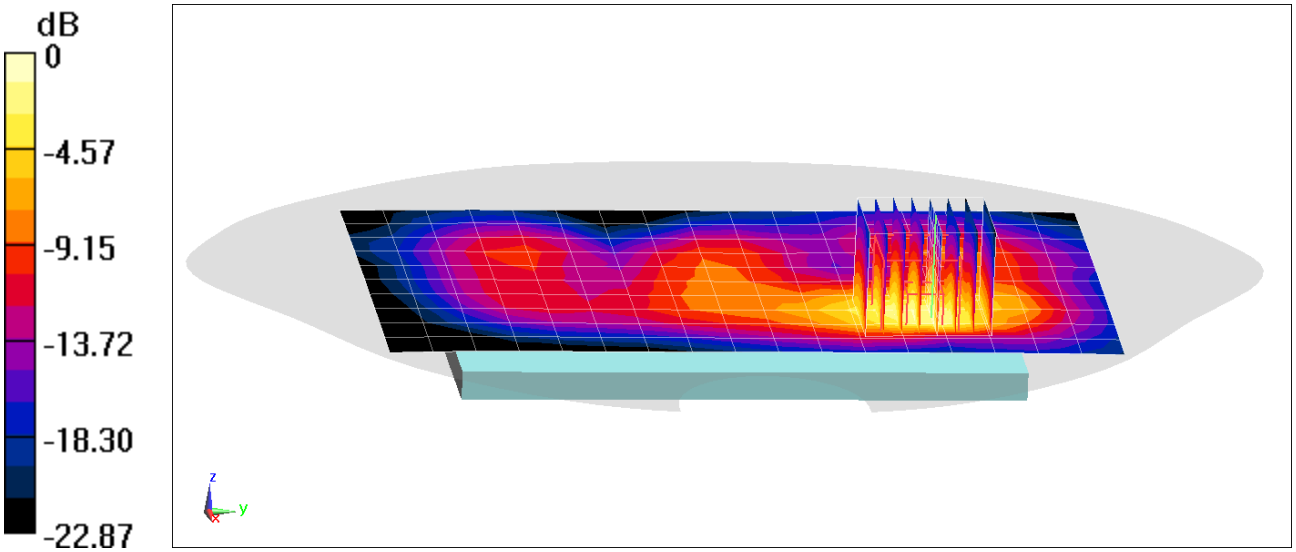
Communication System: UID 0, LTE Band 41; Frequency: 2506 MHz; Duty Cycle: 1:1.58
Medium: 2450-2600 MHz Body; Medium parameters used (interpolated):
f = 2506 MHz; σ = 2.04 S/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-06-2019; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7532; ConvF(7.66, 7.66, 7.66) @ 2506 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 41, Body SAR, Back side, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

Area Scan (11x18x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.96 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 1.82 W/kg
SAR(1 g) = 0.865 W/kg



0 dB = 1.43 W/kg = 1.55 dBW/kg

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02448

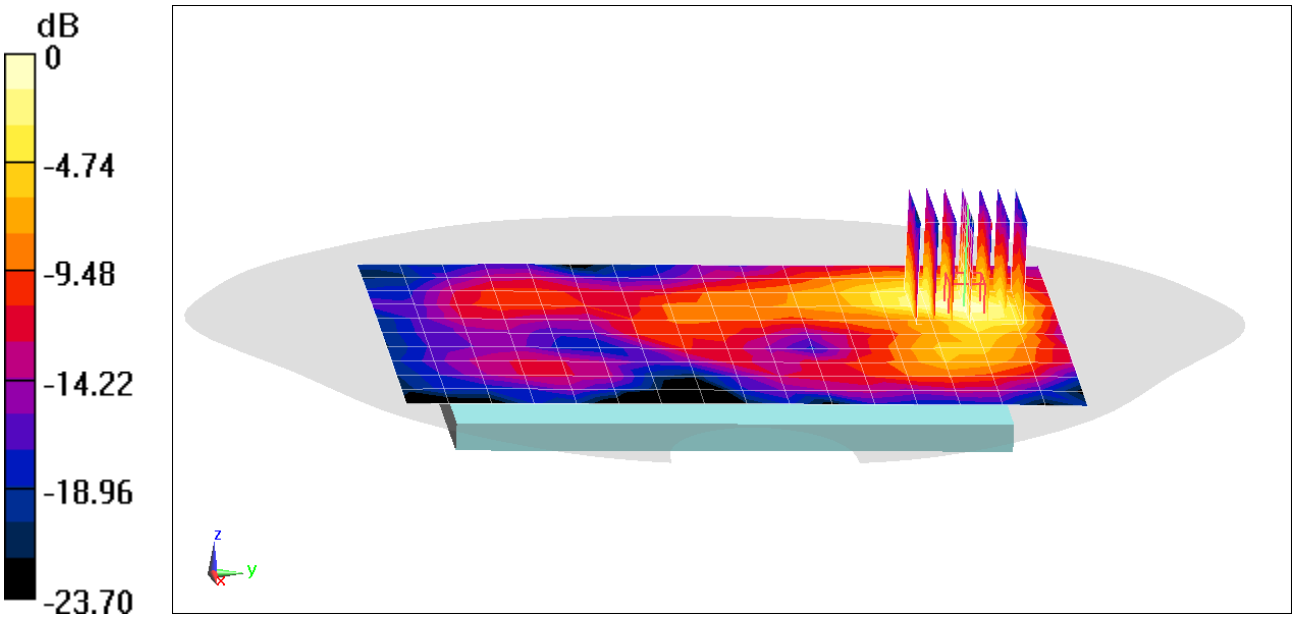
Communication System: UID 0, _IEEE 802.11b; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Body; Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.939 S/m; ε_r = 51.227; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-29-2019; Ambient Temp: 22.6°C; Tissue Temp: 21.4°C

Probe: EX3DV4 - SN7532; ConvF(7.66, 7.66, 7.66) @ 2412 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.545 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.108 W/kg
SAR(1 g) = 0.053 W/kg



0 dB = 0.0856 W/kg = -10.68 dBW/kg

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02448

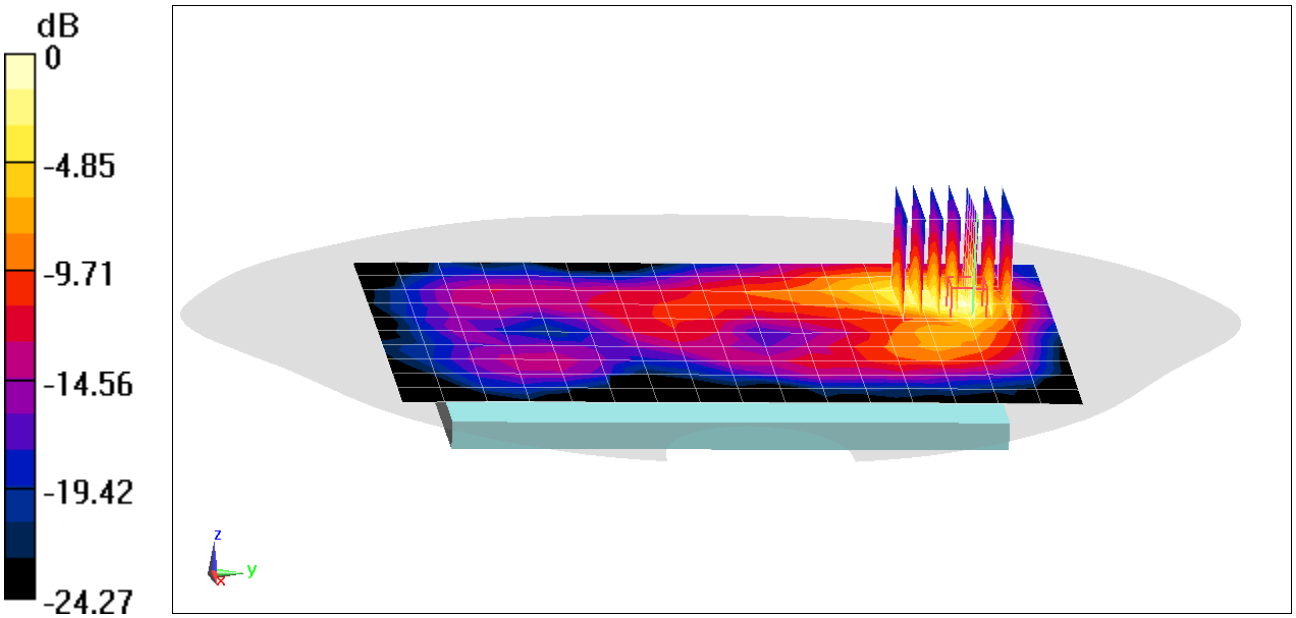
Communication System: UID 0, _IEEE 802.11b; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Body; Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.939 S/m; ε_r = 51.227; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.6°C; Tissue Temp: 21.4°C

Probe: EX3DV4 - SN7532; ConvF(7.66, 7.66, 7.66) @ 2412 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.381 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.289 W/kg
SAR(1 g) = 0.133 W/kg



0 dB = 0.225 W/kg = -6.48 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02497

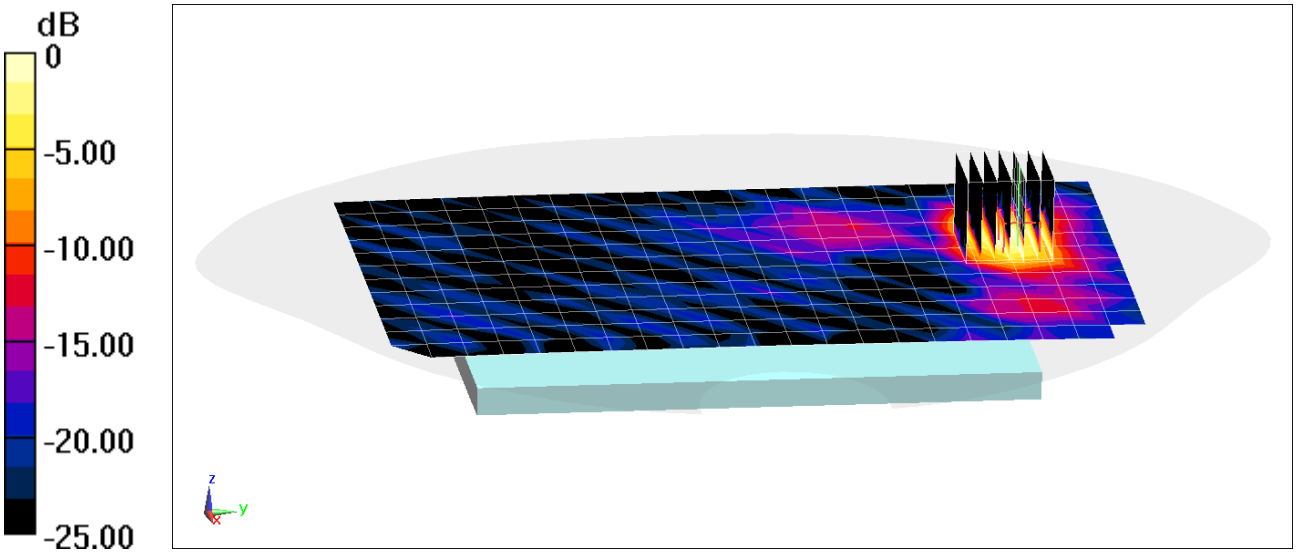
Communication System: UID 0, IEEE 802.11a; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used:
f = 5745 MHz; σ = 6.049 S/m; ε_r = 46.215; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-29-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7420; ConvF(4.36, 4.36, 4.36) @ 5745 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (11x20x1): 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 = 4.354 V/m; Power Drift = 0.21 dB
Peak SAR (extrapolated) = 0.906 W/kg
SAR(1 g) = 0.140 W/kg



0 dB = 0.201 W/kg = -6.97 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02497

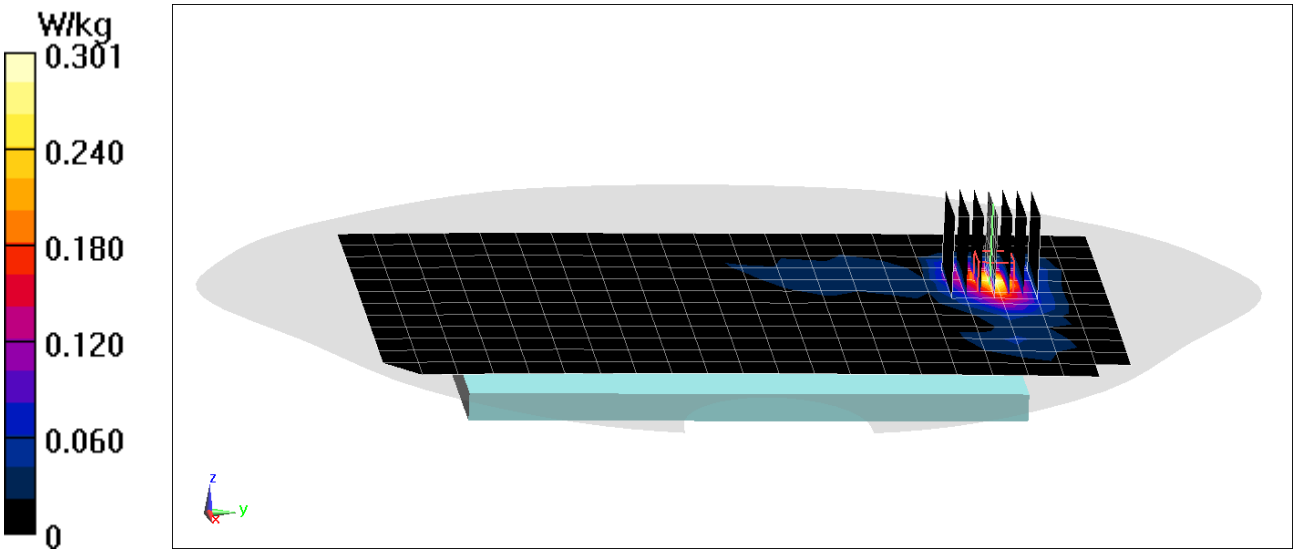
Communication System: UID 0, _IEEE 802.11a; Frequency: 5745 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used:
f = 5745 MHz; σ = 6.049 S/m; ε_r = 46.215; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7420; ConvF(4.36, 4.36, 4.36) @ 5745 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (11x20x1): 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 = 6.325 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.04 W/kg
SAR(1 g) = 0.223 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05995

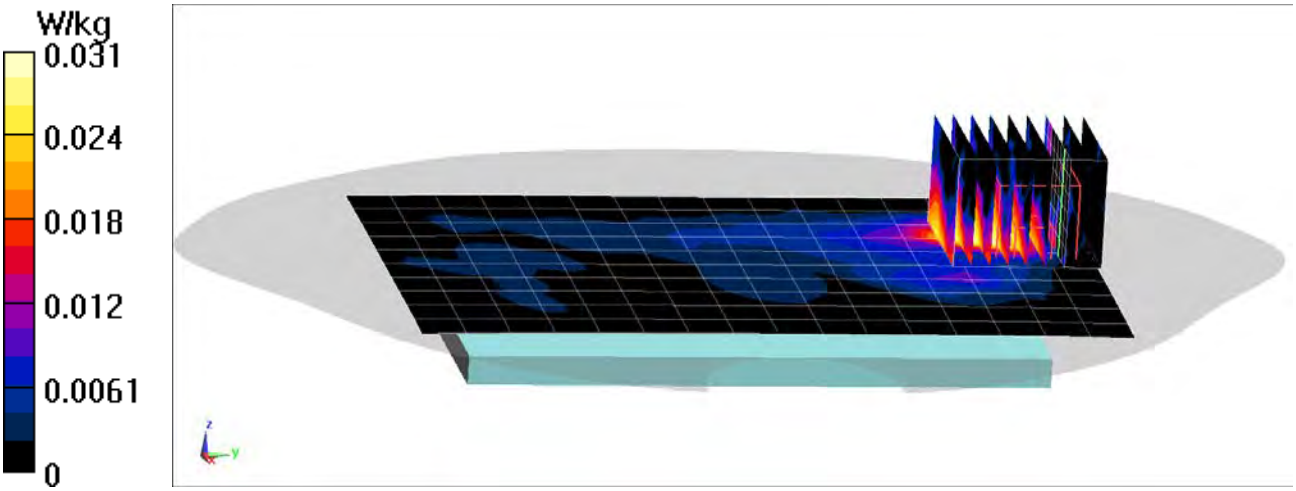
Communication System: UID 0, Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Body; Medium parameters used (interpolated):
f = 2441 MHz; σ = 1.959 S/m; ε_r = 50.948; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7490; ConvF(7.87, 7.87, 7.87) @ 2441 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.437 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 0.0320 W/kg
SAR(1 g) = 0.00311 W/kg



DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

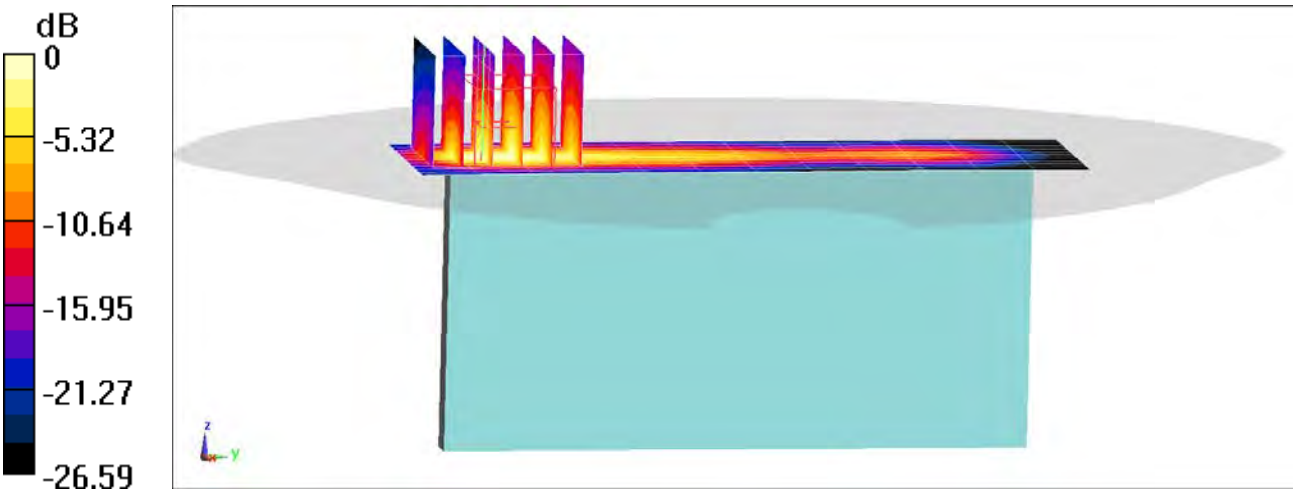
Communication System: UID 0, UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Body; Medium parameters used:
f = 1880 MHz; σ = 1.538 S/m; ε_r = 52.542; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-05-2019; Ambient Temp: 21.7°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7490; ConvF(8.13, 8.13, 8.13) @ 1880 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

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

Area Scan (11x13x1): Measurement grid: dx=5mm, dy=15mm
Zoom Scan (5x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 44.78 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 6.79 W/kg
SAR(10 g) = 1.21 W/kg



0 dB = 5.17 W/kg = 7.13 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 05763

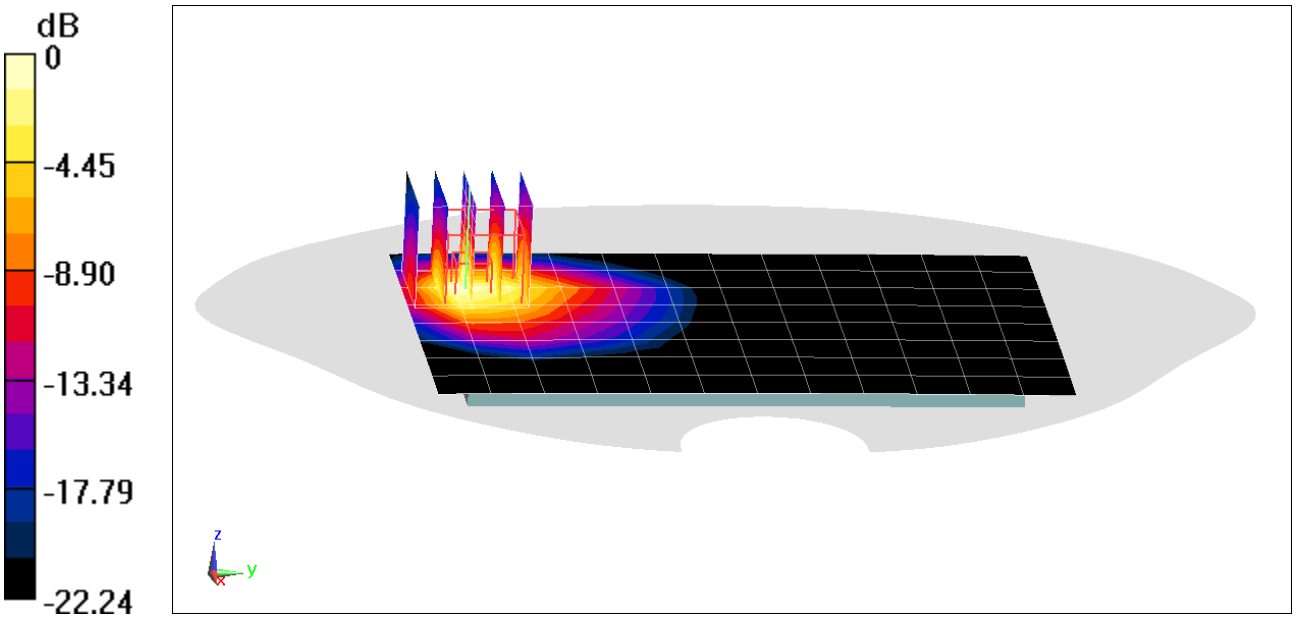
Communication System: UID 0, _LTE Band 2 (PCS); Frequency: 1860 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Body; Medium parameters used (interpolated):
f = 1860 MHz; σ = 1.523 S/m; ε_r = 52.582; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 08-05-2019; Ambient Temp: 21.7°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7490; ConvF(8.13, 8.13, 8.13) @ 1860 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: LTE Band 2 (PCS), Phablet SAR, Front side, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 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 = 50.70 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 7.19 W/kg
SAR(10 g) = 1.67 W/kg



0 dB = 5.46 W/kg = 7.37 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMA307GN; Type: Portable Handset; Serial: 02497

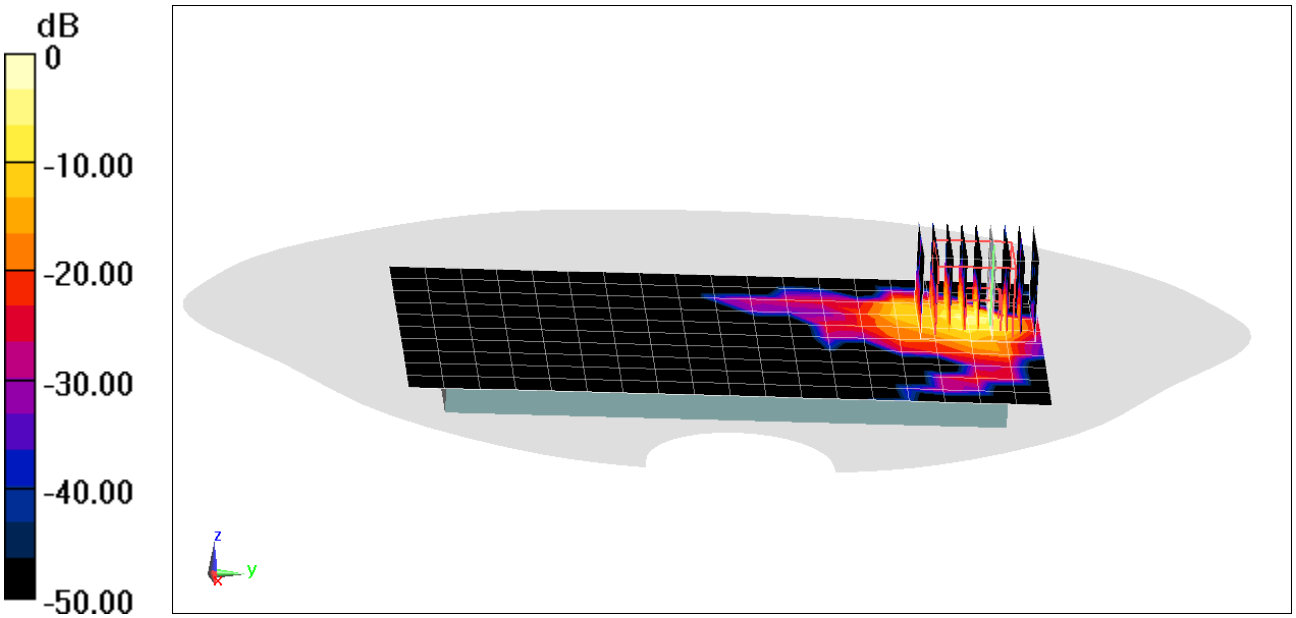
Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body; Medium parameters used:
f = 5500 MHz; σ = 5.696 S/m; ε_r = 46.669; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7420; ConvF(4.08, 4.08, 4.08) @ 5500 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

Mode: IEEE 802.11a, U-NII-2C, 20 MHz Bandwidth, Phablet SAR, Ch 100, 6 Mbps, Back Side

Area Scan (11x19x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Reference Value = 5.612 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 9.20 W/kg
SAR(10 g) = 0.207 W/kg



0 dB = 3.75 W/kg = 5.74 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

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PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1034

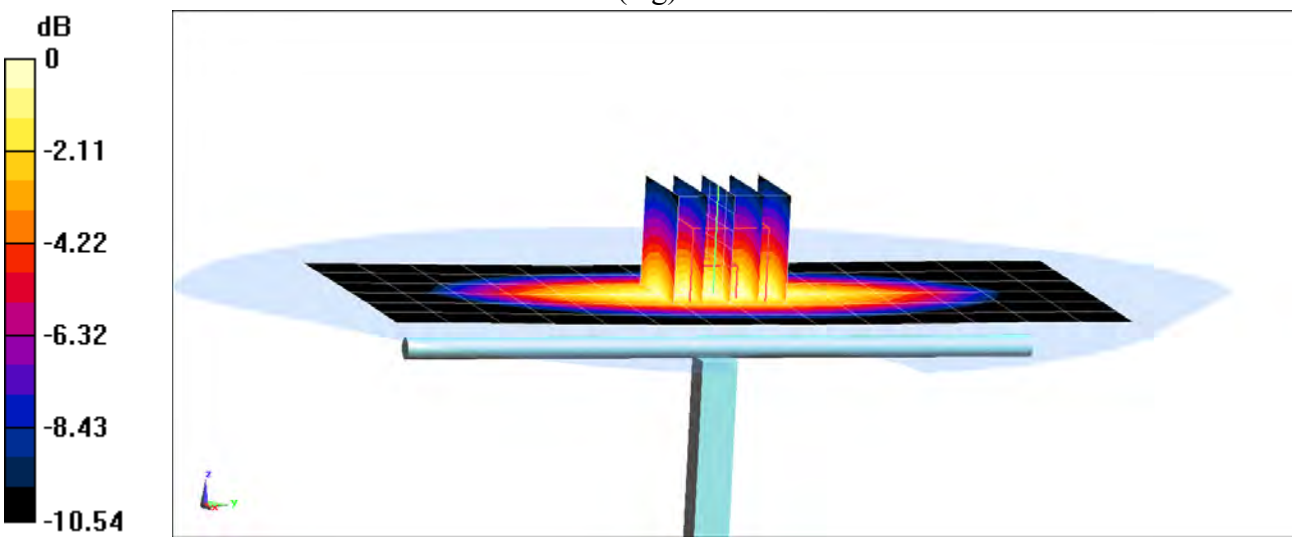
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 MHz Head Medium parameters used (interpolated):
f = 750 MHz; σ = 0.887 S/m; ε_r = 40.908; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-26-2019; Ambient Temp: 22.4°C; Tissue Temp: 20.3°C

Probe: EX3DV4 - SN7427; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 2/19/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1403; Calibrated: 2/13/2019
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

750 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.35 W/kg
SAR(1 g) = 1.58 W/kg
Deviation(1 g) = -5.05%



0 dB = 2.05 W/kg = 3.12 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d040

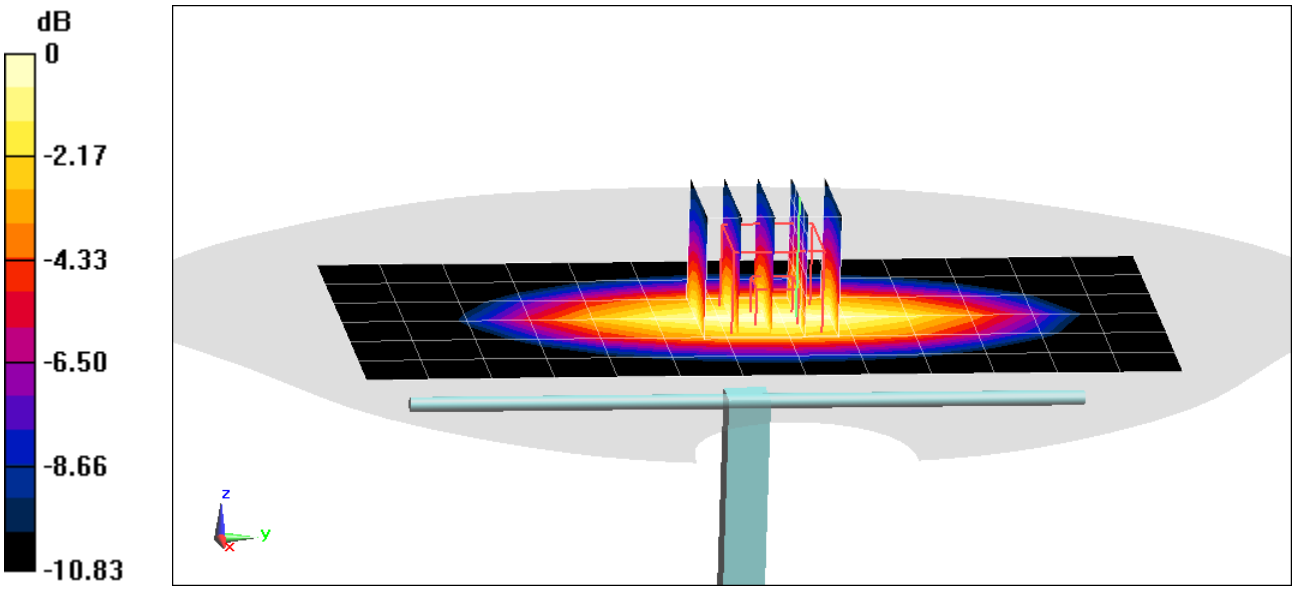
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 MHz Head Medium parameters used:
f = 835 MHz; σ = 0.933 S/m; ε_r = 43.504; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-24-2019; Ambient Temp: 22.5°C; Tissue Temp: 22.3°C

Probe: EX3DV4 - SN7420; ConvF(9.68, 9.68, 9.68) @ 835 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 3.18 W/kg
SAR(1 g) = 2.04 W/kg
Deviation(1 g) = 7.37%



0 dB = 2.77 W/kg = 4.42 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1083

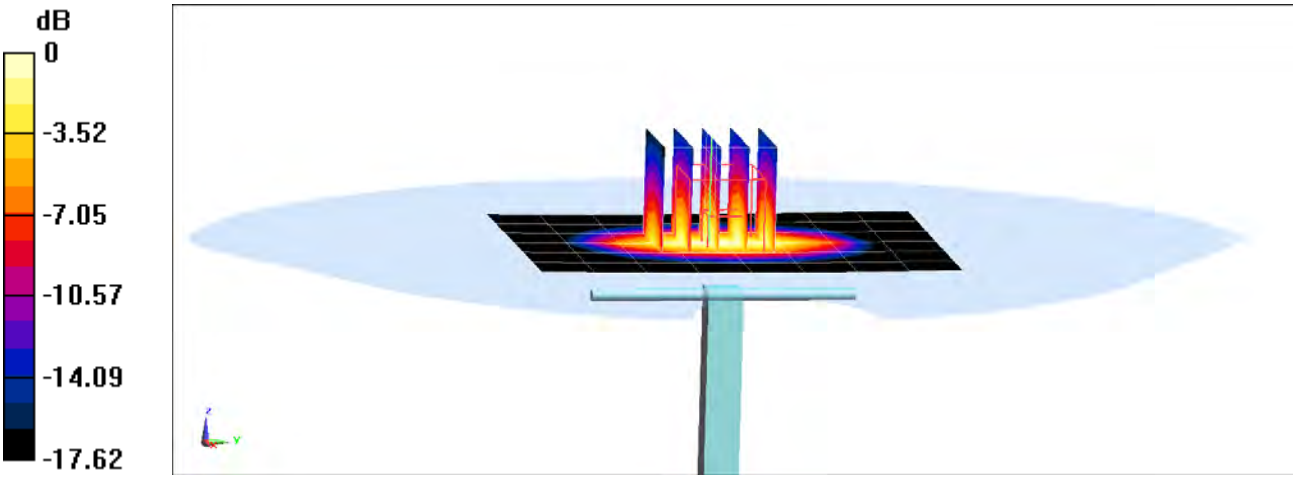
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Head Medium parameters used:
f = 1750 MHz; σ = 1.365 S/m; ε_r = 38.63; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-23-2019; Ambient Temp: 21.3°C; Tissue Temp: 20.5°C

Probe: EX3DV4 - SN7427; ConvF(8.58, 8.58, 8.58) @ 1750 MHz; Calibrated: 2/19/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1403; Calibrated: 2/13/2019
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.53 W/kg
SAR(1 g) = 3.58 W/kg
Deviation(1 g) = -0.83%



0 dB = 5.43 W/kg = 7.35 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1092

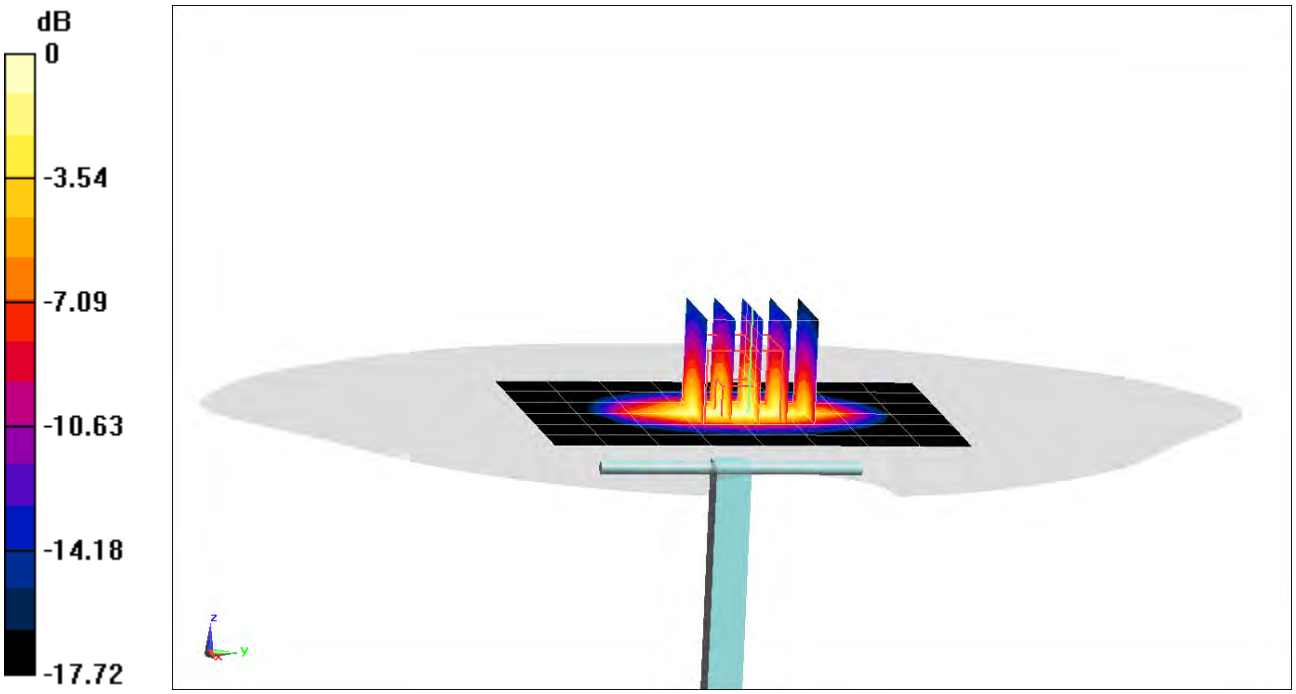
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Head Medium parameters used:
f = 1750 MHz; σ = 1.381 S/m; ε_r = 41.516; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-01-2019; Ambient Temp: 21.1°C; Tissue Temp: 21.1°C

Probe: EX3DV4 - SN7490; ConvF(8.79, 8.79, 8.79) @ 1750 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.82 W/kg
SAR(1 g) = 3.69 W/kg
Deviation(1 g) = 2.22%



0 dB = 5.63 W/kg = 7.51 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d181

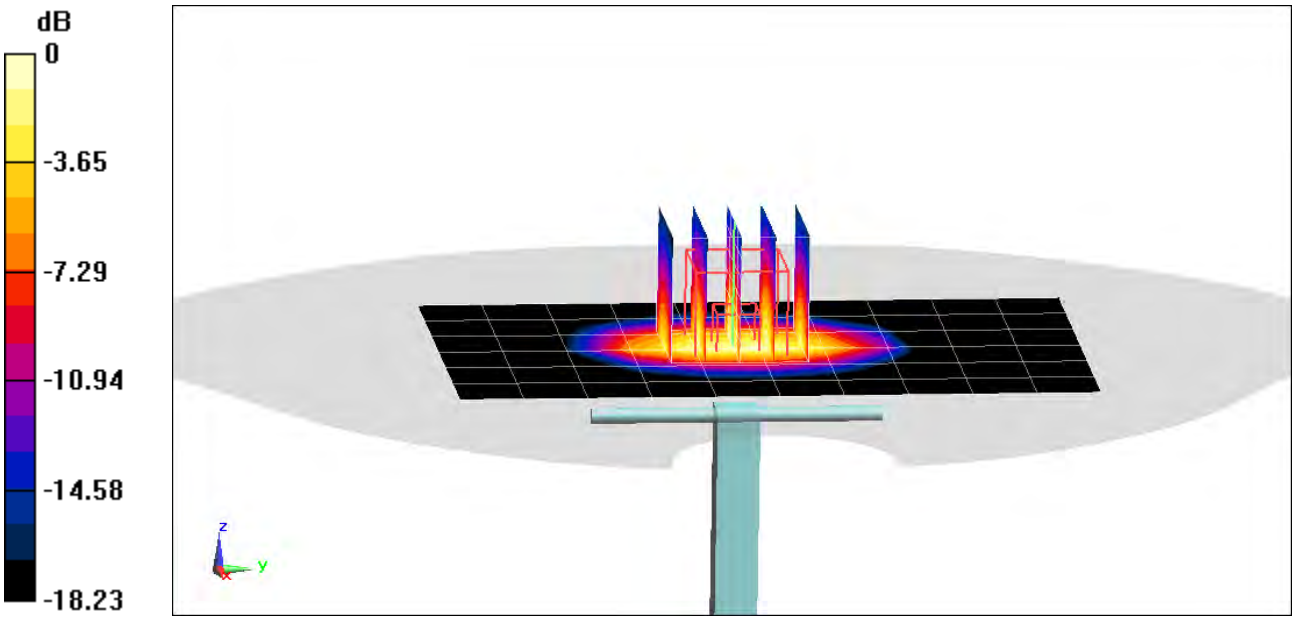
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.436 S/m; ε_r = 40.983; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-01-2019; Ambient Temp: 22.5°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN7416; ConvF(8.05, 8.05, 8.05) @ 1900 MHz; Calibrated: 6/19/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn701; Calibrated: 6/14/2019
Phantom: Twin-SAM V8.0_Left; Type: QD 000 P41 AA; Serial: 1935
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.39 W/kg
SAR(1 g) = 3.97 W/kg
Deviation(1 g) = 0.51%



0 dB = 6.20 W/kg = 7.92 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d181

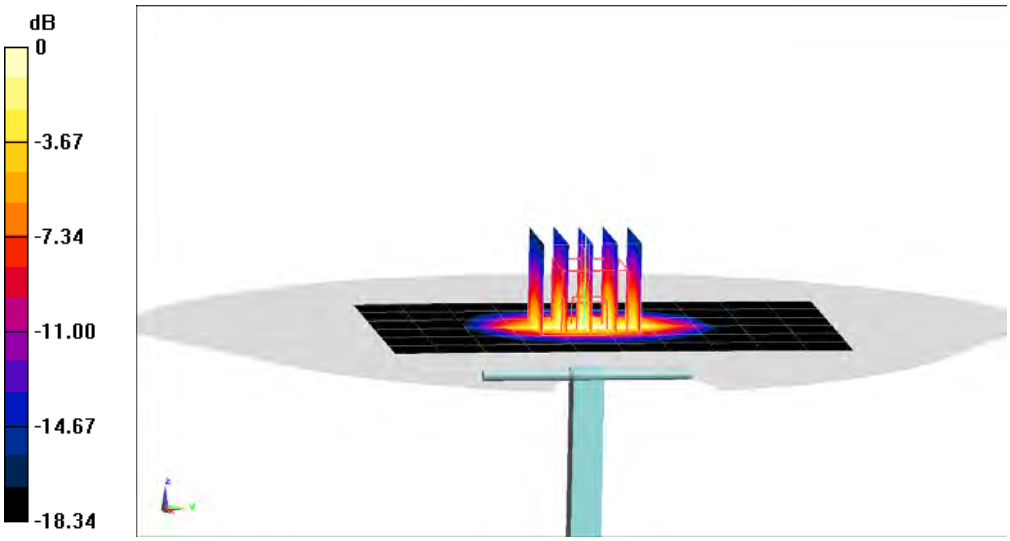
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.436 S/m; ε_r = 40.983; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-01-2019; Ambient Temp: 22.1°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN7490; ConvF(8.27, 8.27, 8.27) @ 1900 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.64 W/kg
SAR(1 g) = 4.12 W/kg
Deviation(1 g) = 4.30%



0 dB = 6.38 W/kg = 8.05 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 750

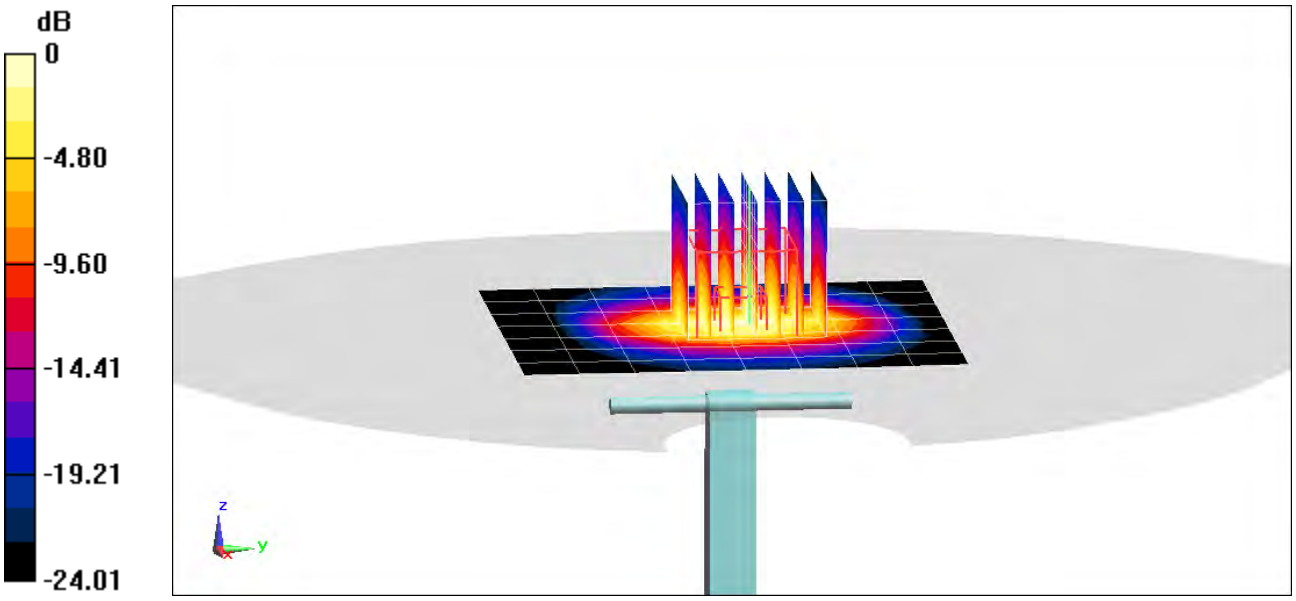
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Head Medium parameters used:
f = 2450 MHz; σ = 1.865 S/m; ε_r = 38.965; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-26-2019; Ambient Temp: 21.6°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3318; ConvF(4.59, 4.59, 4.59) @ 2450 MHz; Calibrated: 11/19/2018
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 8/14/2018
Phantom: Twin-SAM V8.0; Type: QD 000 P41 Ax; Serial: 1936
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 11.3 W/kg
SAR(1 g) = 5.22 W/kg
Deviation(1 g) = -1.69%



0 dB = 6.94 W/kg = 8.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 750

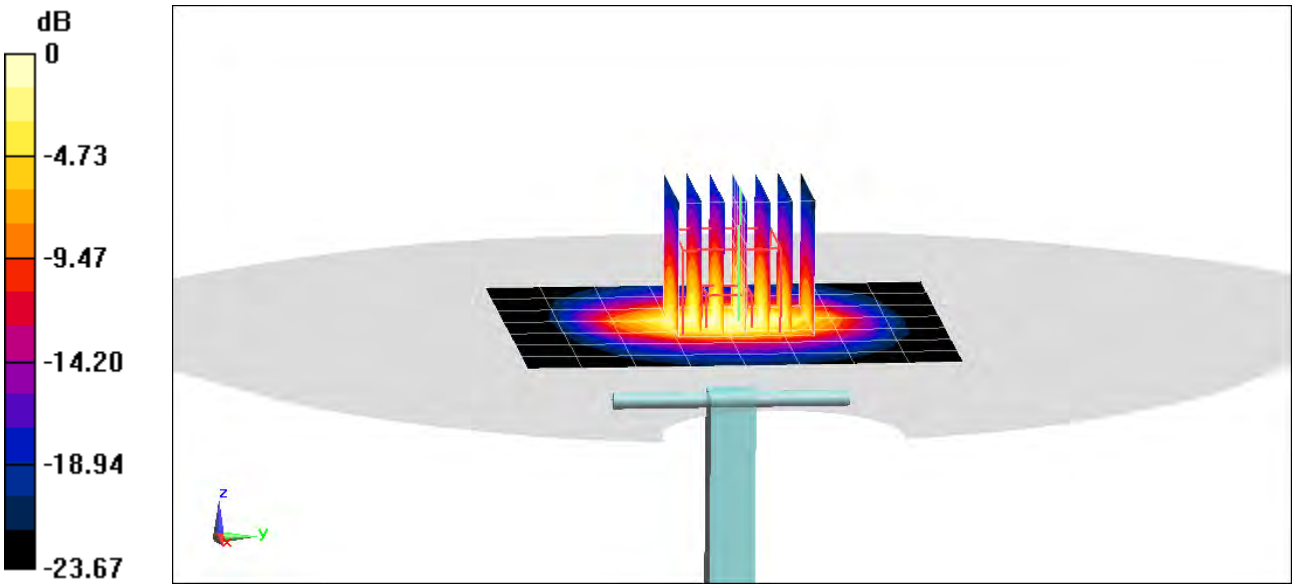
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Head Medium parameters used:
f = 2450 MHz; σ = 1.881 S/m; ε_r = 38.662; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.5°C; Tissue Temp: 20.9°C

Probe: ES3DV3 - SN3318; ConvF(4.59, 4.59, 4.59) @ 2450 MHz; Calibrated: 11/19/2018
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1408; Calibrated: 8/14/2018
Phantom: Twin-SAM V8.0; Type: QD 000 P41 Ax; Serial: 1936
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 11.3 W/kg
SAR(1 g) = 5.34 W/kg
Deviation(1 g) = 0.56%



0 dB = 7.02 W/kg = 8.46 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 921

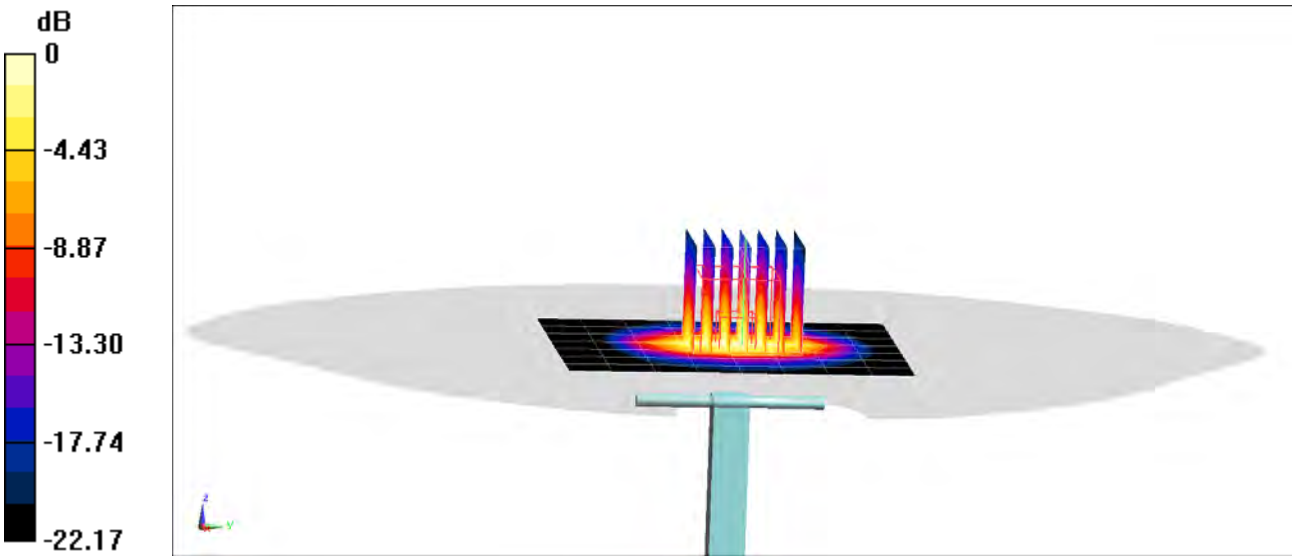
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450-2600 MHz Head Medium parameters used:
f = 2450 MHz; σ = 1.83 S/m; ε_r = 39.885; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-02-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7490; ConvF(7.74, 7.74, 7.74) @ 2450 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 11.4 W/kg
SAR(1 g) = 5.53 W/kg
Deviation(1 g) = 4.14%



0 dB = 9.19 W/kg = 9.63 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1069

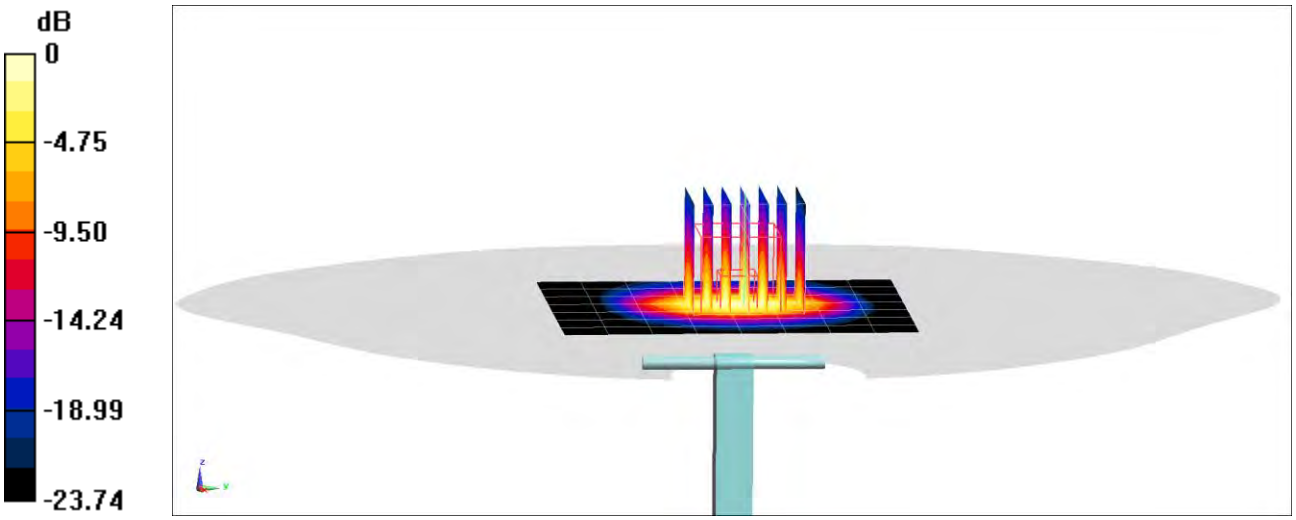
Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1
Medium: 2450-2600 MHz Head Medium parameters used:
f = 2600 MHz; σ = 1.954 S/m; ε_r = 39.611; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-02-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7490; ConvF(7.48, 7.48, 7.48) @ 2600 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2600 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 12.7 W/kg
SAR(1 g) = 6 W/kg
Deviation(1 g) = 5.45%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1123

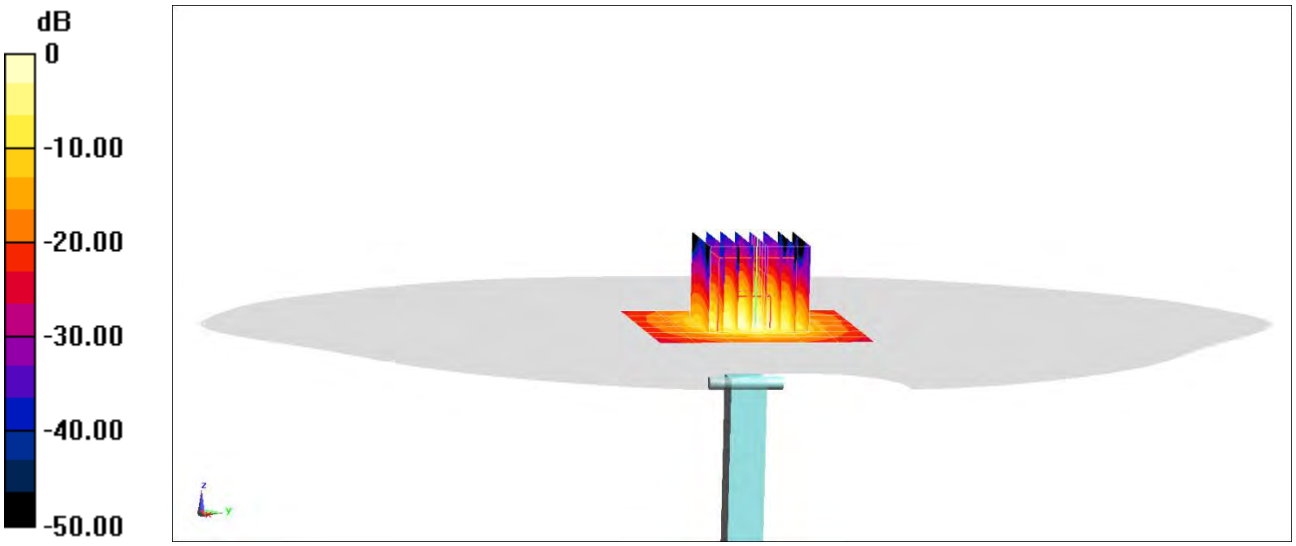
Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used (interpolated):
f = 5250 MHz; σ = 4.612 S/m; ε_r = 36.293; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.7°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7490; ConvF(5.18, 5.18, 5.18) @ 5250 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

5250 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan(8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 15.8 W/kg
SAR(1 g) = 3.94 W/kg
Deviation(1 g) = -3.43%



0 dB = 9.45 W/kg = 9.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1123

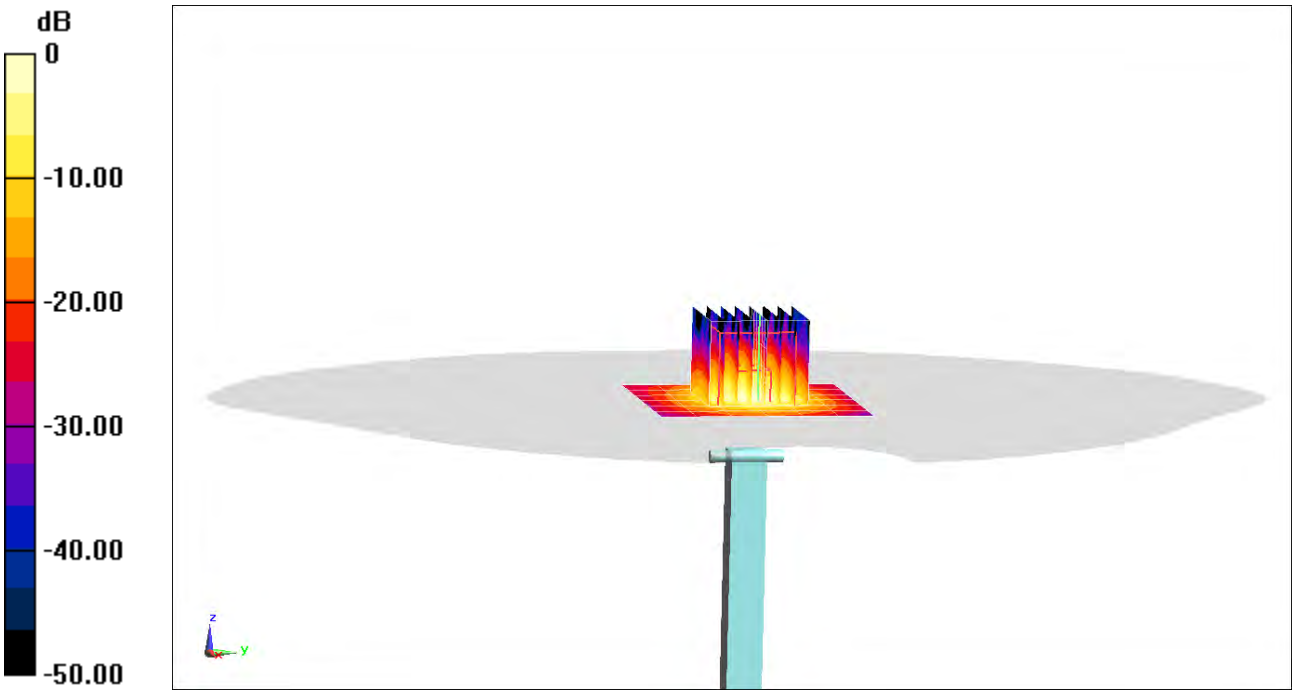
Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5600 MHz; σ = 4.998 S/m; ε_r = 35.678; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.7°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7490; ConvF(4.62, 4.62, 4.62) @ 5600 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

5600 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 18.6 W/kg
SAR(1 g) = 4.27 W/kg
Deviation(1 g) = 0.35%



0 dB = 10.3 W/kg = 10.13 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1123

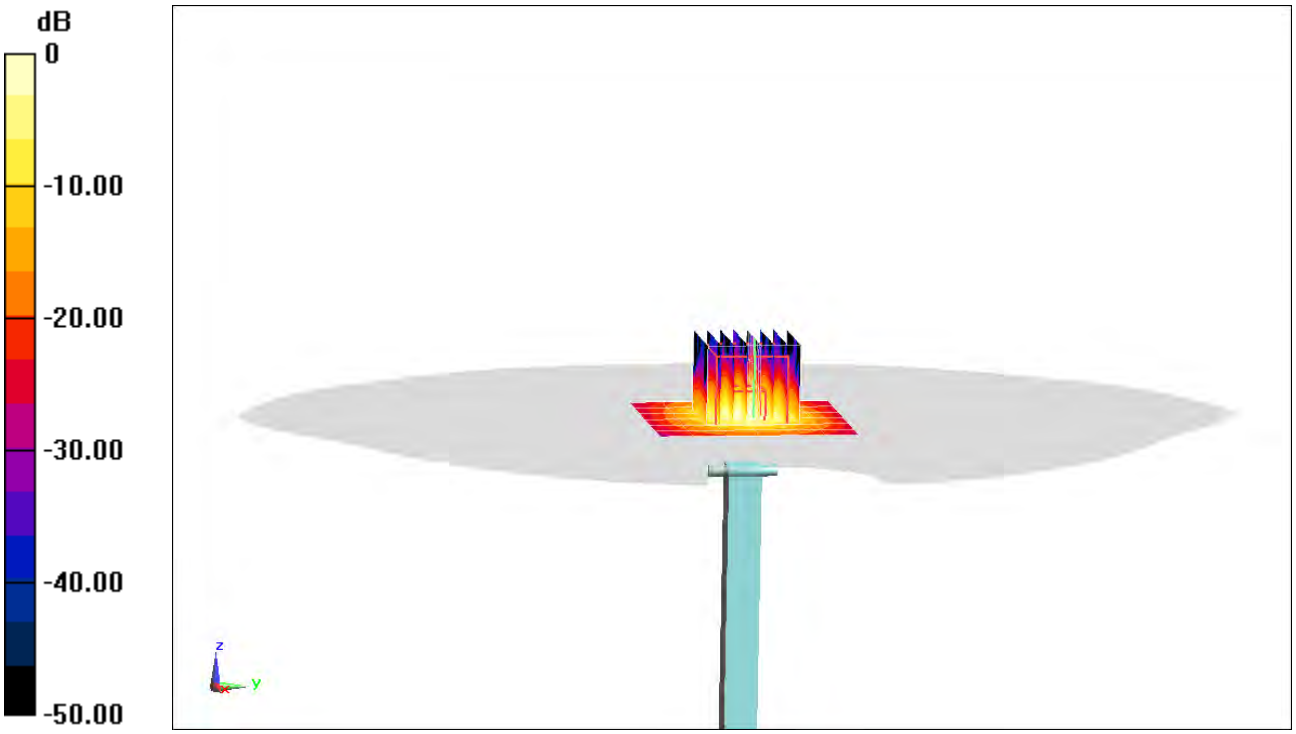
Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used (interpolated):
f = 5750 MHz; σ = 5.162 S/m; ε_r = 35.42; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.7°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7490; ConvF(4.85, 4.85, 4.85) @ 5750 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

5750 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 17.5 W/kg
SAR(1 g) = 3.85 W/kg
Deviation(1 g) = -4.47%



0 dB = 9.33 W/kg = 9.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1097

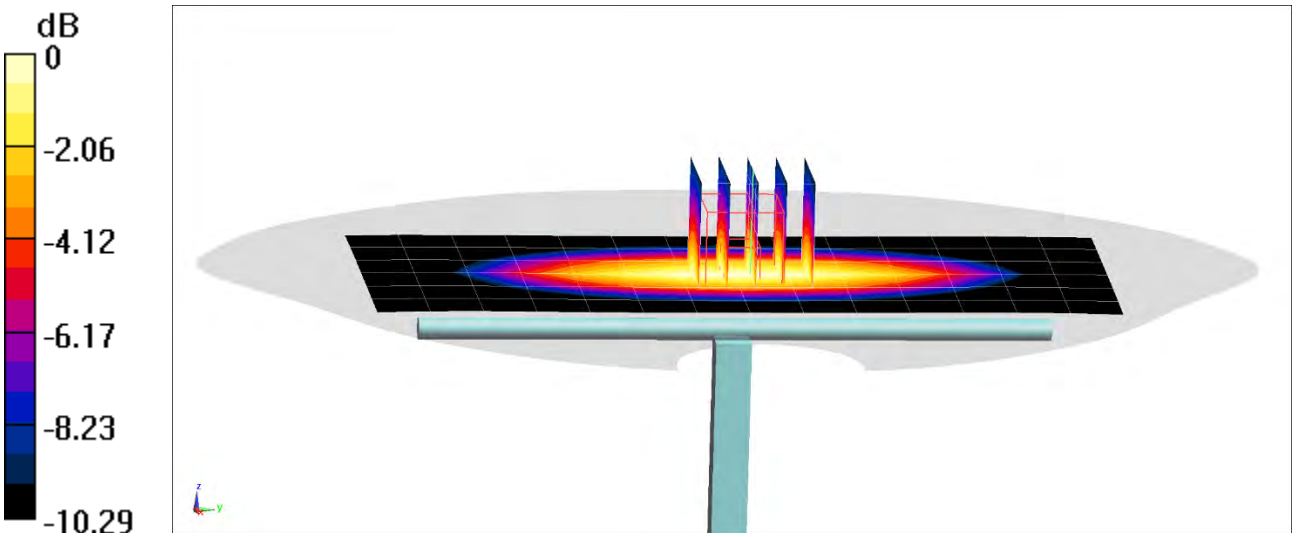
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: 750 Body MHz; Medium parameters used (interpolated):
f = 750 MHz; σ = 0.953 S/m; ε_r = 54.059; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-25-2019; Ambient Temp: 23.6°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.6, 10.6, 10.6) @ 750 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

750 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 2.51 W/kg
SAR(1 g) = 1.66 W/kg
Deviation(1 g) = -3.04%



0 dB = 2.22 W/kg = 3.46 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d040

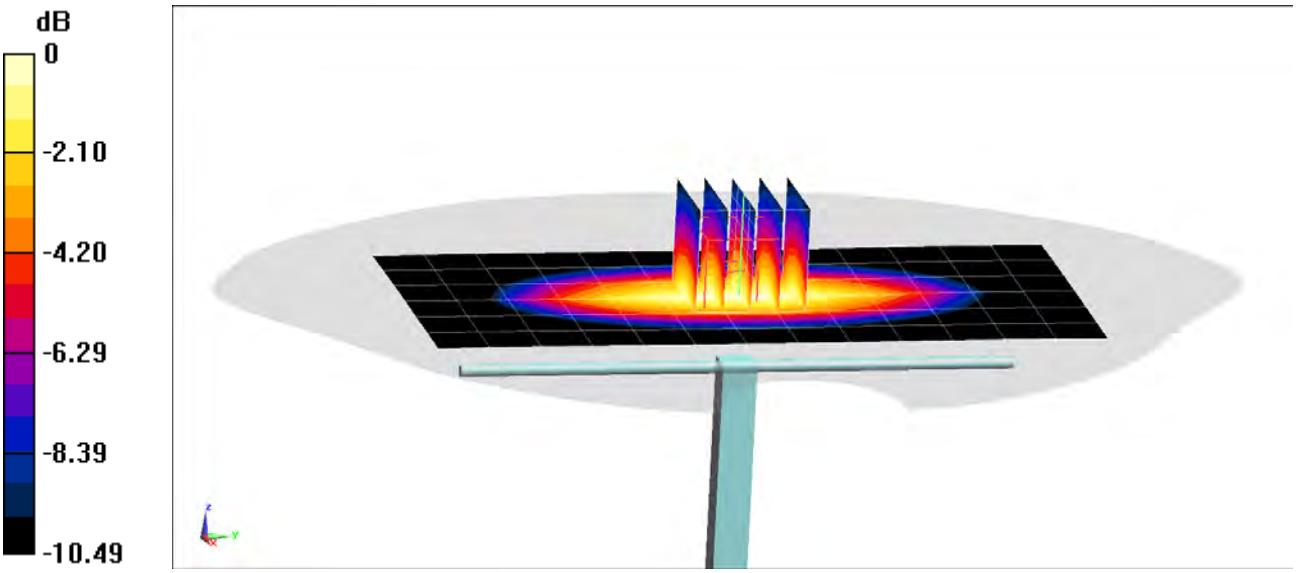
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: 835 MHz Body Medium parameters used:
f = 835 MHz; σ = 0.987 S/m; ε_r = 53.806; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-25-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7532; ConvF(10.14, 10.14, 10.14) @ 835 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

835 MHz System Verification at 23.0 dBm (200 mW)

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 3.09 W/kg
SAR(1 g) = 2.04 W/kg
Deviation(1 g) = 7.03%



0 dB = 2.74 W/kg = 4.38 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1083

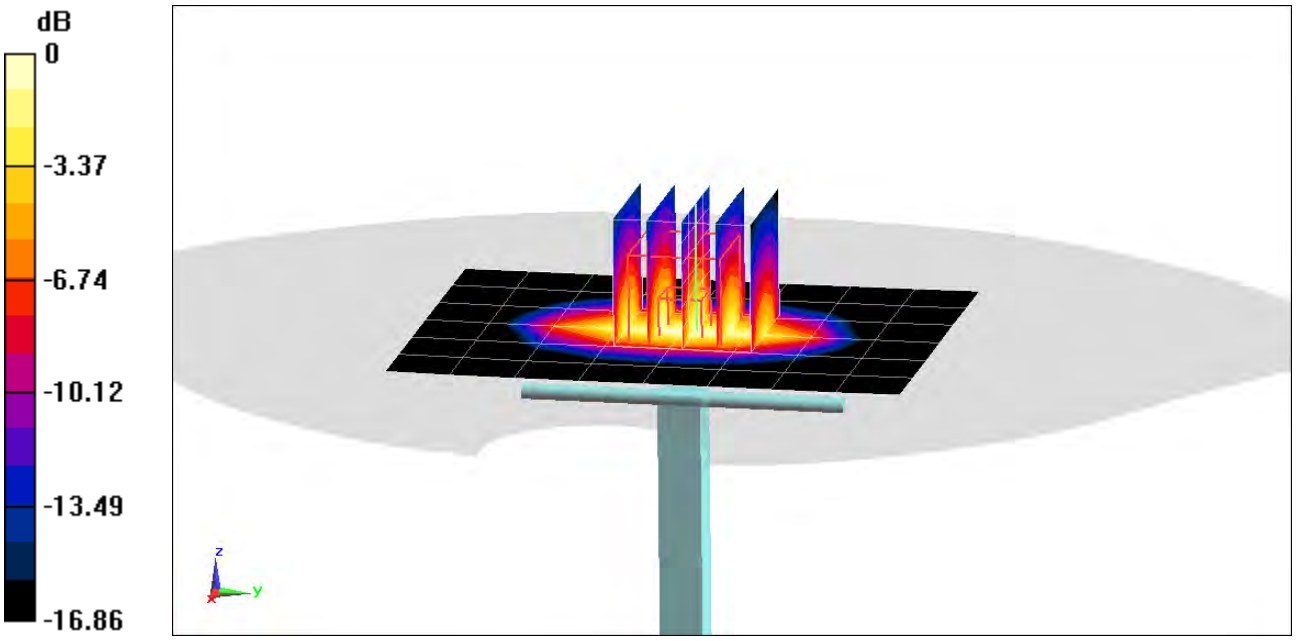
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 MHz Body Medium parameters used:
f = 1750 MHz; σ = 1.437 S/m; ε_r = 51.566; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date:08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.44, 8.44, 8.44) @ 1750 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

1750 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 6.12 W/kg
SAR(1 g) = 3.48 W/kg
Deviation(1 g) = -6.20%



0 dB = 5.24 W/kg = 7.19 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d030

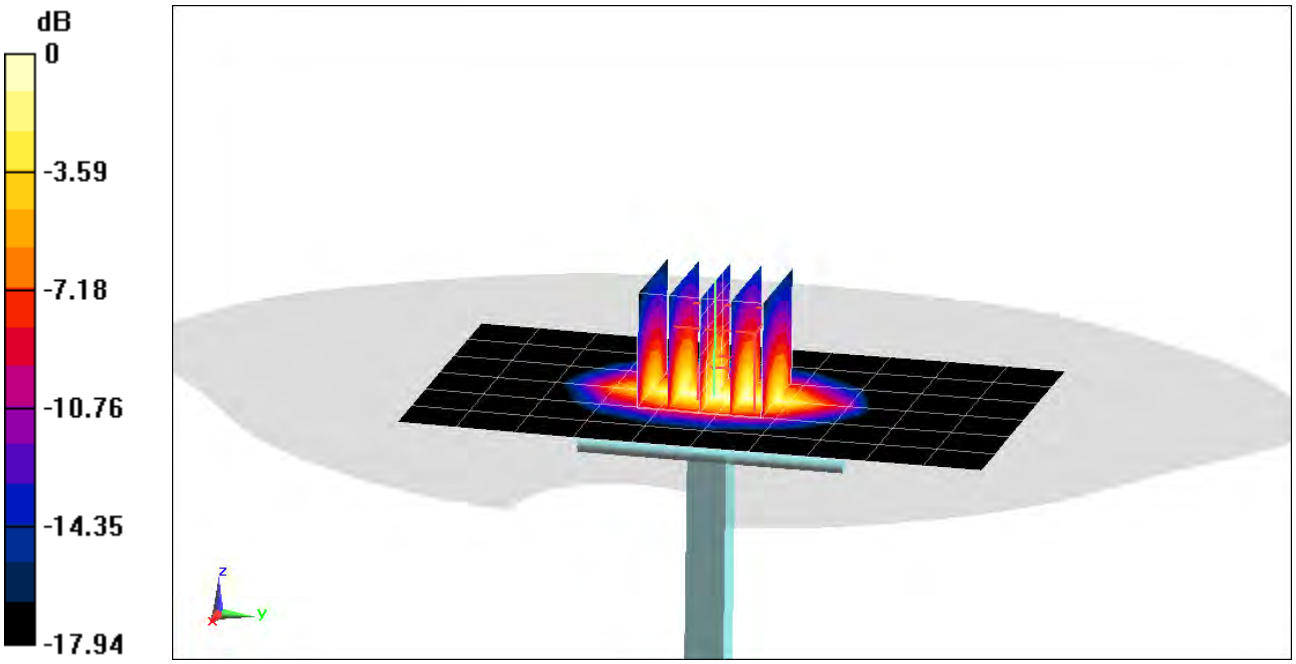
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.538 S/m; ε_r = 51.335; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date:08-01-2019; Ambient Temp: 22.8°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7532; ConvF(8.03, 8.03, 8.03) @ 1900 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.15 W/kg
SAR(1 g) = 3.96 W/kg
Deviation(1 g) = -0.75%



0 dB = 6.05 W/kg = 7.82 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d181

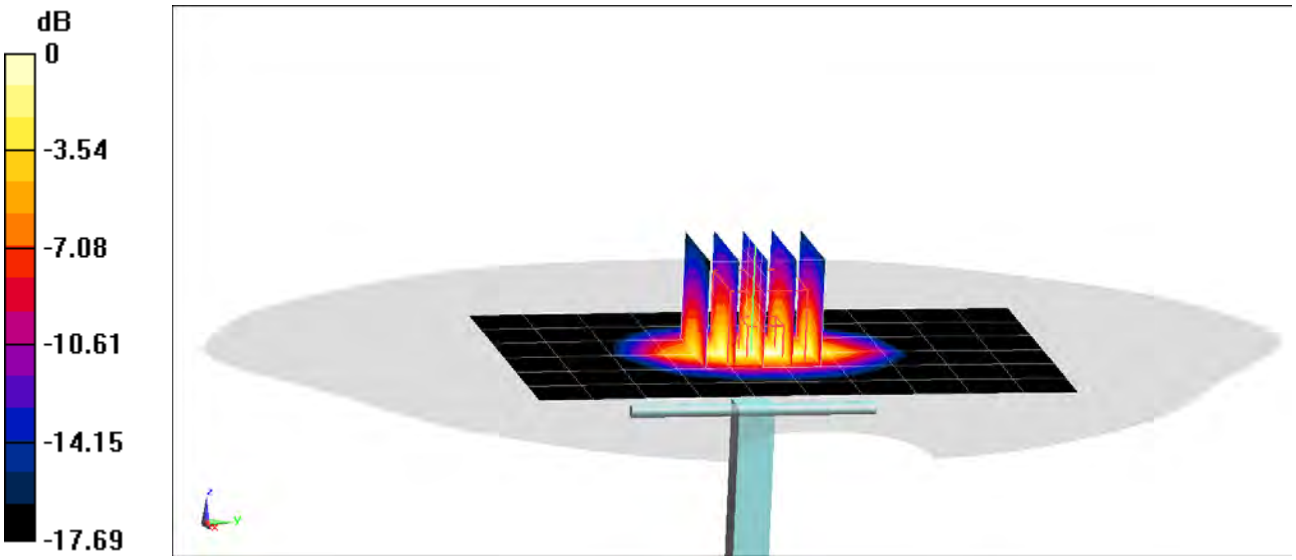
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 MHz Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.554 S/m; ε_r = 52.506; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-05-2019; Ambient Temp: 21.7°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN7490; ConvF(8.13, 8.13, 8.13) @ 1900 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Peak SAR (extrapolated) = 7.31 W/kg
SAR(10 g) = 2.13 W/kg
Deviation(10 g) = 1.91%



0 dB = 6.16 W/kg = 7.90 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d030

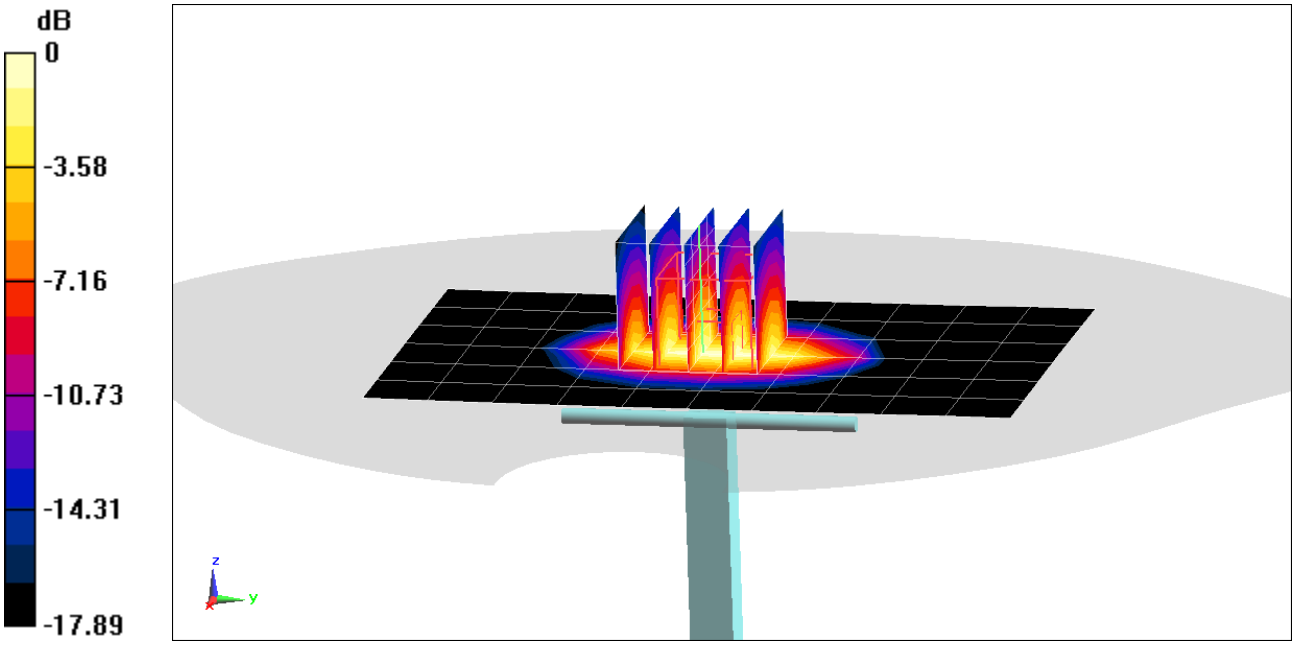
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.494 S/m; ε_r = 52.204; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2019; Ambient Temp: 21.5°C; Tissue Temp: 20.7°C

Probe: EX3DV4 - SN7532; ConvF(8.03, 8.03, 8.03) @ 1900 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

1900 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (7x11x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 57.11 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 7.83 W/kg
SAR(1 g) = 4.29 W/kg
Deviation(1 g) = 7.52%



0 dB = 6.47 W/kg = 8.11 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 921

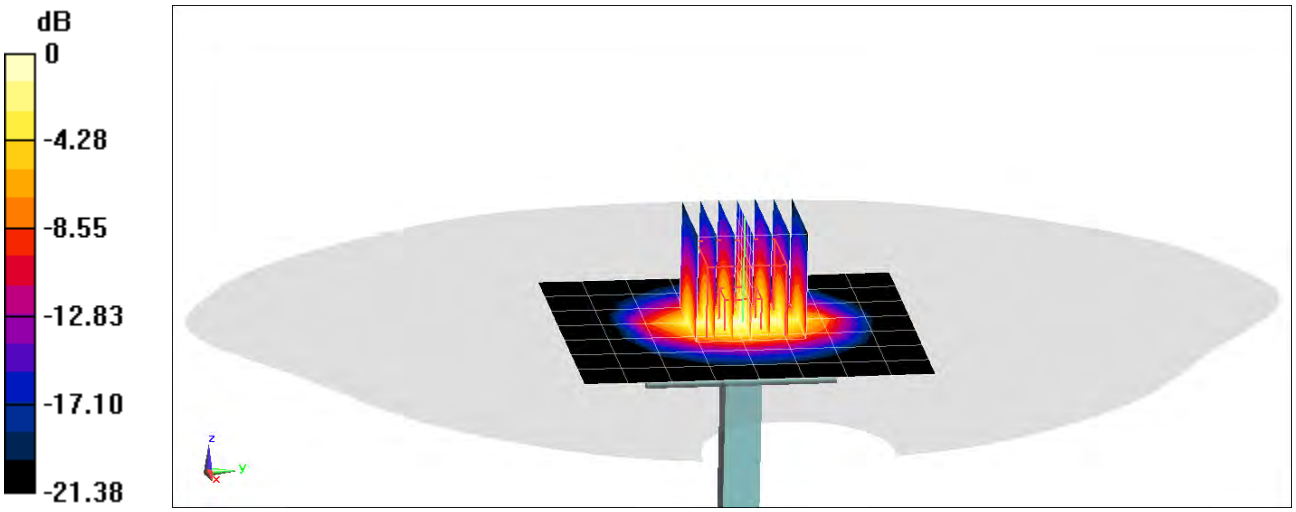
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Body Medium parameters used:
f = 2450 MHz; σ = 1.973 S/m; ε_r = 51.173; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.6°C; Tissue Temp: 21.4°C

Probe: EX3DV4 - SN7532; ConvF(7.66, 7.66, 7.66) @ 2450 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 10.7 W/kg
SAR(1 g) = 5.29 W/kg
Deviation(1 g) = 4.13%



0 dB = 8.71 W/kg = 9.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 921

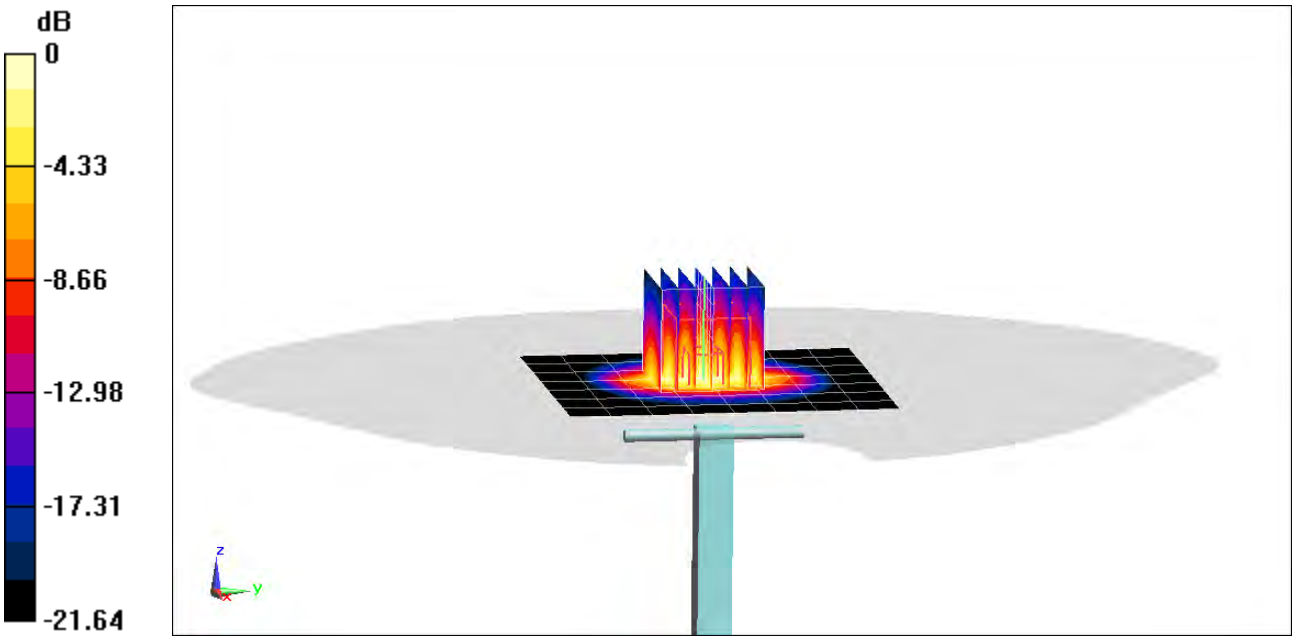
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Body Medium parameters used:
f = 2450 MHz; σ = 1.956 S/m; ε_r = 51.247; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date:08-05-2019; Ambient Temp: 22.5°C; Tissue Temp: 20.8°C

Probe: EX3DV4 - SN7532; ConvF(7.66, 7.66, 7.66) @ 2450 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 10.8 W/kg
SAR(1 g) = 5.33 W/kg
Deviation(1 g) = 4.92%



0 dB = 8.83 W/kg = 9.46 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 921

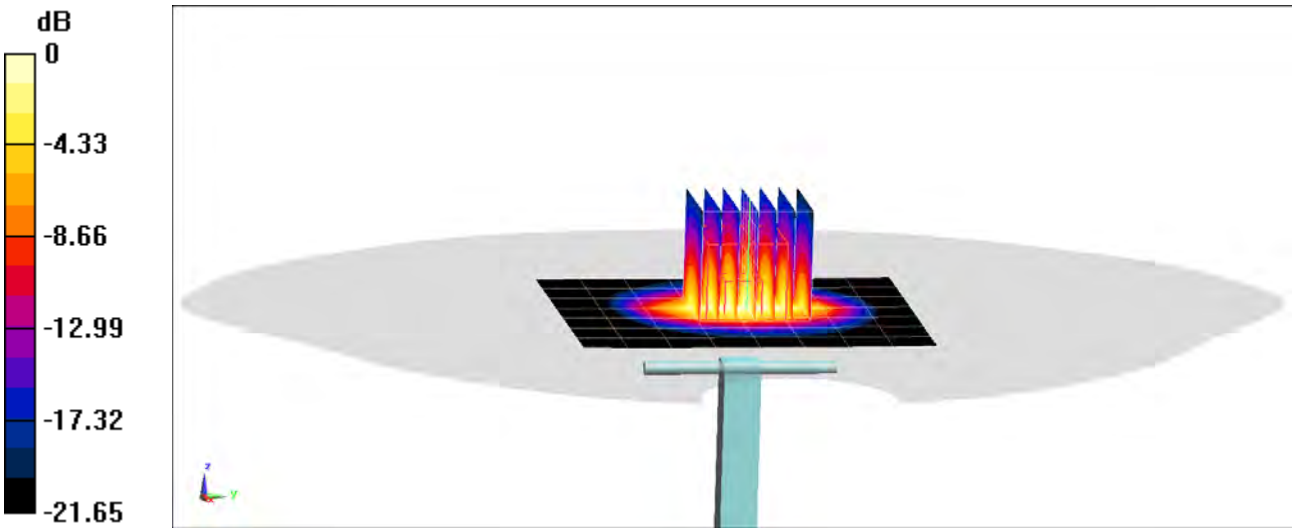
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450-2600 MHz Body Medium parameters used:
f = 2450 MHz; σ = 1.989 S/m; ε_r = 51.3; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-06-2019; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7532; ConvF(7.66, 7.66, 7.66) @ 2450 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 10.8 W/kg
SAR(1 g) = 5.39 W/kg
Deviation(1 g) = 6.10%



0 dB = 8.80 W/kg = 9.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 921

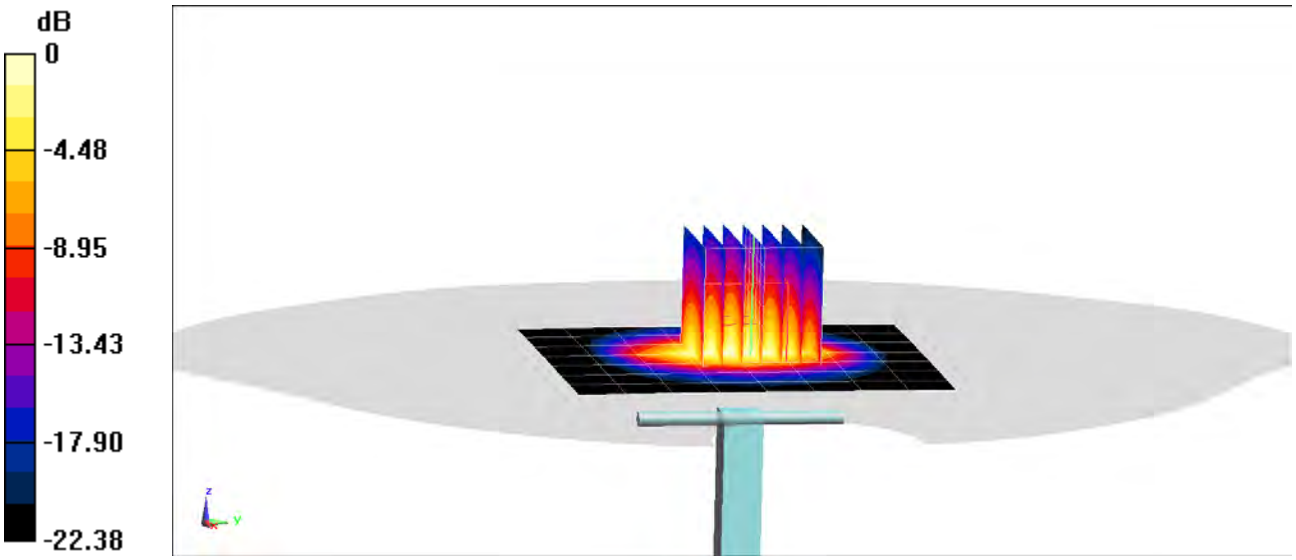
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: 2450 MHz Body Medium parameters used:
f = 2450 MHz; σ = 1.967 S/m; ε_r = 50.939; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2019; Ambient Temp: 22.3°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7490; ConvF(7.87, 7.87, 7.87) @ 2450 MHz; Calibrated: 1/24/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1532; Calibrated: 1/15/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CA; Serial: 1275
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2450 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 10.8 W/kg
SAR(1 g) = 5.19 W/kg
Deviation(1 g) = 2.17%



0 dB = 8.65 W/kg = 9.37 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1069

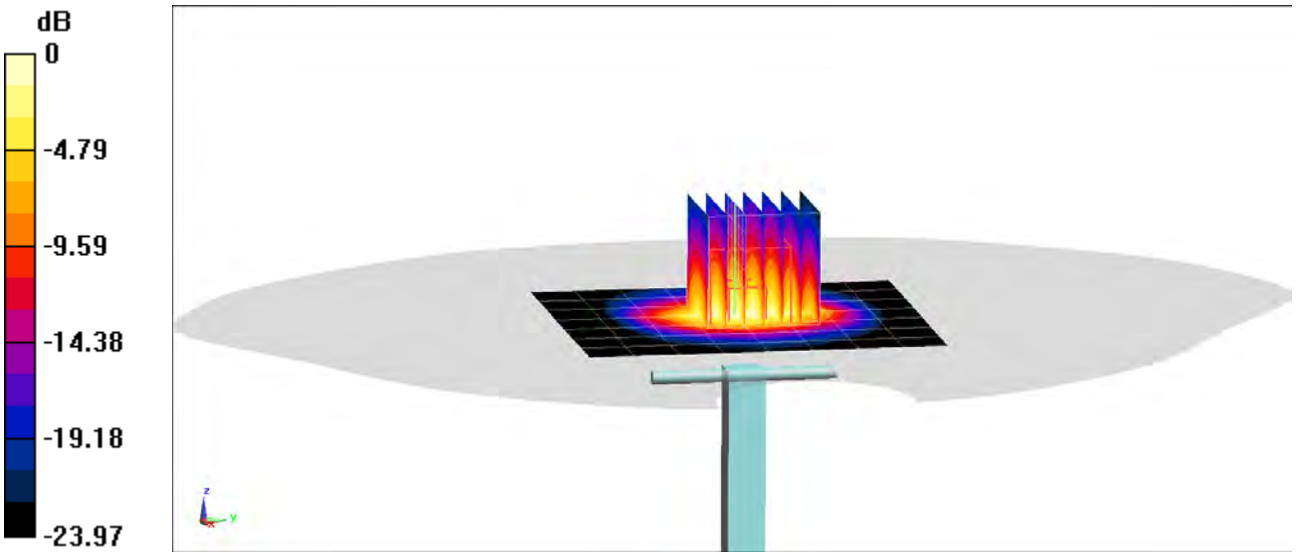
Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1
Medium: 2450-2600 MHz Body Medium parameters used:
f = 2600 MHz; σ = 2.128 S/m; ε_r = 51.03; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-06-2019; Ambient Temp: 21.2°C; Tissue Temp: 21.0°C

Probe: EX3DV4 - SN7532; ConvF(7.47, 7.47, 7.47) @ 2600 MHz; Calibrated: 4/12/2019
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn501; Calibrated: 4/17/2019
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1179
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

2600 MHz System Verification at 20.0 dBm (100 mW)

Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 12.1 W/kg
SAR(1 g) = 5.57 W/kg
Deviation(1 g) = 0.72%



0 dB = 9.54 W/kg = 9.80 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1163

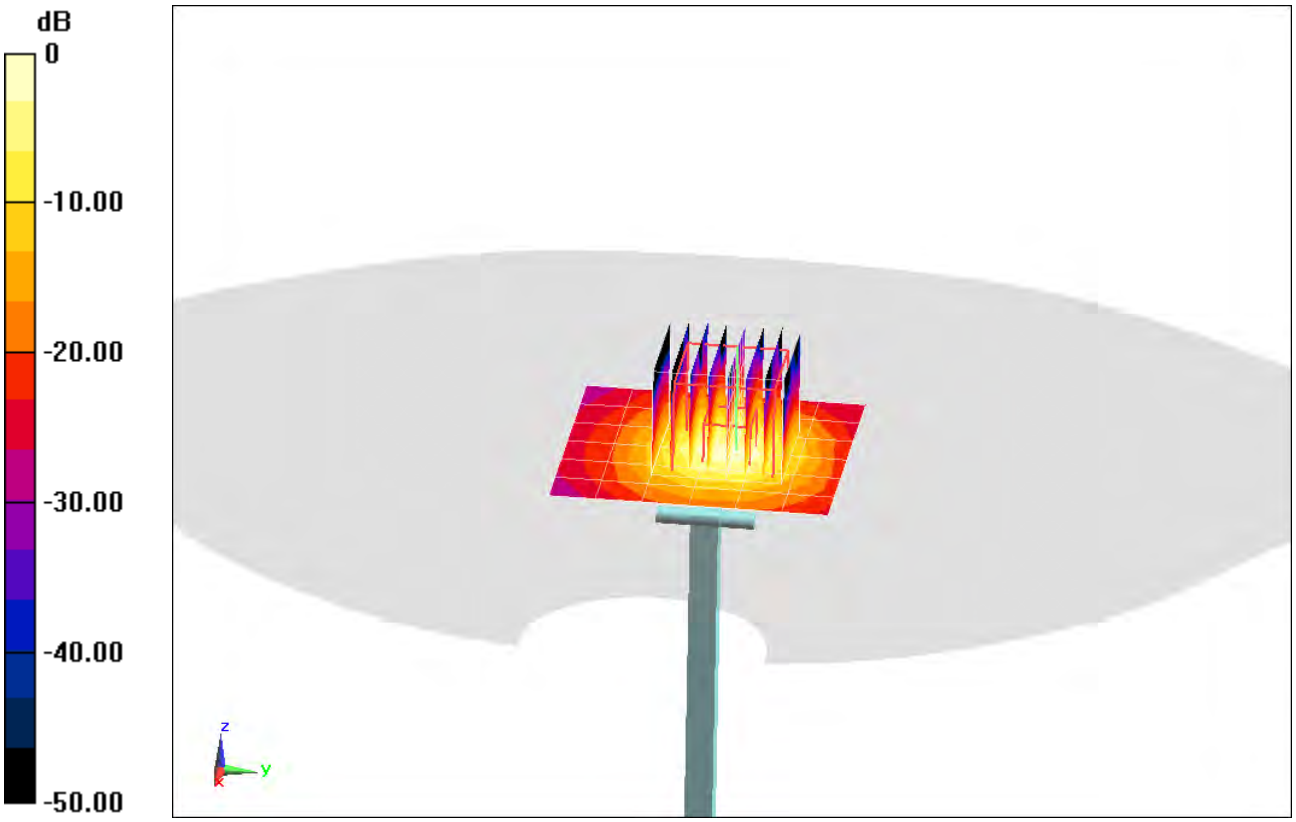
Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5250 MHz; σ = 5.354 S/m; ε_r = 47.168; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7420; ConvF(4.79, 4.79, 4.79) @ 5250 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

5250 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 14.1 W/kg
SAR(1 g) = 3.59 W/kg; SAR(10 g) = 0.997 W/kg
Deviation(1 g) = -7.59%; Deviation(10 g) = -7.26%



0 dB = 8.54 W/kg = 9.31 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1163

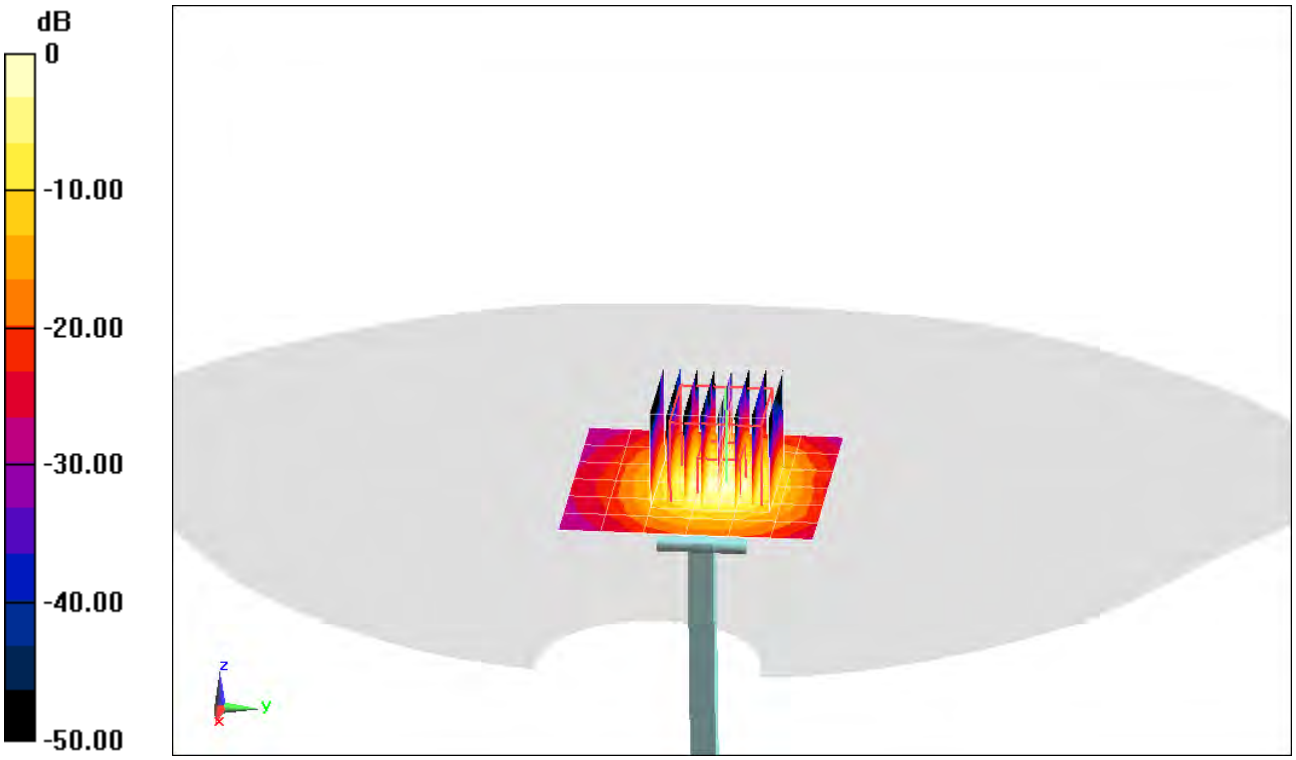
Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.843 S/m; ε_r = 46.482; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7420; ConvF(4.08, 4.08, 4.08) @ 5600 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

5600 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 17.6 W/kg
SAR(1 g) = 3.99 W/kg; SAR(10 g) = 1.09 W/kg
Deviation(1 g) = -0.37%; Deviation(10 g) = -2.24%



0 dB = 10.0 W/kg = 10.00 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1163

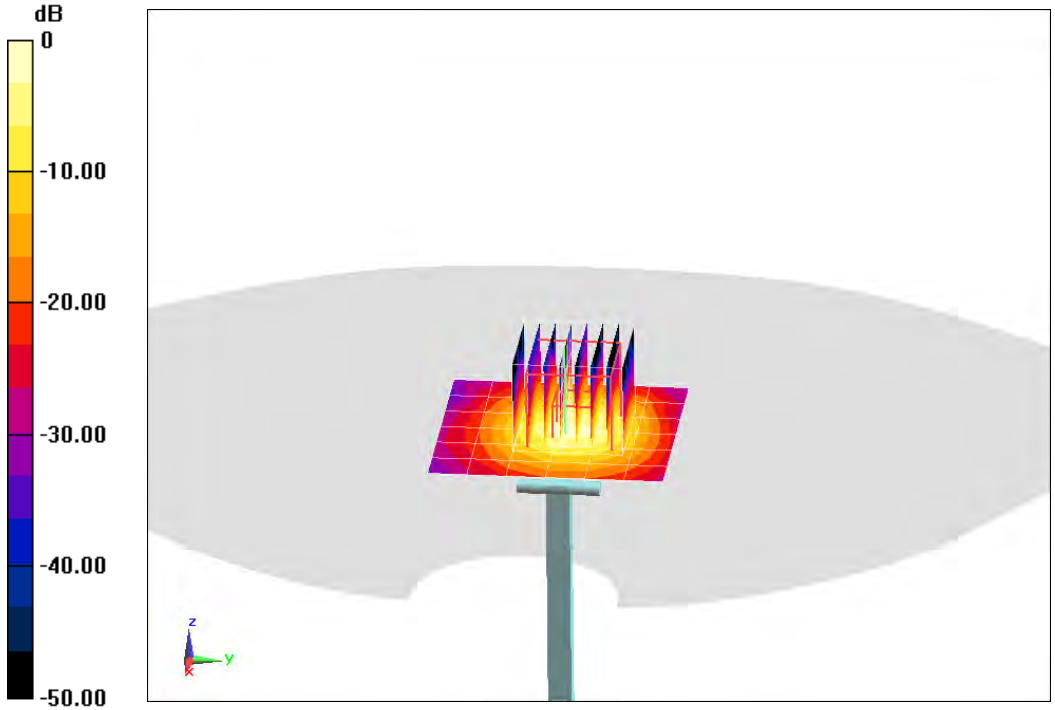
Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used (interpolated):
f = 5750 MHz; σ = 6.056 S/m; ε_r = 46.2; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-29-2019; Ambient Temp: 22.1°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN7420; ConvF(4.36, 4.36, 4.36) @ 5750 MHz; Calibrated: 9/18/2018
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 10/18/2018
Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1596
Measurement SW: DASY52, Version 52.10 (2);SEMCAD X Version 14.6.12 (7470)

5750 MHz System Verification at 17.0 dBm (50 mW)

Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4
Peak SAR (extrapolated) = 16.8 W/kg
SAR(1 g) = 3.76 W/kg; SAR(10 g) = 1.05 W/kg
Deviation(1 g) = -3.34%; Deviation(10 g) = -2.33%



0 dB = 8.96 W/kg = 9.52 dBW/kg

APPENDIX C: PROBE CALIBRATION

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

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

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

Accreditation No.: SCS 0108

Client PC Test

Certificate No: D750V3-1034_May18

CALIBRATION CERTIFICATE

Object	D750V3 - SN:1034
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 18, 2018

SC ✓ 5/31/2018
BN ✓ 08/01/2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

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

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 22, 2018

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
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	41.0 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.32 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.36 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	54.7 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.57 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.67 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.3 Ω + 0.0 jΩ
Return Loss	- 26.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.0 Ω - 3.2 jΩ
Return Loss	- 29.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.034 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 06, 2011

DASY5 Validation Report for Head TSL

Date: 17.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1034

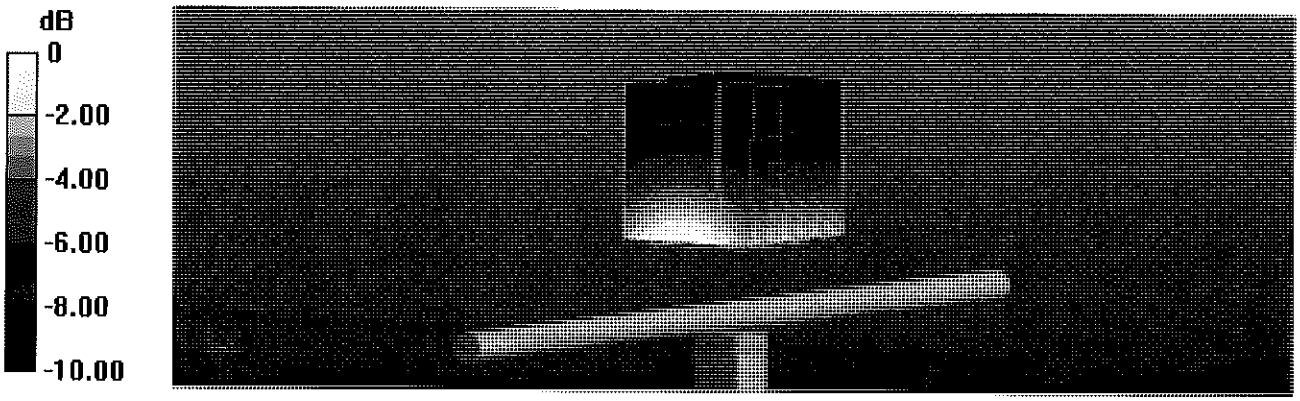
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.89 S/m; ε_r = 41; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

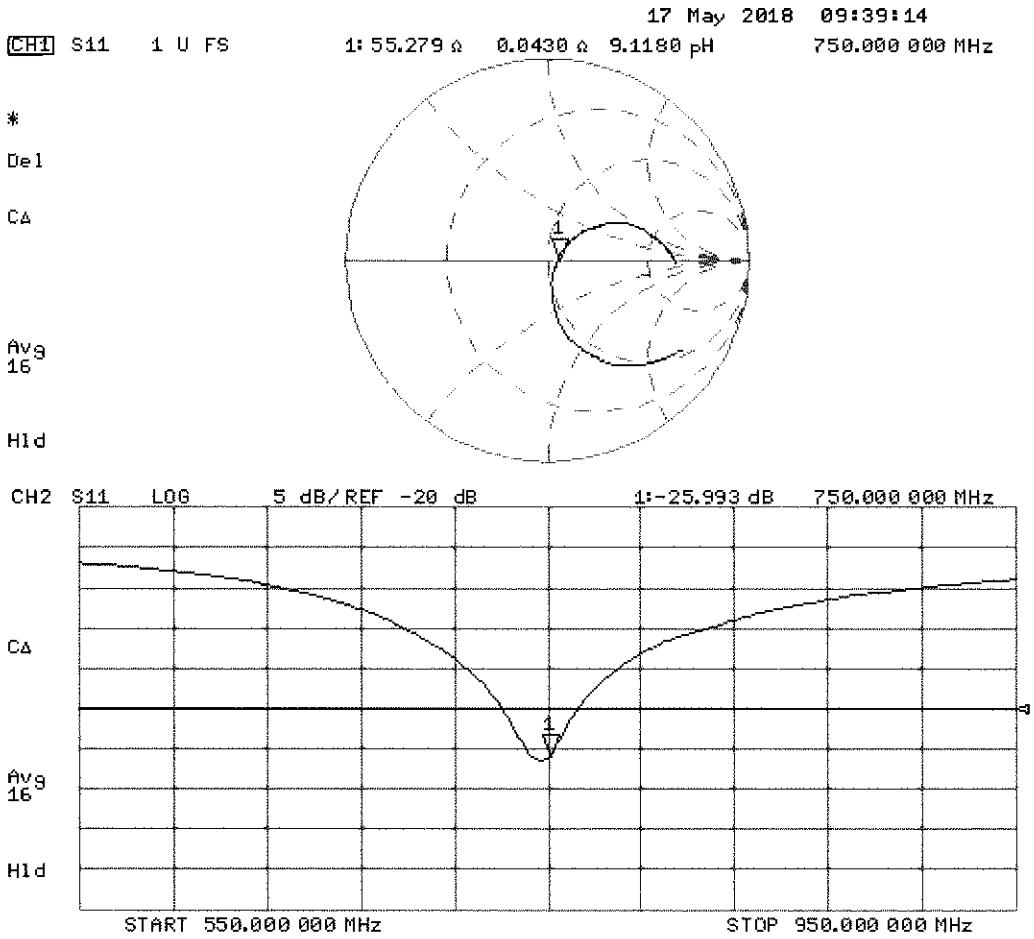
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 59.66 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.18 W/kg
SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.36 W/kg
Maximum value of SAR (measured) = 2.82 W/kg



0 dB = 2.82 W/kg = 4.50 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 18.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1034

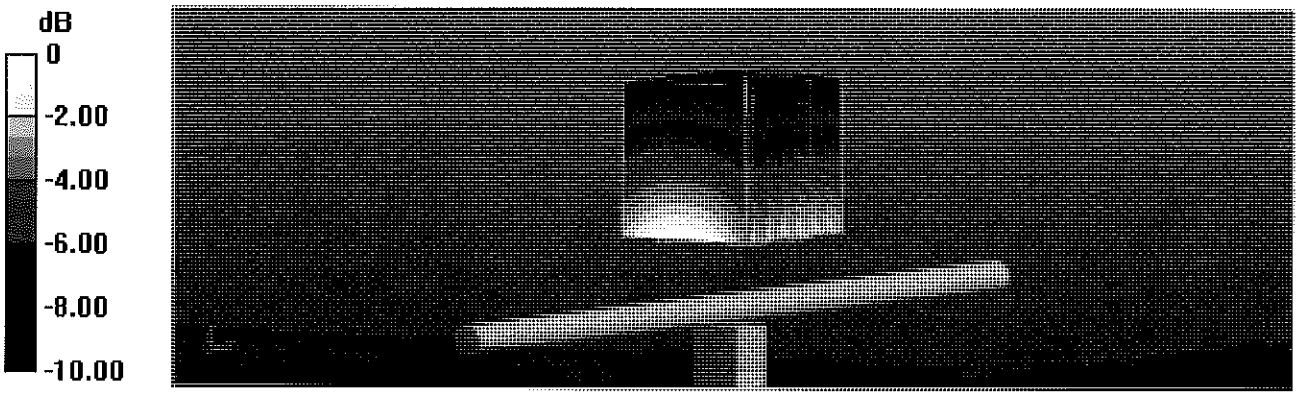
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.96 S/m; ε_r = 54.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19) @ 750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

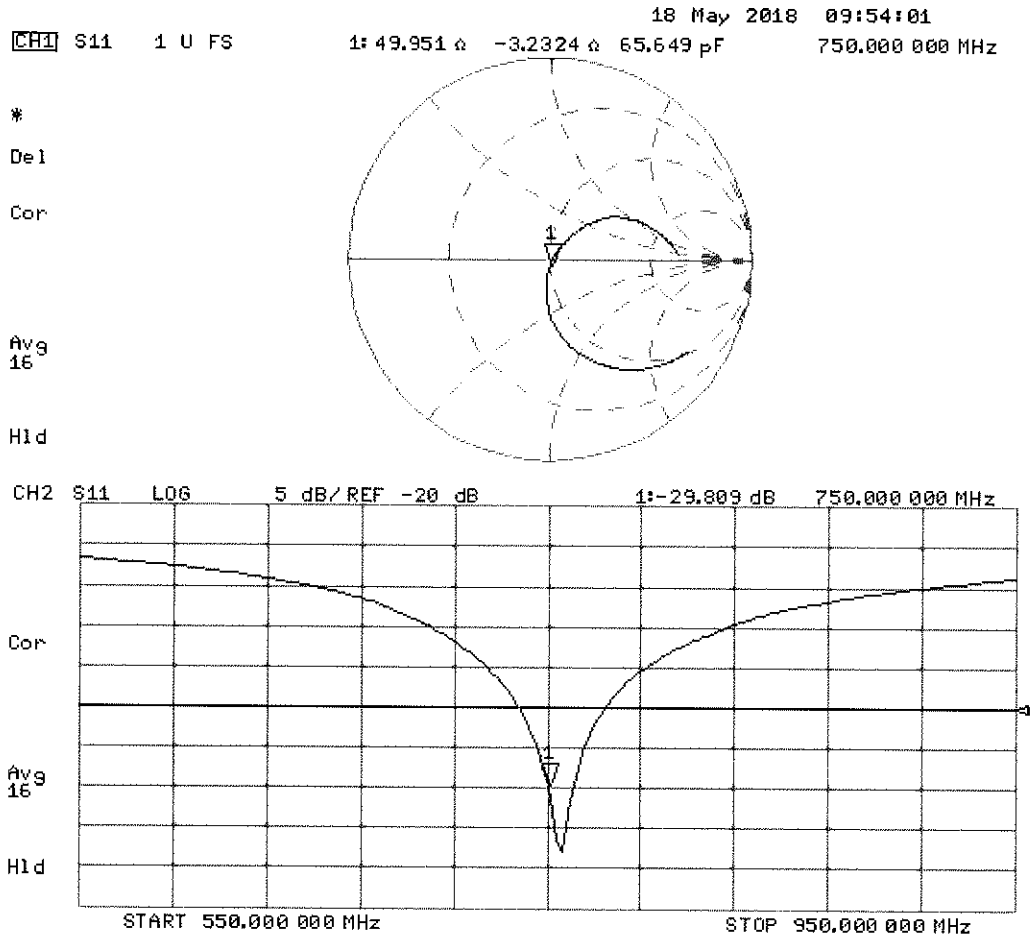
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.60 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.16 W/kg
SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.42 W/kg
Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

Impedance Measurement Plot for Body TSL



Certification of Calibration

Object D750V3 – SN: 1034

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: May 16, 2019

Description: SAR Validation Dipole at 750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/15/2018	Annual	6/15/2019	MY47420837
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAKS-3.5	Portable DAK	9/11/2018	Annual	9/11/2019	1045
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7416
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/10/2018	Annual	7/10/2019	1402

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Parker Jones	Team Lead Engineer	Parker Jones
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	KOK

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

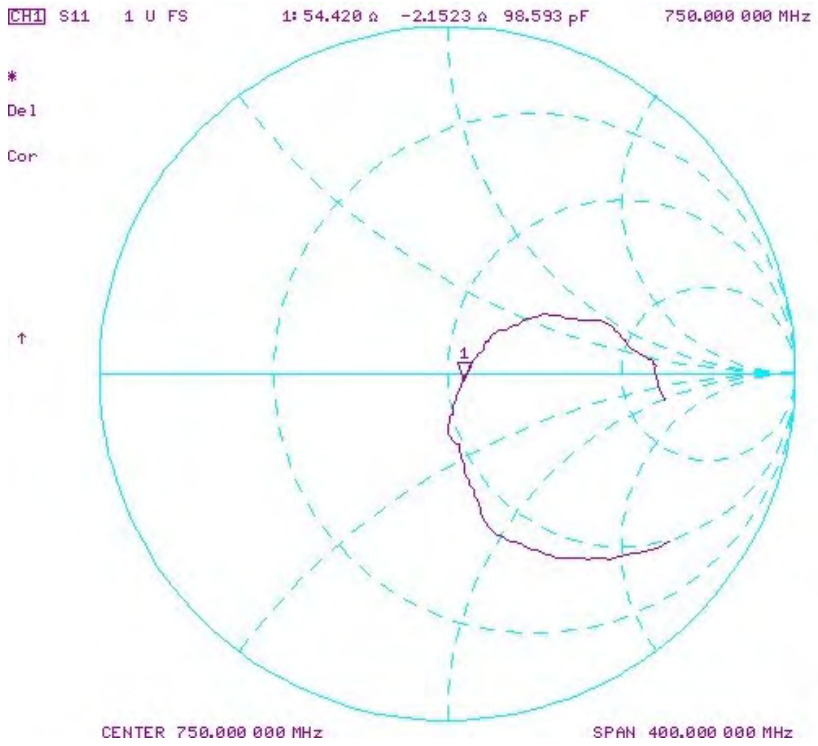
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

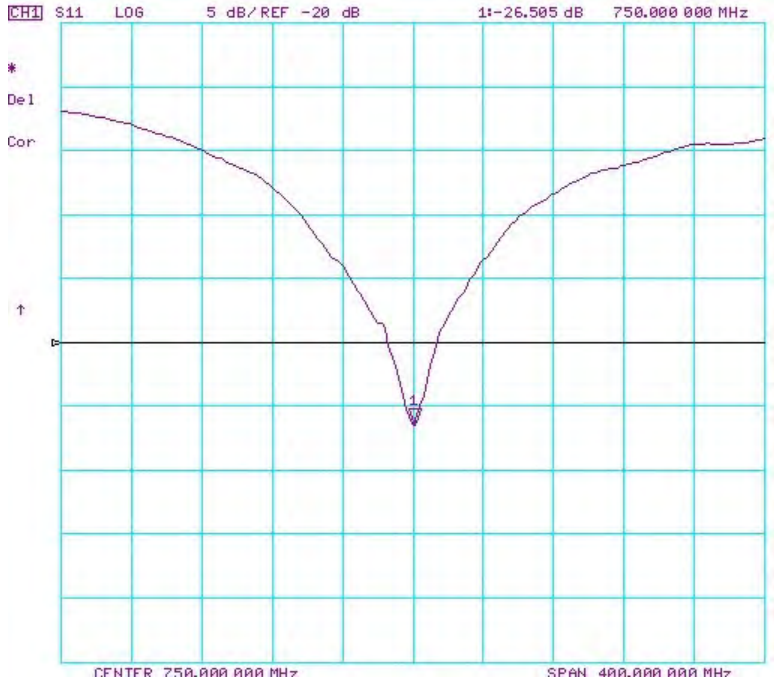
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 23.0 dBm	Measured Head SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 23.0 dBm	Measured Head SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5/18/2018	5/16/2019	1.034	1.664	1.65	-0.84%	1.084	1.08	-0.37%	55.3	54.4	0.9	0	-2.2	2.2	-26	-26.5	-1.90%	PASS

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 23.0 dBm	Measured Body SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 23.0 dBm	Measured Body SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5/18/2018	5/16/2019	1.034	1.714	1.81	5.60%	1.134	1.19	4.94%	50	51.7	1.7	-3.2	-1	2.2	-29.8	-31	-3.90%	PASS

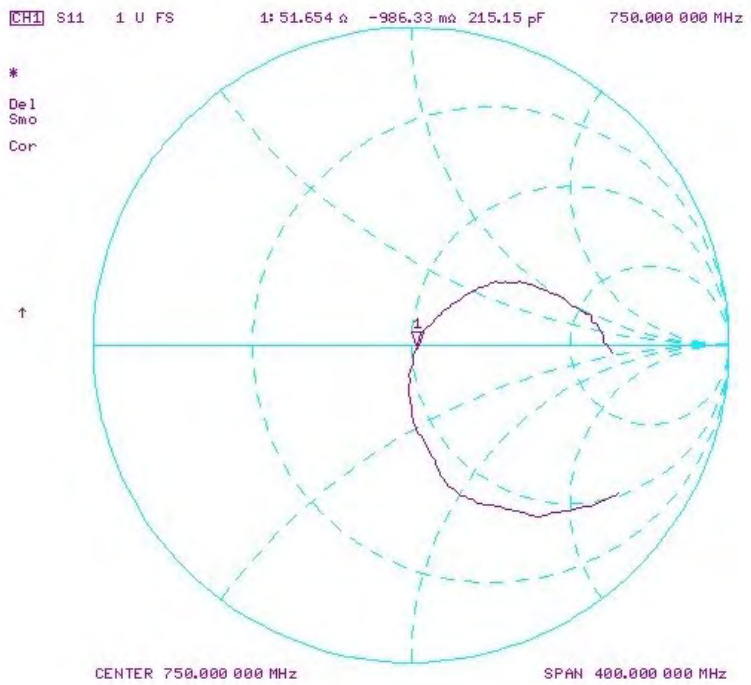
Impedance & Return-Loss Measurement Plot for Head TSL

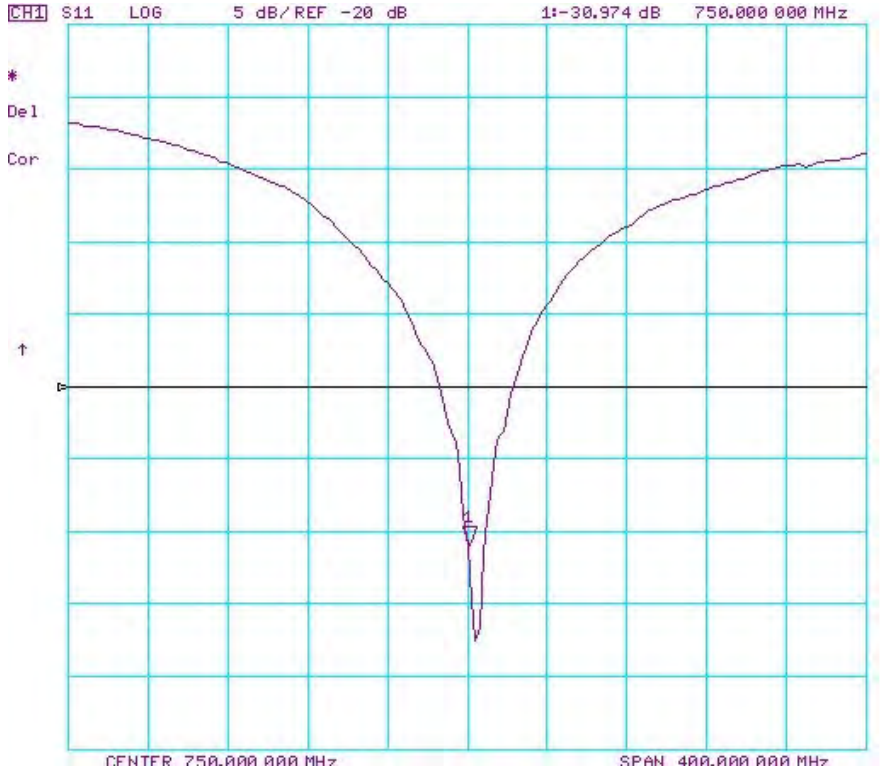




Object:	Date Issued:	Page 3 of 4
D750V3 – SN: 1034	05/16/2019	

Impedance & Return-Loss 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 0108

Client PC Test

Certificate No: D750V3-1097_Sep17

CALIBRATION CERTIFICATE

Object	D750V3 - SN:1097
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	September 08, 2017

SC ✓ 10/03/2017

SC ✓ 9/8/2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

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

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

Issued: September 8, 2017

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	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	41.2 ± 6 %	0.90 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	2.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.22 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.39 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.5 ± 6 %	0.96 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	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.56 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.68 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.4 Ω - 0.6 jΩ
Return Loss	- 27.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.0 Ω - 3.6 jΩ
Return Loss	- 28.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.034 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 05, 2013

DASY5 Validation Report for Head TSL

Date: 08.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1097

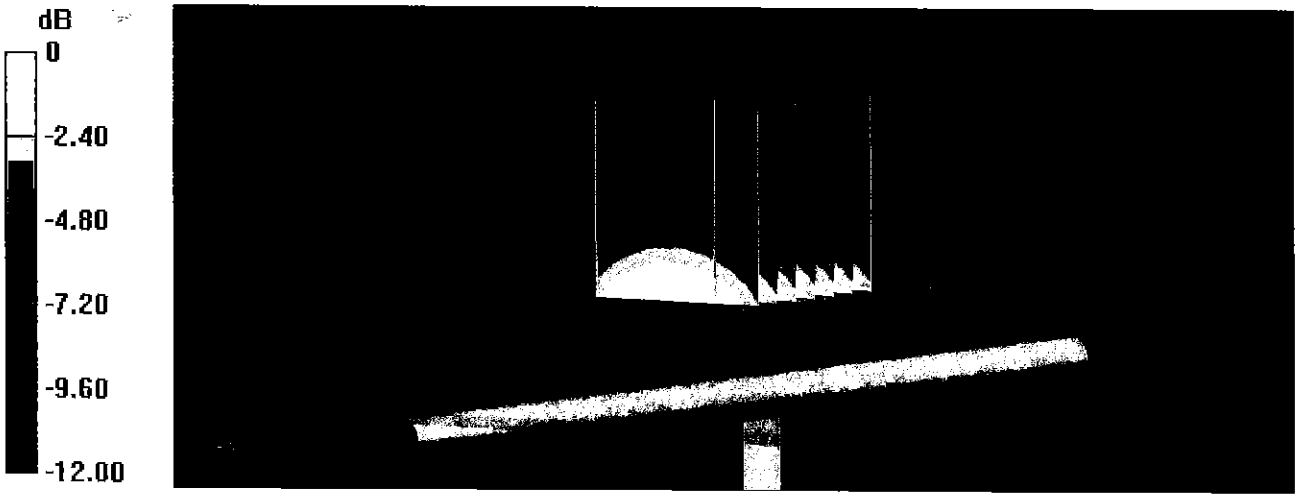
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.9 S/m; ε_r = 41.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.49, 10.49, 10.49); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

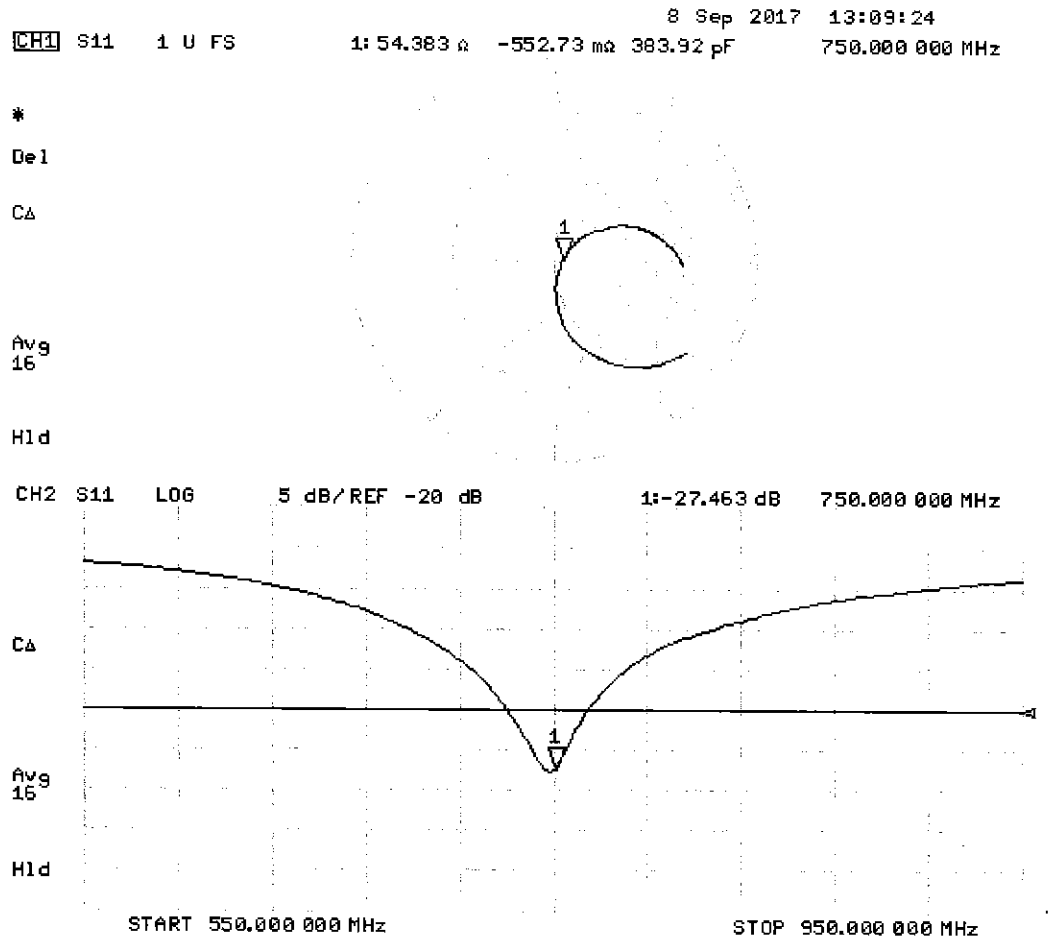
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.59 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.19 W/kg
SAR(1 g) = 2.08 W/kg; SAR(10 g) = 1.36 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: 08.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1097

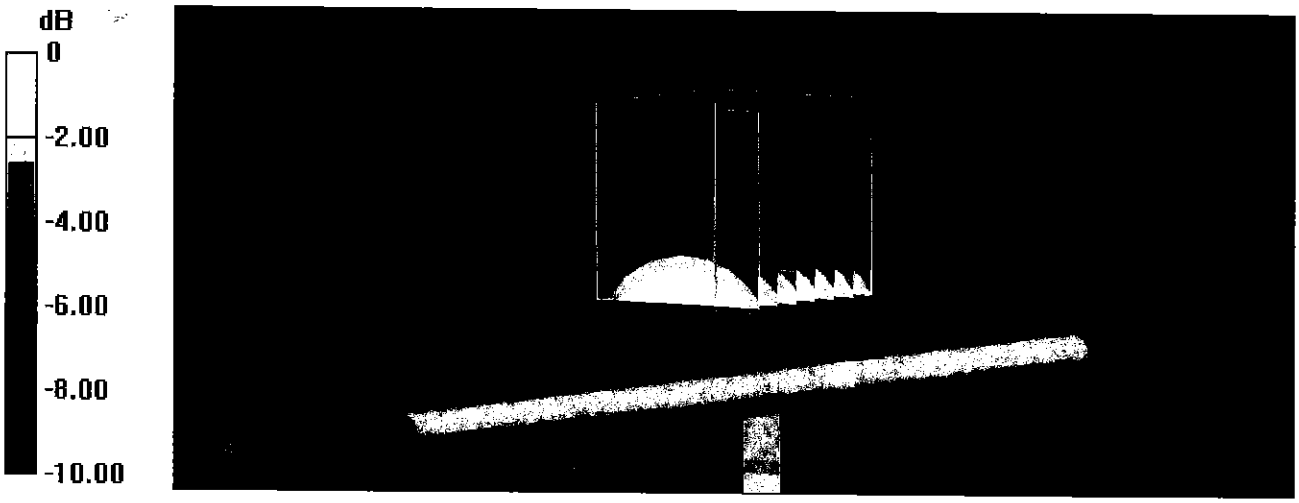
Communication System: UID 0 - CW; Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.96 S/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.35, 10.35, 10.35); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

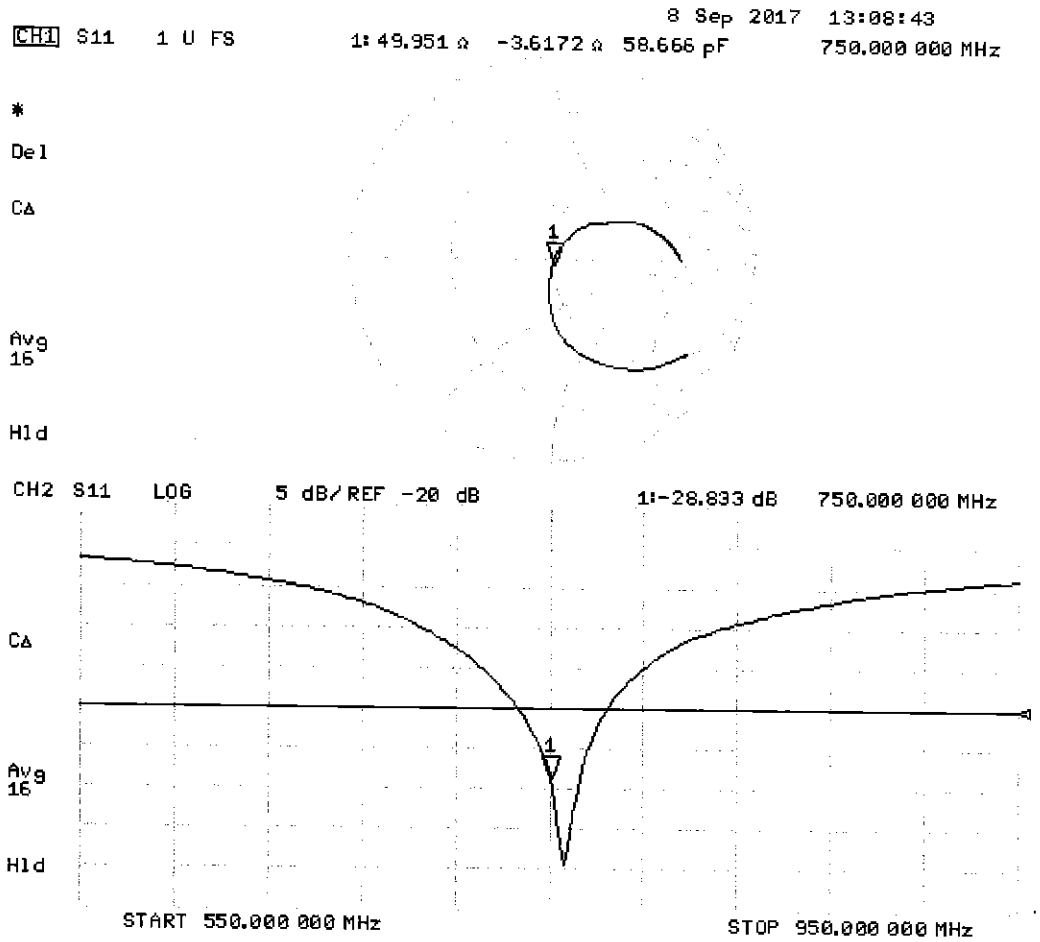
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.96 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.16 W/kg
SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.42 W/kg
Maximum value of SAR (measured) = 2.81 W/kg



0 dB = 2.81 W/kg = 4.49 dBW/kg

Impedance Measurement Plot for Body TSL



Certification of Calibration

Object D750V3 – SN: 1097

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: September 08, 2018

Description: SAR Validation Dipole at 750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	ES3DV3	SAR Probe	9/18/2017	Annual	9/18/2018	3287
SPEAG	DAE4	Data Acquisition Electronics	1/26/2018	Annual	1/26/2019	1533
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7416
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/18/2018	Annual	1/18/2019	793

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

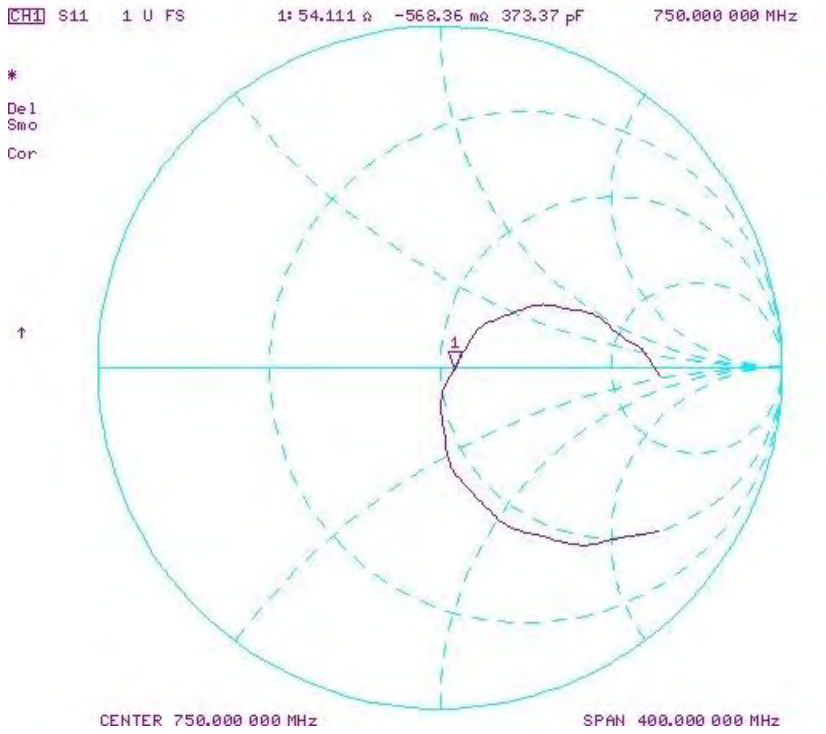
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

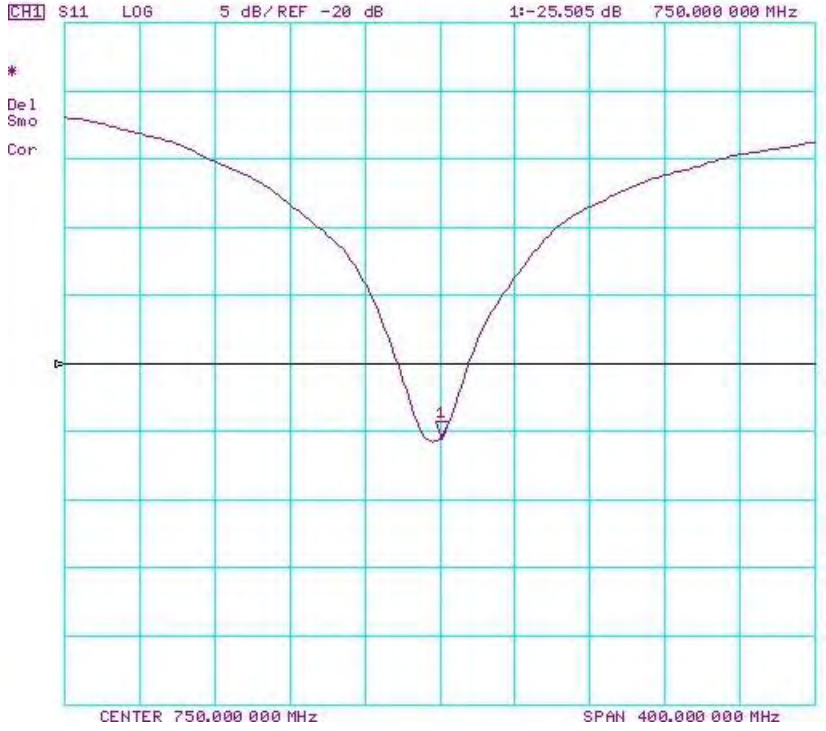
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 23.0 dBm	Measured Head SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 23.0 dBm	Measured Head SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/8/2017	9/8/2018	1.034	1.644	1.7	3.41%	1.078	1.12	3.90%	54.4	54.1	0.3	-0.6	-0.6	0	-27.5	-25.5	7.30%	PASS

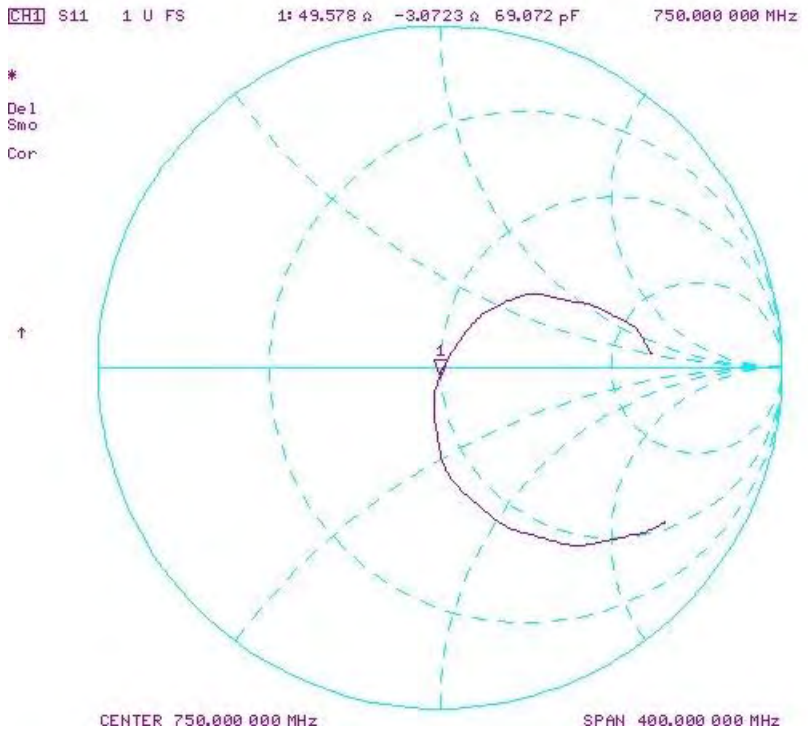
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 23.0 dBm	Measured Body SAR (1g) W/kg @ 23.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 23.0 dBm	Measured Body SAR (10g) W/kg @ 23.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/8/2017	9/8/2018	1.034	1.712	1.78	3.97%	1.136	1.17	2.99%	50	49.6	0.4	-3.6	-3.1	0.5	-28.8	-30.3	-5.20%	PASS

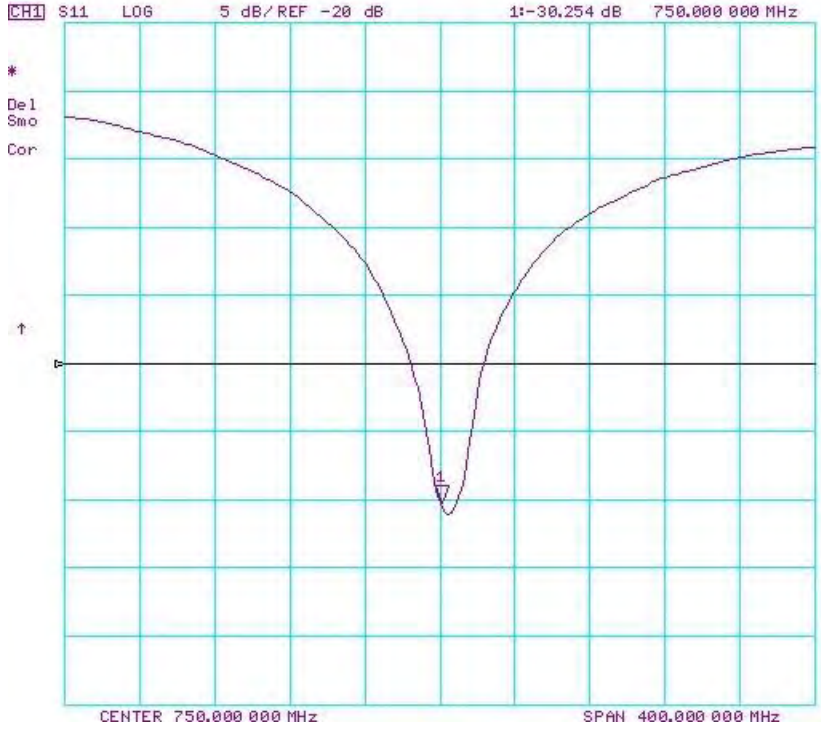
Impedance & Return-Loss Measurement Plot for Head TSL





Impedance & Return-Loss 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 0108

Client **PC Test**

Certificate No: D835V2-4d040_Jun19

CALIBRATION CERTIFICATE

Object	D835V2 - SN:4d040
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	June 20, 2019

ATM 6/28/19

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 21, 2019

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 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	41.8 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.50 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.13 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	55.4 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.53 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.24 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.6 Ω - 4.1 jΩ
Return Loss	- 27.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω - 6.5 jΩ
Return Loss	- 22.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.393 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

DASY5 Validation Report for Head TSL

Date: 20.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d040

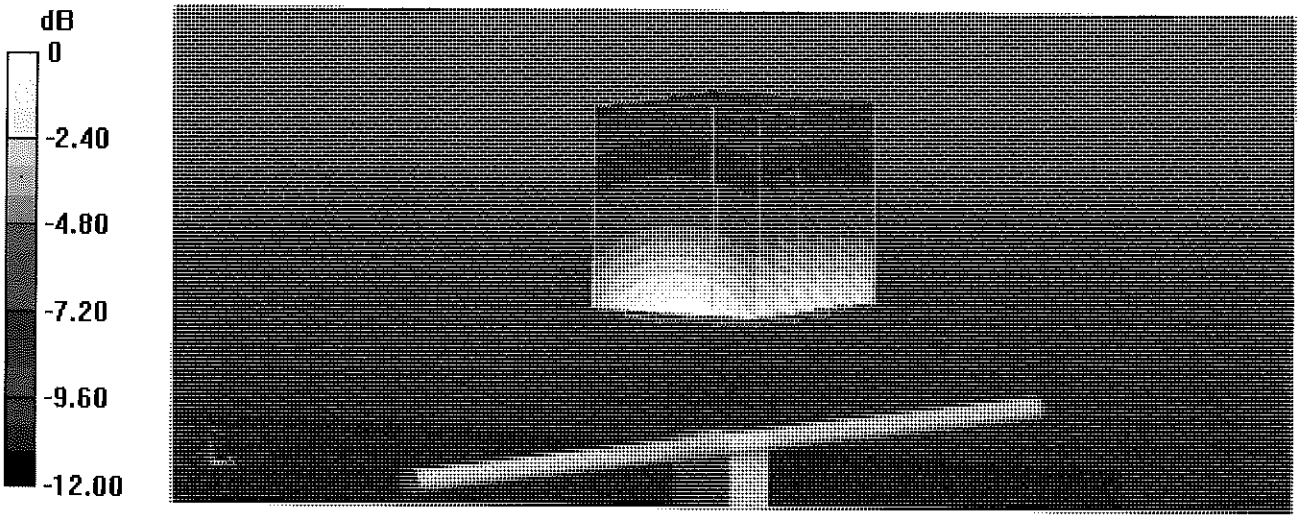
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.91 S/m; ε_r = 41.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.89, 9.89, 9.89) @ 835 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

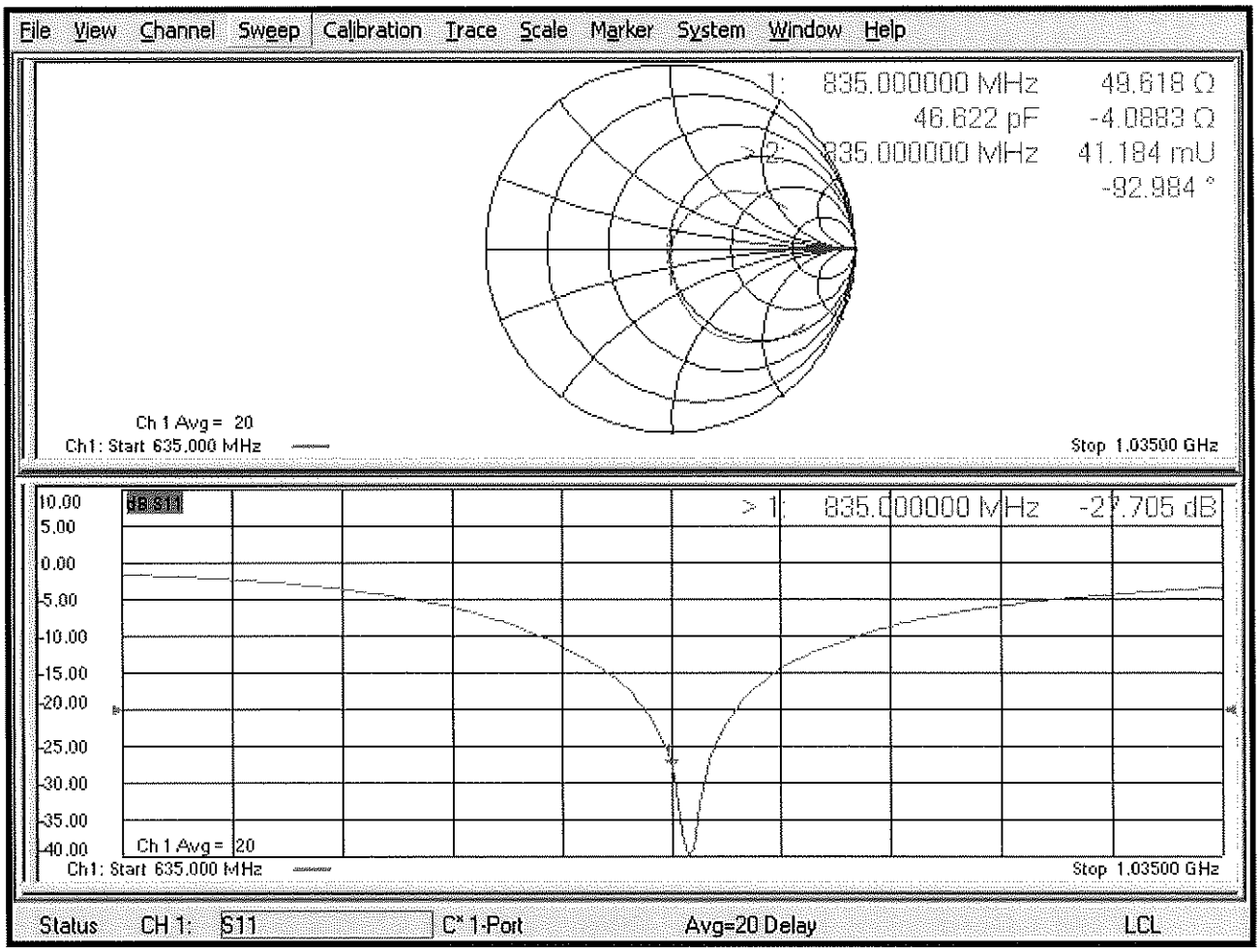
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 63.05 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 3.60 W/kg
SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.54 W/kg
Maximum value of SAR (measured) = 3.19 W/kg



0 dB = 3.19 W/kg = 5.04 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d040

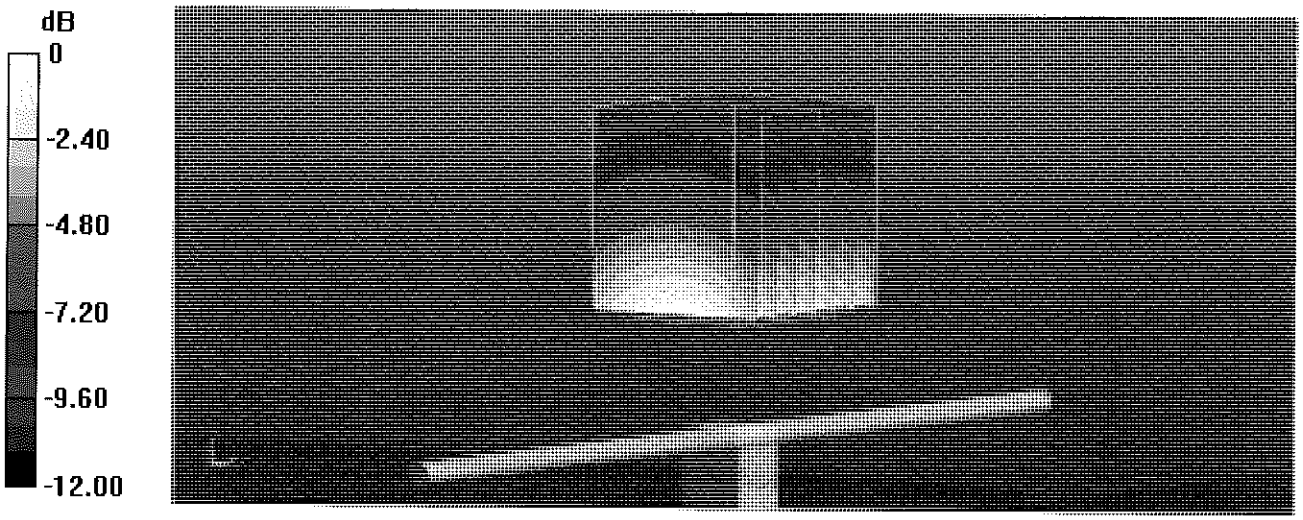
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.98 S/m; ε_r = 55.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.16, 10.16, 10.16) @ 835 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

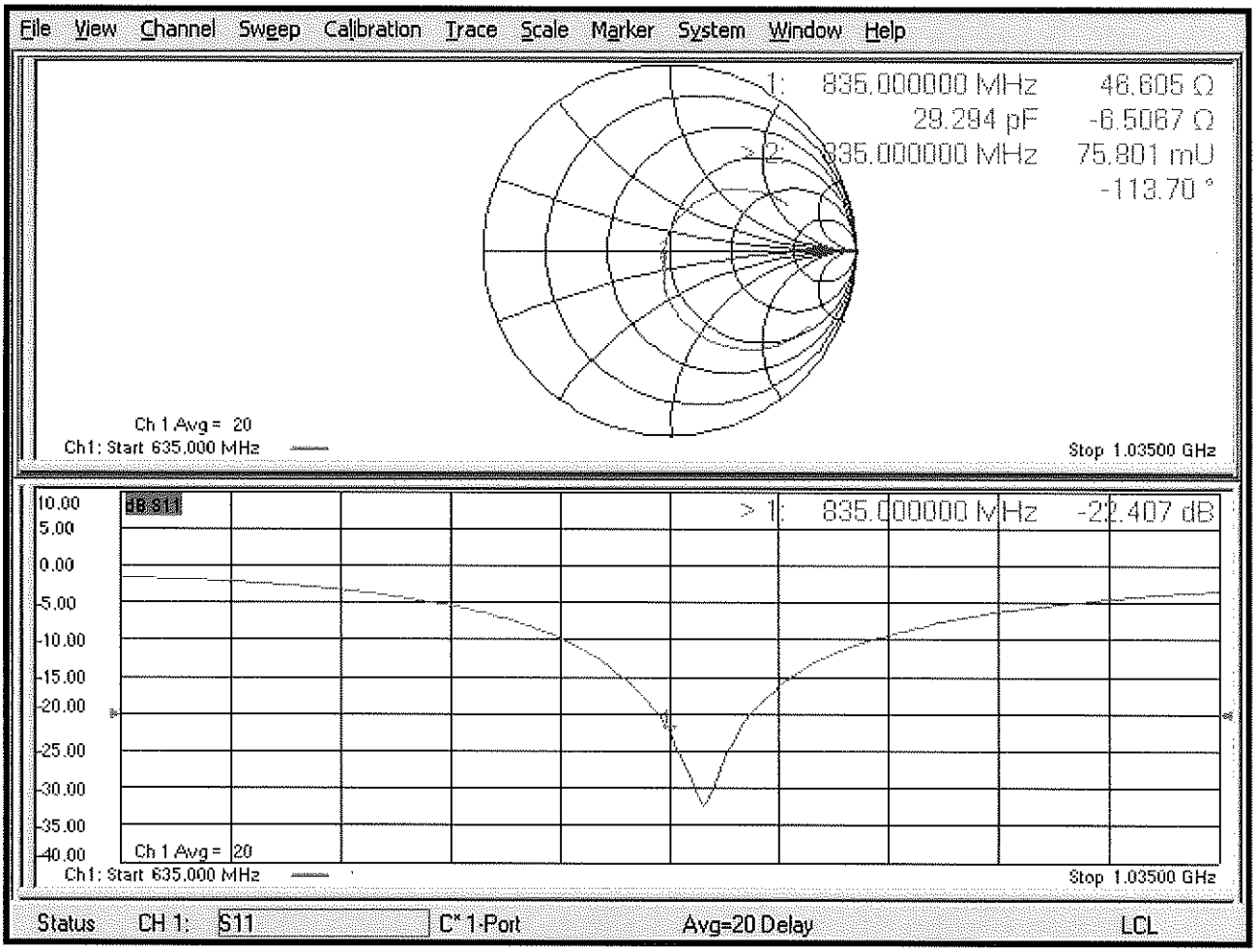
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.73 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 3.59 W/kg
SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 3.21 W/kg



0 dB = 3.21 W/kg = 5.07 dBW/kg

Impedance Measurement Plot for Body TSL



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

S Schweizerischer Kalibrierdienst
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S Swiss Calibration Service

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Accreditation No.: SCS 0108

Client PC Test

Certificate No: D1750V2-1083_Jun19

CALIBRATION CERTIFICATE

Object: D1750V2 - SN:1083

ATM 6/27/19

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: June 19, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: June 20, 2019

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	40.0 ± 6 %	1.34 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	8.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.70 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.9 ± 6 %	1.46 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	9.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**37.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.88 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.7 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.6 Ω - 1.1 jΩ
Return Loss	- 38.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.1 Ω - 2.4 jΩ
Return Loss	- 28.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.220 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

DASY5 Validation Report for Head TSL

Date: 19.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1083

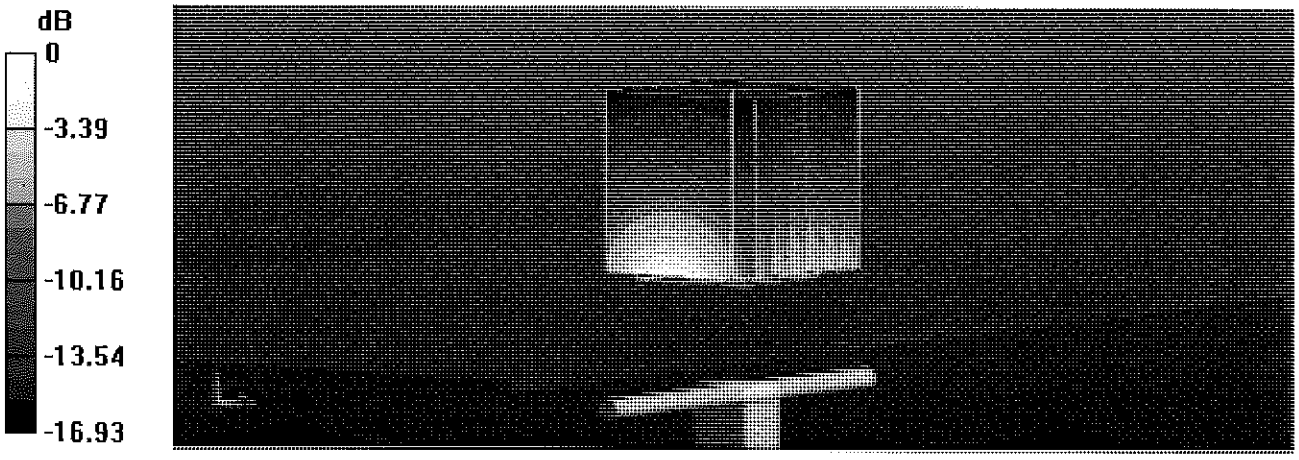
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.34 S/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.67, 8.67, 8.67) @ 1750 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

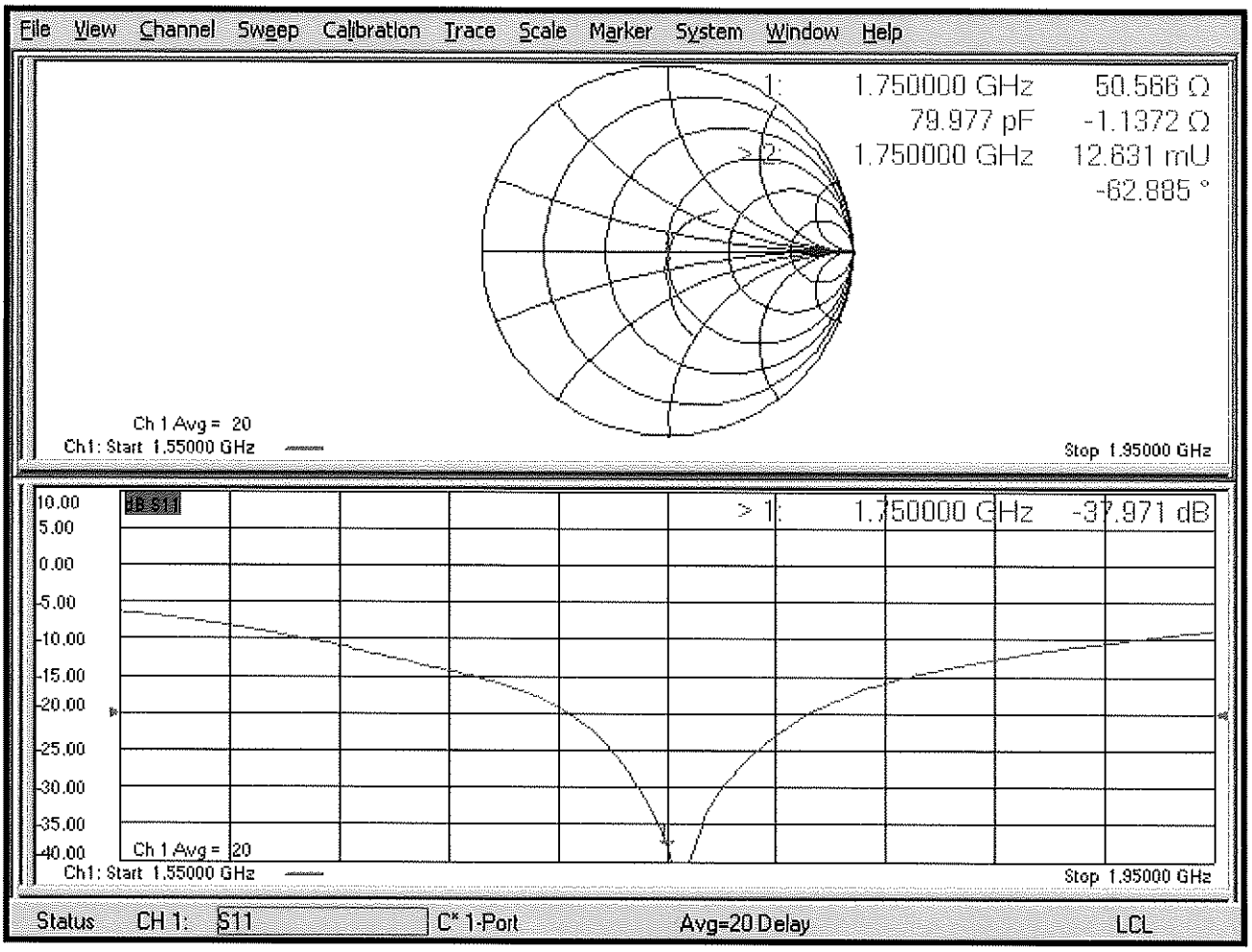
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.8 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 16.7 W/kg
SAR(1 g) = 8.91 W/kg; SAR(10 g) = 4.7 W/kg
Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1083

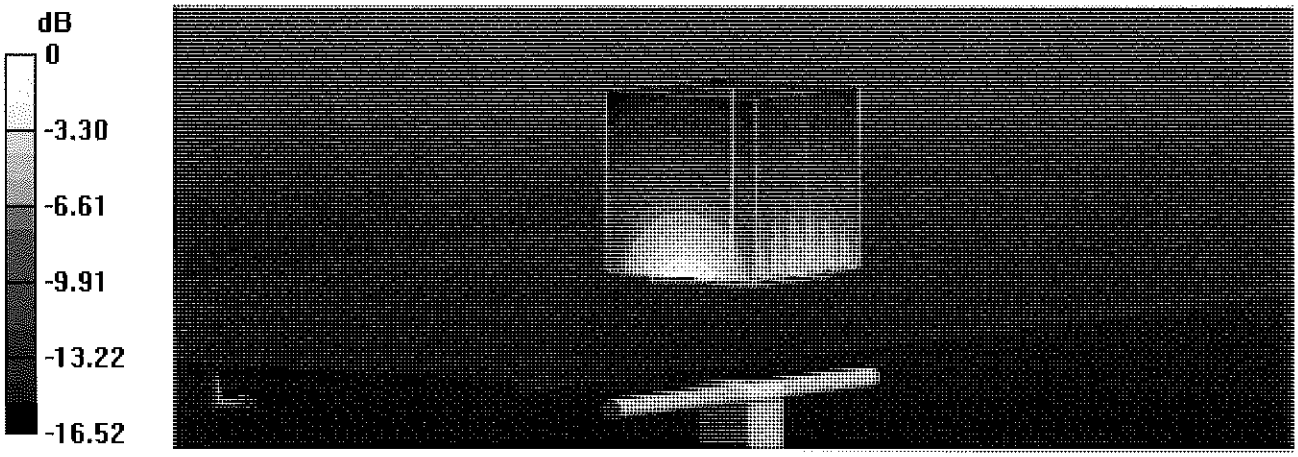
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.46 S/m; ε_r = 53.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.45, 8.45, 8.45) @ 1750 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

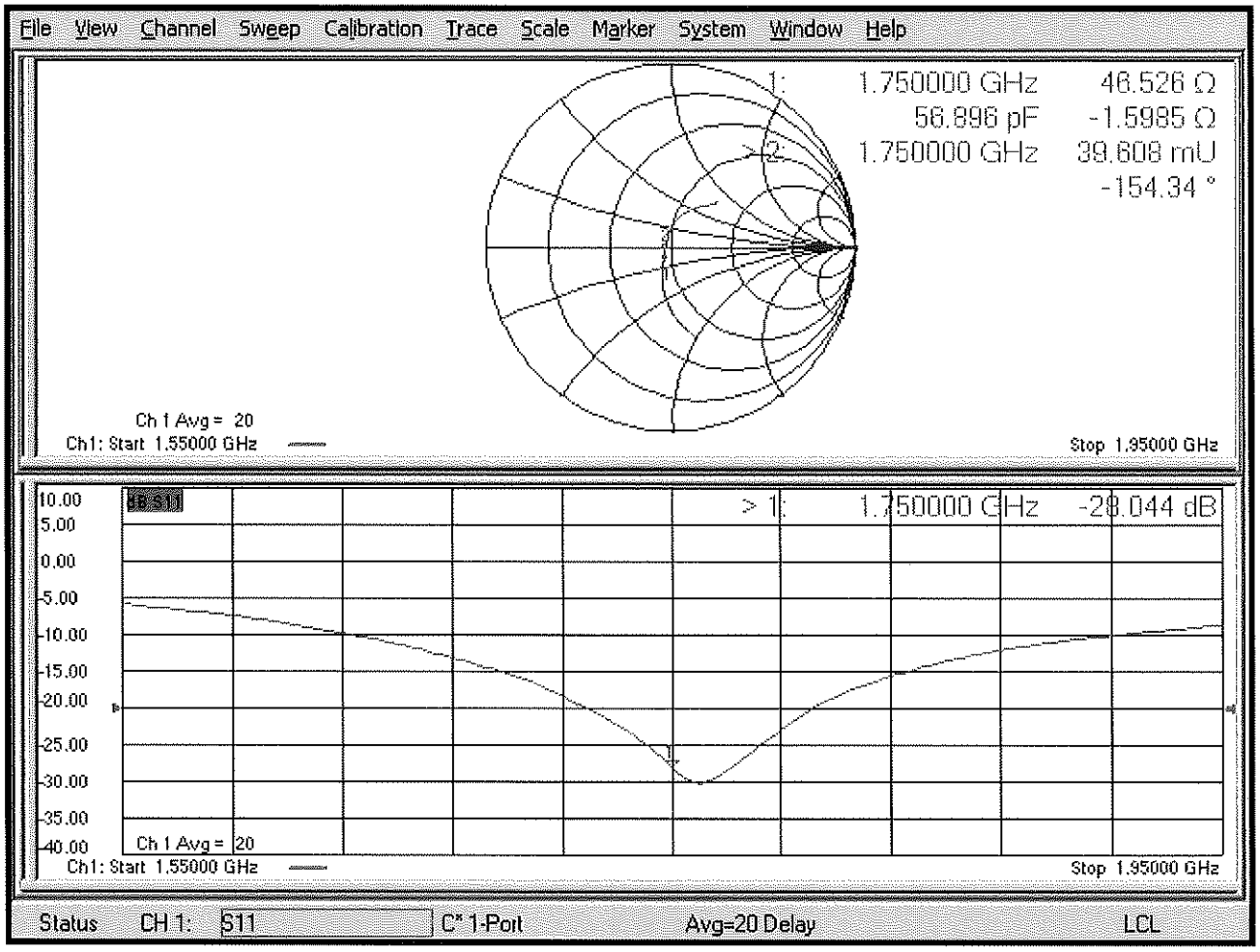
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.8 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 16.2 W/kg
SAR(1 g) = 9.14 W/kg; SAR(10 g) = 4.88 W/kg
Maximum value of SAR (measured) = 13.7 W/kg



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

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 0108

Client PC Test

Certificate No: D1750V2-1092_May18

CALIBRATION CERTIFICATE

Object	D1750V2 - SN:1092
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 15, 2018

SC ✓
5/31/2018
BN ✓
06/01/2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

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

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 17, 2018

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Glossary:

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

Calibration is Performed According to the Following Standards:

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
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 %	1.34 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**36.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.73 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.2 ± 6 %	1.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	8.99 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**36.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.81 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.4 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.2 Ω - 1.0 jΩ
Return Loss	- 37.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.8 Ω - 0.6 jΩ
Return Loss	- 25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.217 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 07, 2012

DASY5 Validation Report for Head TSL

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1092

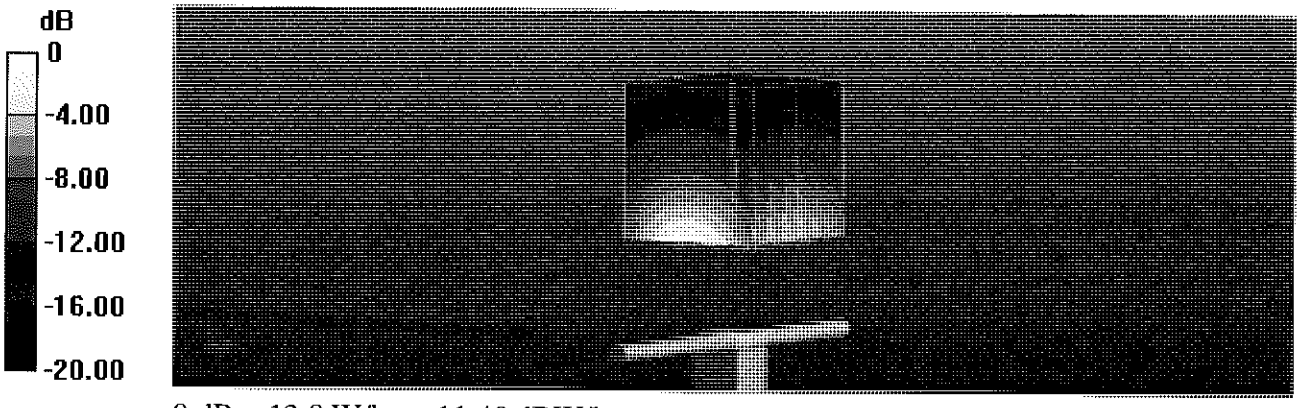
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.34 S/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

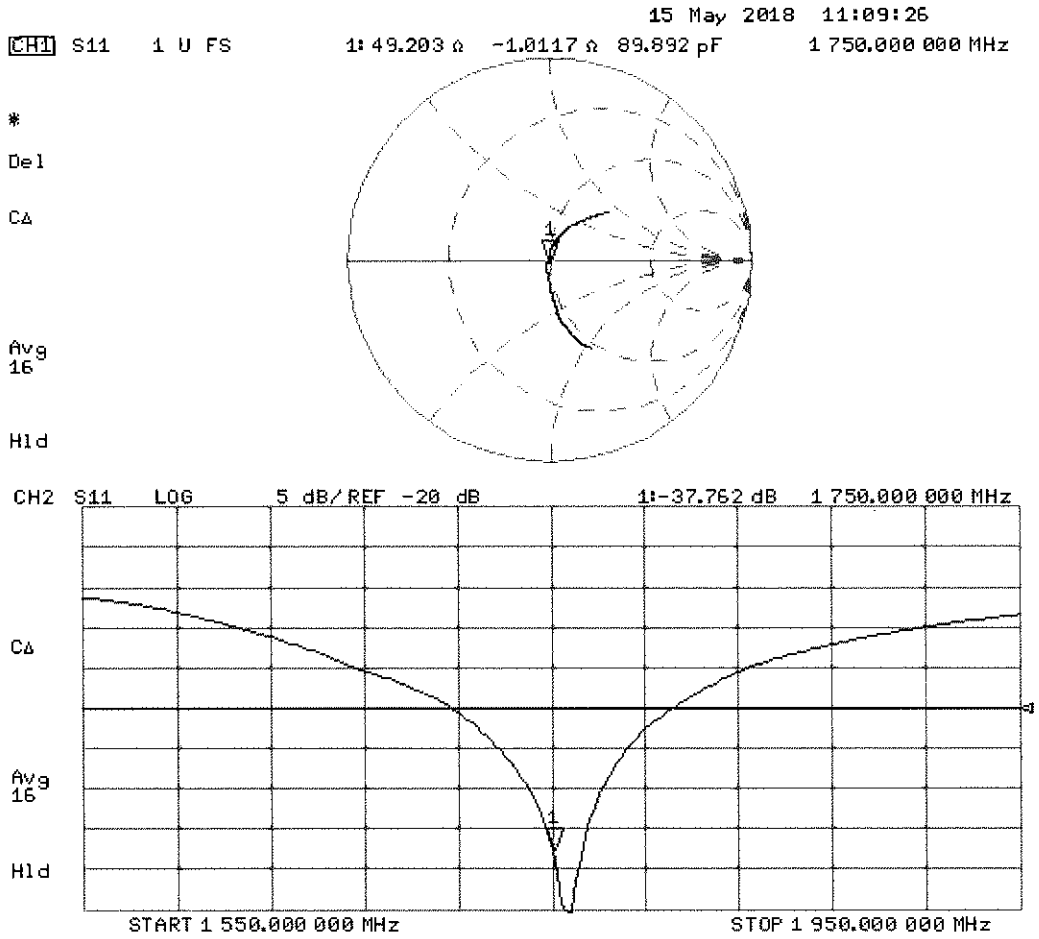
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.8 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 16.3 W/kg
SAR(1 g) = 8.95 W/kg; SAR(10 g) = 4.73 W/kg
Maximum value of SAR (measured) = 13.8 W/kg



0 dB = 13.8 W/kg = 11.40 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.05.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1092

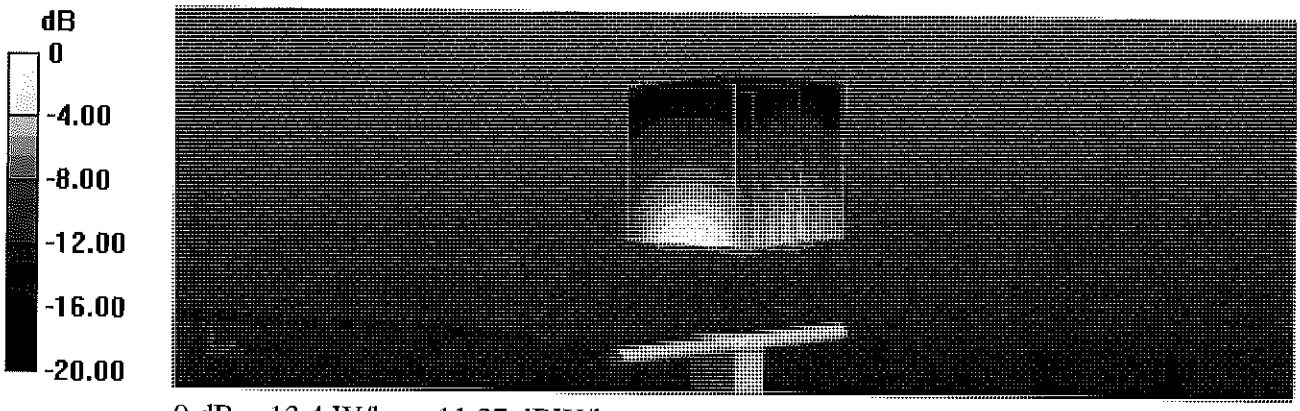
Communication System: UID 0 - CW; Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.46 S/m; ε_r = 53.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

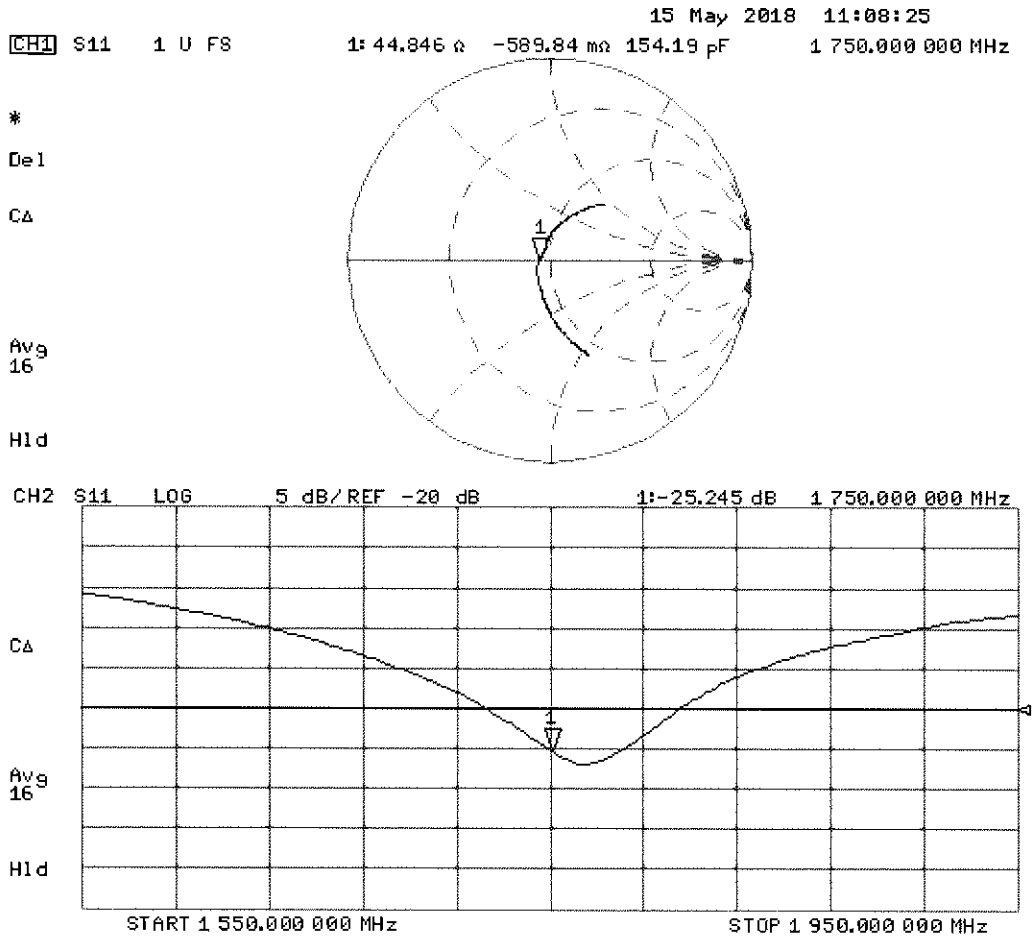
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.4 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 15.8 W/kg
SAR(1 g) = 8.99 W/kg; SAR(10 g) = 4.81 W/kg
Maximum value of SAR (measured) = 13.4 W/kg



0 dB = 13.4 W/kg = 11.27 dBW/kg

Impedance Measurement Plot for Body TSL



Certification of Calibration

Object D1750V2 – SN: 1092

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: May 15, 2019

Description: SAR Validation Dipole at 1750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/15/2018	Annual	6/15/2019	MY47420837
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/28/2018	Biennial	2/28/2020	170330160
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAKS-3.5	Portable DAK	9/11/2018	Annual	9/11/2019	1045
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7416
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/10/2018	Annual	7/10/2019	1402

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Parker Jones	Team Lead Engineer	Parker Jones
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	KOK

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

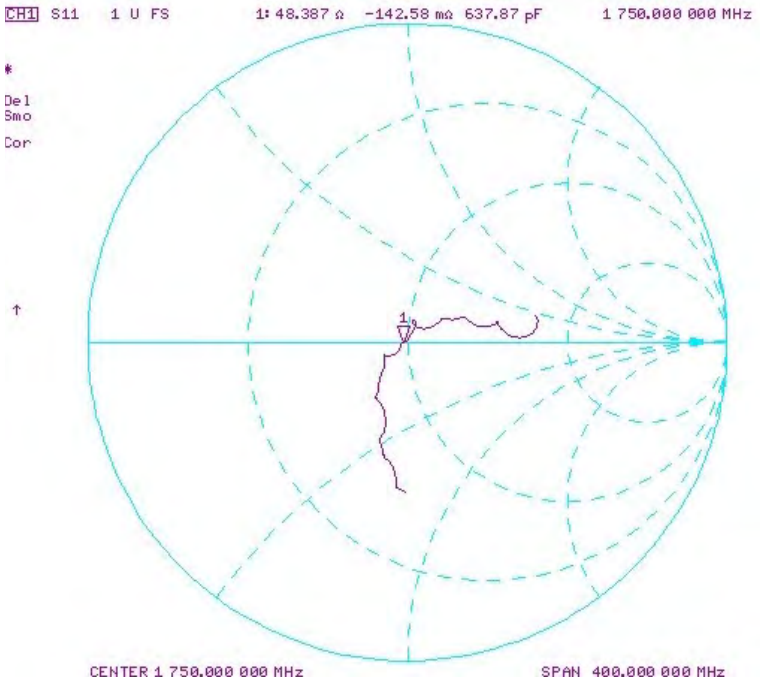
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

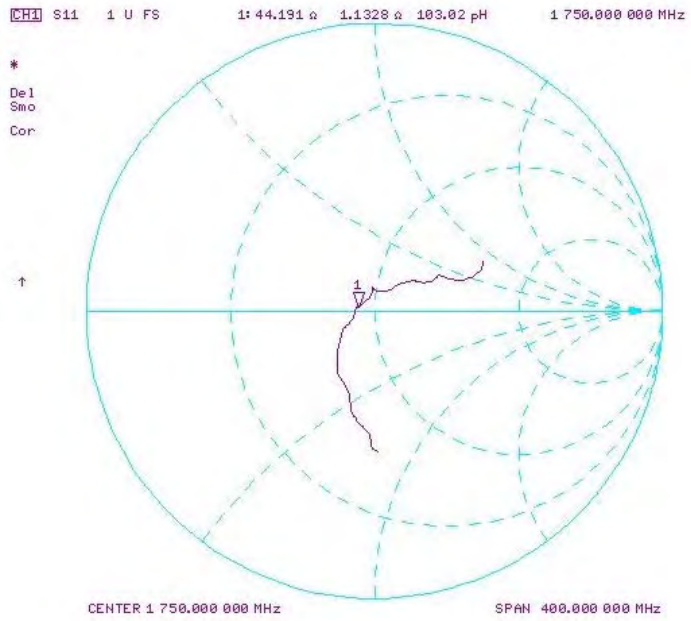
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5/15/2018	5/15/2019	1.217	3.61	3.59	-0.55%	1.9	1.89	-0.53%	49.2	48.4	0.8	-1	-0.1	0.9	-37.8	-38.2	-1.00%	PASS

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5/15/2018	5/15/2019	1.217	3.64	3.62	-0.55%	1.94	1.91	-1.55%	44.8	44.2	0.6	-0.6	1.1	1.7	-25.2	-24.2	3.90%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss 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
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S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client PC Test

Certificate No: D1900V2-5d030_Jun19

CALIBRATION CERTIFICATE

Object: D1900V2 - SN:5d030

ATM 6/28/19

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: June 19, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: June 20, 2019

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	41.4 ± 6 %	1.39 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	9.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.9 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	54.2 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.0 Ω + 4.2 jΩ
Return Loss	- 27.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.0 Ω + 5.4 jΩ
Return Loss	- 24.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.191 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

DASY5 Validation Report for Head TSL

Date: 19.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d030

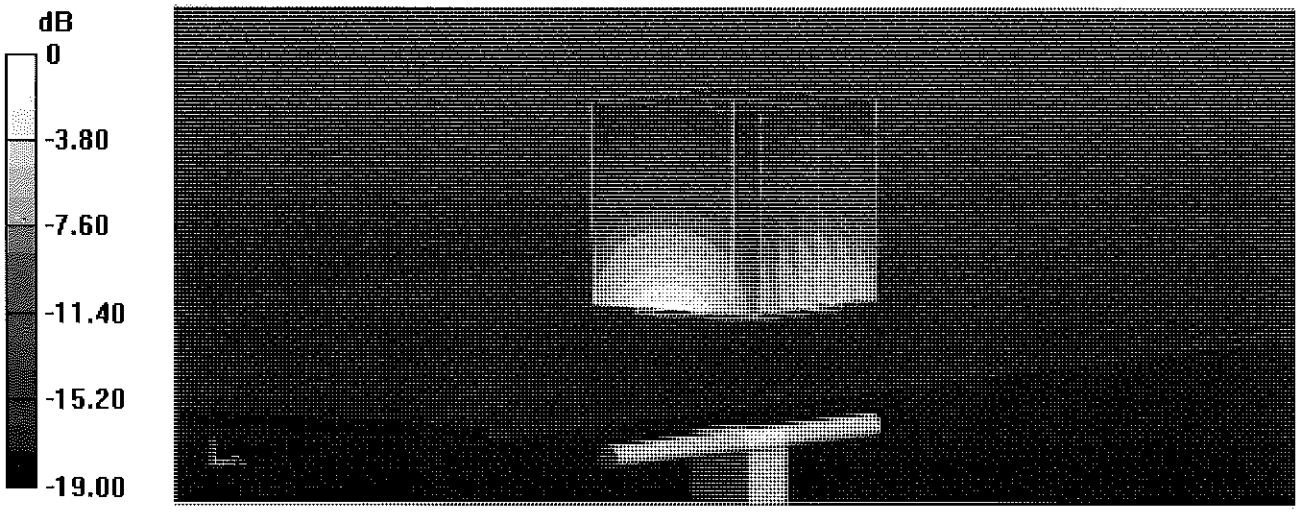
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.39 S/m; ε_r = 41.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.44, 8.44, 8.44) @ 1900 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

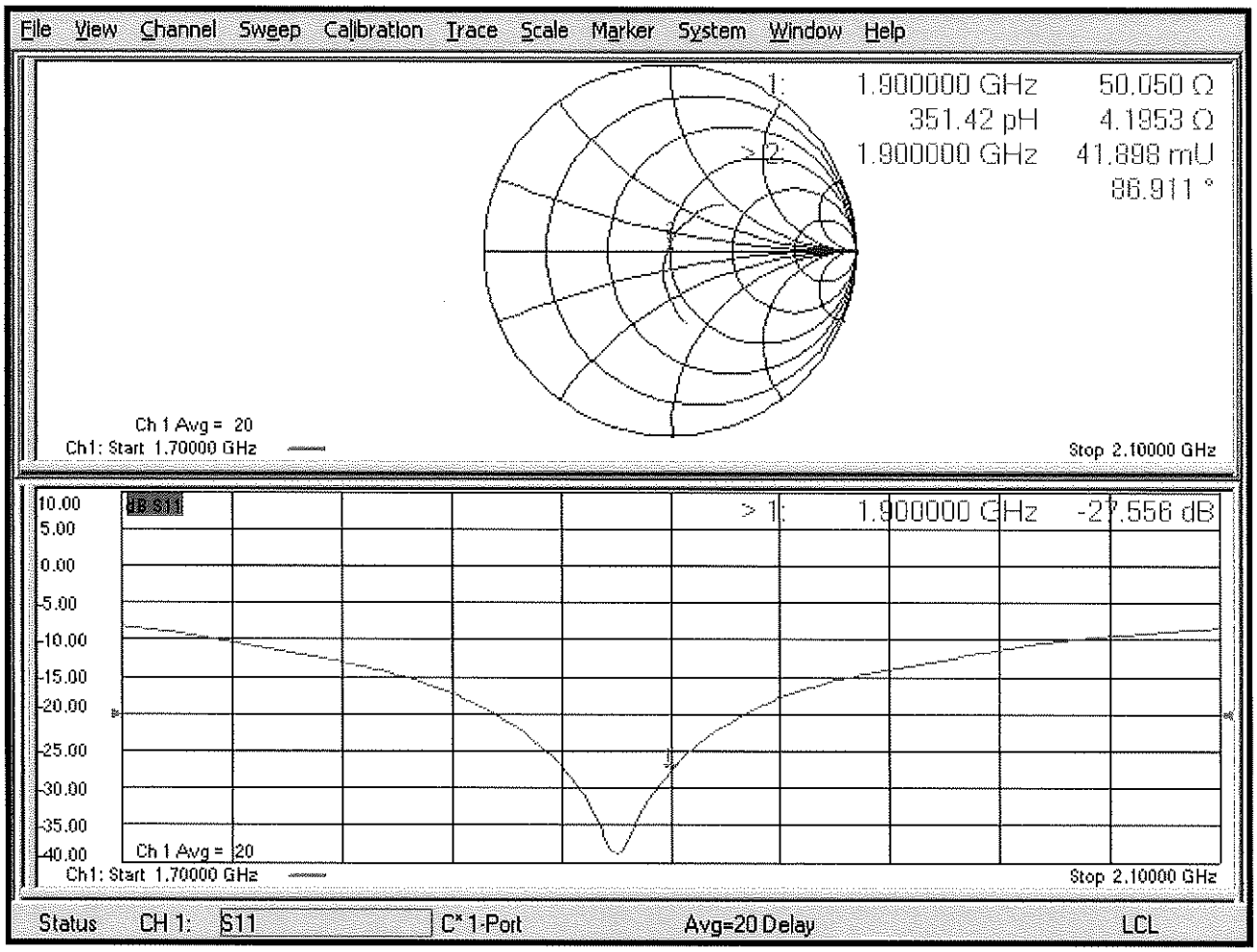
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 109.2 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 9.85 W/kg; SAR(10 g) = 5.19 W/kg
Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 19.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d030

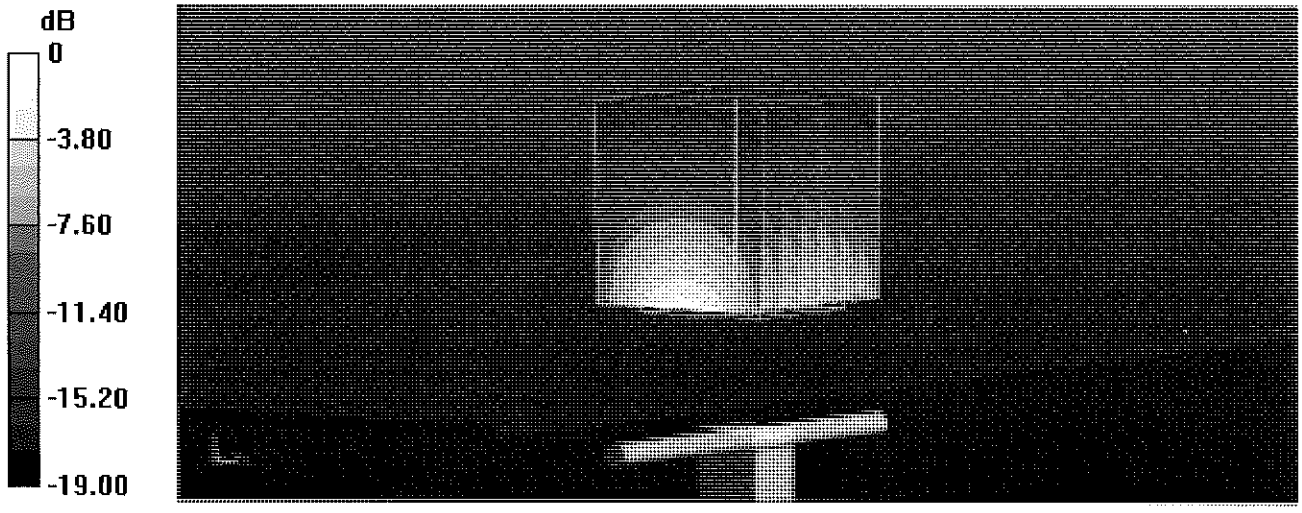
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.5 S/m; ε_r = 54.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.42, 8.42, 8.42) @ 1900 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

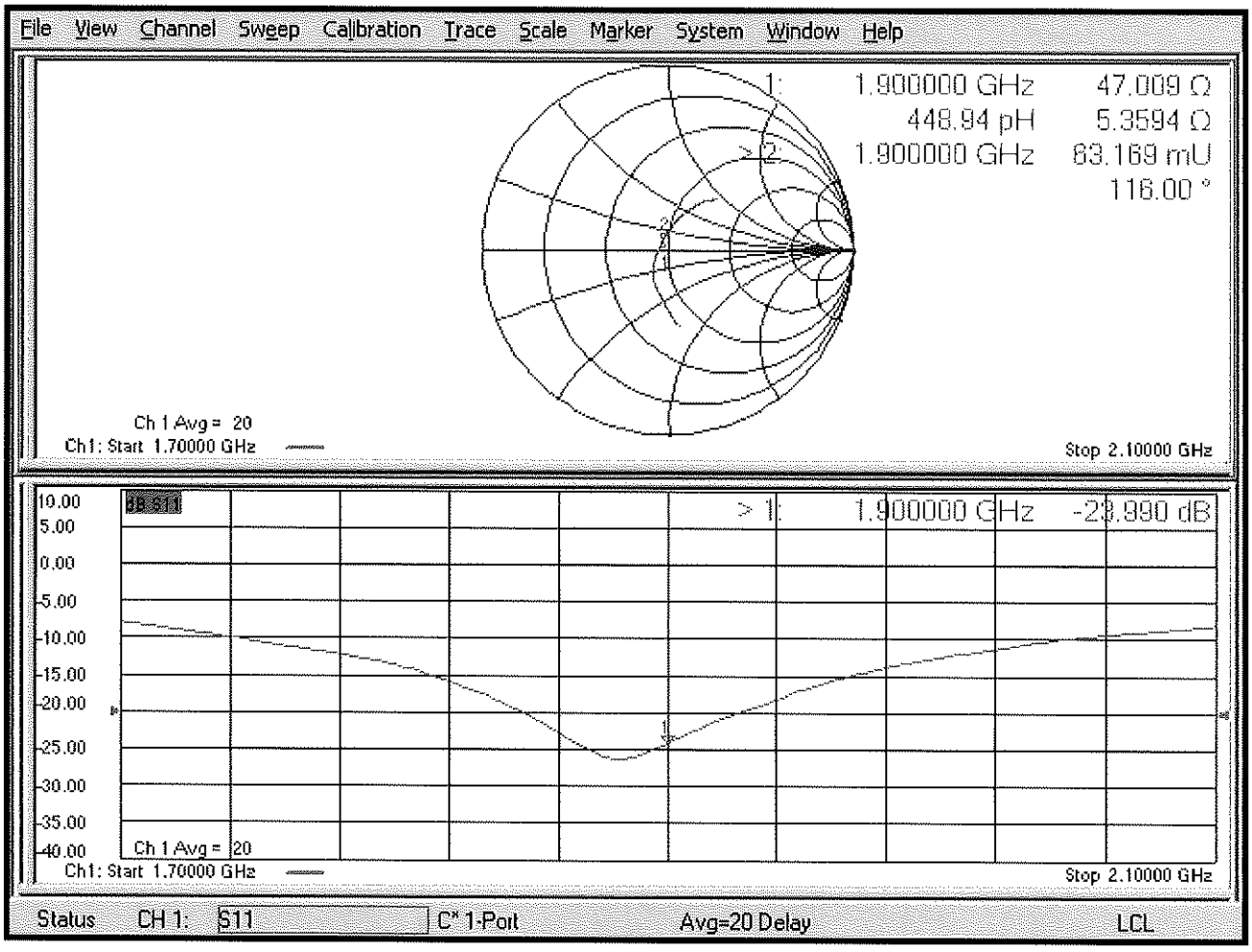
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 104.1 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 17.6 W/kg
SAR(1 g) = 9.86 W/kg; SAR(10 g) = 5.24 W/kg
Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.76 dBW/kg

Impedance Measurement Plot for Body TSL



Schmid & Partner Engineering AG

s p e a g

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Phone +41 44 245 9700, Fax +41 44 245 9779
www.speag.swiss, info@speag.swiss

CUSTOMER COPY

DIPOLE REPAIR REPORT – SPEAG Production Center

PRODUCT	**D1900V2 Dipole**		
SERIAL Nr.:	**SN: 5d030**	**IN DATE:**	**11-Jun-2019**
CUSTOMER:	**PC Test**		

DIPOLE REPAIR MATERIAL	**WORK DESCRIPTION**						**WORKING TIME (h)**	
Dipole Arm	fixed	O	exchanged	O	.....	O		hours
Dipole Connector	fixed	O	exchanged	X	.....	O	0.50	hours
Gold Plating	fixed	O	exchanged	O	.....	O		hours
Housing	fixed	O	exchanged	O	.....	O		hours
Disassemble/clean	fixed	O	exchanged	O	.....			hours
.....:	fixed	O	exchanged	O	.....			hours
.....:	fixed	O	exchanged	O	.....			hours
Analysis:							0.50	hours
Final Assembly:							0.50	hours
Total hours							1.50	hours

COMMENTS: The dipole was returned for re-calibration. Receiving inspection found the SMA-connector was defective, the threaded connection was worn out. Both dipole arms were slightly bent. In order to re-establish full functionality, the SMA-connector was replaced and both dipole arms were straightened. The dipole will be newly calibrated after this repair.

CONDUCTED BY:		**APPROVED BY:**	
DATE:	13.06.2019	**DATE:**	13.06.2019

REPAIR COST:

	USD	Euro
MATERIAL COST:	O	O
REPAIR:	O	O

TOTAL COST: No cost	**QUOTATION #:**

APPROVED BY:

DATE: 13.06.2019

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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S Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client PC Test

Certificate No: D1900V2-5d181_Sep17

CALIBRATION CERTIFICATE

Object	D1900V2 - SN:5d181
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	September 07, 2017

SC ✓ 10/03/2017

SC ✓ 9/7/2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

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

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

Issued: September 7, 2017

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	39.0 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.6 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.3 ± 6 %	1.47 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	9.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω + 4.6 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.2 Ω + 5.6 jΩ
Return Loss	- 24.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.200 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	August 23, 2013

DASY5 Validation Report for Head TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d181

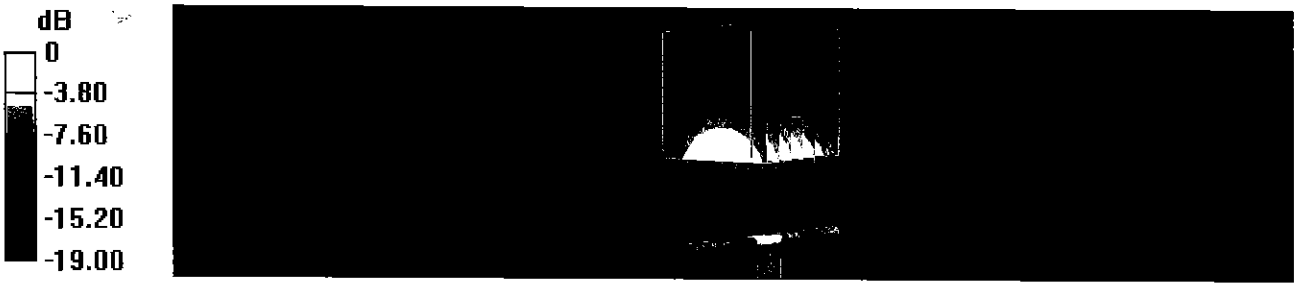
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

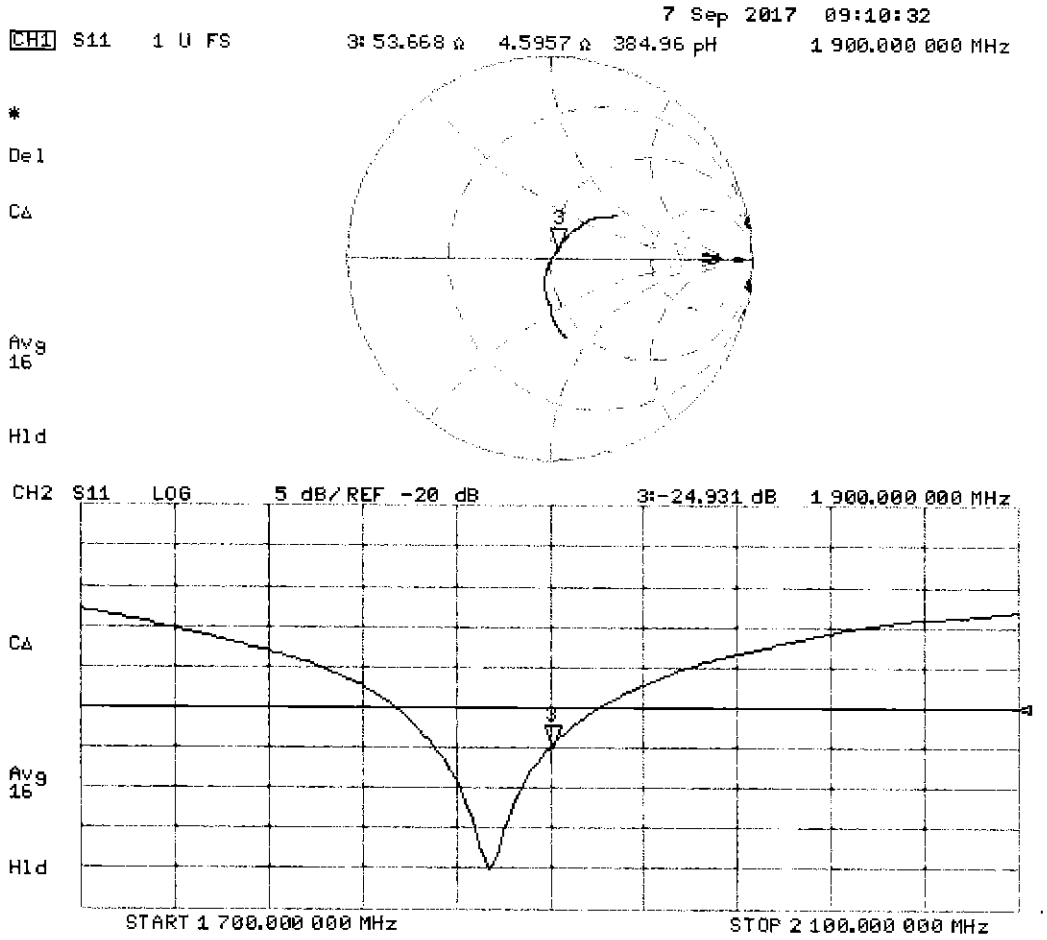
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.8 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 18.5 W/kg
SAR(1 g) = 9.85 W/kg; SAR(10 g) = 5.15 W/kg
Maximum value of SAR (measured) = 14.8 W/kg



0 dB = 14.8 W/kg = 11.70 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d181

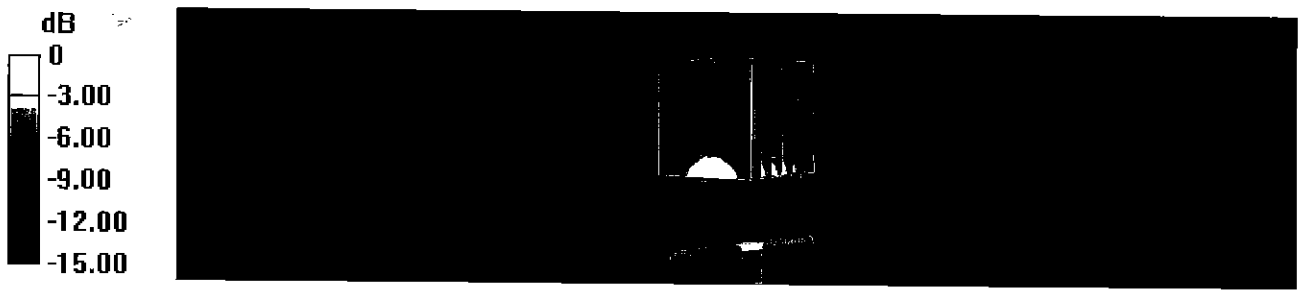
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.47 S/m; ε_r = 54.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.2, 8.2, 8.2); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

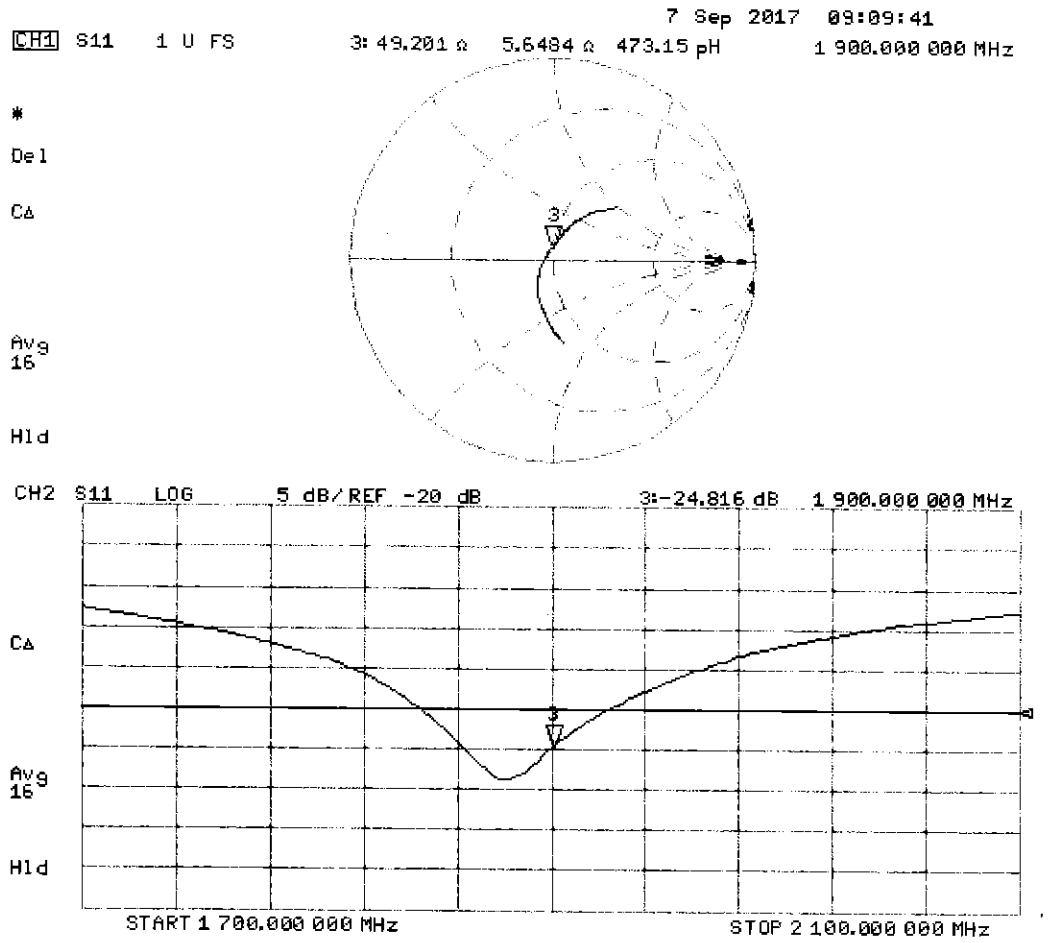
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.4 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 17.0 W/kg
SAR(1 g) = 9.65 W/kg; SAR(10 g) = 5.14 W/kg
Maximum value of SAR (measured) = 13.8 W/kg



0 dB = 13.8 W/kg = 11.40 dBW/kg

Impedance Measurement Plot for Body TSL



Certification of Calibration

Object D1900V2 – SN: 5d181

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: September 07, 2018

Description: SAR Validation Dipole at 1900 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	ES3DV3	SAR Probe	9/18/2017	Annual	9/18/2018	3287
SPEAG	DAE4	Data Acquisition Electronics	1/26/2018	Annual	1/26/2019	1533
SPEAG	ES3DV3	SAR Probe	3/13/2018	Annual	3/13/2019	3131
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/7/2018	Annual	3/7/2019	604

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

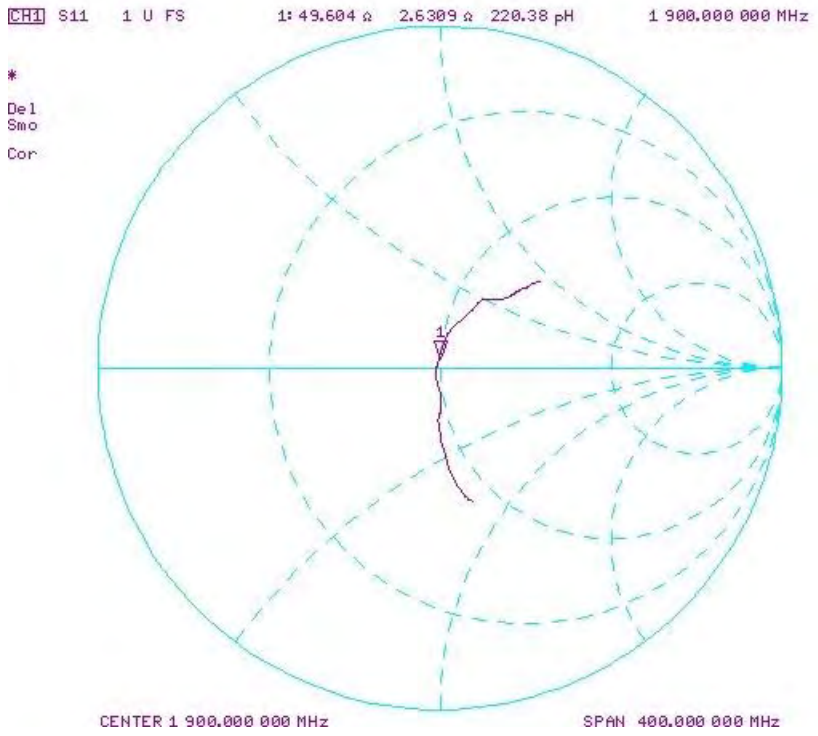
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

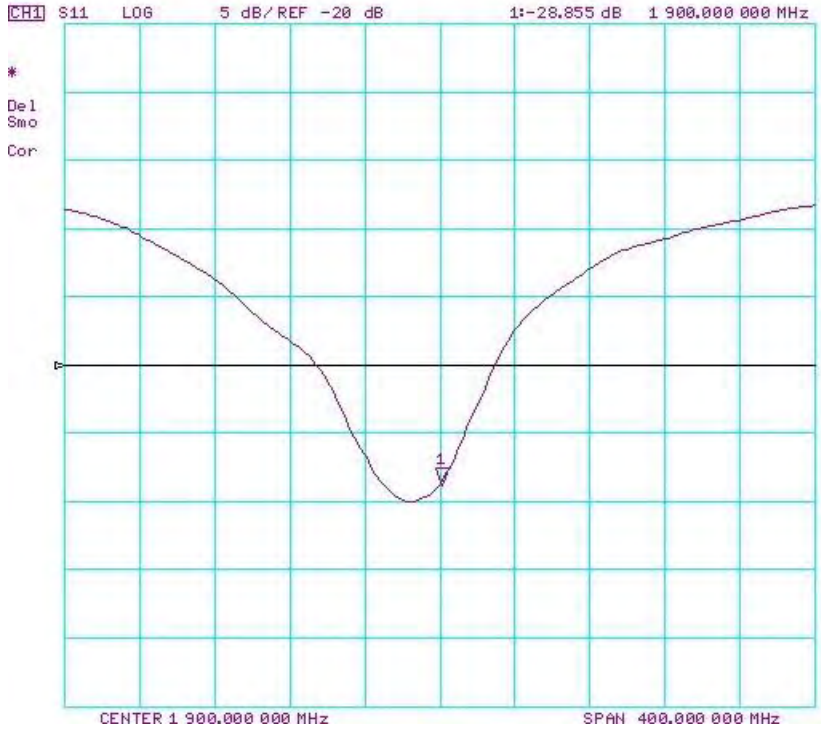
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/7/2017	9/7/2018	1.2	3.95	3.99	1.01%	2.06	2.07	0.49%	53.7	49.6	4.1	4.6	2.6	2	-24.9	-28.9	-16.10%	PASS

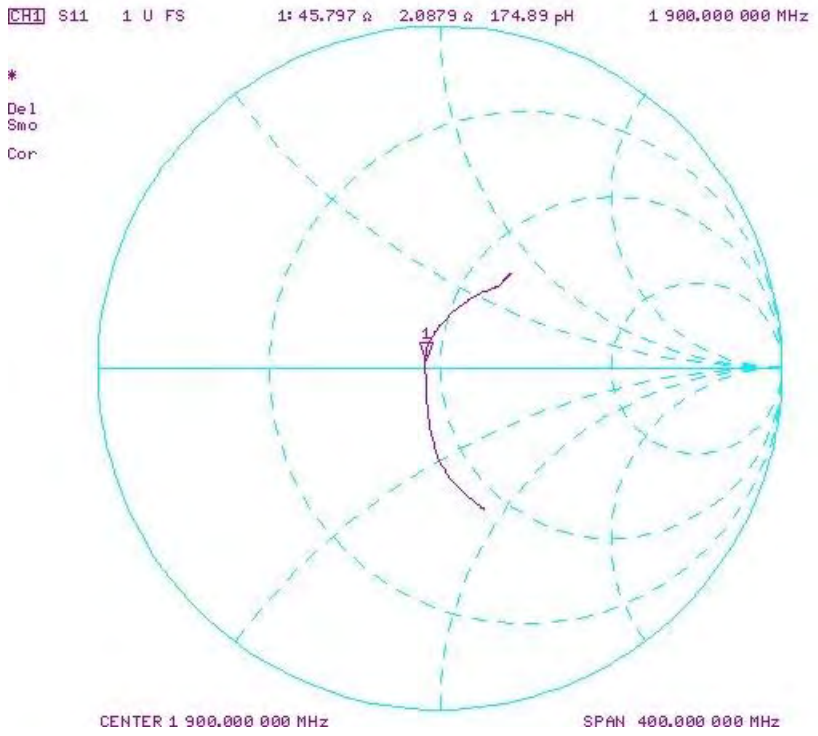
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/7/2017	9/7/2018	1.2	3.95	4.13	4.56%	2.09	2.14	2.39%	49.2	45.8	3.4	5.6	2.1	3.5	-24.8	-24.7	0.40%	PASS

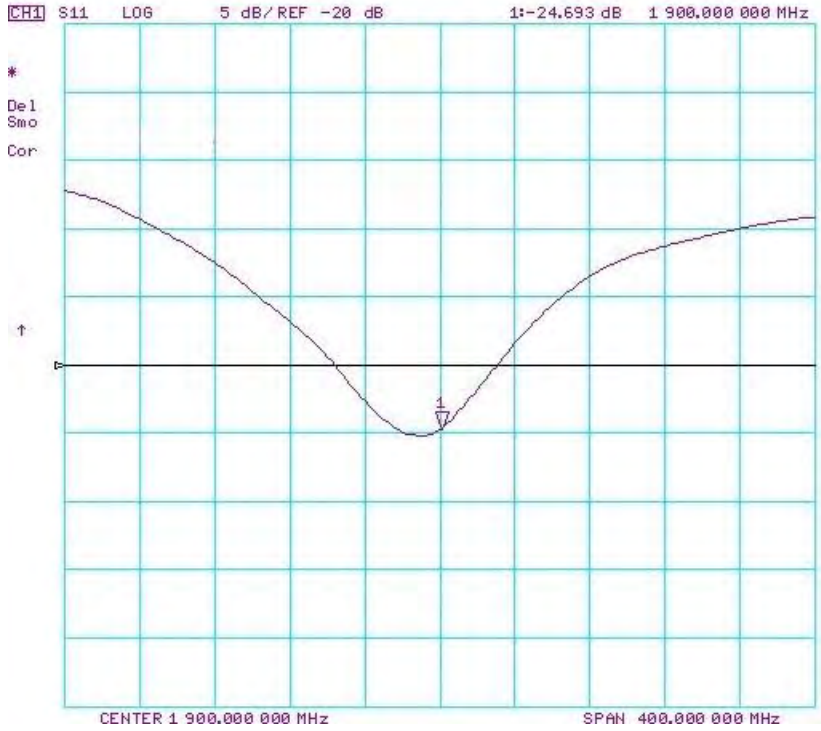
Impedance & Return-Loss Measurement Plot for Head TSL





Impedance & Return-Loss 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 0108

Client PC Test

Certificate No: D2450V2-750_Jun19

CALIBRATION CERTIFICATE

Object: D2450V2 - SN:750

✓ ATM 6/28/19

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: June 14, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: June 20, 2019

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.0 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.1 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω + 3.9 jΩ
Return Loss	- 25.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.3 Ω + 6.2 jΩ
Return Loss	- 24.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 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

DASY5 Validation Report for Head TSL

Date: 14.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:750

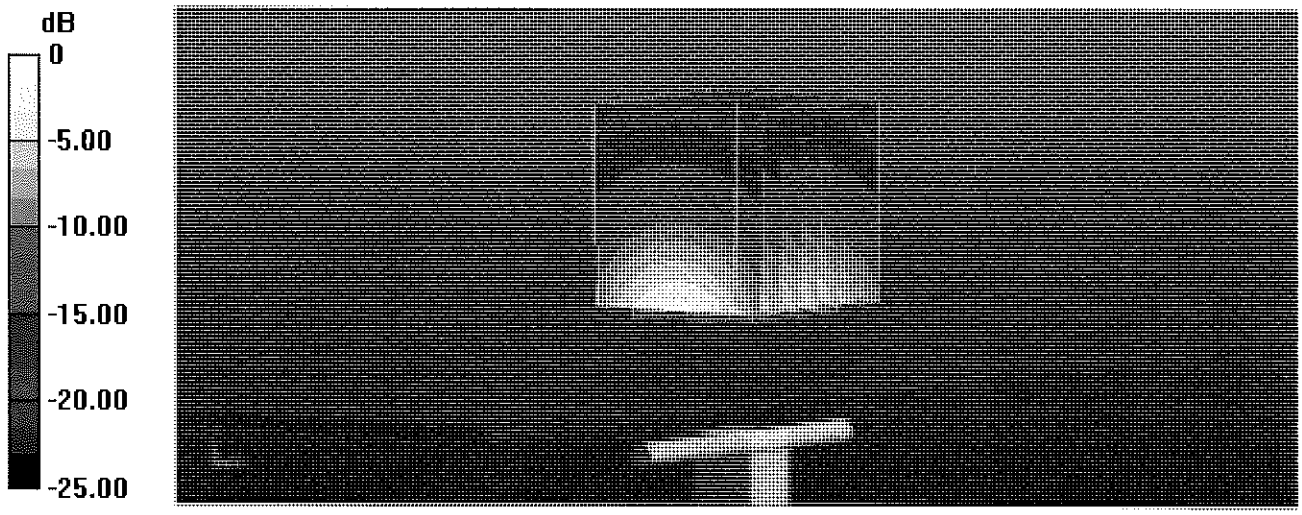
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.9, 7.9, 7.9) @ 2450 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

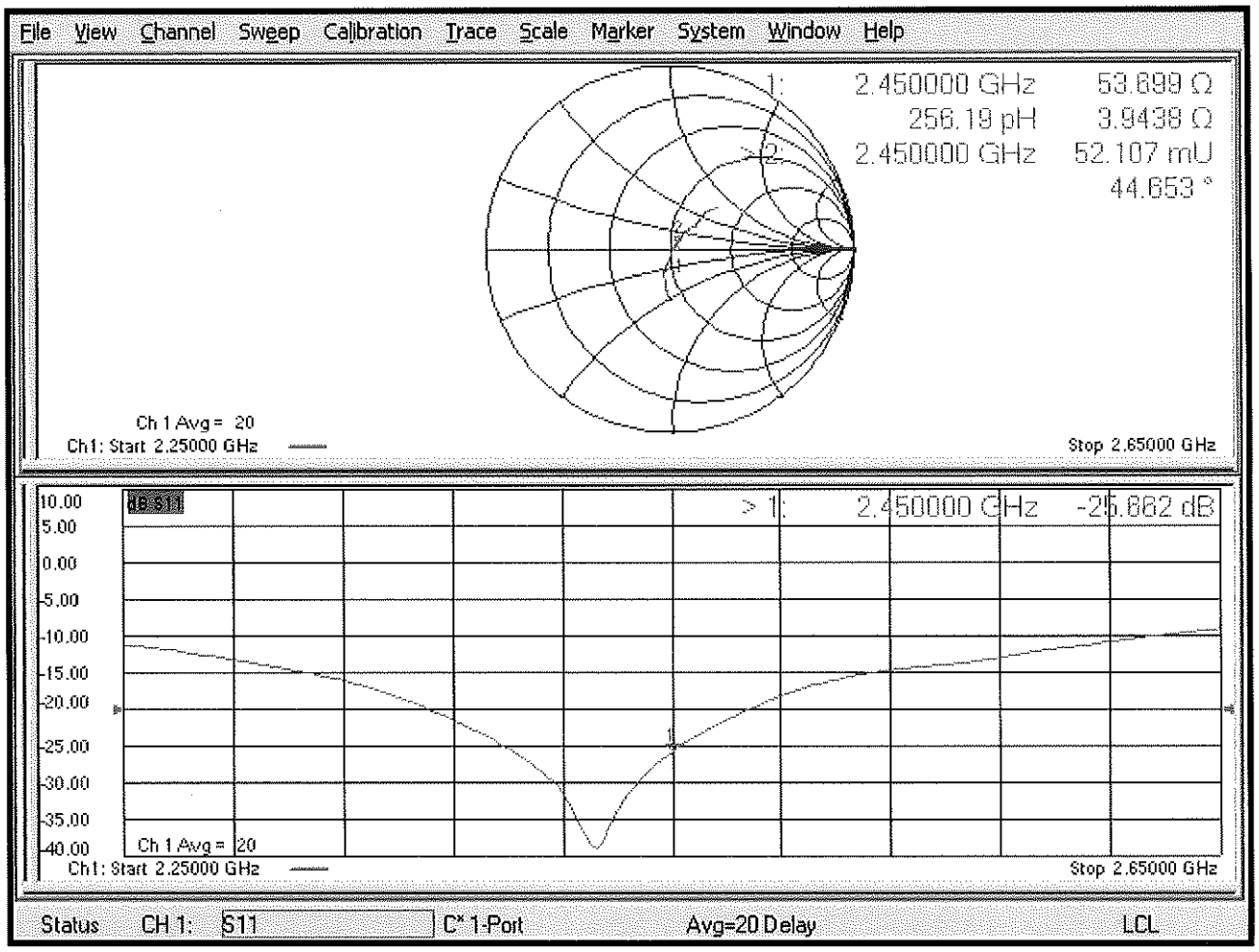
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 117.9 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 26.7 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.34 W/kg
Maximum value of SAR (measured) = 22.3 W/kg



0 dB = 22.3 W/kg = 13.48 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:750

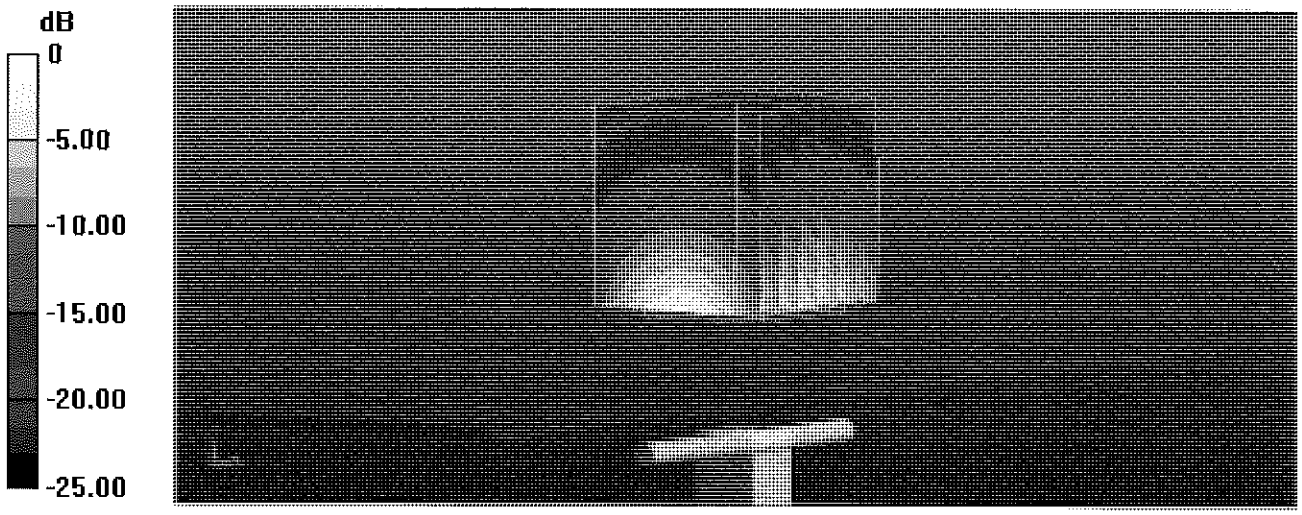
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ε_r = 51; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94) @ 2450 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

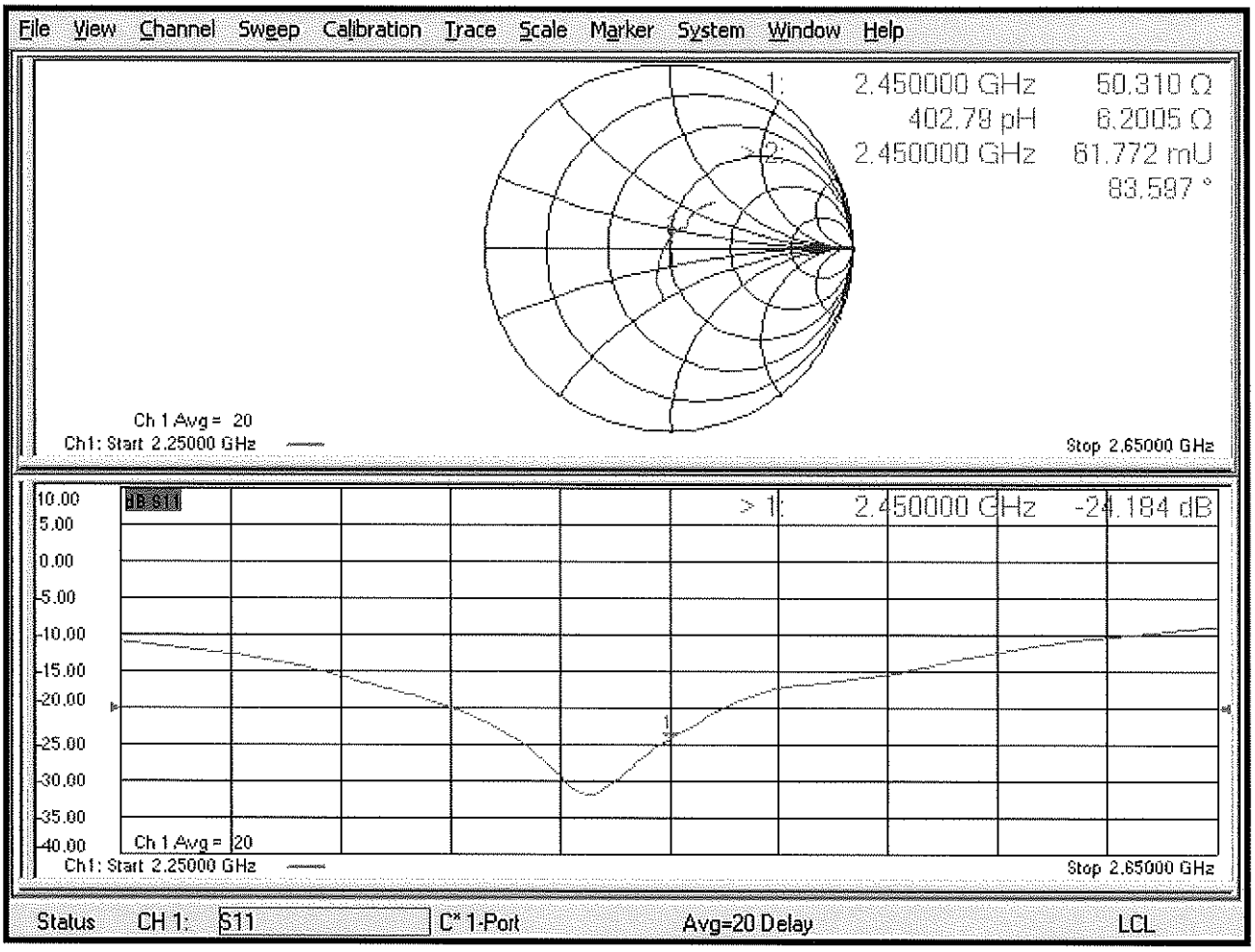
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.6 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 25.9 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.12 W/kg
Maximum value of SAR (measured) = 21.2 W/kg



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

Impedance Measurement Plot for Body TSL



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

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Accreditation No.: SCS 0108

Client PC Test

Certificate No: D2450V2-921_Nov18

CALIBRATION CERTIFICATE

Object: D2450V2 - SN:921

Calibration procedure(s): QA CAL-05.v10
Calibration procedure for dipole validation kits above 700 MHz

SC ✓ 12/A/2018

Calibration date: November 12, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 12, 2018

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.4 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.8 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.7 Ω + 6.5 jΩ
Return Loss	- 22.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.7 Ω + 7.8 jΩ
Return Loss	- 22.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 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 26, 2013

DASY5 Validation Report for Head TSL

Date: 12.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:921

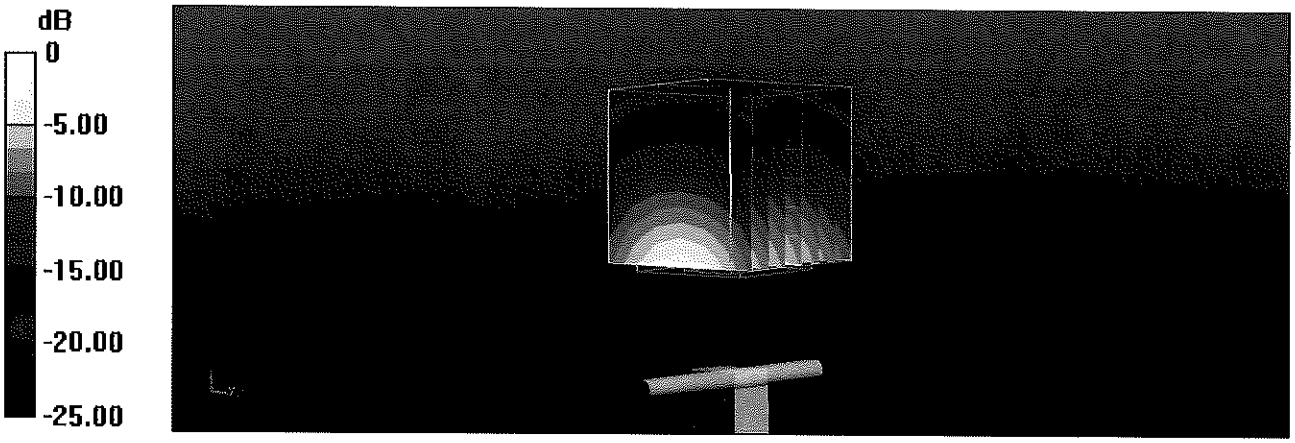
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

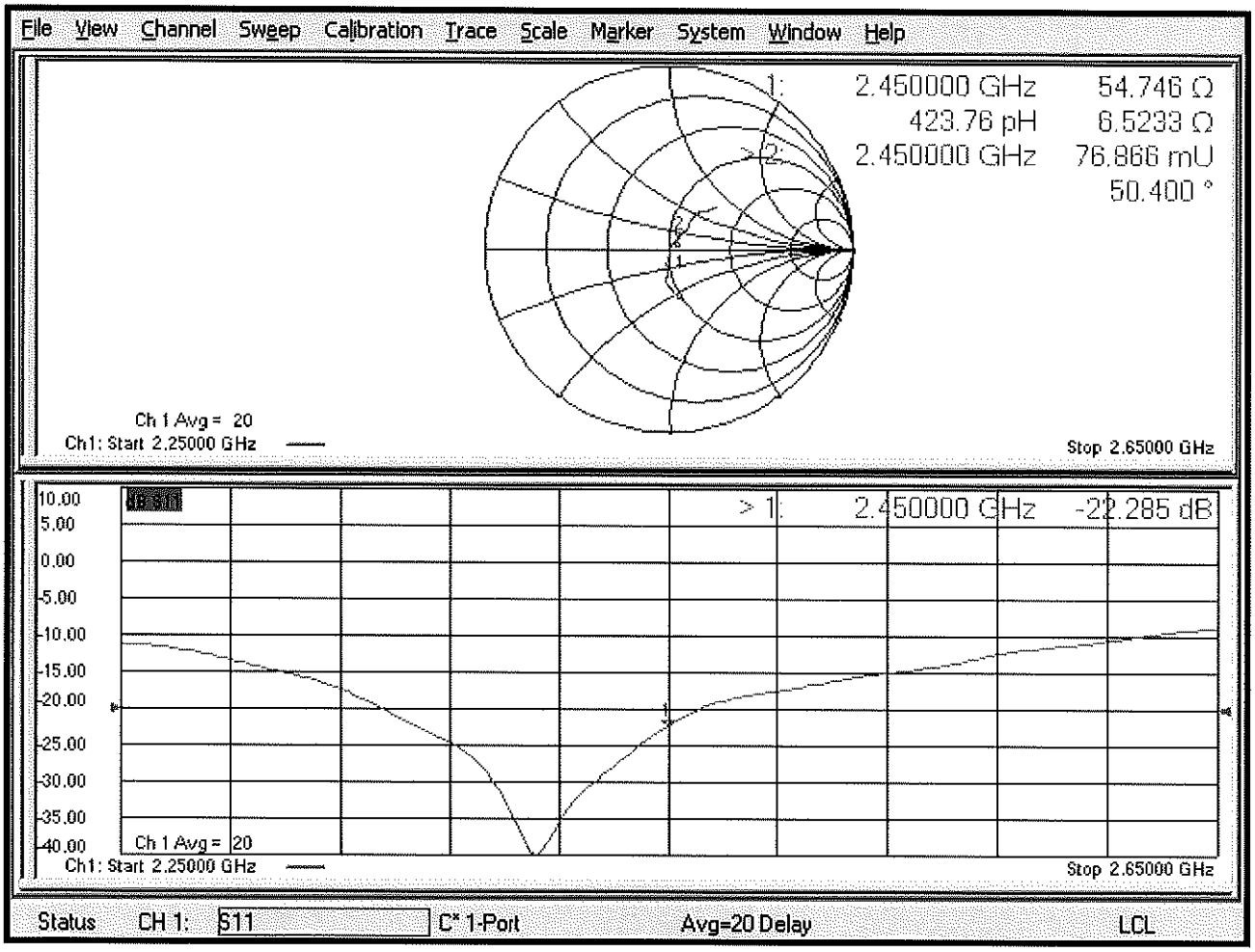
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 117.7 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 27.4 W/kg
SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.28 W/kg
Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.50 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.11.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:921

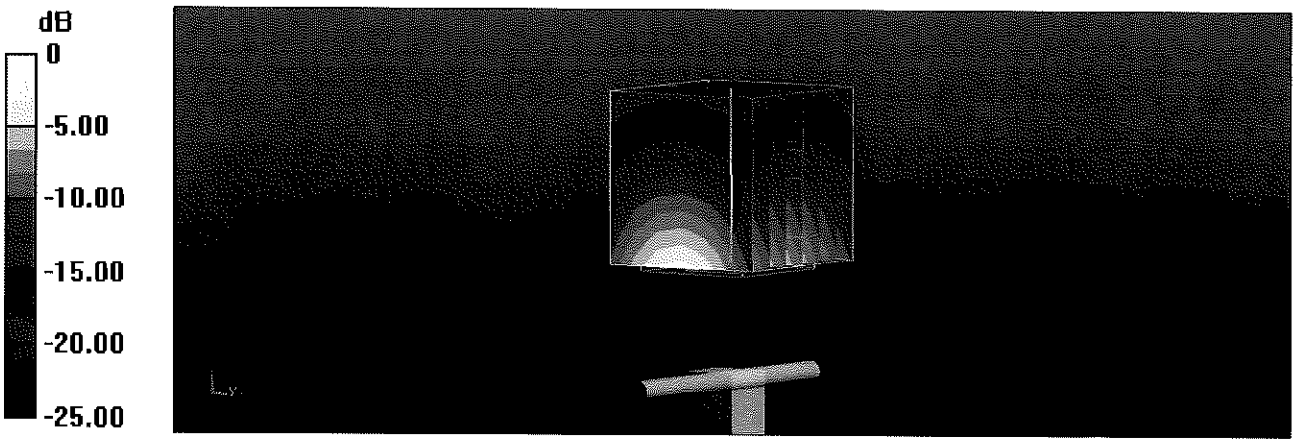
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.10.2018
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

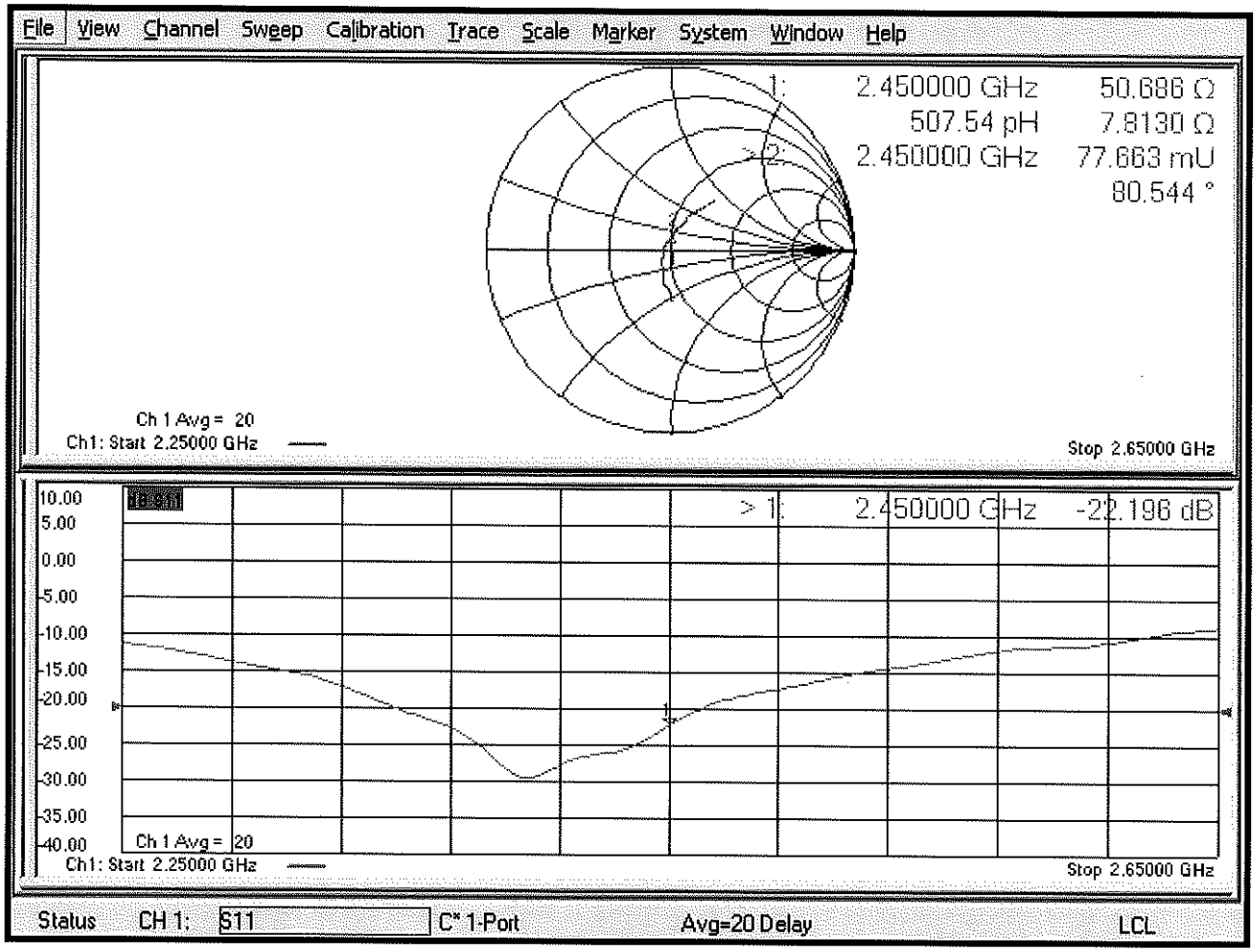
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 108.6 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.1 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.03 W/kg
Maximum value of SAR (measured) = 21.3 W/kg



0 dB = 21.3 W/kg = 13.28 dBW/kg

Impedance Measurement Plot for Body TSL



Schmid & Partner Engineering AG

s p e a g

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info@speag.com, http://www.speag.com

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DIPOLE REPAIR REPORT – SPEAG Production Center

PRODUCT	**D2450V2 Dipole**		
SERIAL Nr.:	**SN: 921**	**IN DATE:**	**8-Nov-2018**
CUSTOMER:	**PC Test**		

DIPOLE REPAIR MATERIAL	**WORK DESCRIPTION**						**WORKING TIME (h)**	
Dipole Arm	fixed	X	exchanged	O	.....	O	0.50	hours
Dipole Connector	fixed	O	exchanged	O	.....	O		hours
Gold Plating	fixed	O	exchanged	O	.....	O		hours
Housing	fixed	O	exchanged	O	.....	O		hours
Disassemble/clean	fixed	O	exchanged	O	.....			hours
.....:	fixed	O	exchanged	O	.....			hours
.....:	fixed	O	exchanged	O	.....			hours
Analysis:							0.50	hours
Final Assembly:							0.50	hours
Total hours							1.50	hours

COMMENTS:

The dipole was returned for calibration. Receiving inspection found the dipole arms and both feed-lines were strongly bent. In order to re-establish full functionality, the dipole arms and feed-lines were straightened. The connector was cleaned as well. The dipole will be newly calibrated after this repair.

CONDUCTED BY:		**APPROVED BY:**	
DATE:	09.11.2018	**DATE:**	09.11.2018

REPAIR COST:

		USD	Euro
MATERIAL COST:		O	O
REPAIR:		O	O

TOTAL COST: No cost	**QUOTATION #:**

APPROVED BY:

DATE: 09.11.2018

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

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

Accreditation No.: SCS 0108

Client **PC Test**

Certificate No: D2600V2-1069_Sep17

CALIBRATION CERTIFICATE

Object	D2600V2 - SN:1069
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	September 11, 2017

SCV 10/03/2017

SCV 9/10/2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-May-17 (No. EX3-7349_May17)	May-18
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

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

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

Issued: September 11, 2017

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.2 ± 6 %	2.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**56.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.4 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.4 ± 6 %	2.23 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**55.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.8 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1 Ω - 6.1 jΩ
Return Loss	- 24.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2 Ω - 4.7 jΩ
Return Loss	- 24.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 17, 2013

DASY5 Validation Report for Head TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1069

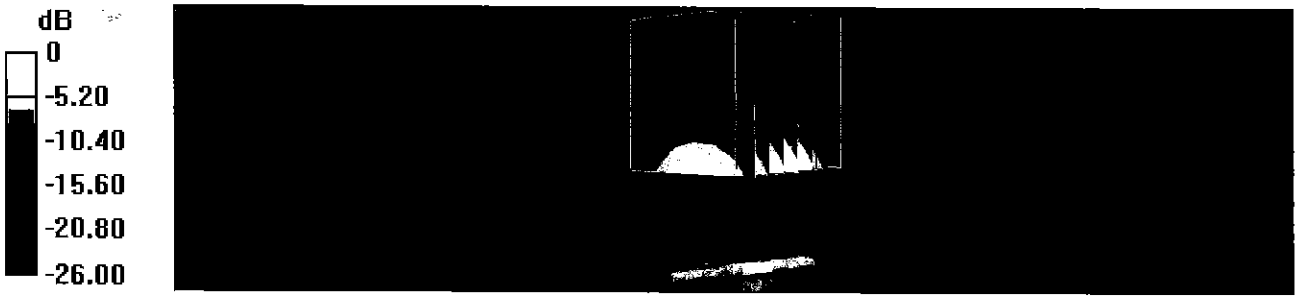
Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.03 S/m; ε_r = 37.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

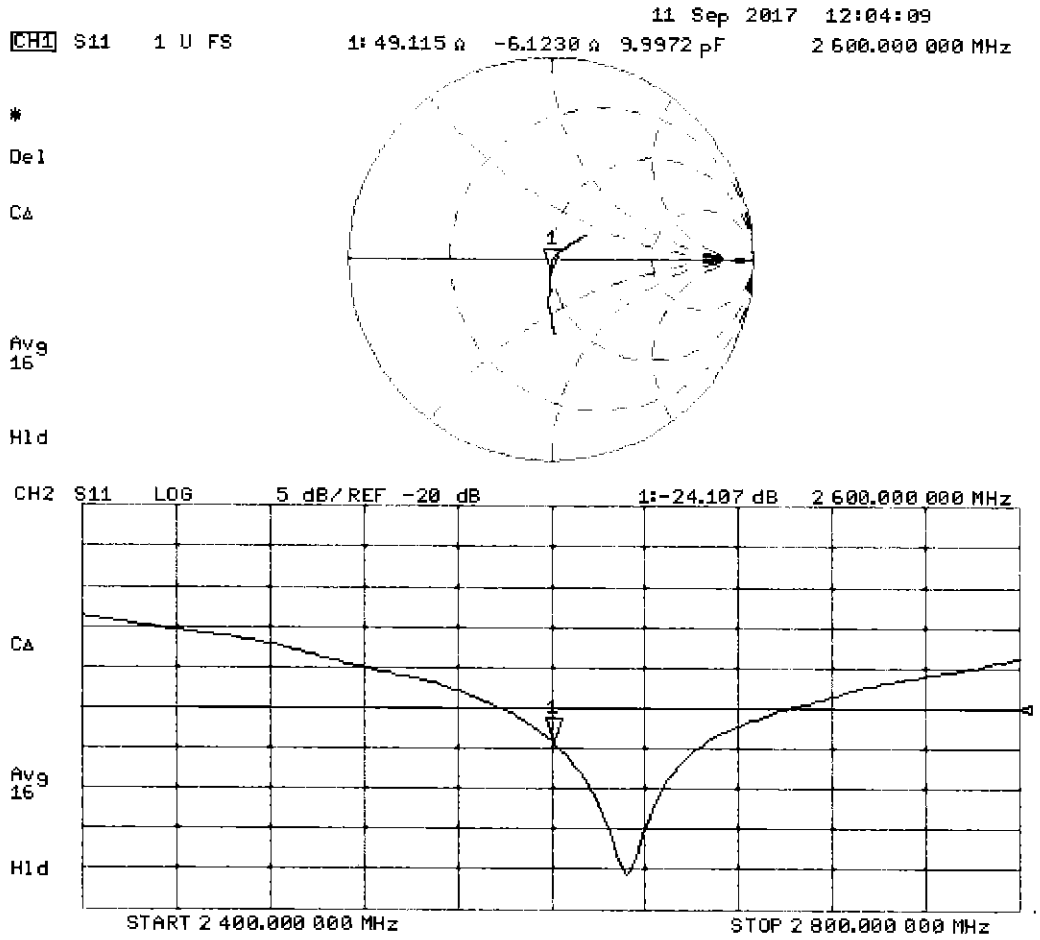
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.4 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 31.2 W/kg
SAR(1 g) = 14.6 W/kg; SAR(10 g) = 6.45 W/kg
Maximum value of SAR (measured) = 24.5 W/kg



0 dB = 24.5 W/kg = 13.89 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1069

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.23 S/m; ε_r = 51.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

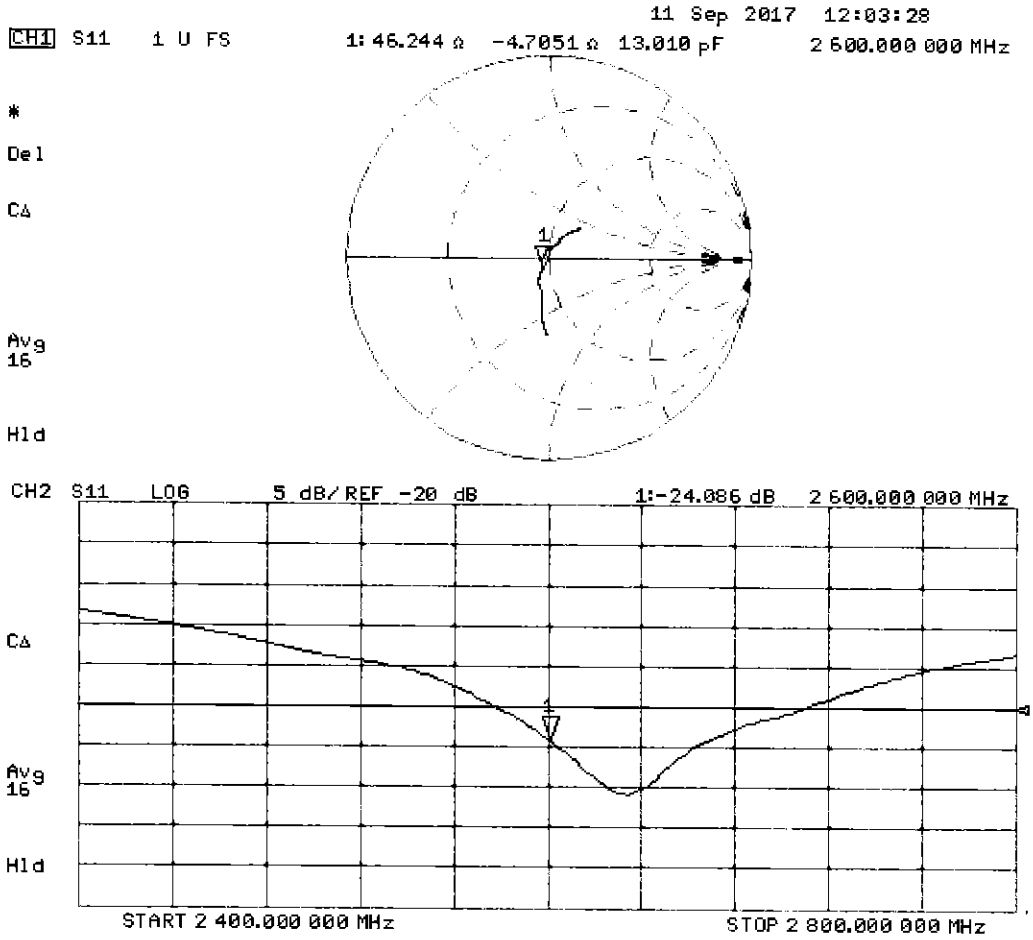
- Probe: EX3DV4 - SN7349; ConvF(7.94, 7.94, 7.94); Calibrated: 31.05.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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 = 105.7 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.26 W/kg
Maximum value of SAR (measured) = 22.9 W/kg

0 dB = 22.9 W/kg = 13.60 dBW/kg

Impedance Measurement Plot for Body TSL



Certification of Calibration

Object D2600V2 – SN: 1069

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extended Calibration date: September 10, 2018

Description: SAR Validation Dipole at 2600 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	9/14/2017	Annual	9/14/2018	US39170118
Agilent	N5182A	MXG Vector Signal Generator	3/19/2018	Annual	3/19/2019	US46240505
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	ML2496A	Power Meter	10/9/2017	Annual	10/9/2018	1138001
Anritsu	MA2411B	Pulse Power Sensor	11/15/2017	Annual	11/15/2018	1339007
Anritsu	MA2411B	Pulse Power Sensor	11/22/2017	Annual	11/22/2018	1339008
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	2/14/2017	Biennial	2/14/2019	170112507
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE5011-1	Torque Wrench	7/19/2017	Biennial	7/19/2019	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	ES3DV3	SAR Probe	9/18/2017	Annual	9/18/2018	3287
SPEAG	DAE4	Data Acquisition Electronics	1/26/2018	Annual	1/26/2019	1533
SPEAG	ES3DV3	SAR Probe	4/12/2018	Annual	4/12/2019	3275
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/12/2018	Annual	4/12/2019	501

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Senior Technical Manager	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

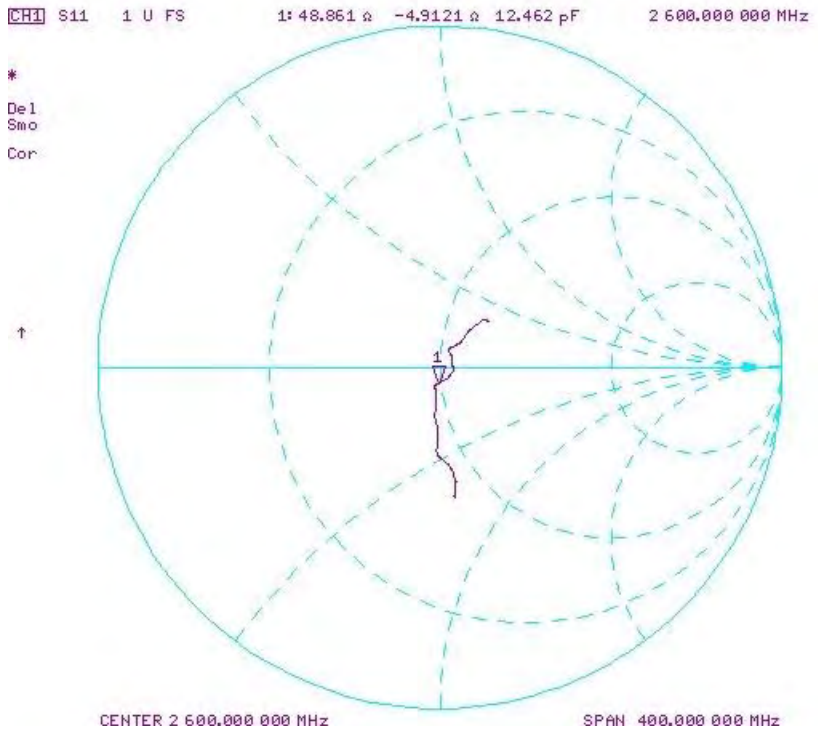
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

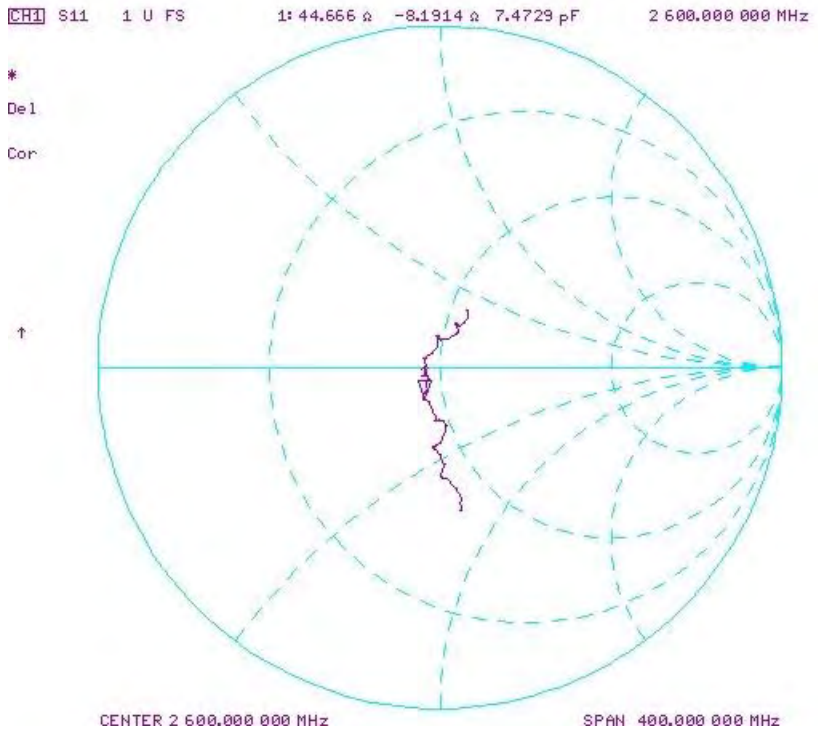
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 20.0 dBm	Measured Head SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 20.0 dBm	Measured Head SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/10/2018	1.152	5.69	5.52	-2.99%	2.54	2.51	-1.18%	49.1	48.9	0.2	-6.1	-4.9	1.2	-24.1	-25.8	-7.10%	PASS

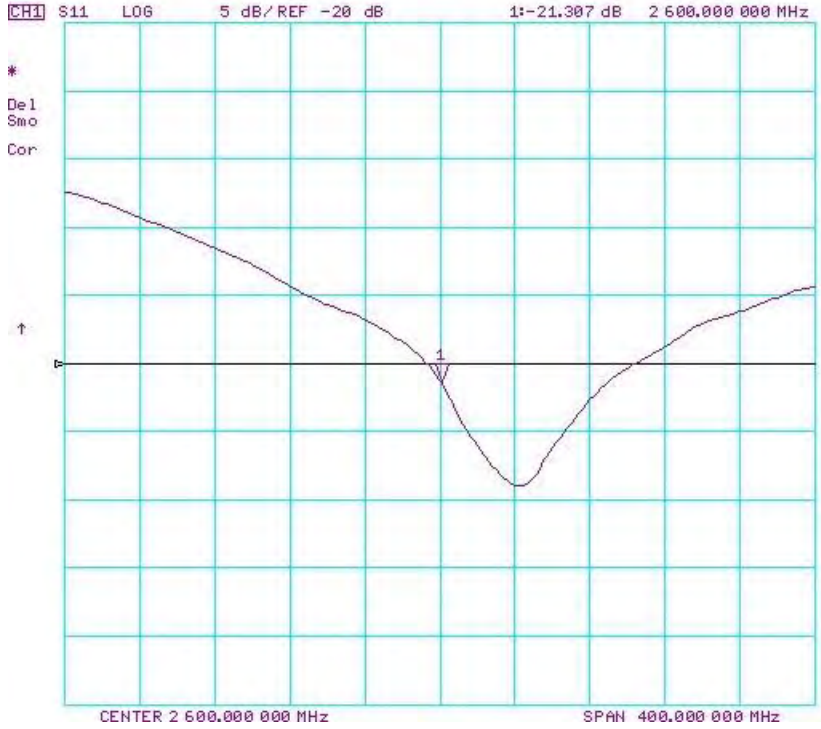
Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 20.0 dBm	Measured Body SAR (1g) W/kg @ 20.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 20.0 dBm	Measured Body SAR (10g) W/kg @ 20.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
9/11/2017	9/10/2018	1.152	5.53	5.28	-4.52%	2.48	2.35	-5.24%	46.2	44.7	1.5	-4.7	-8.2	3.5	-24.1	-21.3	11.60%	PASS

Impedance & Return-Loss Measurement Plot for Head TSL



Impedance & Return-Loss 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 0108

Client PC Test

Certificate No: D5GHzV2-1123_Mar18

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN:1123
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	March 13, 2018

SC ✓ 3/21/18

SC ✓ 3/12/19

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 3503	30-Dec-17 (No. EX3-3503_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

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

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

Issued: March 14, 2018

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.2 ± 6 %	4.58 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.7 ± 6 %	4.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**85.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.3 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.10 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.9 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.6 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	5.97 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.82 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.7 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	6.18 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**74.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	53.2 Ω - 5.2 jΩ
Return Loss	- 24.6 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.2 Ω - 0.4 jΩ
Return Loss	- 23.4 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.7 Ω + 0.9 jΩ
Return Loss	- 23.9 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	51.6 Ω - 4.3 jΩ
Return Loss	- 26.9 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	59.0 Ω - 0.3 jΩ
Return Loss	- 21.7 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	57.8 Ω + 1.0 jΩ
Return Loss	- 22.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.205 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 13.03.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1123

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 4.58 S/m; ε_r = 36.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.94 S/m; ε_r = 35.7; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 5.1 S/m; ε_r = 35.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

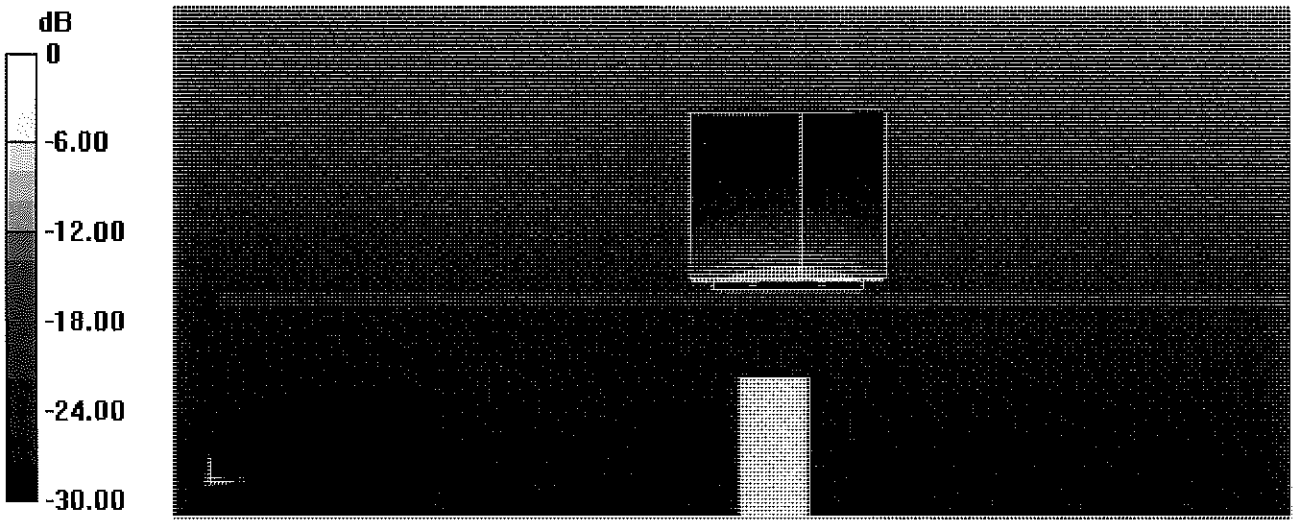
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.51, 5.51, 5.51); Calibrated: 30.12.2017, ConvF(5.05, 5.05, 5.05); Calibrated: 30.12.2017, ConvF(4.98, 4.98, 4.98); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.12 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.35 W/kg
Maximum value of SAR (measured) = 18.4 W/kg

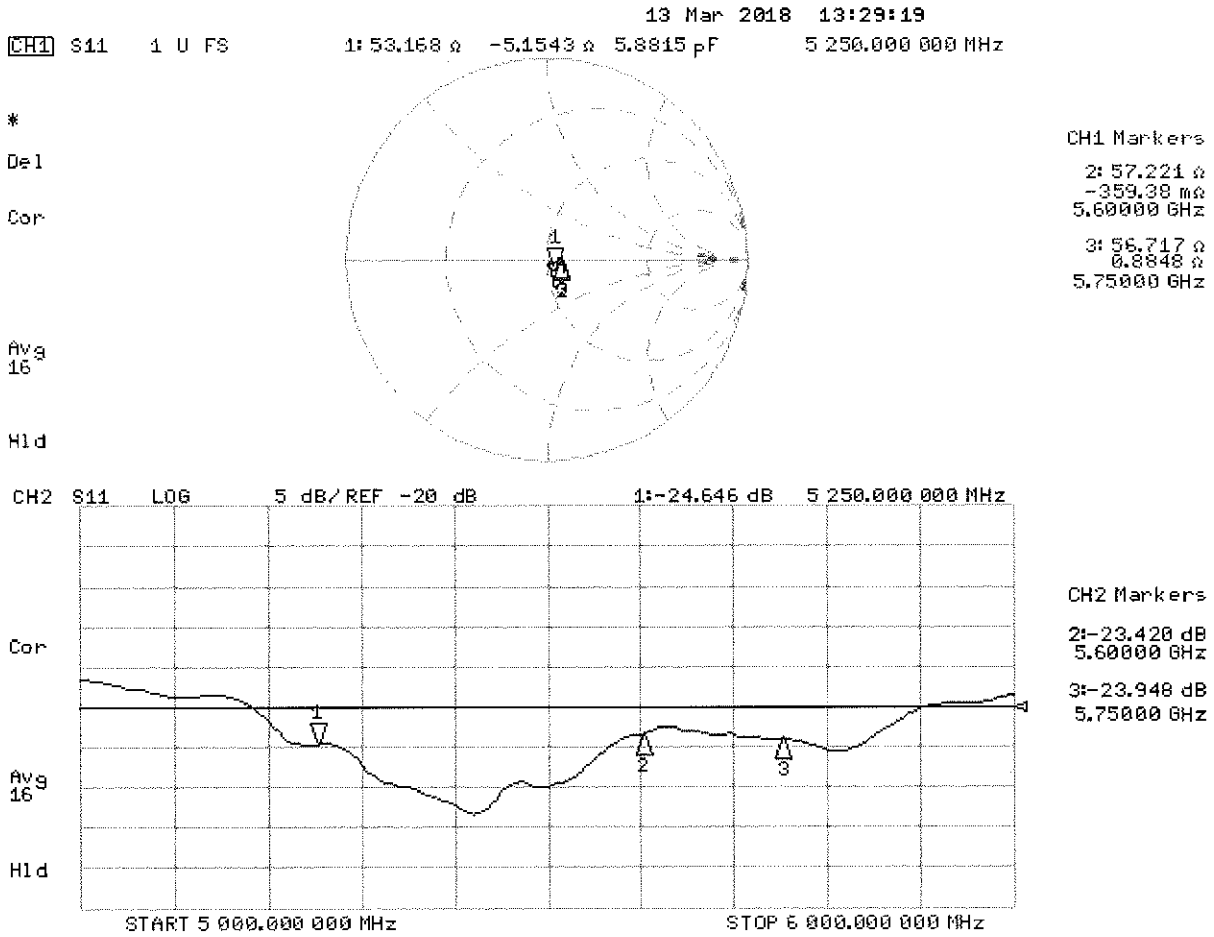
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.34 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 32.4 W/kg
SAR(1 g) = 8.51 W/kg; SAR(10 g) = 2.43 W/kg
Maximum value of SAR (measured) = 19.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.38 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 31.4 W/kg
SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.29 W/kg
Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.1 W/kg = 12.81 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.03.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1123

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 5.49 S/m; ε_r = 47.1; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 5.97 S/m; ε_r = 46.4; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 6.18 S/m; ε_r = 46.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

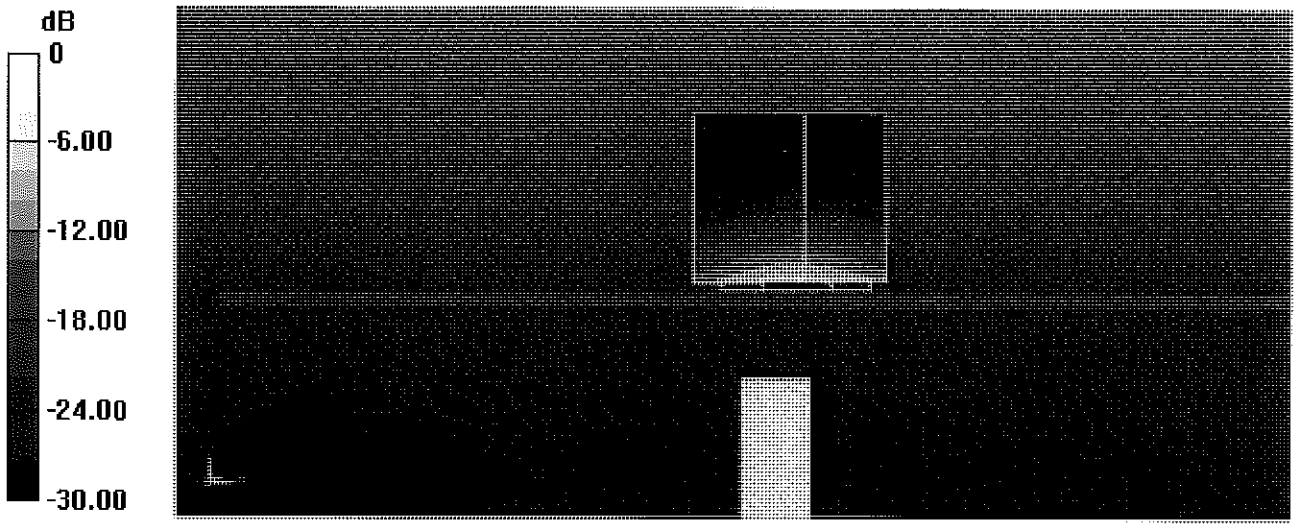
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.26, 5.26, 5.26); Calibrated: 30.12.2017, ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2017, ConvF(4.57, 4.57, 4.57); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.35 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 28.3 W/kg
SAR(1 g) = 7.45 W/kg; SAR(10 g) = 2.08 W/kg
Maximum value of SAR (measured) = 17.6 W/kg

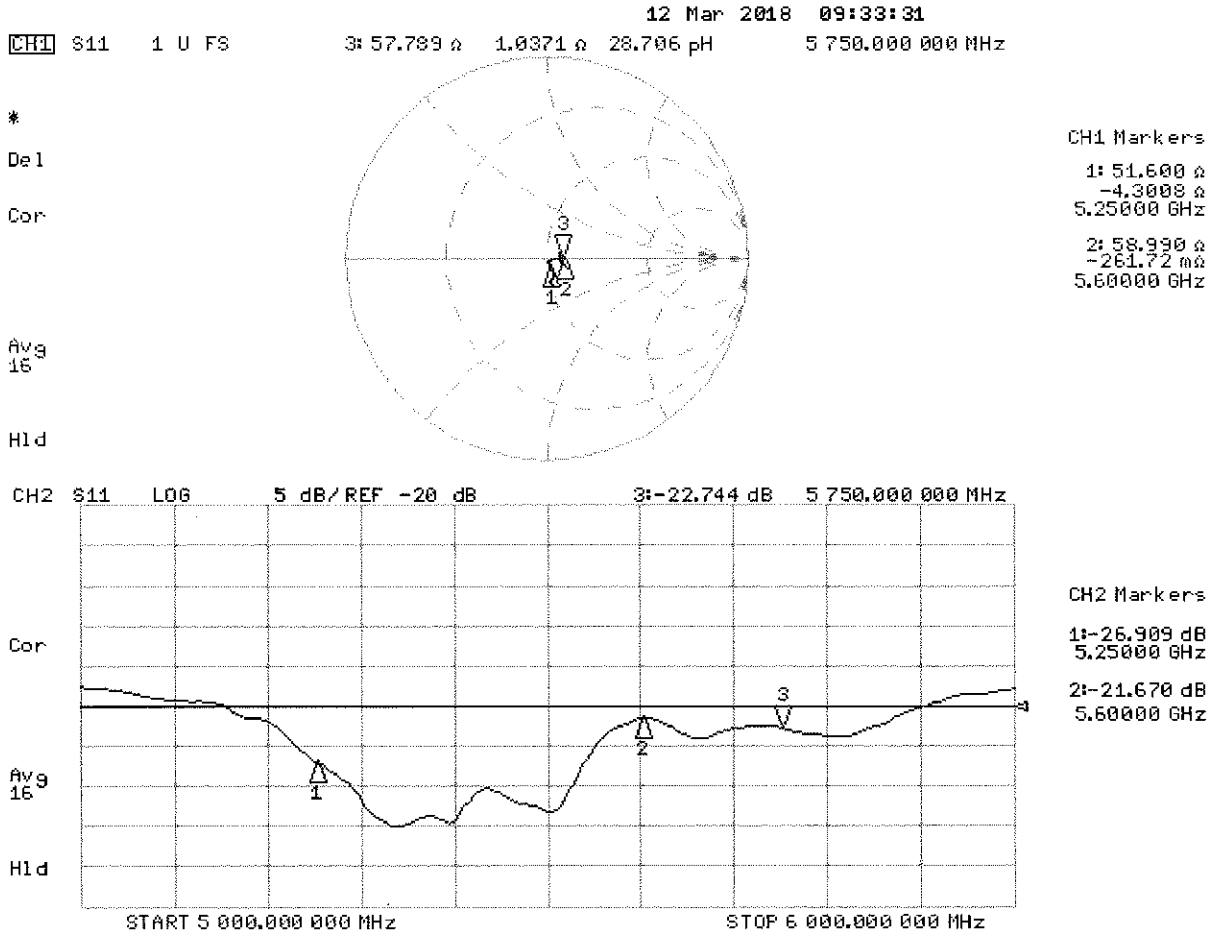
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.20 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 7.82 W/kg; SAR(10 g) = 2.19 W/kg
Maximum value of SAR (measured) = 19.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.74 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 31.8 W/kg
SAR(1 g) = 7.52 W/kg; SAR(10 g) = 2.1 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

Impedance Measurement Plot for Body TSL



Certification of Calibration

Object D5GHzV2 – SN: 1123

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 3/12/2019

Description: SAR Validation Dipole at 5250, 5600, and 5750 MHz.

Calibration Equipment used:

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8753ES	S-Parameter Network Analyzer	10/2/2018	Annual	10/2/2019	US39170118
Agilent	N5182A	MXG Vector Signal Generator	6/15/2018	Annual	6/15/2019	MY47420837
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	343972
Anritsu	MA2411B	Pulse Power Sensor	10/30/2018	Annual	10/30/2019	1207470
Anritsu	MA2411B	Pulse Power Sensor	11/20/2018	Annual	11/20/2019	1339007
Anritsu	ML2495A	Power Meter	10/21/2018	Annual	10/21/2019	941001
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Control Company	4352	Ultra Long Stem Thermometer	5/2/2017	Biennial	5/2/2019	170330158
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/4/2018	Annual	6/4/2019	MY53401181
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Seekonk	NC-100	Torque Wrench	7/11/2018	Annual	7/11/2019	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/10/2018	Annual	7/10/2019	1402
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/18/2018	Annual	10/18/2019	1364
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/15/2018	Annual	5/15/2019	1070
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7416
SPEAG	EX3DV4	SAR Probe	7/20/2018	Annual	7/20/2019	7491

Measurement Uncertainty = ±23% (k=2)

	Name	Function	Signature
Calibrated By:	Sangmin Cha	Team Lead Engineer	
Approved By:	Kaitlin O'Keefe	Managing Director	

DIPOLE CALIBRATION EXTENSION

Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

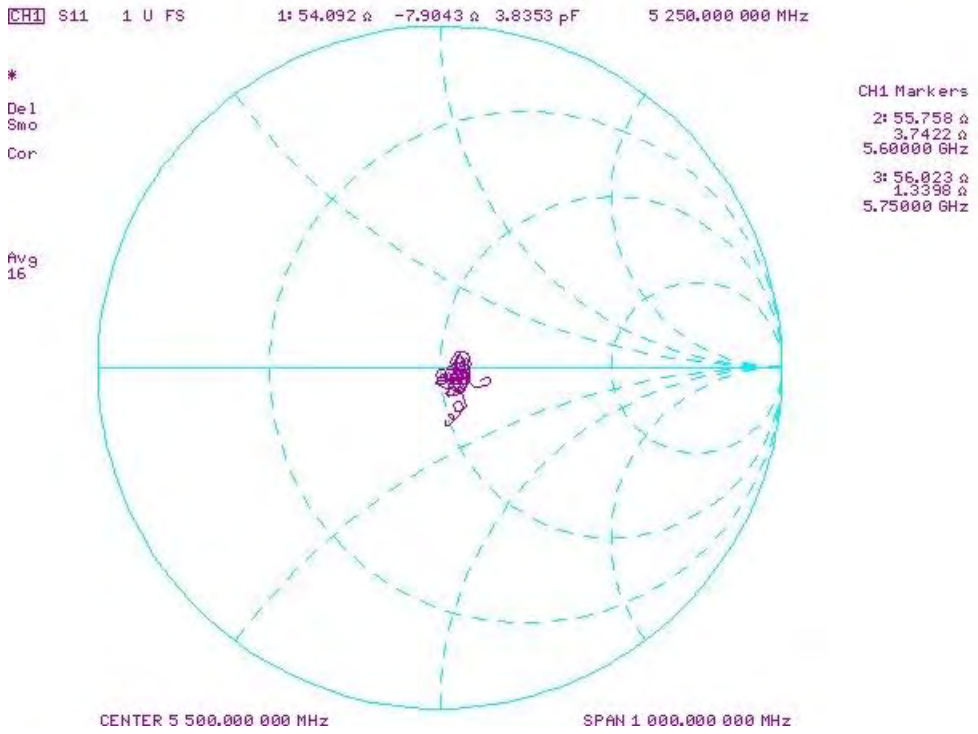
1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

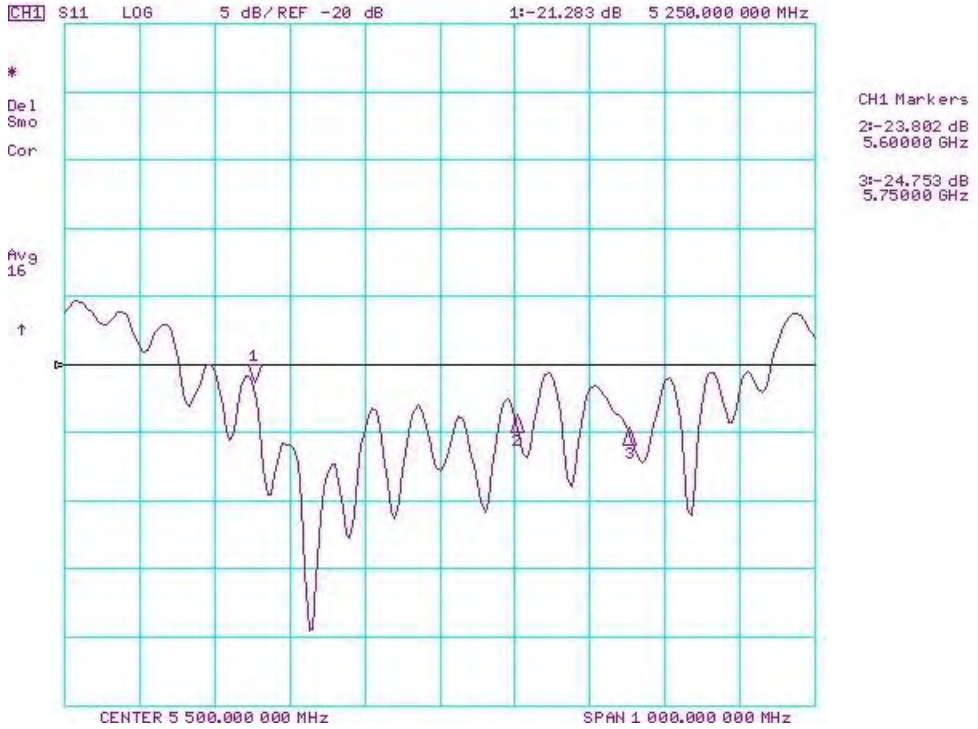
The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Head (1g) W/kg @ 17.0 dBm	Measured Head SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Head (10g) W/kg @ 17.0 dBm	Measured Head SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Head (Ohm) Real	Measured Impedance Head (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Head (Ohm) Imaginary	Measured Impedance Head (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Head (dB)	Measured Return Loss Head (dB)	Deviation (%)	PASS/FAIL
5250	3/13/2018	3/12/2019	1.205	4.08	3.84	-5.88%	1.18	1.09	-7.63%	53.2	54.1	0.9	-5.2	-7.9	2.7	-24.6	-21.3	13.40%	PASS
5600	3/13/2018	3/12/2019	1.205	4.26	4	-6.10%	1.22	1.13	-7.38%	57.2	55.8	1.4	-0.4	3.7	4.1	-23.4	-23.8	-1.70%	PASS
5750	3/13/2018	3/12/2019	1.205	4.03	3.73	-7.44%	1.15	1.06	-7.83%	56.7	56	0.7	0.9	1.3	0.4	-23.9	-24.8	-3.80%	PASS

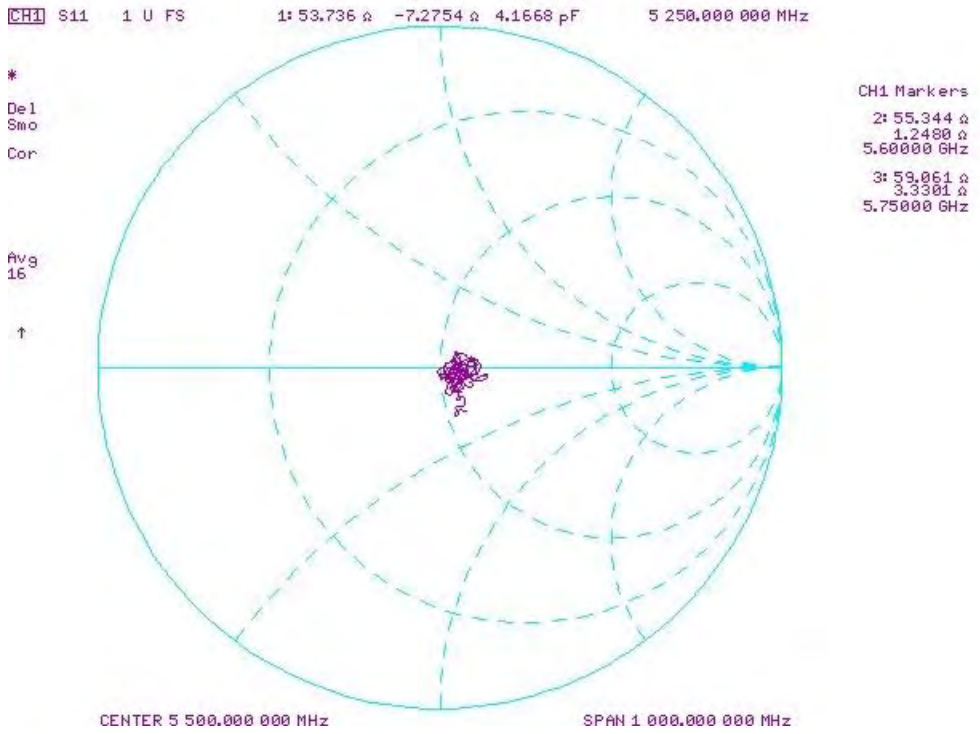
Frequency (MHz)	Calibration Date	Extension Date	Certificate Electrical Delay (ns)	Certificate SAR Target Body (1g) W/kg @ 17.0 dBm	Measured Body SAR (1g) W/kg @ 17.0 dBm	Deviation 1g (%)	Certificate SAR Target Body (10g) W/kg @ 17.0 dBm	Measured Body SAR (10g) W/kg @ 17.0 dBm	Deviation 10g (%)	Certificate Impedance Body (Ohm) Real	Measured Impedance Body (Ohm) Real	Difference (Ohm) Real	Certificate Impedance Body (Ohm) Imaginary	Measured Impedance Body (Ohm) Imaginary	Difference (Ohm) Imaginary	Certificate Return Loss Body (dB)	Measured Return Loss Body (dB)	Deviation (%)	PASS/FAIL
5250	3/13/2018	3/12/2019	1.205	3.7	3.83	3.51%	1.03	1.07	3.88%	51.6	53.7	2.1	-4.3	-7.3	3	-26.9	-22.1	17.80%	PASS
5600	3/13/2018	3/12/2019	1.205	3.88	3.97	2.32%	1.09	1.09	0.00%	59	55.3	3.7	-0.3	1.2	1.5	-21.7	-25.5	-17.50%	PASS
5750	3/13/2018	3/12/2019	1.205	3.74	3.76	0.53%	1.04	1.03	-0.96%	57.8	59.1	1.3	1	3.3	2.3	-22.7	-21.1	7.00%	PASS

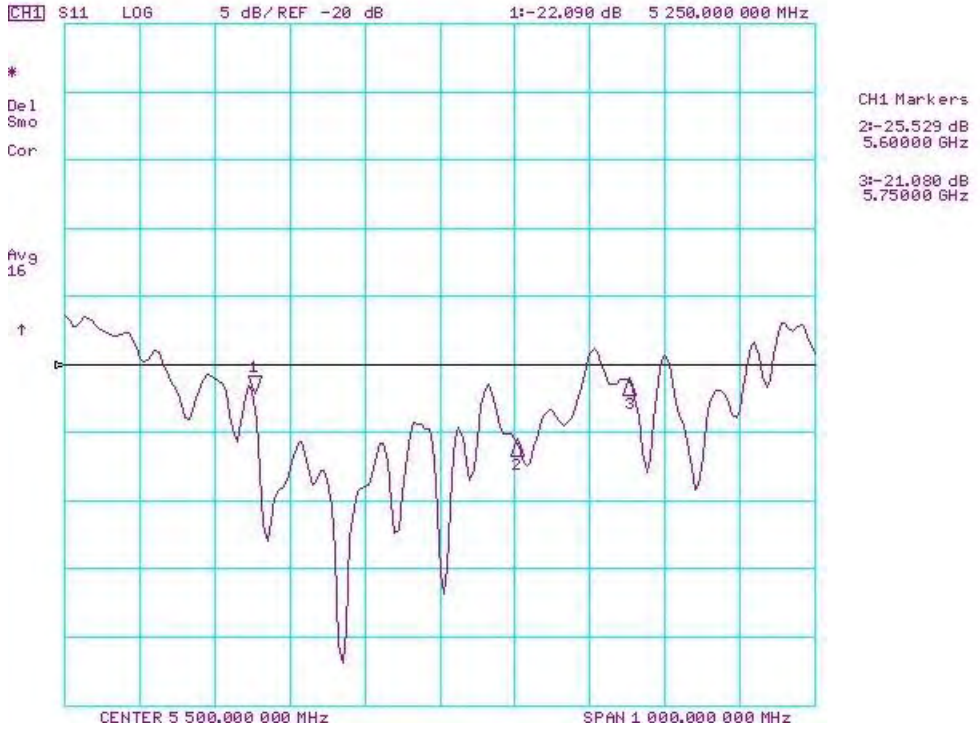
Impedance & Return-Loss Measurement Plot for Head TSL





Impedance & Return-Loss 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 0108

Client **PC Test**

Certificate No: D5GHzV2-1163_Sep18

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN:1163
Calibration procedure(s)	QA CAL-22.v3 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	September 13, 2018

SC ✓ 9/21/2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 3503	30-Dec-17 (No. EX3-3503_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Manu Seitz	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 19, 2018

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom **V**5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.3 ± 6 %	4.52 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.1 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.8 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.0 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	5.03 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.0 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.83 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.7 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	5.93 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**80.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.0 ± 6 %	6.14 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.85 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.5 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	48.0 Ω - 2.0 jΩ
Return Loss	- 30.9 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	49.0 Ω + 4.4 jΩ
Return Loss	- 26.8 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	50.9 Ω + 4.3 jΩ
Return Loss	- 27.2 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	46.4 Ω - 0.4 jΩ
Return Loss	- 28.5 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	50.2 Ω + 4.1 jΩ
Return Loss	- 27.8 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	51.8 Ω + 5.9 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 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 06, 2013

DASY5 Validation Report for Head TSL

Date: 13.09.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1163

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 4.52 S/m; ε_r = 35.3; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.87 S/m; ε_r = 34.8; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 5.03 S/m; ε_r = 34.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

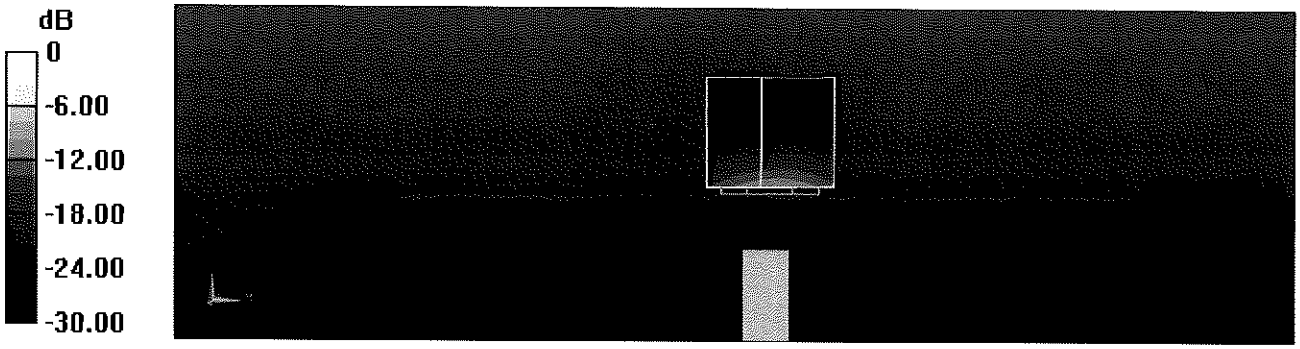
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.51, 5.51, 5.51) @ 5250 MHz, ConvF(5.05, 5.05, 5.05) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601 (5GHz); Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 77.54 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 26.6 W/kg
SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.33 W/kg
Maximum value of SAR (measured) = 17.9 W/kg

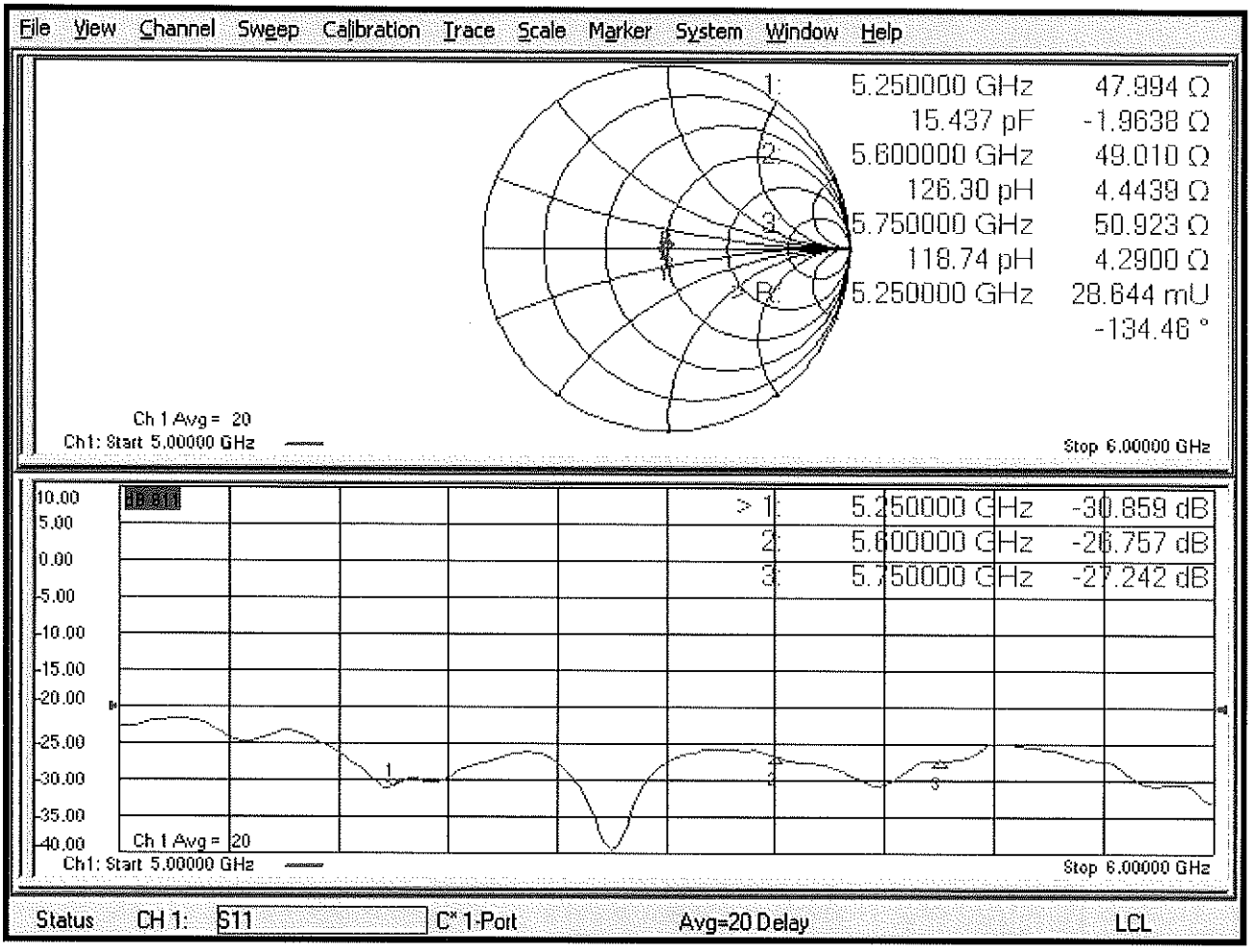
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 77.29 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 8.43 W/kg; SAR(10 g) = 2.42 W/kg
Maximum value of SAR (measured) = 19.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 75.35 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 30.3 W/kg
SAR(1 g) = 8.16 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 17.9 W/kg = 12.53 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.09.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1163

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 5.46 S/m; ε_r = 46.9; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 5.93 S/m; ε_r = 46.3; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 6.14 S/m; ε_r = 46; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

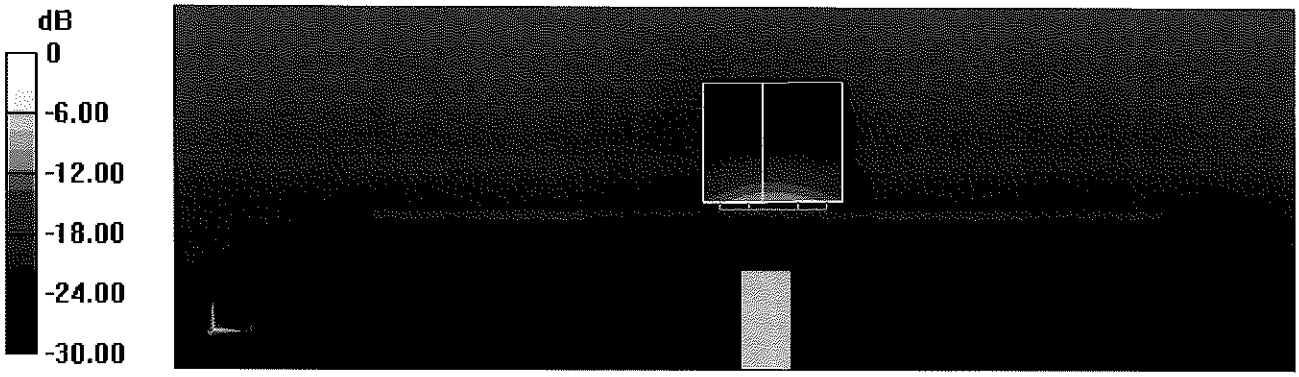
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.26, 5.26, 5.26) @ 5250 MHz,
  ConvF(4.65, 4.65, 4.65) @ 5600 MHz, ConvF(4.57, 4.57, 4.57) @ 5750 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601 (5GHz); Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.57 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 7.83 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 17.8 W/kg

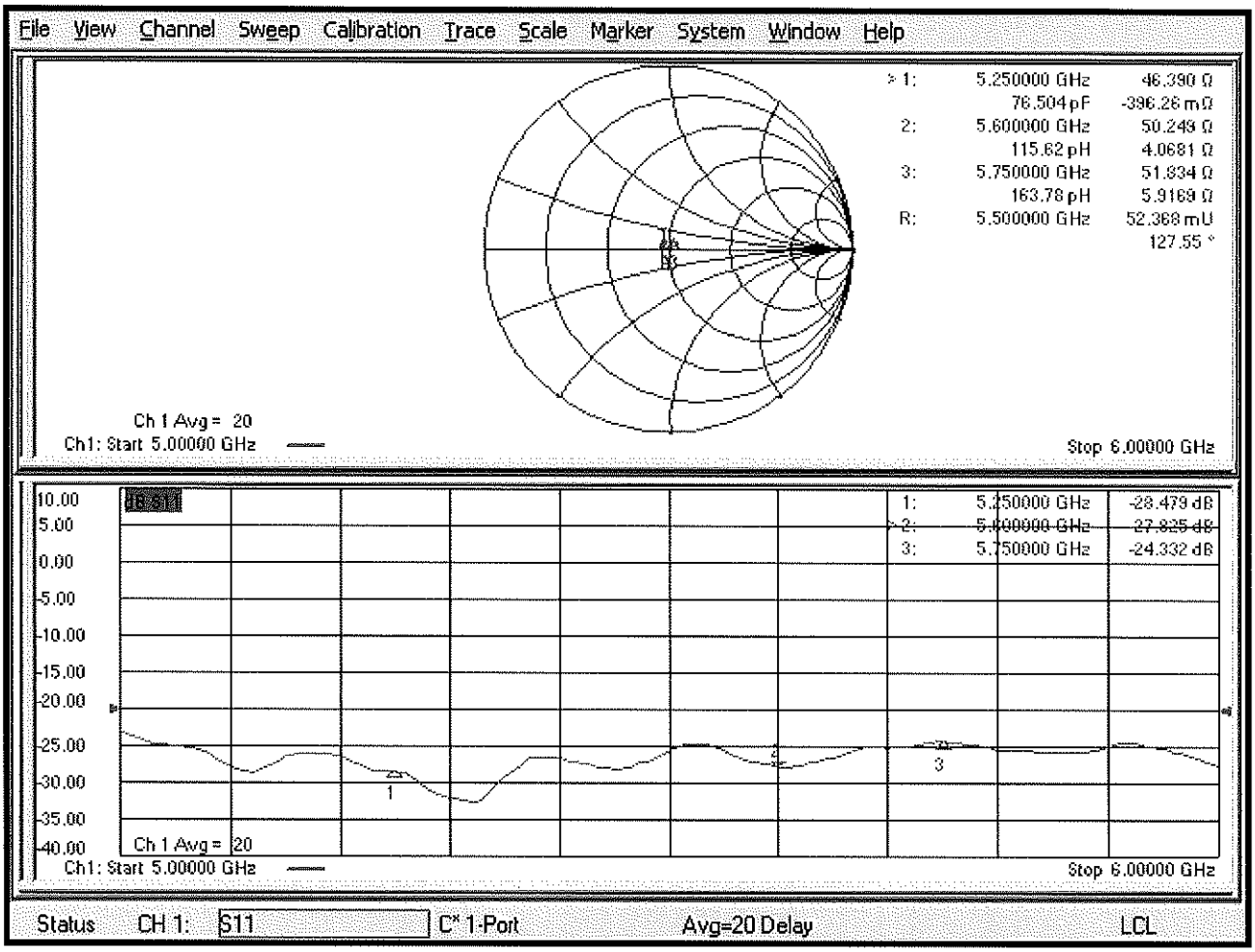
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.75 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 33.7 W/kg
SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.61 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 33.2 W/kg
SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 18.6 W/kg



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

Impedance Measurement Plot for Body TSL



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S Schweizerischer Kalibrierdienst
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Accreditation No.: SCS 0108

Client PC Test

Certificate No: ES3-3318_Nov18

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3318
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v8 Calibration procedure for dosimetric E-field probes
Calibration date:	November 19, 2018

SCV 12/4/2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: November 20, 2018

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

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3318

Manufactured: January 10, 2012
Calibrated: November 19, 2018

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)