



SAR EVALUATION REPORT

Applicant Name:

Samsung Electronics Co., Ltd.
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Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:

01/07/17 - 01/24/17

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

OY1612282070-R1.A3L

FCC ID:

A3LSMG955N

APPLICANT:

SAMSUNG ELECTRONICS CO., LTD.

DUT Type:

Portable Handset

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model:

SM-G955N

Equipment Class	Band & Mode	Tx Frequency	SAR			
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)	10 gm Phablet (W/kg)
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	< 0.1	0.13	0.37	N/A
PCE	UMTS 850	826.40 - 846.60 MHz	0.10	0.12	0.21	N/A
PCE	UMTS 1900	1852.4 - 1907.6 MHz	< 0.1	0.20	0.52	N/A
PCE	LTE Band 12	699.7 - 715.3 MHz	< 0.1	< 0.1	0.13	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	< 0.1	0.11	0.20	N/A
PCE	LTE Band 26 (Cell)	814.7 - 848.3 MHz	0.10	0.19	0.38	N/A
PCE	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.16	0.23	0.54	N/A
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.14	0.46	1.07	N/A
PCE	LTE Band 25 (PCS)	1850.7 - 1914.3 MHz	0.11	0.28	0.69	N/A
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	N/A	N/A	N/A	N/A
PCE	LTE Band 41	2498.5 - 2687.5 MHz	< 0.1	0.11	0.39	N/A
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.38	< 0.1	0.15	N/A
NII	U-NII-1	5180 - 5240 MHz	N/A	N/A	N/A	N/A
NII	U-NII-2A	5260 - 5320 MHz	0.17	< 0.1	N/A	0.18
NII	U-NII-2C	5500 - 5720 MHz	0.11	< 0.1	N/A	0.23
NII	U-NII-3	5745 - 5825 MHz	0.16	< 0.1	0.12	N/A
DSS	Bluetooth	2402 - 2480 MHz	0.10	< 0.1	< 0.1	0.65
Simultaneous SAR per KDB 690783 D01v01r03:			1.21	0.72	1.59	0.65

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.

Note: This revised Test Report (S/N: OY1612282070-R1.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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


Randy Ortanez
President



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 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 26 (Cell)	Voice/Data	814.7 - 848.3 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 25 (PCS)	Voice/Data	1850.7 - 1914.3 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	Data	2412 - 2462 MHz
U-NII-1	Data	5180 - 5240 MHz
U-NII-2A	Data	5260 - 5320 MHz
U-NII-2C	Data	5500 - 5720 MHz
U-NII-3	Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz
ANT+	Data	2402 - 2480 MHz
MST	Data	555Hz - 8.33 kHz

1.2 Power Reduction for SAR

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 Max 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 1900	Maximum	30.2	30.2	27.5	25.0	24.5	24.5	26.0	24.0	22.0	21.0
	Nominal	29.7	29.7	27.0	24.5	24.0	24.0	25.5	23.5	21.5	20.5

Mode / Band		Modulated Average (dBm)		
		3GPP WCDMA	3GPP HSDPA	3GPP HSUPA
UMTS Band 5 (850 MHz)	Maximum	22.5	22.5	22.5
	Nominal	22.0	22.0	22.0
UMTS Band 2 (1900 MHz)	Maximum	22.5	22.5	22.5
	Nominal	22.0	22.0	22.0

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Mode / Band		Modulated Average (dBm)
LTE Band 12	Maximum	23.5
	Nominal	23.0
LTE Band 17	Maximum	23.5
	Nominal	23.0
LTE Band 13	Maximum	24.0
	Nominal	23.5
LTE Band 26 (Cell)	Maximum	23.5
	Nominal	23.0
LTE Band 5 (Cell) Ant A	Maximum	24.5
	Nominal	24.0
LTE Band 5 (Cell) Ant E	Maximum	22.0
	Nominal	21.5
LTE Band 4 (AWS)	Maximum	23.5
	Nominal	23.0
LTE Band 25 (PCS)	Maximum	23.5
	Nominal	23.0
LTE Band 2 (PCS)	Maximum	23.5
	Nominal	23.0
LTE Band 41	Maximum	23.5
	Nominal	23.0
Mode / Band		Modulated Average - Single Tx Chain (Antenna 1 and 2) (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	19.5
	Nominal	19.0
IEEE 802.11g (2.4 GHz)	Maximum	15.5
	Nominal	15.0
IEEE 802.11n (2.4 GHz)	Maximum	14.5
	Nominal	14.0

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Mode / Band		Modulated Average - Single Tx Chain (Antenna 2) (dBm)
Bluetooth (1 Mbps)	Maximum	15.5
	Nominal	15.0
Bluetooth (EDR)	Maximum	9.5
	Nominal	9.0
Bluetooth LE	Maximum	7.5
	Nominal	7.0
Bluetooth LE (2 Mbps, v5.0)	Maximum	8.0
	Nominal	7.5

Mode / Band		Modulated Average - Single Tx Chain (Antenna 1 and 2) (dBm)		
		20 MHz Bandwidth	40 MHz Bandwidth	80 MHz Bandwidth
IEEE 802.11a (5 GHz)	Maximum	14.5		
	Nominal	14.0		
IEEE 802.11n (5 GHz)	Maximum	14.5		
	Nominal	14.0		
IEEE 802.11ac (5 GHz)	Maximum	12.5	12.5	12.5
	Nominal	12.0	12.0	12.0
Mode / Band		Modulated Average - MIMO (dBm)		
		20 MHz Bandwidth	40 MHz Bandwidth	80 MHz Bandwidth
IEEE 802.11g (2.4 GHz)	Maximum	18.5		
	Nominal	18.0		
IEEE 802.11n (2.4 GHz)	Maximum	17.5		
	Nominal	17.0		
IEEE 802.11a (5 GHz)	Maximum	17.5		
	Nominal	17.0		
IEEE 802.11n (5 GHz)	Maximum	17.5	16.5	
	Nominal	17.0	16.0	
IEEE 802.11ac (5 GHz)	Maximum	15.5	15.5	15.5
	Nominal	15.0	15.0	15.0

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1.3.2 WLAN Reduced Power (Held to Ear):

Mode / Band		Modulated Average - Single Tx Chain (Antenna 1 and 2) (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	15.5
	Nominal	15.0
IEEE 802.11g (2.4 GHz)	Maximum	15.5
	Nominal	15.0
IEEE 802.11n (2.4 GHz)	Maximum	14.5
	Nominal	14.0

Mode / Band		Modulated Average - Single Tx Chain (Antenna 1 and 2) (dBm)		
		20 MHz Bandwidth	40 MHz Bandwidth	80 MHz Bandwidth
IEEE 802.11a (5 GHz)	Maximum	12.5		
	Nominal	12.0		
IEEE 802.11n (5 GHz)	Maximum	12.5		
	Nominal	12.0		
IEEE 802.11ac (5 GHz)	Maximum	12.5	12.5	12.5
	Nominal	12.0	12.0	12.0

Mode / Band		Modulated Average - MIMO (dBm)		
		20 MHz Bandwidth	40 MHz Bandwidth	80 MHz Bandwidth
IEEE 802.11g (2.4 GHz)	Maximum	18.5		
	Nominal	18.0		
IEEE 802.11n (2.4 GHz)	Maximum	17.5		
	Nominal	17.0		
IEEE 802.11a (5 GHz)	Maximum	15.5		
	Nominal	15.0		
IEEE 802.11n (5 GHz)	Maximum	15.5	15.5	
	Nominal	15.0	15.0	
IEEE 802.11ac (5 GHz)	Maximum	15.5	15.5	
	Nominal	15.0	15.0	

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1.3.3 Maximum Powers During Conditions with Simultaneous 2.4 GHz and 5 GHz WLAN:

	# Tx	5 GHz WIFI [dBm]		2.4 GHz WIFI [dBm]		802.11 Modes
		Ant1	Ant2	Ant1	Ant2	
2.4 GHz + 5 GHz	2	A	-	-	B	2.4 GHz: b,g,n 5 GHz: a,n,ac
	2	-	A	B	-	
	2	A	-	B	-	
	2	-	A	-	B	
	3	A	A	B	-	2.4 GHz: b, g, n 5 GHz: n, ac, a (CDD + STBC only)
	3	A	A	-	B	
	3	A	-	B	B	2.4 GHz: n, g (CDD + STBC only) 5 GHz: a, n, ac
	3	-	A	B	B	
	4	A	A	B	B	2.4 GHz: n, g (CDD + STBC only) 5 GHz: n, ac, a (CDD + STBC only)

A = 12 dBm

B = 12 dBm

(Upper tolerance: target + 0.5 dB)

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 1900 Ant B	Yes	Yes	No	Yes	No	Yes
UMTS 850 Ant A	Yes	Yes	No	Yes	Yes	Yes
UMTS 1900 Ant B	Yes	Yes	No	Yes	No	Yes
LTE Band 12 Ant A	Yes	Yes	No	Yes	Yes	Yes
LTE Band 13 Ant A	Yes	Yes	No	Yes	Yes	Yes
LTE Band 26 (Cell) Ant A	Yes	Yes	No	Yes	Yes	Yes
LTE Band 5 (Cell) Ant A	Yes	Yes	No	Yes	Yes	Yes
LTE Band 5 (Cell) Ant E	Yes	Yes	Yes	No	Yes	Yes
LTE Band 4 (AWS) Ant B	Yes	Yes	No	Yes	No	Yes
LTE Band 25 (PCS) Ant B	Yes	Yes	No	Yes	No	Yes
LTE Band 41 Ant B	Yes	Yes	No	Yes	No	Yes
2.4 GHz WLAN Ant 1	Yes	Yes	Yes	No	No	Yes
2.4 GHz WLAN Ant 2	Yes	Yes	Yes	No	No	Yes
5 GHz WLAN Ant 1	Yes	Yes	Yes	No	No	Yes
5 GHz WLAN Ant 2	Yes	Yes	Yes	No	No	Yes
Bluetooth WLAN Ant 2	Yes	Yes	Yes	No	No	Yes

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

1.5 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the 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 transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-1 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

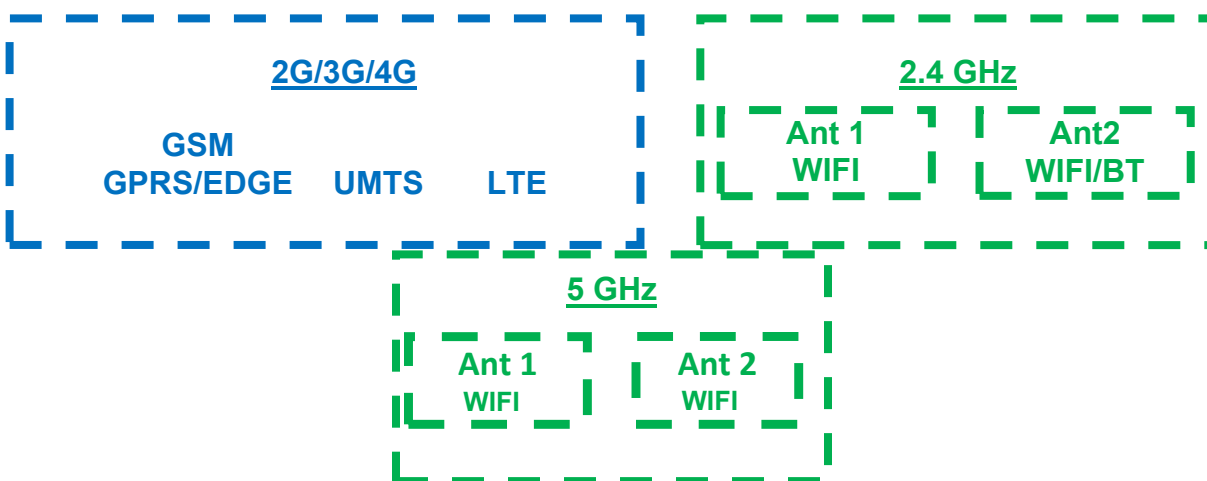


Figure 1-1
Simultaneous Transmission Paths

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

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Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Phablet	Notes
1	GSM voice + 2.4 GHz W-Fi	Yes	Yes	N/A	Yes	
2	GSM voice + 5 GHz W-Fi	Yes	Yes	N/A	Yes	
3	GSM voice + 2.4 GHz Bluetooth	Yes*	Yes	N/A	Yes	* BT Tethering Applications are Considered
4	GSM voice + 2.4 GHz W-Fi MIMO	Yes	Yes	N/A	Yes	
5	GSM voice + 5 GHz W-Fi MIMO	Yes	Yes	N/A	Yes	
6	GSM voice + 2.4 GHz W-Fi + 5 GHz W-Fi	Yes	Yes	N/A	Yes	
7	GSM voice + 2.4 GHz W-Fi MIMO + 5 GHz W-Fi MIMO	Yes	Yes	N/A	Yes	
8	UMTS + 2.4 GHz W-Fi	Yes	Yes	Yes	Yes	
9	UMTS + 5 GHz W-Fi	Yes	Yes	Yes	Yes	
10	UMTS + 2.4 GHz Bluetooth	Yes*	Yes	Yes*	Yes	* BT Tethering Applications are Considered
11	UMTS + 2.4 GHz W-Fi MIMO	Yes	Yes	Yes	Yes	
12	UMTS + 5 GHz W-Fi MIMO	Yes	Yes	Yes	Yes	
13	UMTS + 2.4 GHz W-Fi + 5 GHz W-Fi	Yes	Yes	Yes	Yes	
14	UMTS + 2.4 GHz W-Fi MIMO + 5 GHz W-Fi MIMO	Yes	Yes	Yes	Yes	
15	LTE + 2.4 GHz W-Fi	Yes	Yes	Yes	Yes	
16	LTE + 5 GHz W-Fi	Yes	Yes	Yes	Yes	
17	LTE + 2.4 GHz Bluetooth	Yes*	Yes	Yes*	Yes	* BT Tethering Applications are Considered
18	LTE + 2.4 GHz W-Fi MIMO	Yes	Yes	Yes	Yes	
19	LTE + 5 GHz W-Fi MIMO	Yes	Yes	Yes	Yes	
20	LTE + 2.4 GHz W-Fi + 5 GHz W-Fi	Yes	Yes	Yes	Yes	
21	LTE + 2.4 GHz W-Fi MIMO + 5 GHz W-Fi MIMO	Yes	Yes	Yes	Yes	
22	GPRS/EDGE + 2.4 GHz W-Fi	N/A	N/A	Yes	Yes	
23	GPRS/EDGE + 5 GHz W-Fi	N/A	N/A	Yes	Yes	
24	GPRS/EDGE + 2.4 GHz Bluetooth	N/A	N/A	Yes*	Yes	* BT Tethering Applications are Considered
25	GPRS/EDGE + 2.4 GHz W-Fi MIMO	N/A	N/A	Yes	Yes	
26	GPRS/EDGE + 5 GHz W-Fi MIMO	N/A	N/A	Yes	Yes	
27	GPRS/EDGE + 2.4 GHz W-Fi + 5 GHz W-Fi	N/A	N/A	Yes	Yes	
28	GPRS/EDGE + 2.4 GHz W-Fi MIMO + 5 GHz W-Fi MIMO	N/A	N/A	Yes	Yes	

1. All licensed modes share the same antenna path and cannot transmit simultaneously.
2. 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.
3. 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.
4. 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.
5. This device supports 2x2 MIMO Tx for WLAN 802.11a/g/n/ac supports CDD and STBC and 802.11n/ac additionally supports SDM.
6. This device supports Bluetooth tethering for EDR packet only.

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 Publication 941225 D06v02r01.

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This device supports IEEE 802.11ac with the following features:

- a) Up to 80 MHz Bandwidth only
- b) No aggregate channel configurations
- c) 2 Tx antenna output
- d) 256 QAM is supported
- e) 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 2.4 GHz and U-NII-3 WLAN operations since wireless router 1g SAR was < 1.2 W/kg

(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.

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. Phablet SAR was not evaluated for licensed technologies since wireless router 1g SAR was < 1.2 W/kg for these modes.

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

This device supports both LTE B25 (PCS) and LTE B2 (PCS). Since the supported frequency span for LTE B2 (PCS) falls completely within the supported frequency span for LTE B25 (PCS), both LTE bands have the same target power, and both LTE bands share the same transmission path, SAR was only assessed for LTE B25 (PCS).

LTE Band 5 Ant E is disabled for all held to ear scenarios. Therefore SAR was only assessed for body-worn accessory and wireless router conditions.

LTE with 64QAM in the uplink is permanently disabled for US operations.

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)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)

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1.9 Device Serial Numbers

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

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number	Phablet Serial Number
GSM/GPRS/EDGE 1900	1F3B3	051B0	051B0	-
UMTS 850	051D1	051C8	051C8	-
UMTS 1900	1F3B3	051B0	051B0	-
LTE Band 12	051D1	051D1	051D1	-
LTE Band 13	051D1	051D1	051D1	-
LTE Band 26 (Cell)	051D1	051D1	051D1	-
LTE Band 5 (Cell)	051C8	051C8	051C8	-
LTE Band 4 (AWS)	051D1	051B0	051B0	-
LTE Band 25 (PCS)	051B0	051B0	051B0	-
LTE Band 41	051C8	051B0	051B0	-
2.4 GHz WLAN	1F3B2	1F3B2	1F3B2	-
5 GHz WLAN	051DC	051DC	051DC	051DC
Bluetooth	051DC	051DC	051DC	051DC

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2 LTE INFORMATION

LTE Information					
FCC ID	A3LSMG955N				
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 26 (Cell) (814.7 - 848.3 MHz)				
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)				
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)				
	LTE Band 25 (PCS) (1850.7 - 1914.3 MHz)				
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)				
	LTE Band 41 (2498.5 - 2687.5 MHz)				
	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
Channel Bandwidths	LTE Band 17: 5 MHz, 10 MHz				
	LTE Band 13: 5 MHz, 10 MHz				
	LTE Band 26 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz				
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 25 (PCS): 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 26 (Cell): 1.4 MHz	814.7 (26697)		831.5 (26865)		848.3 (27033)
LTE Band 26 (Cell): 3 MHz	815.5 (26705)		831.5 (26865)		847.5 (27025)
LTE Band 26 (Cell): 5 MHz	816.5 (26715)		831.5 (26865)		846.5 (27015)
LTE Band 26 (Cell): 10 MHz	819 (26740)		831.5 (26865)		844 (26990)
LTE Band 26 (Cell): 15 MHz	821.5 (26765)		831.5 (26865)		841.5 (26965)
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)		836.5 (20525)		848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)		836.5 (20525)		847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)		836.5 (20525)		846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)		836.5 (20525)		844 (20600)
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)		1732.5 (20175)		1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)		1732.5 (20175)		1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)		1732.5 (20175)		1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)		1732.5 (20175)		1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)		1732.5 (20175)		1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)		1732.5 (20175)		1745 (20300)
LTE Band 25 (PCS): 1.4 MHz	1850.7 (26047)		1882.5 (26365)		1914.3 (26683)
LTE Band 25 (PCS): 3 MHz	1851.5 (26055)		1882.5 (26365)		1913.5 (26675)
LTE Band 25 (PCS): 5 MHz	1852.5 (26065)		1882.5 (26365)		1912.5 (26665)
LTE Band 25 (PCS): 10 MHz	1855 (26090)		1882.5 (26365)		1910 (26640)
LTE Band 25 (PCS): 15 MHz	1857.5 (26115)		1882.5 (26365)		1907.5 (26615)
LTE Band 25 (PCS): 20 MHz	1860 (26140)		1882.5 (26365)		1905 (26590)
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	6				
DL UE Category	16				
UL UE Category	5				
Modulations Supported in UL	QPSK, 16QAM				
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3-6.2.5? (manufacturer attestation to be provided)	YES				
A-MPR (Additional MPR) disabled for SAR Testing?	YES				
LTE Carrier Aggregation Possible Combinations	The technical description includes all the possible carrier aggregation combinations				
LTE Release 10 Additional Information	This device does not support full CA features on 3GPP Release 12. All uplink communications are identical to the Release 8 Specifications. The following LTE Release 12 Features are not supported: Carrier Aggregation, Relay, HetNet, Enhanced MIMO, eICIC, WiFi Offloading, MDH, eMBMS, Cross-Carrier Scheduling, Enhanced SC-FDMA.				

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3 INTRODUCTION

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

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

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

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

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

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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:

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.

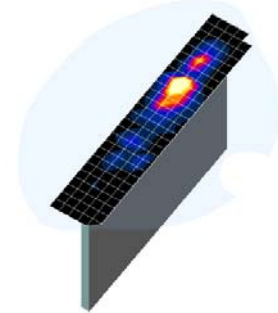


Figure 4-1
Sample SAR Area
Scan

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

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

*Also compliant to IEEE 1528-2013 Table 6

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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].

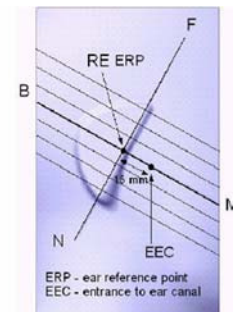


Figure 5-1
Close-Up Side view
of ERP

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 then located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at its top and bottom edges, positioning the “ear reference point” on the outer surface of the both the left and right head phantoms on the ear reference point.



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

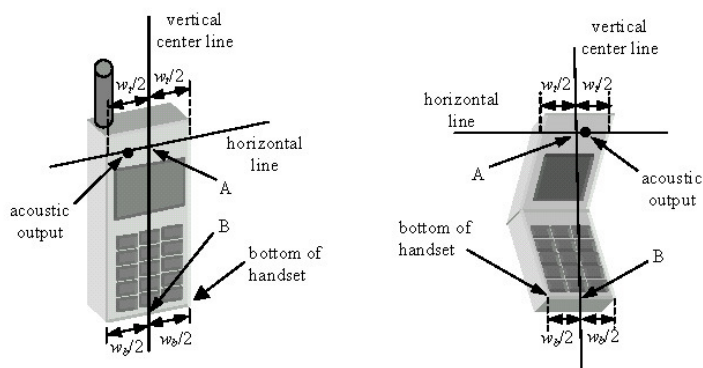


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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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 $\epsilon = 3$ and loss tangent $\delta = 0.02$.

6.2 Positioning for Cheek

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

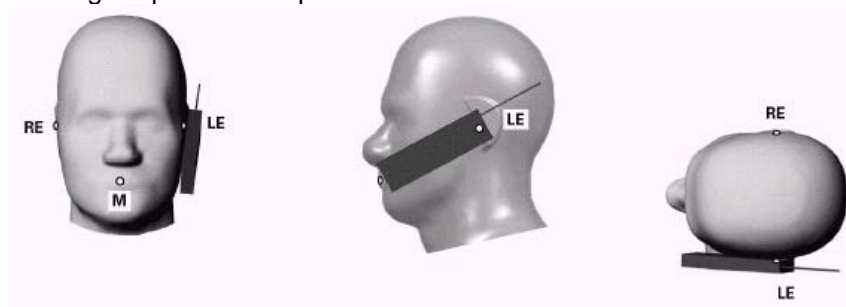


Figure 6-1 Front, Side and Top View of Cheek Position

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

6.3 Positioning for Ear / 15° Tilt

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

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

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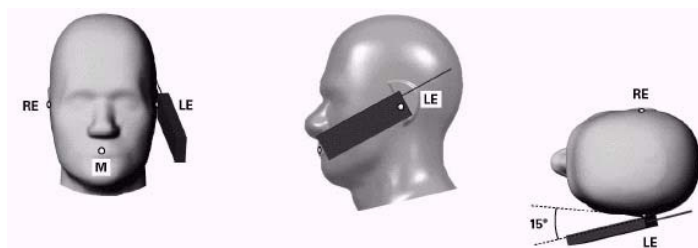


Figure 6-2 Front, Side and Top View of Ear/15° Tilt Position

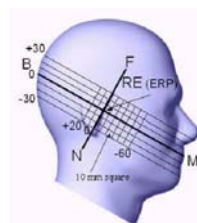


Figure 6-3 Side view w/ relevant markings

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.

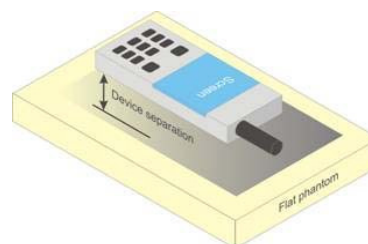


Figure 6-4 Sample Body-Worn Diagram

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

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

6.7 Wireless Router Configurations

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

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 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 10-g SAR. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g SAR > 1.2 W/kg.

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

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

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8 FCC MEASUREMENT PROCEDURES

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

8.1 Measured and Reported SAR

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

8.2 3G SAR Test Reduction Procedure

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

8.3 Procedures Used to Establish RF Signal for SAR

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

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

8.4 SAR Measurement Conditions for UMTS

8.4.1 Output Power Verification

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

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8.4.2 Head SAR Measurements

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

8.4.3 Body SAR Measurements

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

8.4.4 SAR Measurements with Rel 5 HSDPA

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

8.4.5 SAR Measurements with Rel 6 HSUPA

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

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

8.5 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).

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.

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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 $\frac{1}{2}$ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is < 1.45 W/kg.

8.5.5 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.

8.6 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.

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8.6.1 General Device Setup

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

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

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

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

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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 $> 1.2 \text{ W/kg}$. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed. When 10-g 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 $\leq 0.8 \text{ W/kg}$, 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 $\leq 1.2 \text{ W/kg}$ 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 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

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 $\leq 1.2 \text{ W/kg}$, no additional SAR tests for the subsequent test configurations are required. When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.6.9 MIMO SAR considerations

Per KDB Publication 248227 D01v02r02, the simultaneous SAR provisions in KDB Publication 447498 D01v06 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1g single transmission chain SAR measurements is $< 1.6 \text{ W/kg}$, no additional SAR measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation. When 10-g 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

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 1900	512	28.65	28.59	25.94	23.47	22.90	24.95	22.81	21.48	20.19
	661	28.64	28.61	26.09	23.33	22.89	24.61	22.30	20.79	19.49
	810	29.06	29.04	26.55	23.36	23.13	24.44	22.11	20.31	19.30
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 1900	512	19.62	19.56	19.92	19.21	19.89	15.92	16.79	17.22	17.18
	661	19.61	19.58	20.07	19.07	19.88	15.58	16.28	16.53	16.48
	810	20.03	20.01	20.53	19.10	20.12	15.41	16.09	16.05	16.29
GSM 1900	Frame Avg.Targets:	20.67	20.67	20.98	20.24	20.99	16.47	17.48	17.24	17.49

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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: 33 (Max 4 Tx uplink slots)
EDGE Multislot class: 33 (Max 4 Tx uplink slots)
DTM Multislot Class: N/A



Figure 9-1
Power Measurement Setup

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9.2 UMTS Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.47	22.48	22.42	21.95	21.91	21.78	-
99		12.2 kbps AMR	22.47	20.68	22.43	21.92	21.88	21.76	-
6	HSDPA	Subtest 1	22.50	22.45	21.98	21.78	22.18	22.19	0
6		Subtest 2	21.25	21.16	20.95	21.00	21.40	21.20	0
6		Subtest 3	22.17	22.10	22.00	21.39	21.81	21.78	0.5
6		Subtest 4	20.07	20.06	20.00	20.00	20.29	20.00	0.5
6	HSPA	Subtest 1	21.16	21.13	21.06	20.51	20.71	20.85	0
6		Subtest 2	20.09	20.03	19.88	20.40	20.82	20.78	2
6		Subtest 3	21.96	21.73	21.70	21.01	21.37	21.30	1
6		Subtest 4	20.03	19.94	19.91	20.59	20.84	20.81	2
6		Subtest 5	22.50	22.49	22.48	21.99	22.30	22.35	0

This device does not support DC-HSDPA.

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



Figure 9-2
Power Measurement Setup

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9.3 LTE Conducted Powers

9.3.1

LTE Band 12

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

LTE Band 12 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23095 (707.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	23.24	0	0
	1	25	23.28		0
	1	49	23.12		0
	25	0	22.33	0-1	1
	25	12	22.36		1
	25	25	22.28		1
	50	0	22.35		1
16QAM	1	0	22.07	0-1	1
	1	25	22.14		1
	1	49	21.98		1
	25	0	21.37	0-2	2
	25	12	21.26		2
	25	25	21.24		2
	50	0	21.43		2

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

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

LTE Band 12 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23035 (701.5 MHz)	23095 (707.5 MHz)	23155 (713.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.44	23.35	23.50	0	0
	1	12	23.42	23.28	23.44		0
	1	24	23.43	23.37	23.50		0
	12	0	22.41	22.34	22.47	0-1	1
	12	6	22.37	22.36	22.48		1
	12	13	22.39	22.31	22.50		1
	25	0	22.40	22.31	22.47		1
16QAM	1	0	22.38	22.50	22.32	0-1	1
	1	12	22.18	22.42	22.50		1
	1	24	22.25	22.49	22.42		1
	12	0	21.43	21.34	21.50	0-2	2
	12	6	21.44	21.41	21.42		2
	12	13	21.40	21.33	21.50		2
	25	0	21.46	21.36	21.42		2

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

LTE Band 12 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23025 (700.5 MHz)	23095 (707.5 MHz)	23165 (714.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.43	23.29	23.39	0	0
	1	7	23.44	23.31	23.45		0
	1	14	23.43	23.35	23.34		0
	8	0	22.44	22.30	22.37	0-1	1
	8	4	22.40	22.37	22.39		1
	8	7	22.44	22.30	22.40		1
	15	0	22.45	22.33	22.37		1
16QAM	1	0	22.44	22.33	22.24	0-1	1
	1	7	22.45	22.43	22.16		1
	1	14	22.50	22.48	22.39		1
	8	0	21.50	21.21	21.34	0-2	2
	8	4	21.48	21.28	21.45		2
	8	7	21.46	21.28	21.36		2
	15	0	21.48	21.32	21.43		2

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

LTE Band 12 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23017 (699.7 MHz)	23095 (707.5 MHz)	23173 (715.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.43	23.42	23.45	0	0
	1	2	23.46	23.42	23.49		0
	1	5	23.42	23.30	23.37		0
	3	0	23.50	23.40	23.45		0
	3	2	23.44	23.34	23.38		0
	3	3	23.47	23.35	23.42		0
	6	0	22.49	22.36	22.43	0-1	1
16QAM	1	0	22.46	22.30	22.43	0-1	1
	1	2	22.42	22.49	22.42		1
	1	5	22.44	22.50	22.50		1
	3	0	22.45	22.23	22.48		1
	3	2	22.49	22.28	22.46		1
	3	3	22.46	22.43	22.43		1
	6	0	21.50	21.34	21.48	0-2	2

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LTE Band 13

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

LTE Band 13 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23230 (782.0 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	23.03	0	0
	1	25	22.98		0
	1	49	22.85		0
	25	0	21.94	0-1	1
	25	12	21.87		1
	25	25	21.89		1
	50	0	21.90		1
16QAM	1	0	21.82	0-1	1
	1	25	21.71		1
	1	49	21.60		1
	25	0	20.77	0-2	2
	25	12	20.79		2
	25	25	20.80		2
	50	0	20.86		2

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

LTE Band 13 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23230 (782.0 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	22.84	0	0
	1	12	22.85		0
	1	24	22.75		0
	12	0	21.79	0-1	1
	12	6	21.77		1
	12	13	21.76		1
	25	0	21.75		1
16QAM	1	0	21.51	0-1	1
	1	12	21.54		1
	1	24	21.49		1
	12	0	20.58	0-2	2
	12	6	20.57		2
	12	13	20.61		2
	25	0	20.63		2

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

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LTE Band 26 (Cell)

Table 9-7
LTE Band 26 (Cell) Conducted Powers - 15 MHz Bandwidth

LTE Band 26 (Cell) 15 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26865 (831.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	23.38	0	0
	1	36	23.32		0
	1	74	23.12		0
	36	0	22.29	0-1	1
	36	18	22.18		1
	36	37	22.10		1
	75	0	22.19		1
16QAM	1	0	22.11	0-1	1
	1	36	22.05		1
	1	74	21.93		1
	36	0	21.26	0-2	2
	36	18	21.22		2
	36	37	21.10		2
	75	0	21.20		2

Note: LTE Band 26 (Cell) at 15 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 9-8
LTE Band 26 (Cell) Conducted Powers - 10 MHz Bandwidth

LTE Band 26 (Cell) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26740 (819.0 MHz)	26865 (831.5 MHz)	26990 (844.0 MHz)		
QPSK	1	0	23.26	23.29	23.17	0	0
	1	25	23.20	23.32	23.09		0
	1	49	23.08	23.27	23.09		0
	25	0	22.16	22.18	22.07	0-1	1
	25	12	22.14	22.19	22.03		1
	25	25	22.12	22.14	22.03		1
	50	0	22.11	22.20	22.04		1
16QAM	1	0	22.16	22.32	22.33	0-1	1
	1	25	22.09	22.18	22.29		1
	1	49	22.15	22.23	22.30		1
	25	0	21.15	21.23	21.03	0-2	2
	25	12	21.14	21.20	21.03		2
	25	25	21.06	21.15	21.02		2
	50	0	21.14	21.07	21.12		2

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

LTE Band 26 (Cell) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26715 (816.5 MHz)	26865 (831.5 MHz)	27015 (846.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.24	23.27	23.45	0	0
	1	12	23.23	23.31	23.39		0
	1	24	23.24	23.28	23.28		0
	12	0	22.16	22.18	22.28	0-1	1
	12	6	22.19	22.19	22.24		1
	12	13	22.13	22.17	22.28		1
	25	0	22.13	22.15	22.23		1
16QAM	1	0	22.02	22.24	22.47	0-1	1
	1	12	22.21	22.21	22.49		1
	1	24	22.18	22.20	22.54		1
	12	0	21.08	21.24	21.23	0-2	2
	12	6	21.10	21.21	21.24		2
	12	13	21.02	21.15	21.25		2
	25	0	21.13	21.16	21.31		2

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Table 9-10
LTE Band 26 (Cell) Conducted Powers - 3 MHz Bandwidth

LTE Band 26 (Cell) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26705 (815.5 MHz)	26865 (831.5 MHz)	27025 (847.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.31	23.31	23.44	0	0
	1	7	23.25	23.34	23.41		0
	1	14	23.27	23.34	23.41		0
	8	0	22.17	22.25	22.31	0-1	1
	8	4	22.14	22.25	22.27		1
	8	7	22.14	22.21	22.30		1
	15	0	22.20	22.20	22.35		1
16QAM	1	0	22.25	22.19	22.44	0-1	1
	1	7	22.36	22.42	22.46		1
	1	14	22.29	22.18	22.29		1
	8	0	21.18	21.33	21.25	0-2	2
	8	4	21.18	21.24	21.34		2
	8	7	21.12	21.24	21.33		2
	15	0	21.10	21.22	21.32		2

Table 9-11
LTE Band 26 (Cell) Conducted Powers -1.4 MHz Bandwidth

LTE Band 26 (Cell) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26697 (814.7 MHz)	26865 (831.5 MHz)	27033 (848.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.27	23.37	23.44	0	0
	1	2	23.24	23.33	23.43		0
	1	5	23.31	23.37	23.46		0
	3	0	23.21	23.31	23.37		0
	3	2	23.24	23.24	23.39		0
	3	3	23.22	23.24	23.35		0
	6	0	22.21	22.20	22.32	0-1	1
16QAM	1	0	22.31	22.36	22.31	0-1	1
	1	2	22.26	22.40	22.30		1
	1	5	22.27	22.27	22.36		1
	3	0	22.19	22.20	22.27		1
	3	2	22.15	22.20	22.32		1
	3	3	22.22	22.10	22.32		1
	6	0	21.29	21.19	21.35	0-2	2

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LTE Band 5 (Cell) – Antenna A

Table 9-12
LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth

LTE Band 5 (Cell) 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20525 (836.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	23.36	0	0
	1	25	23.29		0
	1	49	23.26		0
	25	0	22.37	0-1	1
	25	12	22.36		1
	25	25	22.32		1
	50	0	22.36		1
16QAM	1	0	22.48	0-1	1
	1	25	22.47		1
	1	49	22.49		1
	25	0	21.48	0-2	2
	25	12	21.42		2
	25	25	21.38		2
	50	0	21.42		2

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

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

LTE Band 5 (Cell) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20425 (826.5 MHz)	20525 (836.5 MHz)	20625 (846.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.83	23.28	23.79	0	0
	1	12	23.82	23.24	23.80		0
	1	24	23.81	23.20	23.81		0
	12	0	22.76	22.21	22.79	0-1	1
	12	6	22.75	22.22	22.77		1
	12	13	22.79	22.20	22.74		1
	25	0	22.77	22.19	22.71		1
16QAM	1	0	23.12	22.49	23.15	0-1	1
	1	12	23.16	22.46	23.10		1
	1	24	23.11	22.44	23.08		1
	12	0	21.79	21.23	21.79	0-2	2
	12	6	21.82	21.22	21.75		2
	12	13	21.81	21.20	21.76		2
	25	0	21.81	21.22	21.75		2

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Table 9-14
LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth

LTE Band 5 (Cell) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20415 (825.5 MHz)	20525 (836.5 MHz)	20635 (847.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.84	23.15	23.82	0	0
	1	7	23.85	23.19	23.84		0
	1	14	23.83	23.17	23.83		0
	8	0	22.77	22.18	22.74	0-1	1
	8	4	22.76	22.16	22.78		1
	8	7	22.78	22.10	22.74		1
	15	0	22.77	22.13	22.80		1
16QAM	1	0	23.09	22.48	23.11	0-1	1
	1	7	23.07	22.50	23.12		1
	1	14	23.08	22.49	23.11		1
	8	0	21.88	21.25	21.82	0-2	2
	8	4	21.86	21.24	21.84		2
	8	7	21.84	21.23	21.86		2
	15	0	21.82	21.32	21.83		2

Table 9-15
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	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20407 (824.7 MHz)	20525 (836.5 MHz)	20643 (848.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.60	23.16	23.85	0	0
	1	2	23.74	23.15	23.79		0
	1	5	23.86	23.20	23.84		0
	3	0	23.87	23.16	23.87		0
	3	2	23.88	23.18	23.86		0
	3	3	23.88	23.15	23.88		0
	6	0	22.83	22.17	22.84	0-1	1
16QAM	1	0	23.05	22.38	23.09	0-1	1
	1	2	23.06	22.40	23.13		1
	1	5	23.05	22.37	23.12		1
	3	0	23.29	22.42	23.33		1
	3	2	23.32	22.45	23.34		1
	3	3	23.30	22.40	23.30		1
	6	0	21.80	21.14	21.88	0-2	2

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LTE Band 5 (Cell) – Antenna E

Table 9-16
LTE Band 5 (Cell) Conducted Powers - 10 MHz Bandwidth

LTE Band 5 (Cell) 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20525 (836.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	21.34	0	0
	1	25	21.25		0
	1	49	21.24		0
	25	0	20.29	0-1	1
	25	12	20.28		1
	25	25	20.25		1
	50	0	20.22		1
16QAM	1	0	20.57	0-1	1
	1	25	20.53		1
	1	49	20.49		1
	25	0	19.32	0-2	2
	25	12	19.27		2
	25	25	19.26		2
	50	0	19.28		2

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

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

LTE Band 5 (Cell) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20425 (826.5 MHz)	20525 (836.5 MHz)	20625 (846.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	21.63	21.05	21.68	0	0
	1	12	21.62	21.04	21.66		0
	1	24	21.63	21.00	21.65		0
	12	0	20.58	20.00	20.63	0-1	1
	12	6	20.54	20.02	20.60		1
	12	13	20.55	20.05	20.58		1
	25	0	20.61	20.03	20.59		1
16QAM	1	0	20.91	20.44	20.96	0-1	1
	1	12	20.89	20.42	21.00		1
	1	24	20.88	20.36	20.99		1
	12	0	19.56	19.00	19.65	0-2	2
	12	6	19.58	18.98	19.62		2
	12	13	19.54	18.97	19.60		2
	25	0	19.56	19.05	19.64		2

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Table 9-18
LTE Band 5 (Cell) Conducted Powers - 3 MHz Bandwidth

LTE Band 5 (Cell) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20415 (825.5 MHz)	20525 (836.5 MHz)	20635 (847.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	21.65	20.94	21.67	0	0
	1	7	21.60	20.97	21.69		0
	1	14	21.61	20.96	21.69		0
	8	0	20.58	19.96	20.60	0-1	1
	8	4	20.56	19.97	20.58		1
	8	7	20.60	19.95	20.56		1
	15	0	20.58	19.97	20.61		1
16QAM	1	0	20.95	20.33	20.98	0-1	1
	1	7	20.91	20.27	20.97		1
	1	14	20.86	20.26	20.92		1
	8	0	19.58	19.02	19.64	0-2	2
	8	4	19.59	19.01	19.67		2
	8	7	19.57	18.99	19.62		2
	15	0	19.67	19.00	20.00		2

Table 9-19
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	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20407 (824.7 MHz)	20525 (836.5 MHz)	20643 (848.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	21.67	20.97	21.70	0	0
	1	2	21.68	21.01	21.76		0
	1	5	21.67	20.95	21.69		0
	3	0	21.64	20.98	21.68		0
	3	2	21.68	20.96	21.71		0
	3	3	21.64	20.97	21.67		0
	6	0	20.62	19.99	20.65	0-1	1
16QAM	1	0	20.93	20.28	20.95	0-1	1
	1	2	20.96	20.24	20.94		1
	1	5	20.94	20.19	20.91		1
	3	0	20.99	20.38	21.00		1
	3	2	21.00	20.41	20.97		1
	3	3	20.97	20.42	20.99		1
	6	0	19.62	18.97	19.70	0-2	2

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LTE Band 4 (AWS)

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

LTE Band 4 (AWS) 20 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20175 (1732.5 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	23.10	0	0
	1	50	22.63		0
	1	99	22.67		0
	50	0	21.60	0-1	1
	50	25	21.61		1
	50	50	21.55		1
	100	0	21.55		1
16QAM	1	0	21.59	0-1	1
	1	50	21.57		1
	1	99	21.24		1
	50	0	20.56	0-2	2
	50	25	20.62		2
	50	50	20.64		2
	100	0	20.57		2

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

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Table 9-21
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

LTE Band 4 (AWS) 15 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20025 (1717.5 MHz)	20175 (1732.5 MHz)	20325 (1747.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.83	22.47	22.66	0	0
	1	36	22.82	22.48	22.56		0
	1	74	22.67	22.40	22.69		0
	36	0	21.80	21.51	21.65	0-1	1
	36	18	21.77	21.50	21.62		1
	36	37	21.79	21.47	21.61		1
	75	0	21.76	21.53	21.65		1
16QAM	1	0	21.83	21.67	21.70	0-1	1
	1	36	21.79	21.56	21.78		1
	1	74	21.81	21.47	21.67		1
	36	0	20.90	20.56	20.72	0-2	2
	36	18	20.83	20.53	20.72		2
	36	37	20.79	20.57	20.67		2
	75	0	20.79	20.58	20.67		2

Table 9-22
LTE Band 4 (AWS) Conducted Powers - 10 MHz Bandwidth

LTE Band 4 (AWS) 10 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20000 (1715.0 MHz)	20175 (1732.5 MHz)	20350 (1750.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.78	22.47	22.73	0	0
	1	25	22.82	22.48	22.63		0
	1	49	22.67	22.40	22.72		0
	25	0	21.79	21.51	21.65	0-1	1
	25	12	21.77	21.50	21.65		1
	25	25	21.79	21.47	21.65		1
	50	0	21.76	21.53	21.65		1
16QAM	1	0	21.88	21.67	21.70	0-1	1
	1	25	21.79	21.54	21.78		1
	1	49	21.81	21.60	21.67		1
	25	0	20.90	20.56	20.73	0-2	2
	25	12	20.84	20.53	20.72		2
	25	25	20.79	20.57	20.72		2
	50	0	20.80	20.58	20.76		2

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Table 9-23
LTE Band 4 (AWS) Conducted Powers - 5 MHz Bandwidth

LTE Band 4 (AWS) 5 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			19975 (1712.5 MHz)	20175 (1732.5 MHz)	20375 (1752.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.70	22.42	22.65	0	0
	1	12	22.69	22.43	22.70		0
	1	24	22.72	22.42	22.63		0
	12	0	21.82	21.48	21.63	0-1	1
	12	6	21.75	21.44	21.59		1
	12	13	21.71	21.44	21.61		1
	25	0	21.82	21.42	21.56		1
16QAM	1	0	21.87	21.73	21.70	0-1	1
	1	12	21.78	21.60	21.68		1
	1	24	21.93	21.70	21.60		1
	12	0	20.86	20.57	20.65	0-2	2
	12	6	20.76	20.58	20.66		2
	12	13	20.78	20.55	20.68		2
	25	0	20.76	20.46	20.66		2

Table 9-24
LTE Band 4 (AWS) Conducted Powers - 3 MHz Bandwidth

LTE Band 4 (AWS) 3 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			19965 (1711.5 MHz)	20175 (1732.5 MHz)	20385 (1753.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.80	22.42	22.68	0	0
	1	7	22.78	22.50	22.67		0
	1	14	22.82	22.45	22.68		0
	8	0	21.89	21.47	21.61	0-1	1
	8	4	21.79	21.46	21.57		1
	8	7	21.85	21.47	21.58		1
	15	0	21.81	21.47	21.62		1
16QAM	1	0	21.98	21.50	21.76	0-1	1
	1	7	21.94	21.60	21.62		1
	1	14	21.76	21.53	21.67		1
	8	0	20.85	20.42	20.64	0-2	2
	8	4	20.84	20.60	20.58		2
	8	7	20.89	20.48	20.63		2
	15	0	20.88	20.47	20.73		2

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Table 9-25
LTE Band 4 (AWS) Conducted Powers -1.4 MHz Bandwidth

LTE Band 4 (AWS) 1.4 MHzBandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			19957 (1710.7 MHz)	20175 (1732.5 MHz)	20393 (1754.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.84	22.55	22.70	0	0
	1	2	22.83	22.49	22.63		0
	1	5	22.85	22.46	22.73		0
	3	0	22.77	22.41	22.61		0
	3	2	22.77	22.39	22.58		0
	3	3	22.75	22.42	22.60		0
	6	0	21.86	21.46	21.60	0-1	1
16QAM	1	0	21.86	21.62	21.57	0-1	1
	1	2	22.05	21.59	21.69		1
	1	5	21.92	21.69	21.81		1
	3	0	22.02	21.60	21.60		1
	3	2	21.87	21.49	21.63		1
	3	3	21.86	21.55	21.48		1
	6	0	20.97	20.49	20.70	0-2	2

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LTE Band 25 (PCS)

Table 9-26
LTE Band 25 (PCS) Conducted Powers - 20 MHz Bandwidth

LTE Band 25 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26140 (1860.0 MHz)	26365 (1882.5 MHz)	26590 (1905.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.24	23.15	23.42	0	0
	1	50	23.35	23.14	23.30		0
	1	99	23.20	23.19	23.37		0
	50	0	22.19	22.20	22.41	0-1	1
	50	25	22.23	22.16	22.29		1
	50	50	22.26	22.22	22.27		1
	100	0	22.19	22.12	22.26		1
16QAM	1	0	22.08	22.13	22.18	0-1	1
	1	50	22.06	21.99	22.06		1
	1	99	22.10	21.99	22.14		1
	50	0	21.30	21.27	21.43	0-2	2
	50	25	21.35	21.24	21.38		2
	50	50	21.37	21.19	21.38		2
	100	0	21.25	21.22	21.41		2

Table 9-27
LTE Band 25 (PCS) Conducted Powers - 15 MHz Bandwidth

LTE Band 25 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26115 (1857.5 MHz)	26365 (1882.5 MHz)	26615 (1907.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.26	23.11	23.28	0	0
	1	36	23.28	23.07	23.17		0
	1	74	23.28	23.17	23.07		0
	36	0	22.24	22.13	22.14	0-1	1
	36	18	22.25	22.11	22.12		1
	36	37	22.26	22.10	22.12		1
	75	0	22.28	22.09	22.15		1
16QAM	1	0	22.32	22.22	22.29	0-1	1
	1	36	22.23	22.22	22.02		1
	1	74	22.48	22.25	22.35		1
	36	0	21.40	21.19	21.24	0-2	2
	36	18	21.36	21.20	21.22		2
	36	37	21.40	21.16	21.25		2
	75	0	21.41	21.19	21.22		2

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Table 9-28
LTE Band 25 (PCS) Conducted Powers - 10 MHz Bandwidth

LTE Band 25 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26090 (1855.0 MHz)	26365 (1882.5 MHz)	26640 (1910.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.26	23.15	23.10	0	0
	1	25	23.31	23.09	23.12		0
	1	49	23.33	23.17	23.08		0
	25	0	22.28	22.19	22.01	0-1	1
	25	12	22.28	22.12	22.01		1
	25	25	22.30	22.11	22.06		1
	50	0	22.29	22.11	21.99		1
16QAM	1	0	22.50	22.20	22.29	0-1	1
	1	25	22.43	22.23	21.97		1
	1	49	22.45	22.25	22.35		1
	25	0	21.34	21.23	21.16	0-2	2
	25	12	21.37	21.24	21.12		2
	25	25	21.37	21.16	21.16		2
	50	0	21.42	21.19	21.09		2

Table 9-29
LTE Band 25 (PCS) Conducted Powers - 5 MHz Bandwidth

LTE Band 25 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26065 (1852.5 MHz)	26365 (1882.5 MHz)	26665 (1912.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.35	23.13	22.98	0	0
	1	12	23.15	23.12	22.94		0
	1	24	23.29	23.14	22.89		0
	12	0	22.22	22.12	21.94	0-1	1
	12	6	22.21	22.11	21.94		1
	12	13	22.21	22.07	21.91		1
	25	0	22.20	22.09	21.94		1
16QAM	1	0	22.35	22.14	22.14	0-1	1
	1	12	22.29	22.39	22.07		1
	1	24	22.35	22.11	22.00		1
	12	0	21.31	21.24	20.96	0-2	2
	12	6	21.32	21.19	20.99		2
	12	13	21.33	21.15	20.96		2
	25	0	21.29	21.23	20.98		2

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Table 9-30
LTE Band 25 (PCS) Conducted Powers - 3 MHz Bandwidth

LTE Band 25 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26055 (1851.5 MHz)	26365 (1882.5 MHz)	26675 (1913.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.26	23.10	23.05	0	0
	1	7	23.26	23.18	23.02		0
	1	14	23.27	23.16	23.01		0
	8	0	22.25	22.15	21.96	0-1	1
	8	4	22.26	22.12	21.98		1
	8	7	22.25	22.16	21.95		1
	15	0	22.23	22.13	21.94		1
16QAM	1	0	22.41	22.46	22.20	0-1	1
	1	7	22.19	22.22	21.94		1
	1	14	22.48	22.23	22.03		1
	8	0	21.34	21.13	20.93	0-2	2
	8	4	21.34	21.14	21.15		2
	8	7	21.32	21.16	20.96		2
	15	0	21.36	21.21	21.10		2

Table 9-31
LTE Band 25 (PCS) Conducted Powers -1.4 MHz Bandwidth

LTE Band 25 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			26047 (1850.7 MHz)	26365 (1882.5 MHz)	26683 (1914.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.31	23.21	23.12	0	0
	1	2	23.27	23.18	23.06		0
	1	5	23.28	23.13	23.06		0
	3	0	23.19	23.07	23.00		0
	3	2	23.19	23.13	23.04		0
	3	3	23.23	23.08	23.04		0
	6	0	22.26	22.14	22.09	0-1	1
16QAM	1	0	22.50	22.07	22.05	0-1	1
	1	2	22.49	22.33	22.06		1
	1	5	22.40	22.15	21.94		1
	3	0	22.35	22.22	22.12		1
	3	2	22.36	22.29	22.06		1
	3	3	22.28	22.26	22.08		1
	6	0	21.44	21.29	21.02	0-2	2

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LTE Band 41

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

LTE Band 41 20 MHzBandwidth									
Modulation	RB Size	RB Offset	Low Channel	Low-Mid Channel	Mid Channel	Mid-High Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			39750 (2506.0 MHz)	40185 (2549.5 MHz)	40620 (2593.0 MHz)	41055 (2636.5 MHz)	41490 (2680.0 MHz)		
			Conducted Power [dBm]						
QPSK	1	0	22.55	22.65	23.06	22.51	22.70	0	0
	1	50	22.54	22.64	23.03	22.52	22.67		0
	1	99	22.56	22.69	23.04	22.49	22.75		0
	50	0	21.52	21.69	21.99	21.39	21.57	0-1	1
	50	25	21.52	21.66	22.03	21.40	21.62		1
	50	50	21.51	21.68	22.01	21.39	21.62		1
	100	0	21.52	21.65	22.02	21.39	21.64		1
16QAM	1	0	21.73	21.85	22.26	21.61	21.81	0-1	1
	1	50	21.72	21.90	22.17	21.63	21.77		1
	1	99	21.80	22.01	22.29	21.70	21.81		1
	50	0	20.54	20.59	21.01	20.38	20.62	0-2	2
	50	25	20.54	20.64	20.97	20.48	20.70		2
	50	50	20.56	20.63	20.98	20.48	20.71		2
	100	0	20.49	20.64	21.00	20.45	20.66		2

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

LTE Band 41 15 MHzBandwidth									
Modulation	RB Size	RB Offset	Low Channel	Low-Mid Channel	Mid Channel	Mid-High Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			39750 (2506.0 MHz)	40185 (2549.5 MHz)	40620 (2593.0 MHz)	41055 (2636.5 MHz)	41490 (2680.0 MHz)		
			Conducted Power [dBm]						
QPSK	1	0	21.92	22.18	22.52	22.11	22.51	0	0
	1	36	21.95	22.24	22.50	22.12	22.52		0
	1	74	21.94	22.25	22.58	22.20	22.53		0
	36	0	20.95	21.17	21.48	21.19	21.49	0-1	1
	36	18	21.00	21.26	21.59	21.15	21.57		1
	36	37	20.95	21.22	21.62	21.16	21.50		1
16QAM	75	0	20.96	21.25	21.58	21.15	21.51	0-1	1
	1	0	21.04	21.24	21.52	21.02	21.44		1
	1	36	21.09	21.23	21.68	21.18	21.52		1
	1	74	21.06	21.29	21.70	21.24	21.55	0-2	1
	36	0	20.01	20.24	20.46	20.03	20.45		2
	36	18	20.02	20.24	20.51	20.11	20.51		2
	36	37	19.95	20.25	20.53	20.13	20.53		2
	75	0	19.95	20.20	20.53	20.15	20.55		2

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

LTE Band 41 10 MHzBandwidth									
Modulation	RB Size	RB Offset	Low Channel	Low-Mid Channel	Mid Channel	Mid-High Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			39750 (2506.0 MHz)	40185 (2549.5 MHz)	40620 (2593.0 MHz)	41055 (2636.5 MHz)	41490 (2680.0 MHz)		
			Conducted Power [dBm]						
QPSK	1	0	22.00	22.24	22.56	22.24	22.58	0	0
	1	25	22.01	22.25	22.57	22.26	22.58		0
	1	49	22.05	22.30	22.62	22.30	22.64		0
	25	0	20.96	21.28	21.57	21.16	21.52	0-1	1
	25	12	21.01	21.26	21.58	21.18	21.55		1
	25	25	21.02	21.31	21.60	21.18	21.54		1
	50	0	20.97	21.29	21.59	21.22	21.55		1
16QAM	1	0	20.87	21.20	21.58	21.17	21.32	0-1	1
	1	25	21.01	21.20	21.65	21.21	21.54		1
	1	49	20.94	21.19	21.62	21.27	21.57		1
	25	0	19.87	20.13	20.54	20.08	20.50	0-2	2
	25	12	19.90	20.18	20.49	20.05	20.47		2
	25	25	19.91	20.20	20.52	20.10	20.46		2
	50	0	20.00	20.26	20.58	20.18	20.59		2

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

LTE Band 41 5 MHzBandwidth									
Modulation	RB Size	RB Offset	Low Channel	Low-Mid Channel	Mid Channel	Mid-High Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			39750 (2506.0 MHz)	40185 (2549.5 MHz)	40620 (2593.0 MHz)	41055 (2636.5 MHz)	41490 (2680.0 MHz)		
			Conducted Power [dBm]						
QPSK	1	0	22.00	22.24	22.58	22.23	22.58	0	0
	1	12	22.04	22.27	22.55	22.20	22.63		0
	1	24	22.00	22.29	22.56	22.22	22.59		0
	12	0	20.95	21.25	21.55	21.13	21.54	0-1	1
	12	6	20.97	21.26	21.55	21.14	21.53		1
	12	13	21.00	21.28	21.57	21.14	21.53		1
	25	0	20.97	21.24	21.58	21.13	21.49		1
16QAM	1	0	20.91	21.38	21.40	21.15	21.43	0-1	1
	1	12	20.88	21.30	21.48	20.98	21.42		1
	1	24	20.86	21.23	21.55	21.11	21.40		1
	12	0	19.98	20.16	20.50	20.16	20.51	0-2	2
	12	6	19.96	20.14	20.48	20.15	20.52		2
	12	13	19.97	20.11	20.48	20.15	20.50		2
	25	0	19.92	20.18	20.42	20.05	20.42		2

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9.4 WLAN Conducted Powers

Table 9-36
2.4 GHz Max Average RF Power- Ant 1

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	19.36	15.49
2437	6	18.88	15.12
2462	11	18.65	15.13

Table 9-37
2.4 GHz Max Average RF Power- Ant 2

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	18.87	15.28
2437	6	19.49	14.84
2462	11	19.25	14.50

Table 9-38
2.4 GHz Reduced Average RF Power (Held to Ear)- Ant 1

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	14.95	15.49
2437	6	14.66	15.12
2462	11	15.34	15.13

Table 9-39
2.4 GHz Reduced Average RF Power (Held to Ear)- Ant 2

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11b	802.11g
2412	1	15.19	15.28
2437	6	15.39	14.84
2462	11	15.09	14.50

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Table 9-40
5 GHz Max Average RF Power – Ant 1

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11a	802.11n
5180	36	13.57	13.54
5200	40	13.56	13.51
5220	44	13.67	13.50
5240	48	13.58	13.58
5260	52	13.82	13.71
5280	56	13.80	13.78
5300	60	13.67	13.84
5320	64	13.97	13.95
5500	100	13.97	13.93
5600	120	13.93	13.84
5620	124	13.86	13.85
5720	144	13.63	13.70
5745	149	13.47	13.66
5785	157	13.54	13.60
5825	165	13.53	13.55

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Table 9-41
5 GHz Max Average RF Power – Ant 2

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]	
		IEEE Transmission Mode	
		802.11a	802.11n
5180	36	13.73	13.68
5200	40	13.71	13.55
5220	44	13.79	13.65
5240	48	13.99	13.78
5260	52	13.90	13.77
5280	56	13.88	13.82
5300	60	13.90	13.88
5320	64	14.06	14.02
5500	100	13.81	13.85
5600	120	13.58	13.55
5620	124	13.59	13.56
5720	144	14.38	14.13
5745	149	13.63	13.66
5785	157	13.74	13.53
5825	165	13.81	13.51

Table 9-42
5 GHz Reduced Average RF Power (Held to Ear) – Ant 1

5GHz (80MHz) Conducted Power [dBm]		
Freq [MHz]	Channel	IEEE Transmission Mode
		802.11ac
5210	42	12.16
5290	58	12.50
5530	106	12.25
5610	122	11.63
5690	138	11.61
5775	155	12.29

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Table 9-43
5 GHz Reduced Average RF Power (Held to Ear) – Ant 2

5GHz (80MHz) Conducted Power [dBm]		
Freq [MHz]	Channel	IEEE Transmission Mode
		802.11ac
5210	42	11.71
5290	58	12.13
5530	106	11.76
5610	122	12.39
5690	138	12.40
5775	155	12.49

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

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

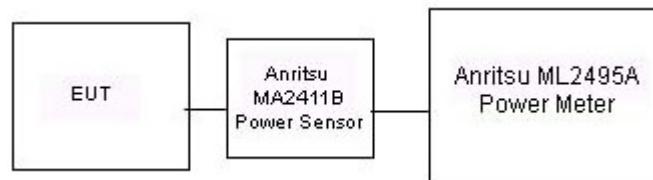


Figure 9-3
Power Measurement Setup for Bandwidths < 50 MHz

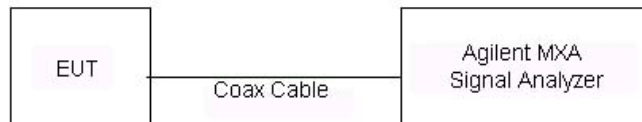


Figure 9-4
Power Measurement Setup for Bandwidths > 50 MHz

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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	14.58	28.720
2441	1.0	39	15.23	33.315
2480	1.0	78	12.86	19.310
2402	2.0	0	9.03	7.999
2441	2.0	39	8.81	7.601
2480	2.0	78	6.49	4.459
2402	3.0	0	9.10	8.123
2441	3.0	39	8.91	7.772
2480	3.0	78	6.64	4.614

Note: The bolded data rate and channel above were tested for SAR.

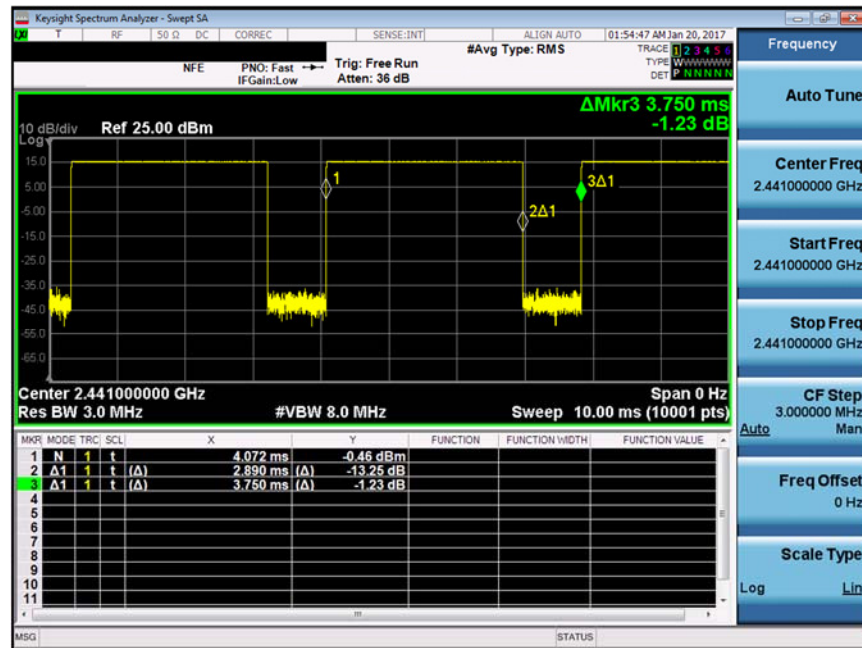


Figure 9-5
Bluetooth Transmission Plot

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Equation 2
Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = Pulse\ \frac{Width}{Period} * 100\% = \frac{2.890ms}{3.750ms} * 100\% = 77.1\%$$

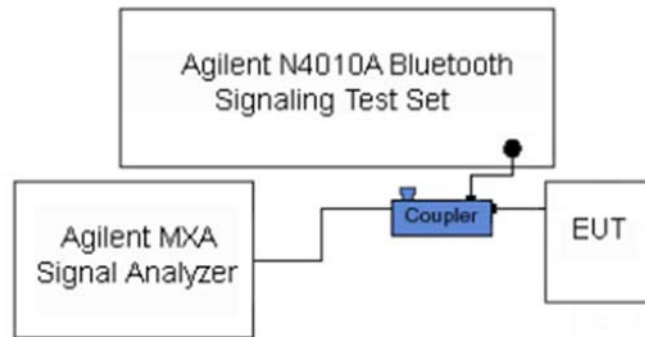


Figure 9-6
Power Measurement Setup

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10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Tissue Properties (Head)

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (°C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	%dev σ	%dev ϵ
1/11/2017	750H	24.0	700	0.858	42.940	0.889	42.201	-3.49%	1.75%
			710	0.869	42.779	0.890	42.149	-2.36%	1.49%
			740	0.895	42.392	0.893	41.994	0.22%	0.95%
			755	0.910	42.109	0.894	41.916	1.79%	0.46%
			770	0.926	41.907	0.895	41.838	3.46%	0.16%
			785	0.940	41.708	0.896	41.760	4.91%	-0.12%
1/9/2017	835H	20.7	820	0.896	41.795	0.899	41.578	-0.33%	0.52%
			835	0.911	41.612	0.900	41.500	1.22%	0.27%
			850	0.925	41.418	0.916	41.500	0.98%	-0.20%
1/12/2017	1750H	23.6	1710	1.306	39.371	1.348	40.142	-3.12%	-1.92%
			1750	1.342	39.159	1.371	40.079	-2.12%	-2.30%
			1790	1.387	39.017	1.394	40.016	-0.50%	-2.50%
1/16/2017	1900H	22.0	1850	1.393	39.545	1.400	40.000	-0.50%	-1.14%
			1880	1.424	39.483	1.400	40.000	1.71%	-1.29%
			1910	1.461	39.309	1.400	40.000	4.36%	-1.73%
1/18/2017	1900H	22.3	1850	1.367	38.433	1.400	40.000	-2.36%	-3.92%
			1880	1.400	38.303	1.400	40.000	0.00%	-4.24%
			1910	1.432	38.185	1.400	40.000	2.29%	-4.54%
1/13/2017	2450H	23.9	2400	1.796	39.376	1.756	39.289	2.28%	0.22%
			2450	1.856	39.156	1.800	39.200	3.11%	-0.11%
			2500	1.914	38.964	1.855	39.136	3.18%	-0.44%
1/22/2017	2450H	24.0	2400	1.814	38.386	1.756	39.289	3.30%	-2.30%
			2450	1.869	38.155	1.800	39.200	3.83%	-2.67%
			2500	1.931	37.926	1.855	39.136	4.10%	-3.09%
1/10/2017	2600H	23.5	2500	1.933	38.944	1.855	39.136	4.20%	-0.49%
			2550	1.990	38.788	1.909	39.073	4.24%	-0.73%
			2600	2.053	38.501	1.964	39.009	4.53%	-1.30%
01/12/2017	5200H-5800H	21.3	5240	4.664	35.601	4.696	35.940	-0.68%	-0.94%
			5260	4.682	35.468	4.717	35.917	-0.74%	-1.25%
			5280	4.692	35.606	4.737	35.894	-0.95%	-0.80%
			5300	4.699	35.414	4.758	35.871	-1.24%	-1.27%
			5520	4.941	35.199	4.983	35.620	-0.84%	-1.18%
			5540	4.959	35.134	5.004	35.597	-0.90%	-1.30%
			5600	5.023	35.039	5.065	35.529	-0.83%	-1.38%
			5680	5.089	35.029	5.147	35.437	-1.13%	-1.15%
			5700	5.126	34.940	5.168	35.414	-0.81%	-1.34%
			5745	5.183	34.879	5.214	35.363	-0.59%	-1.37%
			5765	5.180	34.822	5.234	35.340	-1.03%	-1.47%
			5785	5.213	34.871	5.255	35.317	-0.80%	-1.26%

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Table 10-2
Measured Tissue Properties (Body)

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (°C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	%dev σ	%dev ϵ
1/14/2017	750B	22.0	740	0.940	54.920	0.963	55.570	-2.39%	-1.17%
			755	0.957	54.812	0.964	55.512	-0.73%	-1.26%
			770	0.966	54.706	0.965	55.453	0.10%	-1.35%
			785	0.987	54.478	0.966	55.395	2.17%	-1.66%
1/17/2017	750B	23.2	700	0.915	55.332	0.959	55.726	-4.59%	-0.71%
			710	0.925	55.241	0.960	55.687	-3.65%	-0.80%
			740	0.953	54.935	0.963	55.570	-1.04%	-1.14%
			755	0.967	54.773	0.964	55.512	0.31%	-1.33%
1/11/2017	835B	21.4	820	0.976	53.819	0.969	55.258	0.72%	-2.60%
			835	0.990	53.702	0.970	55.200	2.06%	-2.71%
			850	1.005	53.608	0.988	55.154	1.72%	-2.80%
			820	0.987	55.023	0.969	55.258	1.86%	-0.43%
1/21/2017	835B	20.5	835	1.007	54.915	0.970	55.200	3.81%	-0.52%
			850	1.022	54.765	0.988	55.154	3.44%	-0.71%
			1710	1.421	51.494	1.463	53.537	-2.87%	-3.82%
1/7/2017	1750B	22.0	1750	1.463	51.348	1.488	53.432	-1.68%	-3.90%
			1790	1.517	51.220	1.514	53.326	0.20%	-3.95%
			1710	1.440	51.188	1.463	53.537	-1.57%	-4.39%
1/14/2017	1750B	21.8	1750	1.484	50.912	1.488	53.432	-0.27%	-4.72%
			1790	1.530	50.764	1.514	53.326	1.06%	-4.80%
			1850	1.485	51.187	1.520	53.300	-2.30%	-3.96%
1/11/2017	1900B	23.2	1880	1.522	51.112	1.520	53.300	0.13%	-4.11%
			1910	1.551	51.066	1.520	53.300	2.04%	-4.19%
			1850	1.514	51.467	1.520	53.300	-0.39%	-3.44%
1/16/2017	1900B	22.7	1880	1.550	51.400	1.520	53.300	1.97%	-3.56%
			1910	1.582	51.286	1.520	53.300	4.08%	-3.78%
			2400	1.963	51.025	1.902	52.767	3.21%	-3.30%
1/12/2017	2450B-2600B	22.7	2450	2.035	50.856	1.950	52.700	4.36%	-3.50%
			2500	2.103	50.608	2.021	52.636	4.06%	-3.85%
			2550	2.173	50.421	2.092	52.573	3.87%	-4.09%
			2600	2.243	50.224	2.163	52.509	3.70%	-4.35%
1/14/2017	2450B	23.0	2400	1.895	51.343	1.902	52.767	-0.37%	-2.70%
			2450	1.960	51.131	1.950	52.700	0.51%	-2.98%
			2500	2.029	50.973	2.021	52.636	0.40%	-3.16%
1/24/2017	2450B	23.7	2400	1.951	52.052	1.902	52.767	2.58%	-1.36%
			2450	2.014	51.856	1.950	52.700	3.28%	-1.60%
			2500	2.086	51.676	2.021	52.636	3.22%	-1.82%
01/08/2017	5200B-5800B	21.9	5240	5.485	48.609	5.346	48.960	2.60%	-0.72%
			5260	5.524	48.563	5.369	48.933	2.89%	-0.76%
			5320	5.594	48.433	5.439	48.851	2.85%	-0.86%
			5500	5.839	48.149	5.650	48.607	3.35%	-0.94%
			5600	5.985	47.982	5.766	48.471	3.80%	-1.01%
			5700	6.107	47.797	5.883	48.336	3.81%	-1.12%
			5745	6.167	47.768	5.936	48.275	3.89%	-1.05%
			5765	6.220	47.754	5.959	48.248	4.38%	-1.02%
			5785	6.233	47.694	5.982	48.220	4.20%	-1.09%
			5800	6.242	47.661	6.000	48.200	4.03%	-1.12%
			5805	6.252	47.644	6.006	48.193	4.10%	-1.14%
			5825	6.284	47.600	6.029	48.166	4.23%	-1.18%

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

Table 10-3
System Verification Results (1 g)

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation _{1g} (%)
I	750	HEAD	01/11/2017	23.8	23.8	0.200	1161	3209	1.580	8.170	7.900	-3.30%
H	835	HEAD	01/09/2017	22.2	21.1	0.200	4d133	3319	1.850	9.320	9.250	-0.75%
I	1750	HEAD	01/12/2017	23.6	23.0	0.100	1148	3209	3.700	36.200	37.000	2.21%
G	1900	HEAD	01/16/2017	23.3	21.4	0.100	5d149	3287	4.090	40.100	40.900	2.00%
G	1900	HEAD	01/18/2017	23.3	21.8	0.100	5d149	3287	4.080	40.100	40.800	1.75%
G	2450	HEAD	01/13/2017	21.9	22.5	0.100	797	3287	5.540	52.100	55.400	6.33%
G	2450	HEAD	01/22/2017	23.2	22.5	0.100	981	3287	5.640	52.800	56.400	6.82%
G	2600	HEAD	01/10/2017	23.6	23.0	0.100	1126	3287	5.880	56.300	58.800	4.44%
J	5250	HEAD	01/12/2017	21.5	21.3	0.050	1191	7357	3.890	78.900	77.800	-1.39%
J	5600	HEAD	01/12/2017	21.5	21.3	0.050	1191	7357	4.100	83.600	82.000	-1.91%
J	5750	HEAD	01/12/2017	21.5	21.3	0.050	1191	7357	3.840	79.100	76.800	-2.91%
F	750	BODY	01/14/2017	22.7	22.0	0.200	1054	3332	1.670	8.560	8.350	-2.45%
F	750	BODY	01/17/2017	22.5	23.2	0.200	1054	3332	1.680	8.560	8.400	-1.87%
H	835	BODY	01/11/2017	23.3	21.8	0.200	4d133	3319	2.010	9.500	10.050	5.79%
H	835	BODY	01/21/2017	21.2	20.5	0.200	4d047	3319	2.010	9.570	10.050	5.02%
I	1750	BODY	01/07/2017	23.0	22.0	0.100	1008	3209	3.770	37.300	37.700	1.07%
I	1750	BODY	01/14/2017	23.3	21.8	0.100	1148	3209	3.550	37.100	35.500	-4.31%
K	1900	BODY	01/11/2017	23.7	23.0	0.100	5d149	7409	4.180	39.900	41.800	4.76%
K	1900	BODY	01/16/2017	22.3	22.7	0.100	5d149	7409	4.150	39.900	41.500	4.01%
E	2450	BODY	01/12/2017	24.5	22.7	0.100	981	7406	5.260	50.800	52.600	3.54%
E	2450	BODY	01/14/2017	22.7	22.5	0.100	981	7406	5.110	50.800	51.100	0.59%
H	2450	BODY	01/24/2017	22.4	22.7	0.100	797	3319	5.210	50.700	52.100	2.76%
E	2600	BODY	01/12/2017	24.5	22.7	0.100	1071	7406	5.830	54.200	58.300	7.56%
D	5250	BODY	01/08/2017	20.0	20.3	0.050	1237	3914	3.640	74.800	72.800	-2.67%
D	5600	BODY	01/08/2017	20.0	20.3	0.050	1237	3914	3.770	77.000	75.400	-2.08%
D	5750	BODY	01/08/2017	20.0	20.3	0.050	1237	3914	3.480	75.400	69.600	-7.69%

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Table 10-4
System Verification Results (10 g)

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Dipole SN	Probe SN	Measured SAR _{10g} (W/kg)	1 W Target SAR _{10g} (W/kg)	1 W Normalized SAR _{10g} (W/kg)	Deviation _{10g} (%)
E	2450	BODY	01/14/2017	22.7	22.5	0.100	981	7406	2.340	23.800	23.400	-1.68%
D	5250	BODY	01/08/2017	20.0	20.3	0.050	1237	3914	1.030	21.000	20.600	-1.90%
D	5600	BODY	01/08/2017	20.0	20.3	0.050	1237	3914	1.070	21.500	21.400	-0.47%
D	5750	BODY	01/08/2017	20.0	20.3	0.050	1237	3914	0.979	20.900	19.580	-6.32%

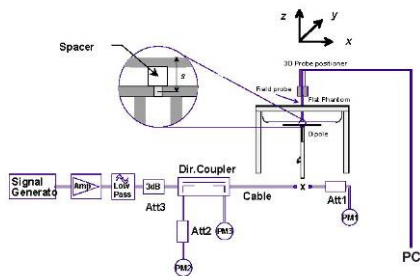


Figure 10-1
System Verification Setup Diagram



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 1900 Head SAR**

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	30.2	28.64	0.09	Right	Cheek	1F3B3	1:8.3	0.018	1.432	0.026	
1880.00	661	GSM 1900	GSM	30.2	28.64	-0.10	Right	Tilt	1F3B3	1:8.3	0.007	1.432	0.010	
1880.00	661	GSM 1900	GSM	30.2	28.64	0.07	Left	Cheek	1F3B3	1:8.3	0.019	1.432	0.027	A1
1880.00	661	GSM 1900	GSM	30.2	28.64	0.10	Left	Tilt	1F3B3	1:8.3	0.006	1.432	0.009	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram						

**Table 11-2
UMTS 850 Head SAR**

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	22.5	22.48	0.04	Right	Cheek	051D1	1:1	0.100	1.005	0.101	A2
836.60	4183	UMTS 850	RMC	22.5	22.48	0.01	Right	Tilt	051D1	1:1	0.035	1.005	0.035	
836.60	4183	UMTS 850	RMC	22.5	22.48	0.03	Left	Cheek	051D1	1:1	0.084	1.005	0.084	
836.60	4183	UMTS 850	RMC	22.5	22.48	0.13	Left	Tilt	051D1	1:1	0.039	1.005	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 11-3
UMTS 1900 Head SAR**

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	22.5	21.91	-0.01	Right	Cheek	1F3B3	1:1	0.034	1.146	0.039	
1880.00	9400	UMTS 1900	RMC	22.5	21.91	0.05	Right	Tilt	1F3B3	1:1	0.016	1.146	0.018	
1880.00	9400	UMTS 1900	RMC	22.5	21.91	-0.01	Left	Cheek	1F3B3	1:1	0.041	1.146	0.047	A3
1880.00	9400	UMTS 1900	RMC	22.5	21.91	0.05	Left	Tilt	1F3B3	1:1	0.021	1.146	0.024	
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
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	23.5	23.28	-0.02	0	Right	Cheek	QPSK	1	25	051D1	1:1	0.037	1.052	0.039	A4
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	0.20	1	Right	Cheek	QPSK	25	12	051D1	1:1	0.029	1.033	0.030	
707.50	23095	Mid	LTE Band 12	10	23.5	23.28	0.10	0	Right	Tilt	QPSK	1	25	051D1	1:1	0.016	1.052	0.017	
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	0.14	1	Right	Tilt	QPSK	25	12	051D1	1:1	0.013	1.033	0.013	
707.50	23095	Mid	LTE Band 12	10	23.5	23.28	0.17	0	Left	Cheek	QPSK	1	25	051D1	1:1	0.026	1.052	0.027	
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	0.16	1	Left	Cheek	QPSK	25	12	051D1	1:1	0.020	1.033	0.021	
707.50	23095	Mid	LTE Band 12	10	23.5	23.28	0.06	0	Left	Tilt	QPSK	1	25	051D1	1:1	0.019	1.052	0.020	
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	0.14	1	Left	Tilt	QPSK	25	12	051D1	1:1	0.015	1.033	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									

Table 11-5
LTE Band 13 Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	0.11	0	Right	Cheek	QPSK	1	0	051D1	1:1	0.048	1.250	0.060	A5
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.19	1	Right	Cheek	QPSK	25	0	051D1	1:1	0.040	1.276	0.051	
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	0.20	0	Right	Tilt	QPSK	1	0	051D1	1:1	0.024	1.250	0.030	
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.03	1	Right	Tilt	QPSK	25	0	051D1	1:1	0.017	1.276	0.022	
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	0.14	0	Left	Cheek	QPSK	1	0	051D1	1:1	0.030	1.250	0.038	
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.11	1	Left	Cheek	QPSK	25	0	051D1	1:1	0.024	1.276	0.031	
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	0.05	0	Left	Tilt	QPSK	1	0	051D1	1:1	0.028	1.250	0.035	
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.12	1	Left	Tilt	QPSK	25	0	051D1	1:1	0.022	1.276	0.028	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 11-6
LTE Band 26 (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)		
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	-0.03	0	Right	Cheek	QPSK	1	0	051D1	1:1	0.097	1.028	0.100	A6
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	0.07	1	Right	Cheek	QPSK	36	0	051D1	1:1	0.083	1.050	0.087	
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	0.12	0	Right	Tilt	QPSK	1	0	051D1	1:1	0.038	1.028	0.039	
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	0.16	1	Right	Tilt	QPSK	36	0	051D1	1:1	0.032	1.050	0.034	
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	-0.05	0	Left	Cheek	QPSK	1	0	051D1	1:1	0.063	1.028	0.065	
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	-0.10	1	Left	Cheek	QPSK	36	0	051D1	1:1	0.035	1.050	0.037	
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	0.10	0	Left	Tilt	QPSK	1	0	051D1	1:1	0.041	1.028	0.042	
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	0.04	1	Left	Tilt	QPSK	36	0	051D1	1:1	0.019	1.050	0.020	
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 5 (Cell) Head SAR

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Antenna State	Power Drift [dB]	MPR [dB]	Side	Test Position	Antenna	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.																(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.36	4	0.06	0	Right	Cheek	Ant A	QPSK	1	0	051C8	1:1	0.121	1.300	0.157	A7
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.37	4	0.06	1	Right	Cheek	Ant A	QPSK	25	0	051C8	1:1	0.097	1.297	0.126	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.36	4	0.08	0	Right	Tilt	Ant A	QPSK	1	0	051C8	1:1	0.045	1.300	0.059	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.37	4	0.14	1	Right	Tilt	Ant A	QPSK	25	0	051C8	1:1	0.033	1.297	0.043	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.36	4	0.08	0	Left	Cheek	Ant A	QPSK	1	0	051C8	1:1	0.097	1.300	0.126	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.37	4	0.05	1	Left	Cheek	Ant A	QPSK	25	0	051C8	1:1	0.076	1.297	0.099	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.36	4	0.16	0	Left	Tilt	Ant A	QPSK	1	0	051C8	1:1	0.061	1.300	0.079	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.37	4	0.01	1	Left	Tilt	Ant A	QPSK	25	0	051C8	1:1	0.042	1.297	0.054	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram											

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

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
Mhz	Ch.	(W/kg)														(W/kg)			
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	0.11	0	Right	Cheek	QPSK	1	0	051D1	1:1	0.094	1.096	0.103	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.61	0.11	1	Right	Cheek	QPSK	50	25	051D1	1:1	0.072	1.227	0.088	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	-0.03	0	Right	Tilt	QPSK	1	0	051D1	1:1	0.069	1.096	0.076	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.61	0.13	1	Right	Tilt	QPSK	50	25	051D1	1:1	0.053	1.227	0.065	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	-0.06	0	Left	Cheek	QPSK	1	0	051D1	1:1	0.130	1.096	0.142	A8
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.61	0.12	1	Left	Cheek	QPSK	50	25	051D1	1:1	0.101	1.227	0.124	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	0.09	0	Left	Tilt	QPSK	1	0	051D1	1:1	0.074	1.096	0.081	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.61	0.04	1	Left	Tilt	QPSK	50	25	051D1	1:1	0.060	1.227	0.074	
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 25 (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)		
1905.00	26590	High	LTE Band 25 (PCS)	20	23.5	23.42	0.05	0	Right	Cheek	QPSK	1	0	051B0	1:1	0.098	1.019	0.100	
1905.00	26590	High	LTE Band 25 (PCS)	20	22.5	22.41	-0.03	1	Right	Cheek	QPSK	50	0	051B0	1:1	0.066	1.021	0.067	
1905.00	26590	High	LTE Band 25 (PCS)	20	23.5	23.42	0.16	0	Right	Tilt	QPSK	1	0	051B0	1:1	0.040	1.019	0.041	
1905.00	26590	High	LTE Band 25 (PCS)	20	22.5	22.41	-0.07	1	Right	Tilt	QPSK	50	0	051B0	1:1	0.032	1.021	0.033	
1905.00	26590	High	LTE Band 25 (PCS)	20	23.5	23.42	0.08	0	Left	Cheek	QPSK	1	0	051B0	1:1	0.106	1.019	0.108	A9
1905.00	26590	High	LTE Band 25 (PCS)	20	22.5	22.41	0.04	1	Left	Cheek	QPSK	50	0	051B0	1:1	0.073	1.021	0.075	
1905.00	26590	High	LTE Band 25 (PCS)	20	23.5	23.42	-0.14	0	Left	Tilt	QPSK	1	0	051B0	1:1	0.042	1.019	0.043	
1905.00	26590	High	LTE Band 25 (PCS)	20	22.5	22.41	0.00	1	Left	Tilt	QPSK	50	0	051B0	1:1	0.031	1.021	0.032	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT																			
Spatial Peak									Head										
Uncontrolled Exposure/General Population									1.6 W/kg (mW/g)										
									averaged over 1 gram										

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Table 11-10
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 #
																(W/kg)		(W/kg)	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.06	0.11	0	Right	Cheek	QPSK	1	0	051C8	1:1.58	0.022	1.107	0.024	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.03	0.04	1	Right	Cheek	QPSK	50	25	051C8	1:1.58	0.018	1.114	0.020	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.06	0.16	0	Right	Tilt	QPSK	1	0	051C8	1:1.58	0.024	1.107	0.027	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.03	0.06	1	Right	Tilt	QPSK	50	25	051C8	1:1.58	0.019	1.114	0.021	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.06	0.04	0	Left	Cheek	QPSK	1	0	051C8	1:1.58	0.027	1.107	0.030	A10
2593.00	40620	Mid	LTE Band 41	20	22.5	22.03	0.06	1	Left	Cheek	QPSK	50	25	051C8	1:1.58	0.024	1.114	0.027	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.06	0.15	0	Left	Tilt	QPSK	1	0	051C8	1:1.58	0.016	1.107	0.018	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.03	0.04	1	Left	Tilt	QPSK	50	25	051C8	1:1.58	0.013	1.114	0.014	
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
DTS Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2462	11	802.11b	DSSS	22	15.5	15.34	0.13	Right	Cheek	1	1F3B2	1	99.8	0.368	0.330	1.038	1.002	0.343	
2462	11	802.11b	DSSS	22	15.5	15.34	0.03	Right	Tilt	1	1F3B2	1	99.8	0.260	-	1.038	1.002	-	
2462	11	802.11b	DSSS	22	15.5	15.34	0.08	Left	Cheek	1	1F3B2	1	99.8	0.112	-	1.038	1.002	-	
2462	11	802.11b	DSSS	22	15.5	15.34	0.05	Left	Tilt	1	1F3B2	1	99.8	0.092	-	1.038	1.002	-	
2437	6	802.11b	DSSS	22	15.5	15.39	0.12	Right	Cheek	2	1F3B2	1	99.8	0.486	0.367	1.026	1.002	0.377	A11
2437	6	802.11b	DSSS	22	15.5	15.39	-0.03	Right	Tilt	2	1F3B2	1	99.8	0.226	-	1.026	1.002	-	
2437	6	802.11b	DSSS	22	15.5	15.39	0.08	Left	Cheek	2	1F3B2	1	99.8	0.125	-	1.026	1.002	-	
2437	6	802.11b	DSSS	22	15.5	15.39	0.09	Left	Tilt	2	1F3B2	1	99.8	0.094	-	1.026	1.002	-	
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 11-12
NII Head SAR**

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5290	58	802.11ac	OFDM	80	12.5	12.50	0.12	Right	Cheek	1	051DC	29.3	96.3	0.053	0.020	1.000	1.038	0.021	
5290	58	802.11ac	OFDM	80	12.5	12.50	0.10	Right	Tilt	1	051DC	29.3	96.3	0.038	-	1.000	1.038	-	
5290	58	802.11ac	OFDM	80	12.5	12.50	-0.03	Left	Cheek	1	051DC	29.3	96.3	0.021	-	1.000	1.038	-	
5290	58	802.11ac	OFDM	80	12.5	12.50	0.01	Left	Tilt	1	051DC	29.3	96.3	0.011	-	1.000	1.038	-	
5290	58	802.11ac	OFDM	80	12.5	12.13	0.03	Right	Cheek	2	051DC	29.3	96.3	0.366	0.150	1.089	1.038	0.170	A12
5290	58	802.11ac	OFDM	80	12.5	12.13	0.02	Right	Tilt	2	051DC	29.3	96.3	0.212	-	1.089	1.038	-	
5290	58	802.11ac	OFDM	80	12.5	12.13	0.03	Left	Cheek	2	051DC	29.3	96.3	0.091	-	1.089	1.038	-	
5290	58	802.11ac	OFDM	80	12.5	12.13	0.02	Left	Tilt	2	051DC	29.3	96.3	0.085	-	1.089	1.038	-	
5530	106	802.11ac	OFDM	80	12.5	12.25	0.18	Right	Cheek	1	051DC	29.3	96.3	0.163	0.065	1.059	1.038	0.071	
5530	106	802.11ac	OFDM	80	12.5	12.25	0.16	Right	Tilt	1	051DC	29.3	96.3	0.151	-	1.059	1.038	-	
5530	106	802.11ac	OFDM	80	12.5	12.25	0.17	Left	Cheek	1	051DC	29.3	96.3	0.117	-	1.059	1.038	-	
5530	106	802.11ac	OFDM	80	12.5	12.25	0.02	Left	Tilt	1	051DC	29.3	96.3	0.089	-	1.059	1.038	-	
5690	138	802.11ac	OFDM	80	12.5	12.40	0.05	Right	Cheek	2	051DC	29.3	96.3	0.262	0.107	1.023	1.038	0.114	
5690	138	802.11ac	OFDM	80	12.5	12.40	0.08	Right	Tilt	2	051DC	29.3	96.3	0.201	-	1.023	1.038	-	
5690	138	802.11ac	OFDM	80	12.5	12.40	0.04	Left	Cheek	2	051DC	29.3	96.3	0.181	-	1.023	1.038	-	
5690	138	802.11ac	OFDM	80	12.5	12.40	0.03	Left	Tilt	2	051DC	29.3	96.3	0.141	-	1.023	1.038	-	
5775	155	802.11ac	OFDM	80	12.5	12.29	0.06	Right	Cheek	1	051DC	29.3	96.3	0.419	0.145	1.050	1.038	0.158	
5775	155	802.11ac	OFDM	80	12.5	12.29	0.08	Right	Tilt	1	051DC	29.3	96.3	0.341	-	1.050	1.038	-	
5775	155	802.11ac	OFDM	80	12.5	12.29	0.03	Left	Cheek	1	051DC	29.3	96.3	0.223	-	1.050	1.038	-	
5775	155	802.11ac	OFDM	80	12.5	12.29	0.02	Left	Tilt	1	051DC	29.3	96.3	0.209	-	1.050	1.038	-	
5775	155	802.11ac	OFDM	80	12.5	12.49	0.16	Right	Cheek	2	051DC	29.3	96.3	0.227	0.100	1.002	1.038	0.104	
5775	155	802.11ac	OFDM	80	12.5	12.49	0.09	Right	Tilt	2	051DC	29.3	96.3	0.175	-	1.002	1.038	-	
5775	155	802.11ac	OFDM	80	12.5	12.49	0.03	Left	Cheek	2	051DC	29.3	96.3	0.134	-	1.002	1.038	-	
5775	155	802.11ac	OFDM	80	12.5	12.49	0.05	Left	Tilt	2	051DC	29.3	96.3	0.100	-	1.002	1.038	-	
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 11-13
DSSS 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 (1 g)	Scaling Factor (Conducted Power)	Scaling Factor (Duty Cycle)	Reported SAR (1 g)	Plot #
MHz	Ch.											(W/kg)			(W/kg)	
2402	0	Bluetooth	FHSS	9.5	9.03	0.04	Right	Cheek	051DC	2	77.1	0.067	1.114	1.297	0.097	A13
2402	0	Bluetooth	FHSS	9.5	9.03	-0.06	Right	Tilt	051DC	2	77.1	0.045	1.114	1.297	0.065	
2402	0	Bluetooth	FHSS	9.5	9.03	-0.13	Left	Cheek	051DC	2	77.1	0.024	1.114	1.297	0.035	
2402	0	Bluetooth	FHSS	9.5	9.03	-0.06	Left	Tilt	051DC	2	77.1	0.013	1.114	1.297	0.019	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram								

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11.2 Standalone Body-Worn SAR Data

Table 11-14
GSM/UMTS Body-Worn SAR Data

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	30.2	28.64	-0.04	15 mm	Ant B	051B0	1	1:8.3	back	0.091	1.432	0.130	A14
836.60	4183	UMTS 850	RMC	22.5	22.48	-0.02	15 mm	Ant A	051C8	N/A	1:1	back	0.115	1.005	0.116	A16
1880.00	9400	UMTS 1900	RMC	22.5	21.91	-0.02	15 mm	Ant B	051B0	N/A	1:1	back	0.178	1.146	0.204	A18
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram									

Table 11-15
LTE Body-Worn SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Bandwidth [MHz]	Antenna State	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Antenna	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Reported SAR (1g) (W/kg)
MHz	Ch.																(W/kg)	
707.50	23095	Mid	LTE Band 12	10	N/A	23.5	23.28	0.08	0	Ant A	051D1	QPSK	1	25	15 mm	back	1:1	0.078
707.50	23095	Mid	LTE Band 12	10	N/A	22.5	22.36	0.01	1	Ant A	051D1	QPSK	25	12	15 mm	back	1:1	0.062
782.00	23230	Mid	LTE Band 13	10	N/A	24.0	23.03	-0.01	0	Ant A	051D1	QPSK	1	0	15 mm	back	1:1	0.089
782.00	23230	Mid	LTE Band 13	10	N/A	23.0	21.94	0.05	1	Ant A	051D1	QPSK	25	0	15 mm	back	1:1	0.068
831.50	26865	Mid	LTE Band 26 (Cell)	15	N/A	23.5	23.38	0.03	0	Ant A	051D1	QPSK	1	0	15 mm	back	1:1	0.188
831.50	26865	Mid	LTE Band 26 (Cell)	15	N/A	22.5	22.29	0.01	1	Ant A	051D1	QPSK	36	0	15 mm	back	1:1	0.148
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	24.5	23.36	-0.01	0	Ant A	051C8	QPSK	1	0	15 mm	back	1:1	0.173
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	23.5	22.37	0.04	1	Ant A	051C8	QPSK	25	0	15 mm	back	1:1	0.146
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	22.0	21.34	-0.04	0	Ant E	051C8	QPSK	1	0	15 mm	back	1:1	0.105
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	21.0	20.29	-0.06	1	Ant E	051C8	QPSK	25	0	15 mm	back	1:1	0.083
1732.50	20175	Mid	LTE Band 4 (AWS)	20	N/A	23.5	23.10	0.02	0	Ant B	051B0	QPSK	1	0	15 mm	back	1:1	0.417
1732.50	20175	Mid	LTE Band 4 (AWS)	20	N/A	22.5	21.61	0.02	1	Ant B	051B0	QPSK	50	25	15 mm	back	1:1	0.328
1905.00	26590	High	LTE Band 25 (PCS)	20	N/A	23.5	23.42	0.06	0	Ant B	051B0	QPSK	1	0	15 mm	back	1:1	0.274
1905.00	26590	High	LTE Band 25 (PCS)	20	N/A	22.5	22.41	-0.09	1	Ant B	051B0	QPSK	50	0	15 mm	back	1:1	0.197
2593.00	40620	Mid	LTE Band 41	20	N/A	23.5	23.06	-0.04	0	Ant B	051B0	QPSK	1	0	15 mm	back	1:1.58	0.100
2593.00	40620	Mid	LTE Band 41	20	N/A	22.5	22.03	-0.04	1	Ant B	051B0	QPSK	50	25	15 mm	back	1:1.58	0.085
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram									

Table 11-16
DTS Body-Worn SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Reported SAR (1g) (W/kg)
MHz	Ch.													W/kg	(W/kg)	
2412	1	802.11b	DSSS	22	19.5	19.36	0.17	15 mm	1	1F3B2	1	back	99.8	0.073	0.054	0.056
2437	6	802.11b	DSSS	22	19.5	19.49	-0.03	15 mm	2	1F3B2	1	back	99.8	0.089	0.059	0.059
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 11-17
NII Body-Worn SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5320	64	802.11a	OFDM	20	14.5	13.97	-0.17	15 mm	1	051DC	6	back	98.8	0.171	0.012	1.130	1.012	0.014	
5320	64	802.11a	OFDM	20	14.5	14.06	-0.05	15 mm	2	051DC	6	back	98.8	0.062	0.031	1.107	1.012	0.035	
5500	100	802.11a	OFDM	20	14.5	13.97	-0.07	15 mm	1	051DC	6	back	98.8	0.180	0.018	1.130	1.012	0.021	
5720	144	802.11a	OFDM	20	14.5	14.38	0.05	15 mm	2	051DC	6	back	98.8	0.098	0.048	1.028	1.012	0.050	
5785	157	802.11a	OFDM	20	14.5	13.54	0.08	15 mm	1	051DC	6	back	98.8	0.790	0.065	1.247	1.012	0.082	A36
5825	165	802.11a	OFDM	20	14.5	13.81	0.10	15 mm	2	051DC	6	back	98.8	0.107	0.055	1.172	1.012	0.065	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Table 11-18
DSSS Body-Worn 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 (Conducted Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)			(W/kg)	
2441	39	Bluetooth	FHSS	15.5	15.23	-0.13	15 mm	051DC	1	back	77.1	0.039	1.064	1.297	0.054	A38
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body								
Spatial Peak								1.6 W/kg (mW/g)								
Uncontrolled Exposure/General Population								averaged over 1 gram								

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	Antenna	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GPRS	24.5	22.89	0.03	10 mm	Ant B	051B0	4	1:2.076	back	0.181	1.449	0.262	
1880.00	661	GSM 1900	GPRS	24.5	22.89	-0.03	10 mm	Ant B	051B0	4	1:2.076	front	0.160	1.449	0.232	
1880.00	661	GSM 1900	GPRS	24.5	22.89	-0.01	10 mm	Ant B	051B0	4	1:2.076	bottom	0.257	1.449	0.372	A15
1880.00	661	GSM 1900	GPRS	24.5	22.89	-0.02	10 mm	Ant B	051B0	4	1:2.076	left	0.078	1.449	0.113	
836.60	4183	UMTS 850	RMC	22.5	22.48	-0.03	10 mm	Ant A	051C8	N/A	1:1	back	0.211	1.005	0.212	A17
836.60	4183	UMTS 850	RMC	22.5	22.48	0.00	10 mm	Ant A	051C8	N/A	1:1	front	0.187	1.005	0.188	
836.60	4183	UMTS 850	RMC	22.5	22.48	-0.01	10 mm	Ant A	051C8	N/A	1:1	bottom	0.108	1.005	0.109	
836.60	4183	UMTS 850	RMC	22.5	22.48	-0.01	10 mm	Ant A	051C8	N/A	1:1	right	0.103	1.005	0.104	
836.60	4183	UMTS 850	RMC	22.5	22.48	-0.03	10 mm	Ant A	051C8	N/A	1:1	left	0.043	1.005	0.043	
1880.00	9400	UMTS 1900	RMC	22.5	21.91	0.01	10 mm	Ant B	051B0	N/A	1:1	back	0.274	1.146	0.314	
1880.00	9400	UMTS 1900	RMC	22.5	21.91	0.00	10 mm	Ant B	051B0	N/A	1:1	front	0.280	1.146	0.321	
1880.00	9400	UMTS 1900	RMC	22.5	21.91	-0.09	10 mm	Ant B	051B0	N/A	1:1	bottom	0.451	1.146	0.517	A19
1880.00	9400	UMTS 1900	RMC	22.5	21.91	0.00	10 mm	Ant B	051B0	N/A	1:1	left	0.139	1.146	0.159	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body								
Spatial Peak								1.6 W/kg (mW/g)								
Uncontrolled Exposure/General Population								averaged over 1 gram								

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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]	Antenna	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	23.5	23.28	0.02	0	Ant A	051D1	QPSK	1	25	10 mm	back	1:1	0.126	1.052	0.133	A21
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	-0.01	1	Ant A	051D1	QPSK	25	12	10 mm	back	1:1	0.101	1.033	0.104	
707.50	23095	Mid	LTE Band 12	10	23.5	23.28	-0.09	0	Ant A	051D1	QPSK	1	25	10 mm	front	1:1	0.100	1.052	0.105	
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	0.10	1	Ant A	051D1	QPSK	25	12	10 mm	front	1:1	0.079	1.033	0.082	
707.50	23095	Mid	LTE Band 12	10	23.5	23.28	-0.02	0	Ant A	051D1	QPSK	1	25	10 mm	bottom	1:1	0.073	1.052	0.077	
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	-0.02	1	Ant A	051D1	QPSK	25	12	10 mm	bottom	1:1	0.058	1.033	0.060	
707.50	23095	Mid	LTE Band 12	10	23.5	23.28	0.08	0	Ant A	051D1	QPSK	1	25	10 mm	right	1:1	0.082	1.052	0.086	
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	0.02	1	Ant A	051D1	QPSK	25	12	10 mm	right	1:1	0.065	1.033	0.067	
707.50	23095	Mid	LTE Band 12	10	23.5	23.28	-0.02	0	Ant A	051D1	QPSK	1	25	10 mm	left	1:1	0.020	1.052	0.021	
707.50	23095	Mid	LTE Band 12	10	22.5	22.36	0.06	1	Ant A	051D1	QPSK	25	12	10 mm	left	1:1	0.016	1.033	0.017	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body												
Spatial Peak								1.6 W/kg (mW/g)												
Uncontrolled Exposure/General Population								averaged over 1 gram												

Table 11-21
LTE Band 13 Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Maxim um Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Antenna	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.															(W/kg)		(W/kg)		
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	0.11	0	Ant A	051D1	QPSK	1	0	10 mm	back	1:1	0.163	1.250	0.204	A23
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.15	1	Ant A	051D1	QPSK	25	0	10 mm	back	1:1	0.128	1.276	0.163	
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	0.05	0	Ant A	051D1	QPSK	1	0	10 mm	front	1:1	0.123	1.250	0.154	
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.06	1	Ant A	051D1	QPSK	25	0	10 mm	front	1:1	0.101	1.276	0.129	
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	-0.04	0	Ant A	051D1	QPSK	1	0	10 mm	bottom	1:1	0.097	1.250	0.121	
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.13	1	Ant A	051D1	QPSK	25	0	10 mm	bottom	1:1	0.076	1.276	0.097	
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	0.02	0	Ant A	051D1	QPSK	1	0	10 mm	right	1:1	0.079	1.250	0.099	
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.02	1	Ant A	051D1	QPSK	25	0	10 mm	right	1:1	0.064	1.276	0.082	
782.00	23230	Mid	LTE Band 13	10	24.0	23.03	0.04	0	Ant A	051D1	QPSK	1	0	10 mm	left	1:1	0.019	1.250	0.024	
782.00	23230	Mid	LTE Band 13	10	23.0	21.94	0.18	1	Ant A	051D1	QPSK	25	0	10 mm	left	1:1	0.016	1.276	0.020	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body												
Spatial Peak								1.6 W/kg (mW/g)												
Uncontrolled Exposure/General Population								averaged over 1 gram												

Table 11-22
LTE Band 26 (Cell) Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Antenna	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)		
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	0.02	0	Ant A	051D1	QPSK	1	0	10 mm	back	1:1	0.370	1.028	0.380	A25
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	-0.03	1	Ant A	051D1	QPSK	36	0	10 mm	back	1:1	0.301	1.050	0.316	
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	-0.01	0	Ant A	051D1	QPSK	1	0	10 mm	front	1:1	0.348	1.028	0.358	
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	-0.02	1	Ant A	051D1	QPSK	36	0	10 mm	front	1:1	0.269	1.050	0.282	
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	0.04	0	Ant A	051D1	QPSK	1	0	10 mm	bottom	1:1	0.215	1.028	0.221	
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	0.00	1	Ant A	051D1	QPSK	36	0	10 mm	bottom	1:1	0.165	1.050	0.173	
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	0.06	0	Ant A	051D1	QPSK	1	0	10 mm	right	1:1	0.155	1.028	0.159	
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	-0.01	1	Ant A	051D1	QPSK	36	0	10 mm	right	1:1	0.122	1.050	0.128	
831.50	26865	Mid	LTE Band 26 (Cell)	15	23.5	23.38	0.06	0	Ant A	051D1	QPSK	1	0	10 mm	left	1:1	0.045	1.028	0.046	
831.50	26865	Mid	LTE Band 26 (Cell)	15	22.5	22.29	-0.05	1	Ant A	051D1	QPSK	36	0	10 mm	left	1:1	0.035	1.050	0.037	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body												
Spatial Peak								1.6 W/kg (mW/g)												
Uncontrolled Exposure/General Population								averaged over 1 gram												

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Table 11-23
LTE Band 5 (Cell) Hotspot SAR

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Bandwidth [MHz]	Antenna State	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Antenna	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	4	24.5	23.36	-0.06	0	Ant A	051C8	QPSK	1	0	10 mm	back	1:1	0.414	1.300	0.538	A27
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	23.5	22.37	0.01	1	Ant A	051C8	QPSK	25	0	10 mm	back	1:1	0.324	1.297	0.420	
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	24.5	23.36	0.01	0	Ant A	051C8	QPSK	1	0	10 mm	front	1:1	0.353	1.300	0.459	
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	23.5	22.37	-0.03	1	Ant A	051C8	QPSK	25	0	10 mm	front	1:1	0.285	1.297	0.370	
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	24.5	23.36	0.05	0	Ant A	051C8	QPSK	1	0	10 mm	bottom	1:1	0.201	1.300	0.261	
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	23.5	22.37	0.04	1	Ant A	051C8	QPSK	25	0	10 mm	bottom	1:1	0.161	1.297	0.209	
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	24.5	23.36	0.01	0	Ant A	051C8	QPSK	1	0	10 mm	right	1:1	0.168	1.300	0.218	
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	23.5	22.37	-0.05	1	Ant A	051C8	QPSK	25	0	10 mm	right	1:1	0.129	1.297	0.167	
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	24.5	23.36	0.09	0	Ant A	051C8	QPSK	1	0	10 mm	left	1:1	0.042	1.300	0.055	
836.50	20525	Mid	LTE Band 5 (Cell)	10	4	23.5	22.37	-0.11	1	Ant A	051C8	QPSK	25	0	10 mm	left	1:1	0.039	1.297	0.051	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	22.0	21.34	-0.02	0	Ant E	051C8	QPSK	1	0	10 mm	back	1:1	0.207	1.164	0.241	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	21.0	20.29	0.04	1	Ant E	051C8	QPSK	25	0	10 mm	back	1:1	0.155	1.178	0.183	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	22.0	21.34	-0.08	0	Ant E	051C8	QPSK	1	0	10 mm	front	1:1	0.213	1.164	0.248	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	21.0	20.29	-0.01	1	Ant E	051C8	QPSK	25	0	10 mm	front	1:1	0.171	1.178	0.201	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	22.0	21.34	-0.02	0	Ant E	051C8	QPSK	1	0	10 mm	top	1:1	0.120	1.164	0.140	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	21.0	20.29	0.04	1	Ant E	051C8	QPSK	25	0	10 mm	top	1:1	0.093	1.178	0.110	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	22.0	21.34	0.06	0	Ant E	051C8	QPSK	1	0	10 mm	right	1:1	0.021	1.164	0.024	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	21.0	20.29	-0.11	1	Ant E	051C8	QPSK	25	0	10 mm	right	1:1	0.018	1.178	0.021	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	22.0	21.34	-0.04	0	Ant E	051C8	QPSK	1	0	10 mm	left	1:1	0.127	1.164	0.148	
836.50	20525	Mid	LTE Band 5 (Cell)	10	N/A	21.0	20.29	0.02	1	Ant E	051C8	QPSK	25	0	10 mm	left	1:1	0.099	1.178	0.117	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak									Body 1.6 W/kg (mW/g) averaged over 1 gram												
Uncontrolled Exposure/General Population																					

Table 11-24
LTE Band 4 (AWS) Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Antenna	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.															(W/kg)		(W/kg)		
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	0.05	0	Ant B	051B0	QPSK	1	0	10 mm	back	1:1	0.689	1.096	0.755	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.61	-0.02	1	Ant B	051B0	QPSK	50	25	10 mm	back	1:1	0.544	1.227	0.667	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	-0.01	0	Ant B	051B0	QPSK	1	0	10 mm	front	1:1	0.661	1.096	0.724	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.61	-0.05	1	Ant B	051B0	QPSK	50	25	10 mm	front	1:1	0.511	1.227	0.627	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	-0.03	0	Ant B	051B0	QPSK	1	0	10 mm	bottom	1:1	0.958	1.096	1.050	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.61	-0.03	1	Ant B	051B0	QPSK	50	25	10 mm	bottom	1:1	0.671	1.227	0.823	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.55	-0.03	1	Ant B	051B0	QPSK	100	0	10 mm	bottom	1:1	0.671	1.245	0.835	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	0.00	0	Ant B	051B0	QPSK	1	0	10 mm	left	1:1	0.153	1.096	0.168	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.5	21.61	0.10	1	Ant B	051B0	QPSK	50	25	10 mm	left	1:1	0.112	1.227	0.137	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.5	23.10	0.01	0	Ant B	051B0	QPSK	1	0	10 mm	bottom	1:1	0.972	1.096	1.065	A29
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram											

Note: Variability Measurement is Highlighted in Blue

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Table 11-25
LTE Band 25 (PCS) Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Antenna	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)		
1905.00	26590	High	LTE Band 25 (PCS)	20	23.5	23.42	-0.01	0	Ant B	051B0	QPSK	1	0	10 mm	back	1:1	0.396	1.019	0.404	
1905.00	26590	High	LTE Band 25 (PCS)	20	22.5	22.41	0.07	1	Ant B	051B0	QPSK	50	0	10 mm	back	1:1	0.343	1.021	0.350	
1905.00	26590	High	LTE Band 25 (PCS)	20	23.5	23.42	0.05	0	Ant B	051B0	QPSK	1	0	10 mm	front	1:1	0.414	1.019	0.422	
1905.00	26590	High	LTE Band 25 (PCS)	20	22.5	22.41	0.05	1	Ant B	051B0	QPSK	50	0	10 mm	front	1:1	0.309	1.021	0.315	
1905.00	26590	High	LTE Band 25 (PCS)	20	23.5	23.42	-0.06	0	Ant B	051B0	QPSK	1	0	10 mm	bottom	1:1	0.677	1.019	0.690	A31
1905.00	26590	High	LTE Band 25 (PCS)	20	22.5	22.41	0.02	1	Ant B	051B0	QPSK	50	0	10 mm	bottom	1:1	0.508	1.021	0.519	
1905.00	26590	High	LTE Band 25 (PCS)	20	23.5	23.42	-0.04	0	Ant B	051B0	QPSK	1	0	10 mm	left	1:1	0.216	1.019	0.220	
1905.00	26590	High	LTE Band 25 (PCS)	20	22.5	22.41	-0.02	1	Ant B	051B0	QPSK	50	0	10 mm	left	1:1	0.169	1.021	0.173	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body												
Spatial Peak								1.6 W/kg (mW/g)												
Uncontrolled Exposure/General Population								averaged over 1 gram												

Table 11-26
LTE Band 41 Hotspot SAR

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Maxim um Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Antenna	Device Serial Number	Modulation	RB Size	RB Off set	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.															(W/kg)		(W/kg)		
2593.00	40620	Mid	LTE Band 41	20	23.5	23.06	0.12	0	Ant B	051B0	QPSK	1	0	10 mm	back	1:1.58	0.181	1.107	0.200	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.03	0.06	1	Ant B	051B0	QPSK	50	25	10 mm	back	1:1.58	0.154	1.114	0.172	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.06	0.11	0	Ant B	051B0	QPSK	1	0	10 mm	front	1:1.58	0.174	1.107	0.193	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.03	0.05	1	Ant B	051B0	QPSK	50	25	10 mm	front	1:1.58	0.144	1.114	0.160	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.06	0.03	0	Ant B	051B0	QPSK	1	0	10 mm	bottom	1:1.58	0.350	1.107	0.387	A33
2593.00	40620	Mid	LTE Band 41	20	22.5	22.03	-0.06	1	Ant B	051B0	QPSK	50	25	10 mm	bottom	1:1.58	0.300	1.114	0.334	
2593.00	40620	Mid	LTE Band 41	20	23.5	23.06	0.04	0	Ant B	051B0	QPSK	1	0	10 mm	left	1:1.58	0.119	1.107	0.132	
2593.00	40620	Mid	LTE Band 41	20	22.5	22.03	-0.03	1	Ant B	051B0	QPSK	50	25	10 mm	left	1:1.58	0.100	1.114	0.111	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body												
Spatial Peak								1.6 W/kg (mW/g)												
Uncontrolled Exposure/General Population								averaged over 1 gram												

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**Table 11-27
WLAN Hotspot SAR**

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	19.5	19.36	0.01	10 mm	1	1F3B2	1	back	99.8	0.167	0.148	1.033	1.002	0.153	
2412	1	802.11b	DSSS	22	19.5	19.36	0.06	10 mm	1	1F3B2	1	front	99.8	0.119	-	1.033	1.002	-	
2412	1	802.11b	DSSS	22	19.5	19.36	0.05	10 mm	1	1F3B2	1	top	99.8	0.104	-	1.033	1.002	-	
2412	1	802.11b	DSSS	22	19.5	19.36	0.03	10 mm	1	1F3B2	1	left	99.8	0.113	-	1.033	1.002	-	
2437	6	802.11b	DSSS	22	19.5	19.49	0.05	10 mm	2	1F3B2	1	back	99.8	0.214	0.150	1.002	1.002	0.151	A35
2437	6	802.11b	DSSS	22	19.5	19.49	0.14	10 mm	2	1F3B2	1	front	99.8	0.083	-	1.002	1.002	-	
2437	6	802.11b	DSSS	22	19.5	19.49	0.13	10 mm	2	1F3B2	1	top	99.8	0.003	-	1.002	1.002	-	
2437	6	802.11b	DSSS	22	19.5	19.49	0.19	10 mm	2	1F3B2	1	left	99.8	0.030	-	1.002	1.002	-	
5785	157	802.11a	OFDM	20	14.5	13.54	0.04	10 mm	1	051DC	6	back	98.8	0.176	0.093	1.247	1.012	0.117	A37
5785	157	802.11a	OFDM	20	14.5	13.54	0.03	10 mm	1	051DC	6	front	98.8	0.040	-	1.247	1.012	-	
5785	157	802.11a	OFDM	20	14.5	13.54	-0.18	10 mm	1	051DC	6	top	98.8	0.097	-	1.247	1.012	-	
5785	157	802.11a	OFDM	20	14.5	13.54	-0.14	10 mm	1	051DC	6	left	98.8	0.066	-	1.247	1.012	-	
5825	165	802.11a	OFDM	20	14.5	13.81	0.09	10 mm	2	051DC	6	back	98.8	0.176	0.089	1.172	1.012	0.106	
5825	165	802.11a	OFDM	20	14.5	13.81	0.13	10 mm	2	051DC	6	front	98.8	0.074	-	1.172	1.012	-	
5825	165	802.11a	OFDM	20	14.5	13.81	0.04	10 mm	2	051DC	6	top	98.8	0.054	-	1.172	1.012	-	
5825	165	802.11a	OFDM	20	14.5	13.81	0.12	10 mm	2	051DC	6	left	98.8	0.015	-	1.172	1.012	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT																			
Spatial Peak								Body											
Uncontrolled Exposure/General Population								1.6 W/kg (mW/g) averaged over 1 gram											

**Table 11-28
DSSS 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 (1 g)	Scaling Factor (Conducted Power)	Scaling Factor (Duty Cycle)	Reported SAR (1 g)	Plot #
MHz	Ch.											(W/kg)			(W/kg)	
2402	0	Bluetooth	FHSS	9.5	9.03	0.02	10 mm	051DC	2	back	77.1	0.012	1.114	1.297	0.017	A39
2402	0	Bluetooth	FHSS	9.5	9.03	0.12	10 mm	051DC	2	front	77.1	0.006	1.114	1.297	0.009	
2402	0	Bluetooth	FHSS	9.5	9.03	0.08	10 mm	051DC	2	top	77.1	0.003	1.114	1.297	0.004	
2402	0	Bluetooth	FHSS	9.5	9.03	-0.15	10 mm	051DC	2	left	77.1	0.003	1.114	1.297	0.004	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram									

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11.4 Standalone Phablet SAR Data

Table 11-29
WLAN Phablet SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (10g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (10g)	Plot #
MHz	Ch.													W/kg	(W/kg)			(W/kg)	
5320	64	802.11a	OFDM	20	14.5	13.97	-0.08	0 mm	1	051DC	6	back	98.8	0.885	0.089	1.130	1.012	0.102	
5320	64	802.11a	OFDM	20	14.5	13.97	0.06	0 mm	1	051DC	6	front	98.8	0.561	-	1.130	1.012	-	
5320	64	802.11a	OFDM	20	14.5	13.97	0.10	0 mm	1	051DC	6	top	98.8	0.077	-	1.130	1.012	-	
5320	64	802.11a	OFDM	20	14.5	13.97	-0.10	0 mm	1	051DC	6	left	98.8	0.030	-	1.130	1.012	-	
5320	64	802.11a	OFDM	20	14.5	14.06	-0.11	0 mm	2	051DC	6	back	98.8	1.514	-	1.107	1.012	-	
5320	64	802.11a	OFDM	20	14.5	14.06	-0.17	0 mm	2	051DC	6	front	98.8	1.784	0.160	1.107	1.012	0.179	
5320	64	802.11a	OFDM	20	14.5	14.06	0.14	0 mm	2	051DC	6	top	98.8	0.043	-	1.107	1.012	-	
5320	64	802.11a	OFDM	20	14.5	14.06	0.03	0 mm	2	051DC	6	left	98.8	0.030	-	1.107	1.012	-	
5500	100	802.11a	OFDM	20	14.5	13.97	0.19	0 mm	1	051DC	6	back	98.8	0.903	0.138	1.130	1.012	0.158	
5500	100	802.11a	OFDM	20	14.5	13.97	0.03	0 mm	1	051DC	6	front	98.8	0.693	-	1.130	1.012	-	
5500	100	802.11a	OFDM	20	14.5	13.97	0.02	0 mm	1	051DC	6	top	98.8	0.146	-	1.130	1.012	-	
5500	100	802.11a	OFDM	20	14.5	13.97	0.02	0 mm	1	051DC	6	left	98.8	0.043	-	1.130	1.012	-	
5720	144	802.11a	OFDM	20	14.5	14.38	-0.05	0 mm	2	051DC	6	back	98.8	2.842	0.224	1.028	1.012	0.233	A40
5720	144	802.11a	OFDM	20	14.5	14.38	0.02	0 mm	2	051DC	6	front	98.8	0.894	-	1.028	1.012	-	
5720	144	802.11a	OFDM	20	14.5	14.38	-0.05	0 mm	2	051DC	6	top	98.8	0.046	-	1.028	1.012	-	
5720	144	802.11a	OFDM	20	14.5	14.38	0.11	0 mm	2	051DC	6	left	98.8	0.027	-	1.028	1.012	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT																			
Spatial Peak								Phablet											
Uncontrolled Exposure/General Population								4.0 W/kg (mW/g)											
								averaged over 10 grams											

Table 11-30
DSSS Phablet 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 (10g)	Scaling Factor (Conducted Power)	Scaling Factor (Duty Cycle)	Reported SAR (10g)	Plot #
MHz	Ch.											(W/kg)	(W/kg)	(W/kg)	(W/kg)	
2441	39	Bluetooth	FHSS	15.5	15.23	0.16	0 mm	051DC	1	back	77.1	0.470	1.064	1.297	0.649	A41
2441	39	Bluetooth	FHSS	15.5	15.23	-0.06	0 mm	051DC	1	front	77.1	0.225	1.064	1.297	0.311	
2441	39	Bluetooth	FHSS	15.5	15.23	-0.13	0 mm	051DC	1	top	77.1	0.055	1.064	1.297	0.076	
2441	39	Bluetooth	FHSS	15.5	15.23	-0.06	0 mm	051DC	1	left	77.1	0.059	1.064	1.297	0.081	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Phablet 4.0 W/kg (mW/g) averaged over 10 gram								

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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.
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. 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 supports dynamic antenna tuning for some bands. Per FCC Guidance, SAR was measured according to the normally required SAR measurement configurations with tuner active. The auto-tune state determined by the device was verified before and after each SAR measurement and is listed in tables above. Please see Section 14 for supplemental data.

GSM Test Notes:

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

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UMTS Notes:

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

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 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 (scaled) for LTE Band 41 SAR measured at the highest output power channel in a given a test configuration was > 0.6 W/kg, 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. LTE Band 5 Ant E is disabled for all held to ear scenarios. Therefore SAR was only assessed for body-worn accessory and wireless router conditions.

WLAN Notes:

1. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 8.6.5 for more information.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 8.6.6 for more information.
4. Per KDB Publication 248227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498 D01v06. Please see Section 12 for complete analysis.
5. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.

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6. When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.
7. 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.

Bluetooth Notes:

1. Body Worn 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 is supported for BT EDR tethering applications.
3. Head and Hotspot Bluetooth SAR were measured with the device connected to a call box with hopping disabled with 2DH5 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.

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12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

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

12.2 Simultaneous Transmission Procedures

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

Main antenna SAR testing was not required for phablet exposure conditions per FCC KDB 648474 D04v01r03. Therefore, no further analysis was required to determine that possible simultaneous scenarios would not exceed the SAR limit.

12.3 Head SAR Simultaneous Transmission Analysis

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	GSM 1900	0.027	0.343	0.377	0.370	0.404	0.747
	UMTS 850	0.101	0.343	0.377	0.444	0.478	0.821
	UMTS 1900	0.047	0.343	0.377	0.390	0.424	0.767
	LTE Band 12	0.039	0.343	0.377	0.382	0.416	0.759
	LTE Band 13	0.060	0.343	0.377	0.403	0.437	0.780
	LTE Band 26 (Cell)	0.100	0.343	0.377	0.443	0.477	0.820
	LTE Band 5 (Cell)	0.157	0.343	0.377	0.500	0.534	0.877
	LTE Band 4 (AWS)	0.142	0.343	0.377	0.485	0.519	0.862
	LTE Band 25 (PCS)	0.108	0.343	0.377	0.451	0.485	0.828
	LTE Band 41	0.030	0.343	0.377	0.373	0.407	0.750

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

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	GSM 1900	0.027	0.158	0.170	0.185	0.197	0.355
	UMTS 850	0.101	0.158	0.170	0.259	0.271	0.429
	UMTS 1900	0.047	0.158	0.170	0.205	0.217	0.375
	LTE Band 12	0.039	0.158	0.170	0.197	0.209	0.367
	LTE Band 13	0.060	0.158	0.170	0.218	0.230	0.388
	LTE Band 26 (Cell)	0.100	0.158	0.170	0.258	0.270	0.428
	LTE Band 5 (Cell)	0.157	0.158	0.170	0.315	0.327	0.485
	LTE Band 4 (AWS)	0.142	0.158	0.170	0.300	0.312	0.470
	LTE Band 25 (PCS)	0.108	0.158	0.170	0.266	0.278	0.436
	LTE Band 41	0.030	0.158	0.170	0.188	0.200	0.358

Table 12-3
Simultaneous Transmission Scenario with 2.4 GHz and 5 GHz (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	4	5	1+2+3+4+5
Head SAR	GSM 1900	0.027	0.343	0.377	0.158	0.170	1.075
	UMTS 850	0.101	0.343	0.377	0.158	0.170	1.149
	UMTS 1900	0.047	0.343	0.377	0.158	0.170	1.095
	LTE Band 12	0.039	0.343	0.377	0.158	0.170	1.087
	LTE Band 13	0.060	0.343	0.377	0.158	0.170	1.108
	LTE Band 26 (Cell)	0.100	0.343	0.377	0.158	0.170	1.148
	LTE Band 5 (Cell)	0.157	0.343	0.377	0.158	0.170	1.205
	LTE Band 4 (AWS)	0.142	0.343	0.377	0.158	0.170	1.190
	LTE Band 25 (PCS)	0.108	0.343	0.377	0.158	0.170	1.156
	LTE Band 41	0.030	0.343	0.377	0.158	0.170	1.078

Note: 2.4 GHz Head SISO SAR at higher power was used because it is more conservative

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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 1900	0.027	0.097	0.124
	UMTS 850	0.101	0.097	0.198
	UMTS 1900	0.047	0.097	0.144
	LTE Band 12	0.039	0.097	0.136
	LTE Band 13	0.060	0.097	0.157
	LTE Band 26 (Cell)	0.100	0.097	0.197
	LTE Band 5 (Cell)	0.157	0.097	0.254
	LTE Band 4 (AWS)	0.142	0.097	0.239
	LTE Band 25 (PCS)	0.108	0.097	0.205
	LTE Band 41	0.030	0.097	0.127

12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-5
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 Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn	GSM 1900	0.130	0.056	0.059	0.186	0.189	0.245
	UMTS 850	0.116	0.056	0.059	0.172	0.175	0.231
	UMTS 1900	0.204	0.056	0.059	0.260	0.263	0.319
	LTE Band 12	0.082	0.056	0.059	0.138	0.141	0.197
	LTE Band 13	0.111	0.056	0.059	0.167	0.170	0.226
	LTE Band 26 (Cell)	0.193	0.056	0.059	0.249	0.252	0.308
	LTE Band 5 (Cell)	0.225	0.056	0.059	0.281	0.284	0.340
	LTE Band 4 (AWS)	0.457	0.056	0.059	0.513	0.516	0.572
	LTE Band 25 (PCS)	0.279	0.056	0.059	0.335	0.338	0.394
	LTE Band 41	0.111	0.056	0.059	0.167	0.170	0.226

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Table 12-6
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 Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body-Worn	GSM 1900	0.130	0.082	0.065	0.212	0.195	0.277
	UMTS 850	0.116	0.082	0.065	0.198	0.181	0.263
	UMTS 1900	0.204	0.082	0.065	0.286	0.269	0.351
	LTE Band 12	0.082	0.082	0.065	0.164	0.147	0.229
	LTE Band 13	0.111	0.082	0.065	0.193	0.176	0.258
	LTE Band 26 (Cell)	0.193	0.082	0.065	0.275	0.258	0.340
	LTE Band 5 (Cell)	0.225	0.082	0.065	0.307	0.290	0.372
	LTE Band 4 (AWS)	0.457	0.082	0.065	0.539	0.522	0.604
	LTE Band 25 (PCS)	0.279	0.082	0.065	0.361	0.344	0.426
	LTE Band 41	0.111	0.082	0.065	0.193	0.176	0.258

Table 12-7
Simultaneous Transmission Scenario with 2.4 GHz and 5 GHz (Body-Worn at 1.5 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	4	5	1+2+3+4+5
Body-Worn	GSM 1900	0.130	0.056	0.059	0.082	0.065	0.392
	UMTS 850	0.116	0.056	0.059	0.082	0.065	0.378
	UMTS 1900	0.204	0.056	0.059	0.082	0.065	0.466
	LTE Band 12	0.082	0.056	0.059	0.082	0.065	0.344
	LTE Band 13	0.111	0.056	0.059	0.082	0.065	0.373
	LTE Band 26 (Cell)	0.193	0.056	0.059	0.082	0.065	0.455
	LTE Band 5 (Cell)	0.225	0.056	0.059	0.082	0.065	0.487
	LTE Band 4 (AWS)	0.457	0.056	0.059	0.082	0.065	0.719
	LTE Band 25 (PCS)	0.279	0.056	0.059	0.082	0.065	0.541
	LTE Band 41	0.111	0.056	0.059	0.082	0.065	0.373

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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 1900	0.130	0.054	0.184
	UMTS 850	0.116	0.054	0.170
	UMTS 1900	0.204	0.054	0.258
	LTE Band 12	0.082	0.054	0.136
	LTE Band 13	0.111	0.054	0.165
	LTE Band 26 (Cell)	0.193	0.054	0.247
	LTE Band 5 (Cell)	0.225	0.054	0.279
	LTE Band 4 (AWS)	0.457	0.054	0.511
	LTE Band 25 (PCS)	0.279	0.054	0.333
	LTE Band 41	0.111	0.054	0.165

12.5 Hotspot SAR Simultaneous Transmission Analysis

Table 12-9
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 Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Hotspot SAR	GPRS 1900	0.372	0.153	0.151	0.525	0.523	0.676
	UMTS 850	0.212	0.153	0.151	0.365	0.363	0.516
	UMTS 1900	0.517	0.153	0.151	0.670	0.668	0.821
	LTE Band 12	0.133	0.153	0.151	0.286	0.284	0.437
	LTE Band 13	0.204	0.153	0.151	0.357	0.355	0.508
	LTE Band 26 (Cell)	0.380	0.153	0.151	0.533	0.531	0.684
	LTE Band 5 (Cell)	0.538	0.153	0.151	0.691	0.689	0.842
	LTE Band 4 (AWS)	1.065	0.153	0.151	1.218	1.216	1.369
	LTE Band 25 (PCS)	0.690	0.153	0.151	0.843	0.841	0.994
	LTE Band 41	0.387	0.153	0.151	0.540	0.538	0.691

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Table 12-10
Simultaneous Transmission Scenario with 5.8 GHz WLAN (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Hotspot SAR	GPRS 1900	0.372	0.117	0.106	0.489	0.478	0.595
	UMTS 850	0.212	0.117	0.106	0.329	0.318	0.435
	UMTS 1900	0.517	0.117	0.106	0.634	0.623	0.740
	LTE Band 12	0.133	0.117	0.106	0.250	0.239	0.356
	LTE Band 13	0.204	0.117	0.106	0.321	0.310	0.427
	LTE Band 26 (Cell)	0.380	0.117	0.106	0.497	0.486	0.603
	LTE Band 5 (Cell)	0.538	0.117	0.106	0.655	0.644	0.761
	LTE Band 4 (AWS)	1.065	0.117	0.106	1.182	1.171	1.288
	LTE Band 25 (PCS)	0.690	0.117	0.106	0.807	0.796	0.913
	LTE Band 41	0.387	0.117	0.106	0.504	0.493	0.610

Table 12-11
Simultaneous Transmission Scenario with 2.4 GHz and 5.8 GHz WLAN (Hotspot at 1.0 cm)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	4	3	1+2+3+4+5
Hotspot SAR	GPRS 1900	0.372	0.153	0.151	0.117	0.106	0.899
	UMTS 850	0.212	0.153	0.151	0.117	0.106	0.739
	UMTS 1900	0.517	0.153	0.151	0.117	0.106	1.044
	LTE Band 12	0.133	0.153	0.151	0.117	0.106	0.660
	LTE Band 13	0.204	0.153	0.151	0.117	0.106	0.731
	LTE Band 26 (Cell)	0.380	0.153	0.151	0.117	0.106	0.907
	LTE Band 5 (Cell)	0.538	0.153	0.151	0.117	0.106	1.065
	LTE Band 4 (AWS)	1.065	0.153	0.151	0.117	0.106	1.592
	LTE Band 25 (PCS)	0.690	0.153	0.151	0.117	0.106	1.217
	LTE Band 41	0.387	0.153	0.151	0.117	0.106	0.914

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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 1900	0.372	0.017	0.389
	UMTS 850	0.212	0.017	0.229
	UMTS 1900	0.517	0.017	0.534
	LTE Band 12	0.133	0.017	0.150
	LTE Band 13	0.204	0.017	0.221
	LTE Band 26 (Cell)	0.380	0.017	0.397
	LTE Band 5 (Cell)	0.538	0.017	0.555
	LTE Band 4 (AWS)	1.065	0.017	1.082
	LTE Band 25 (PCS)	0.690	0.017	0.707
	LTE Band 41	0.387	0.017	0.404

12.6 Phablet SAR Simultaneous Transmission Analysis

Table 12-13
Simultaneous Transmission Scenario 5 GHz WLAN (Phablet at 0.0 cm)

Exposure Condition	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
Phablet SAR	0.158	0.233	0.391

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 ($\sim 10\%$ from the 1-g SAR limit).
- 3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .
- 4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg
- 5) When 10-g 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	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)
1750	1732.50	20175	LTE Band 4 (AWS), 20 MHz Bandwidth	QPSK, 1 RB, 0 RB Offset	bottom	10 mm	0.958	0.972	1.01	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT						Body						
Spatial Peak						1.6 W/kg (mW/g)						
Uncontrolled Exposure/General Population						averaged over 1 gram						

13.2 Measurement Uncertainty

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

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14 ADDITIONAL TESTING PER FCC GUIDANCE

14.1 Tuner Testing

The following test procedures were followed to demonstrate that the SAR results in Section 11 represented the appropriate SAR test conditions. For bands with dynamic tuning implemented, SAR was measured according to the required FCC SAR test procedures with the dynamic tuner active to allow the device to automatically tune to the antenna state for the respective RF exposure test configurations. Additional single point SAR time-sweep measurements were evaluated for other tuner states to determine that the other tuner configurations would result in equivalent or lower SAR values. The additional tuner hardware has no influence to the antenna characteristics, other than impedance matching.

To evaluate all of the tuner states, the 25 tuner states were divided evenly among band, mode and exposure combinations so that at least one single point SAR measurement was measured among the configurations. Single point time-sweep measurements were performed at the peak SAR location determined by the zoom scan of the configuration with the highest reported SAR for each combination. While inserting and removing the USB cable between single point SAR measurements, the device was ensured to capture the same physical point SAR that generated the highest SAR. The SAR probe remained stationary at the same position throughout the entire series of single point measurements for each combination.

The operational description contains more information about the design and implementation of the dynamic antenna tuning.

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Table 14-1
LTE Supplemental Head SAR Data

Supplemental Head SAR Data	
LTE Band 5 Ant A	
QPSK, 10MHz Bandwidth, 1 RB, 0 RB Offset	
Test Position	Right Cheek
Frequency (MHz)	836.5
Channel	20525
Measured 1g SAR (W/kg)	0.121
Average Value of Time Sweep (W/kg)	
Auto-tune (State 4)	0.136
Default (State 4)	0.141
State 2	0.138
State 4	0.141
State 6	0.142
State 8	0.138
State 10	0.138
State 12	0.121
State 14	0.148
State 16	0.136
State 18	0.134
State 19	0.144
State 20	0.085
State 22	0.142
State 24	0.132

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Table 14-2
LTE Supplemental Body SAR Data

Supplemental Body SAR Data	
LTE Band 5 Ant A	
QPSK, 10MHz Bandwidth, 1 RB, 0 RB Offset	
Test Position	Back Side
Spacing	10 mm
Frequency (MHz)	836.5
Channel	20525
Measured 1g SAR (W/kg)	0.414
Average Value of Time Sweep (W/kg)	
Auto-tune (State 4)	0.547
Default (State 4)	0.532
State 1	0.464
State 3	0.474
State 5	0.536
State 7	0.538
State 9	0.475
State 11	0.310
State 13	0.499
State 15	0.463
State 17	0.479
State 19	0.270
State 21	0.483
State 23	0.462
State 25	0.471

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15 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8753E	(30kHz-6GHz) Network Analyzer	3/2/2016	Annual	3/2/2017	JP38020182
Agilent	E4438C	ESG Vector Signal Generator	3/2/2016	Annual	3/2/2017	MY47270002
Agilent	E5515C	Wireless Communications Test Set	12/12/2016	Annual	12/12/2017	GB44400860
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/2/2016	Annual	3/2/2017	MY45470194
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB44450273
Agilent	N5182A	MXG Vector Signal Generator	10/27/2016	Annual	10/27/2017	MY47420603
Agilent	N9020A	MXA Signal Analyzer	10/28/2016	Annual	10/28/2017	US46470561
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA24106A	USB Power Sensor	6/2/2016	Annual	6/2/2017	1231535
Anritsu	MA24106A	USB Power Sensor	6/2/2016	Annual	6/2/2017	1231538
Anritsu	MA2411B	Pulse Power Sensor	8/18/2016	Annual	8/18/2017	1126066
Anritsu	MA2411B	Pulse Power Sensor	8/18/2016	Annual	8/18/2017	1207470
Anritsu	ML2495A	Power Meter	10/16/2015	Biennial	10/16/2017	941001
Anritsu	ML2496A	Power Meter	3/5/2016	Annual	3/5/2017	1351001
Anritsu	MT8820C	Radio Communication Analyzer	9/15/2016	Annual	9/15/2017	6200901190
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M155A00-009
Control Company	4040	Digital Thermometer	3/18/2015	Biennial	3/18/2017	150194895
Control Company	4352	Ultra Long Stem Thermometer	3/8/2016	Biennial	3/8/2018	160261694
Control Company	4353	Long Stem Thermometer	3/5/2015	Biennial	3/5/2017	150149565
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mitutoyo	CD-6"CSX	Digital Caliper	3/2/2016	Biennial	3/2/2018	13264162
Mitutoyo	CD-6"CSX	Digital Caliper	3/2/2016	Biennial	3/2/2018	13264165
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	NC-100	Torque Wrench	11/6/2015	Biennial	11/6/2017	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	10/20/2016	Annual	10/20/2017	100976
Seekonk	NC-100	Torque Wrench	11/6/2015	Biennial	11/6/2017	22313
SPEAG	CLA-13	Confined Loop Antenna	10/3/2016	Annual	10/3/2017	1002
SPEAG	D1750V2	1750 MHz SAR Dipole	5/9/2016	Annual	5/9/2017	1148
SPEAG	D1765V2	1765 MHz SAR Dipole	5/11/2016	Annual	5/11/2017	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	7/15/2016	Annual	7/15/2017	50149
SPEAG	D2450V2	2450 MHz SAR Dipole	9/13/2016	Annual	9/13/2017	797
SPEAG	D2450V2	2450 MHz SAR Dipole	7/25/2016	Annual	7/25/2017	981
SPEAG	D2600V2	2600 MHz SAR Dipole	9/13/2016	Annual	9/13/2017	1071
SPEAG	D2600V2	2600 MHz SAR Dipole	7/25/2016	Annual	7/25/2017	1126
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/21/2016	Annual	9/21/2017	1191
SPEAG	D5GHzV2	5 GHz SAR Dipole	8/2/2016	Annual	8/2/2017	1237
SPEAG	D750V3	750 MHz Dipole	3/16/2016	Annual	3/16/2017	1054
SPEAG	D750V3	750 MHz SAR Dipole	7/13/2016	Annual	7/13/2017	1161
SPEAG	D835V2	835 MHz SAR Dipole	7/13/2016	Annual	7/13/2017	40407
SPEAG	D835V2	835 MHz SAR Dipole	7/14/2016	Annual	7/14/2017	40133
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/19/2016	Annual	2/19/2017	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/11/2016	Annual	5/11/2017	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/18/2016	Annual	2/18/2017	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/15/2016	Annual	9/15/2017	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/22/2016	Annual	8/22/2017	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/14/2016	Annual	3/14/2017	1368
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/14/2016	Annual	4/14/2017	1407
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/14/2016	Annual	9/14/2017	1408
SPEAG	ES3DV3	SAR Probe	3/18/2016	Annual	3/18/2017	3209
SPEAG	ES3DV3	SAR Probe	9/19/2016	Annual	9/19/2017	3287
SPEAG	ES3DV3	SAR Probe	3/18/2016	Annual	3/18/2017	3319
SPEAG	EX3DV4	SAR Probe	2/22/2016	Annual	2/22/2017	3914
SPEAG	EX3DV4	SAR Probe	4/19/2016	Annual	4/19/2017	7357
SPEAG	EX3DV4	SAR Probe	4/19/2016	Annual	4/19/2017	7406
SPEAG	EX3DV4	SAR Probe	5/17/2016	Annual	5/17/2017	7409
SPEAG	ES3DV3	SAR Probe	8/25/2016	Annual	8/25/2017	3332
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/10/2016	Annual	5/10/2017	1070

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

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16 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 Uncertainty	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
Expanded Uncertainty (95% CONFIDENCE LEVEL)						k=2	23.0	22.6

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17 CONCLUSION

17.1 Measurement Conclusion

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

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

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APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 1F3B3

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

Medium: 1900 Head Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.424 \text{ S/m}$; $\epsilon_r = 39.483$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-16-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3287; ConvF(5.27, 5.27, 5.27); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

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

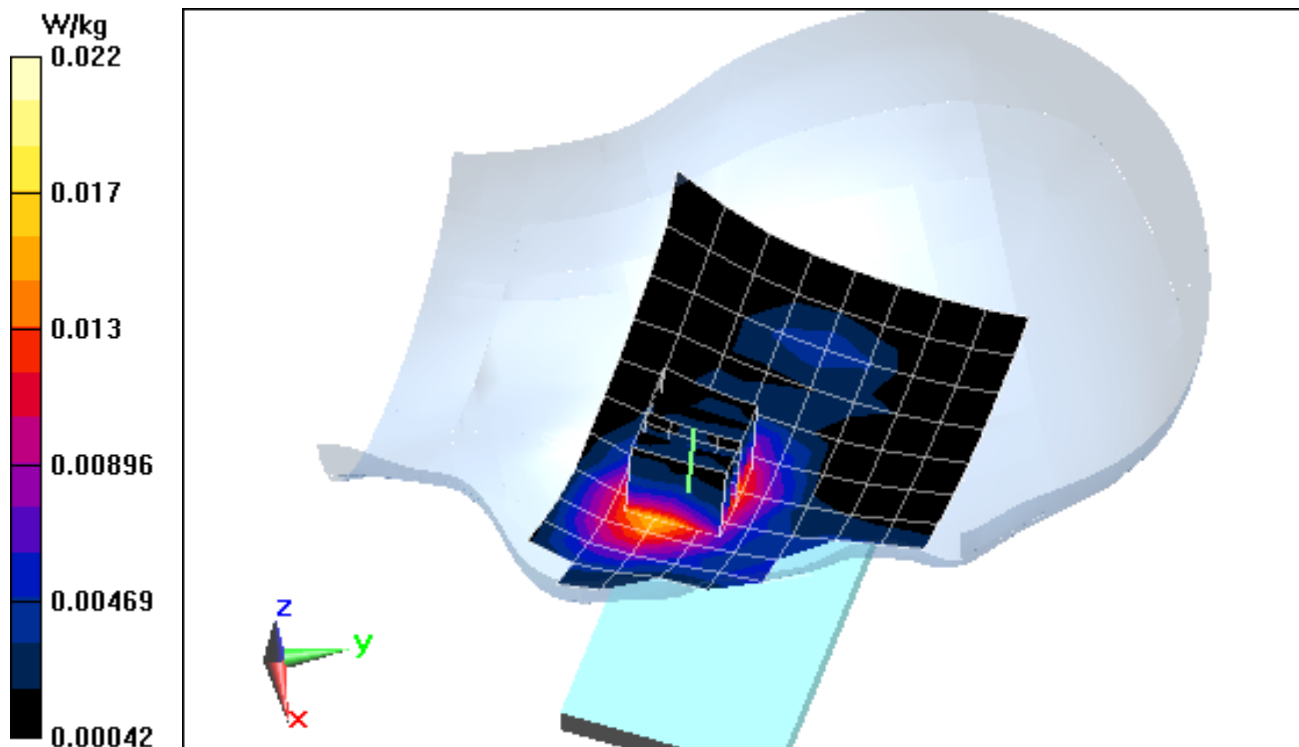
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 3.834 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.0280 W/kg

SAR(1 g) = 0.019 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

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

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.912 \text{ S/m}$; $\epsilon_r = 41.591$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-09-2017; Ambient Temp: 22.2°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3319; ConvF(6.16, 6.16, 6.16); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759

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

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

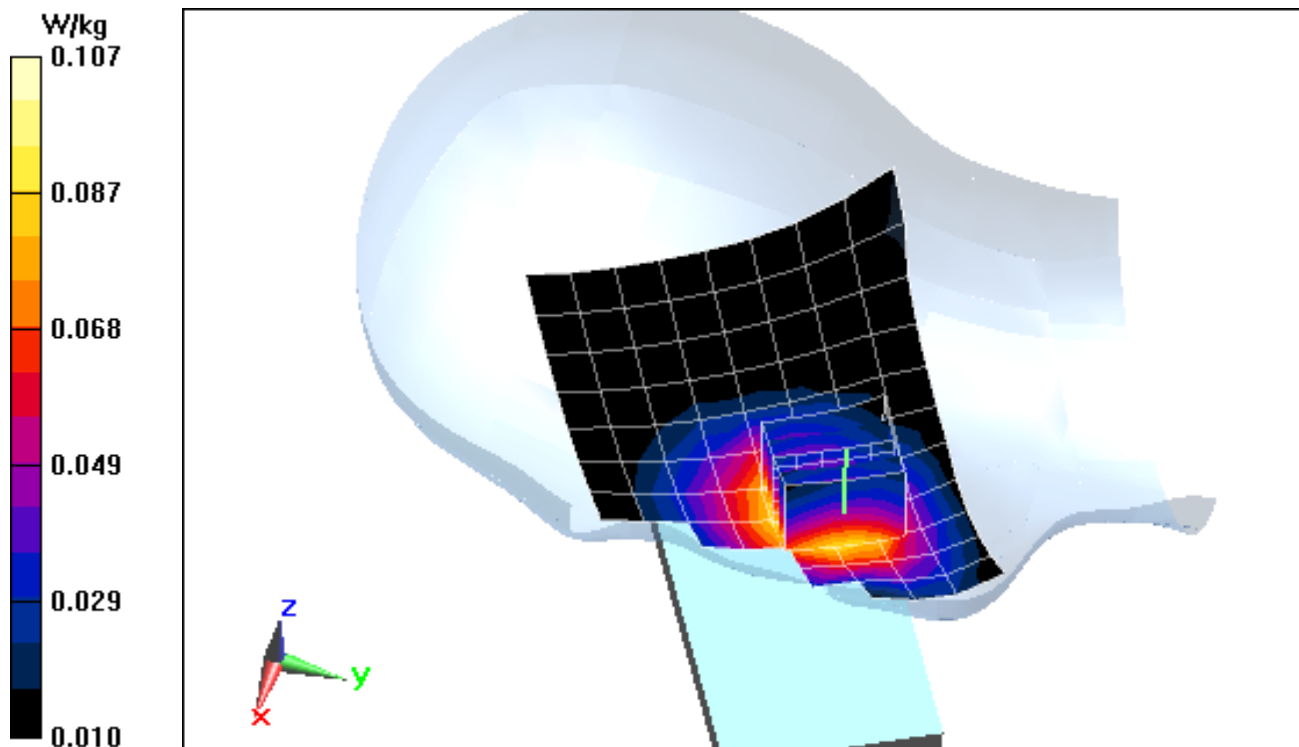
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 10.85 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.122 W/kg

SAR(1 g) = 0.100 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 1F3B3

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

Medium: 1900 Head Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.424 \text{ S/m}$; $\epsilon_r = 39.483$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-16-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3287; ConvF(5.27, 5.27, 5.27); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

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

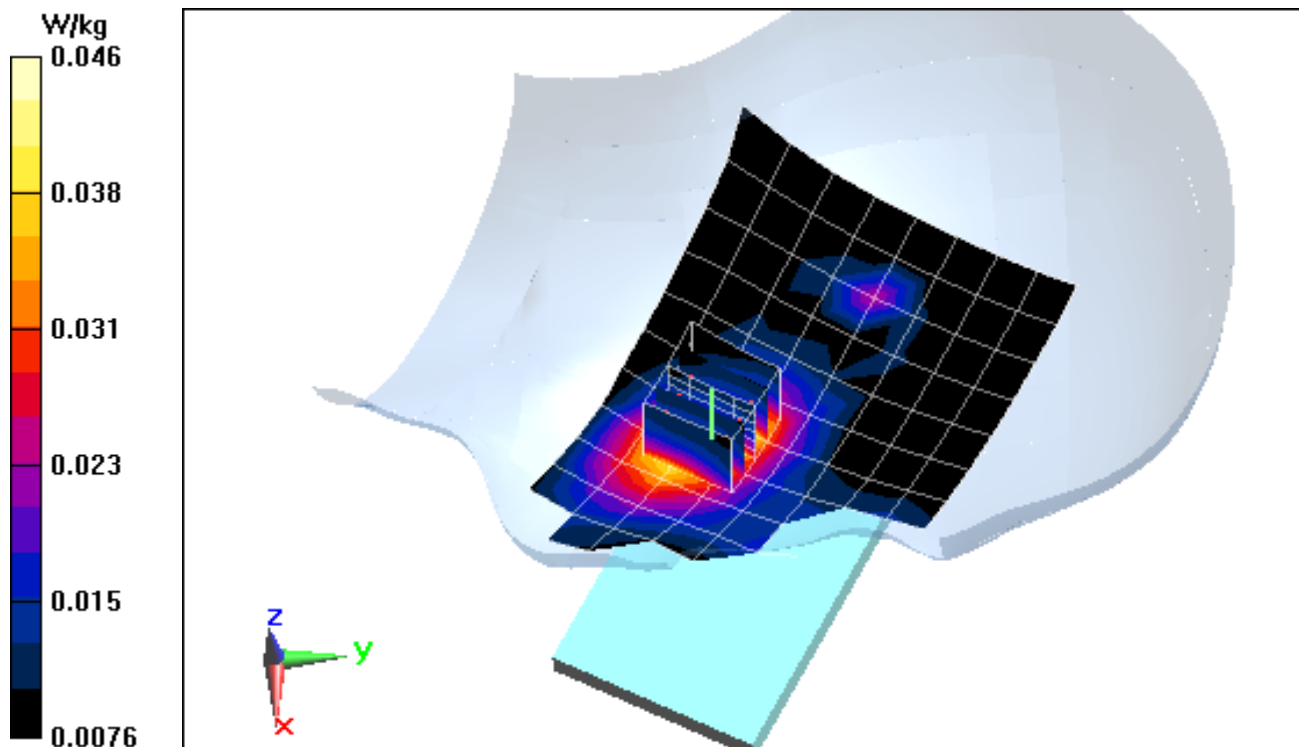
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 5.610 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.0590 W/kg

SAR(1 g) = 0.041 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

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

Medium: 750 Head Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.866 \text{ S/m}$; $\epsilon_r = 42.819$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-11-2017; Ambient Temp: 23.8°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(6.6, 6.6, 6.6); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Right; Type: SAM; Serial: 1757

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

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

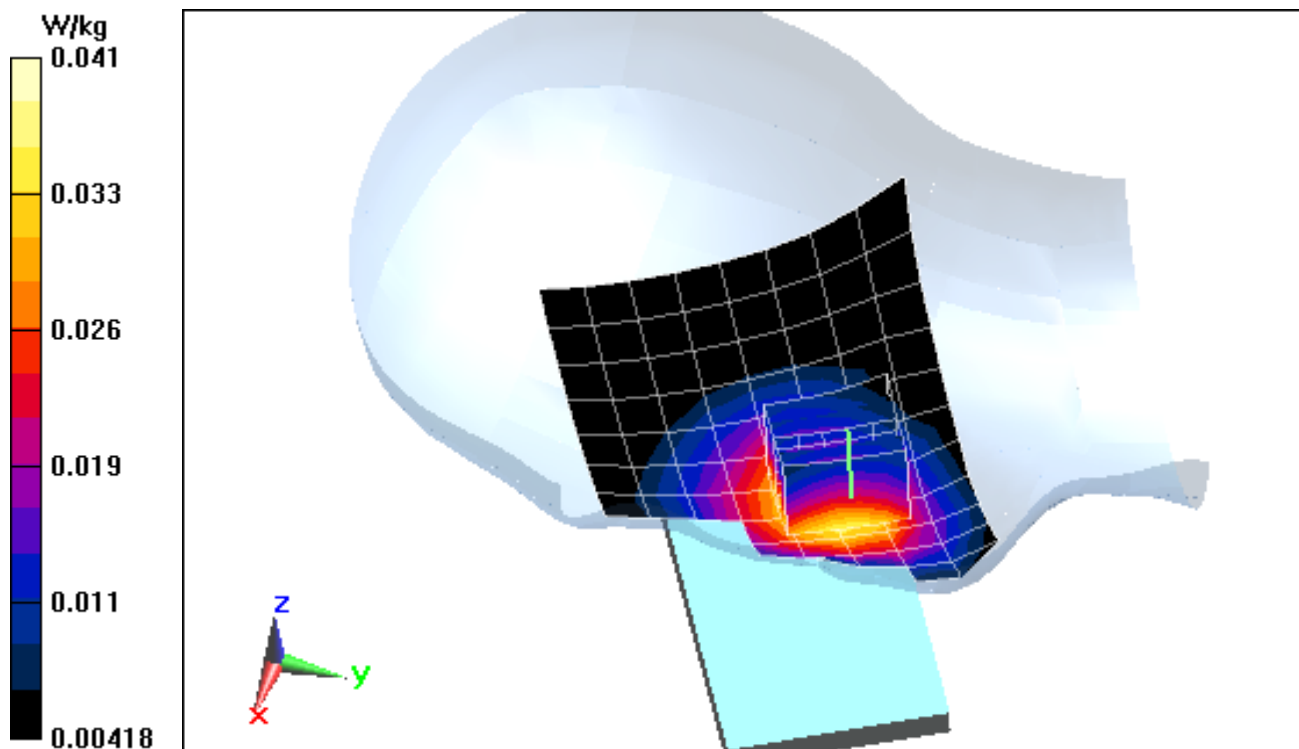
Area Scan (9x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 7.198 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.0470 W/kg

SAR(1 g) = 0.037 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1

Medium: 750 Head Medium parameters used (interpolated):

$f = 782 \text{ MHz}$; $\sigma = 0.937 \text{ S/m}$; $\epsilon_r = 41.748$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-11-2017; Ambient Temp: 23.8°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(6.6, 6.6, 6.6); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Right; Type: SAM; Serial: 1757

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

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

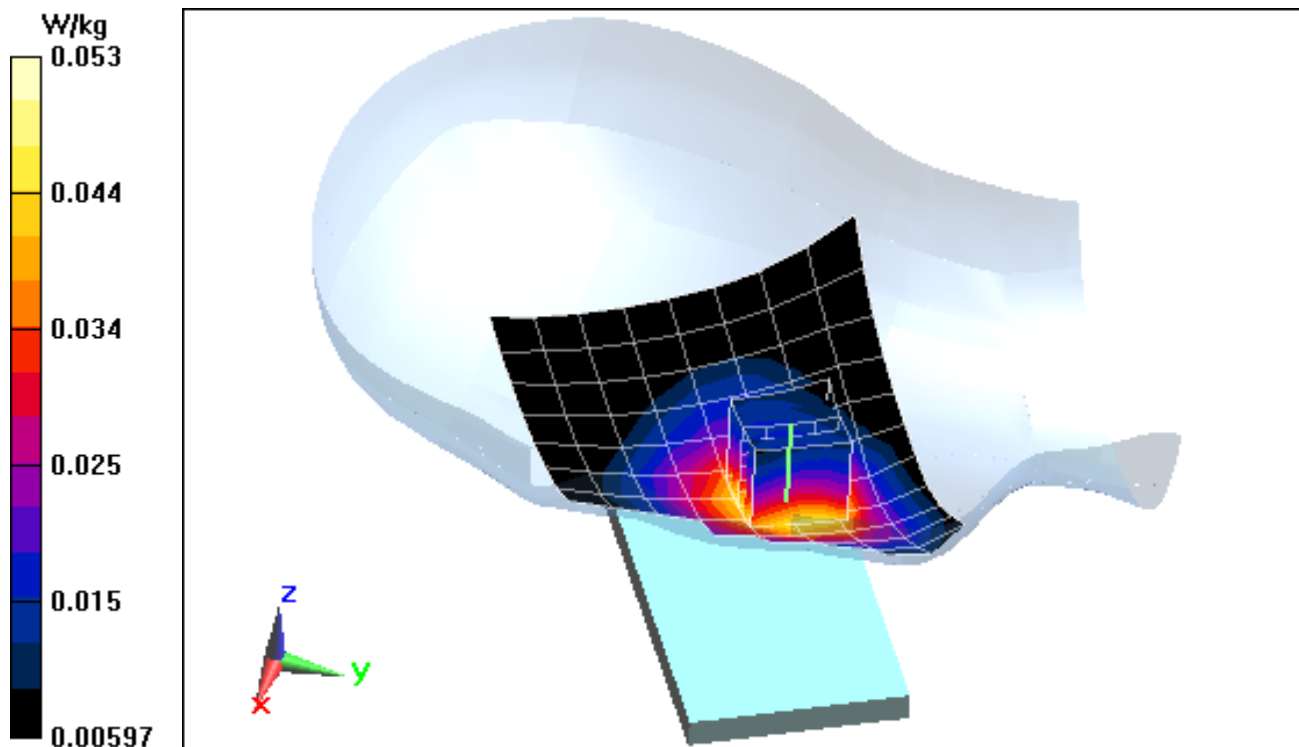
Area Scan (9x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 7.829 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.0620 W/kg

SAR(1 g) = 0.048 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

Communication System: UID 0, LTE Band 26; Frequency: 831.5 MHz; Duty Cycle: 1:1

Medium: 835 Head Medium parameters used (interpolated):

$f = 831.5 \text{ MHz}$; $\sigma = 0.908 \text{ S/m}$; $\epsilon_r = 41.655$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-09-2017; Ambient Temp: 22.2°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3319; ConvF(6.16, 6.16, 6.16); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759

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

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

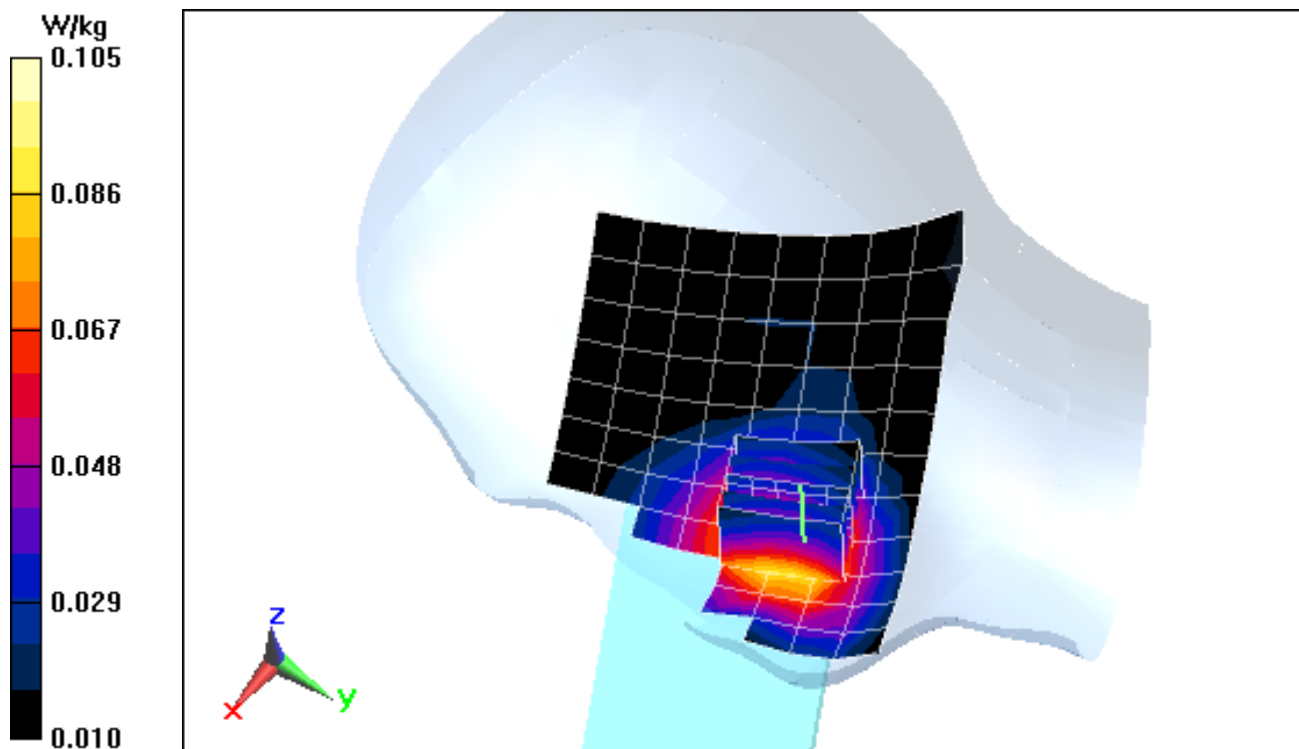
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 11.21 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.119 W/kg

SAR(1 g) = 0.097 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051C8

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

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 0.912 \text{ S/m}$; $\epsilon_r = 41.593$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-09-2017; Ambient Temp: 22.2°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3319; ConvF(6.16, 6.16, 6.16); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759

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

Mode: LTE Band 5 (Cell.), Right Head, Cheek, Mid.ch,

10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset

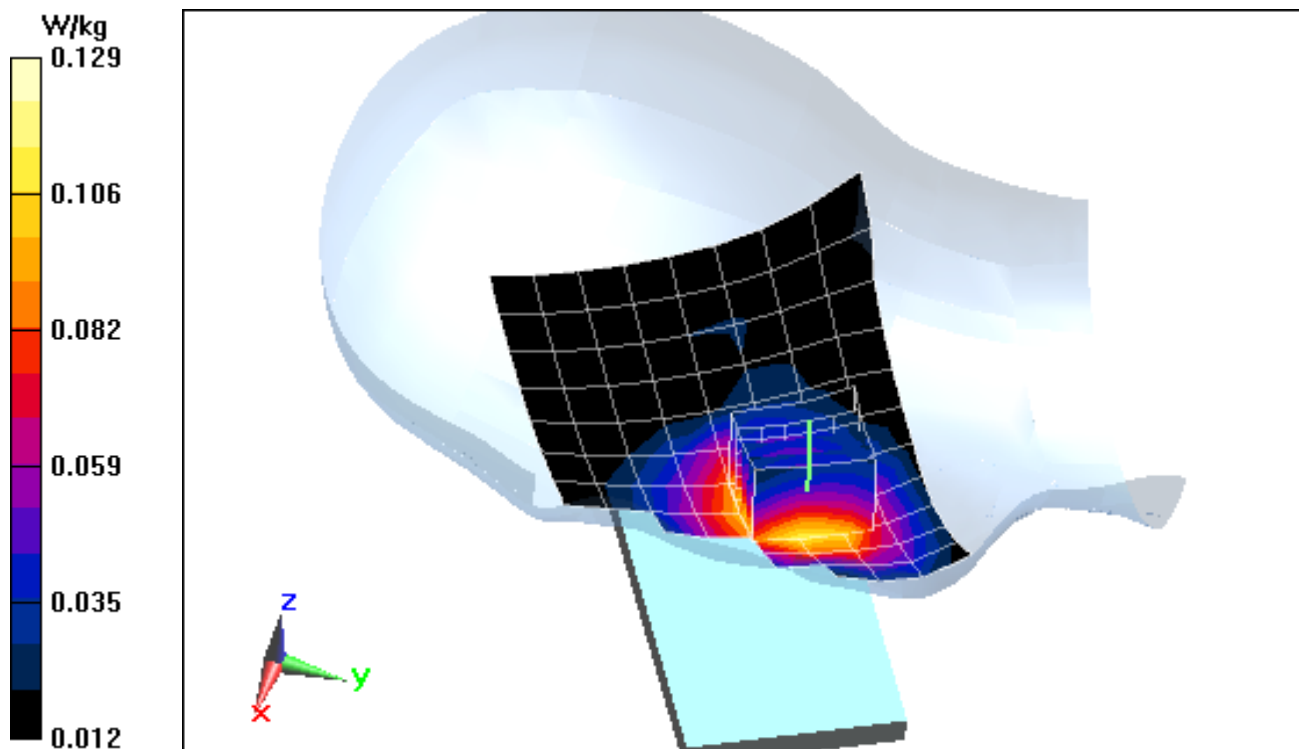
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 12.41 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.151 W/kg

SAR(1 g) = 0.121 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

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

Medium: 1750 Head Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.326 \text{ S/m}$; $\epsilon_r = 39.252$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-12-2017; Ambient Temp: 23.6°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3209; ConvF(5.28, 5.28, 5.28); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

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

**Mode: LTE Band 4 (AWS), Left Head, Cheek, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

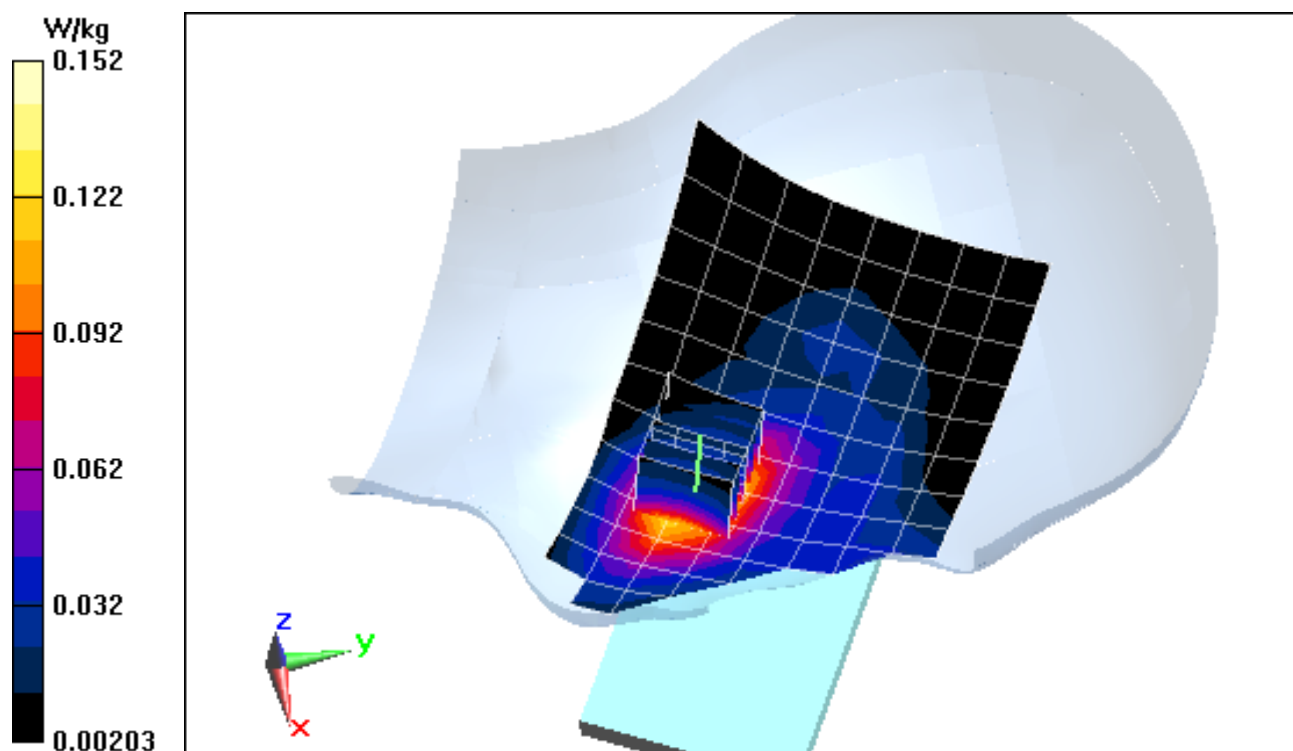
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 11.06 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.192 W/kg

SAR(1 g) = 0.130 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

Communication System: UID 0, LTE Band 25 (PCS); Frequency: 1905 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1905 \text{ MHz}$; $\sigma = 1.427 \text{ S/m}$; $\epsilon_r = 38.205$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-18-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3287; ConvF(5.27, 5.27, 5.27); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

**Mode: LTE Band 25 (PCS), Left Head, Cheek, High.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

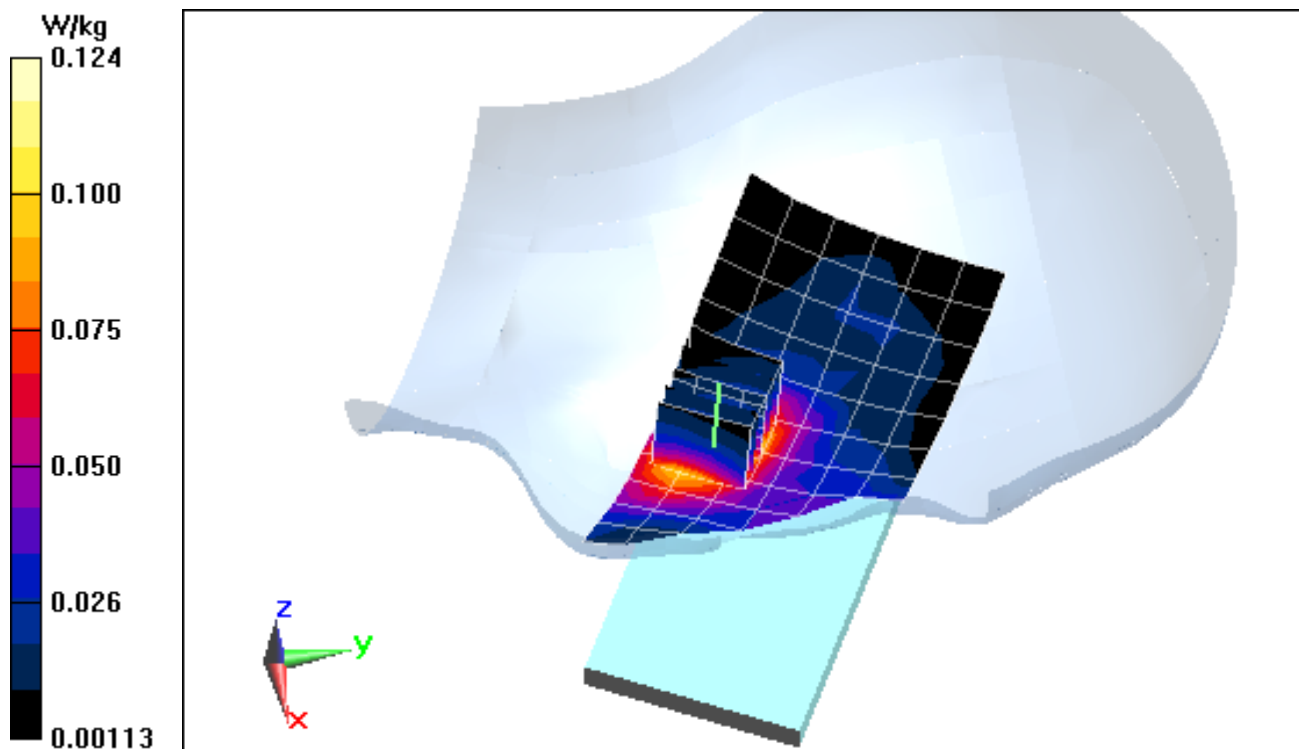
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 9.541 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.161 W/kg

SAR(1 g) = 0.106 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051C8

Communication System: UID 0, LTE Band 41; Frequency: 2593 MHz; Duty Cycle: 1:1.58

Medium: 2600 Head Medium parameters used (interpolated):

$f = 2593 \text{ MHz}$; $\sigma = 2.044 \text{ S/m}$; $\epsilon_r = 38.541$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 01-10-2017; Ambient Temp: 23.6°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3287; ConvF(4.41, 4.41, 4.41); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

**Mode: LTE Band 41, Left Head, Cheek, Mid.ch,
QPSK, 20 MHz Bandwidth, 1 RB, 0 RB Offset**

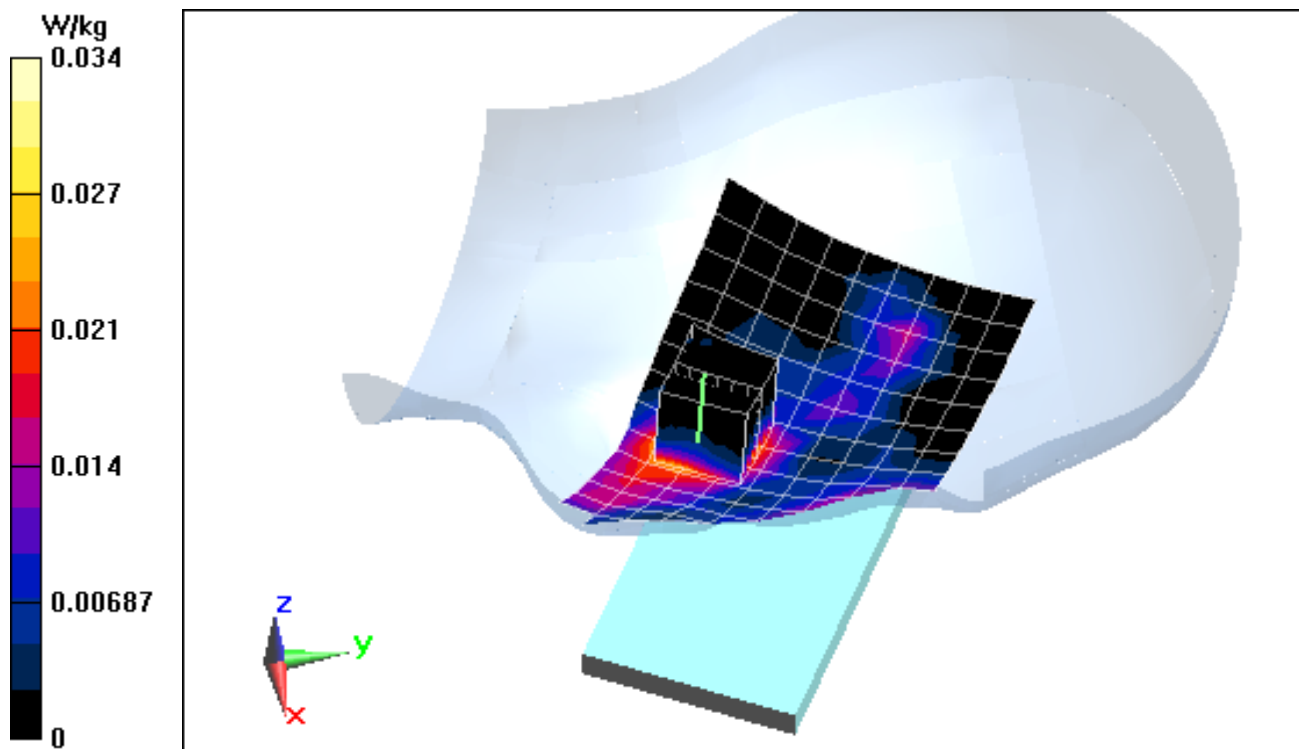
Area Scan (10x17x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 4.215 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.0530 W/kg

SAR(1 g) = 0.027 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 1F3B2

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

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.84 \text{ S/m}$; $\epsilon_r = 39.213$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-13-2017; Ambient Temp: 21.9°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3287; ConvF(4.54, 4.54, 4.54); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

Mode: IEEE 802.11b, 22 MHz Bandwidth, Antenna 2

Right Head, Cheek, Ch 6, 1 Mbps

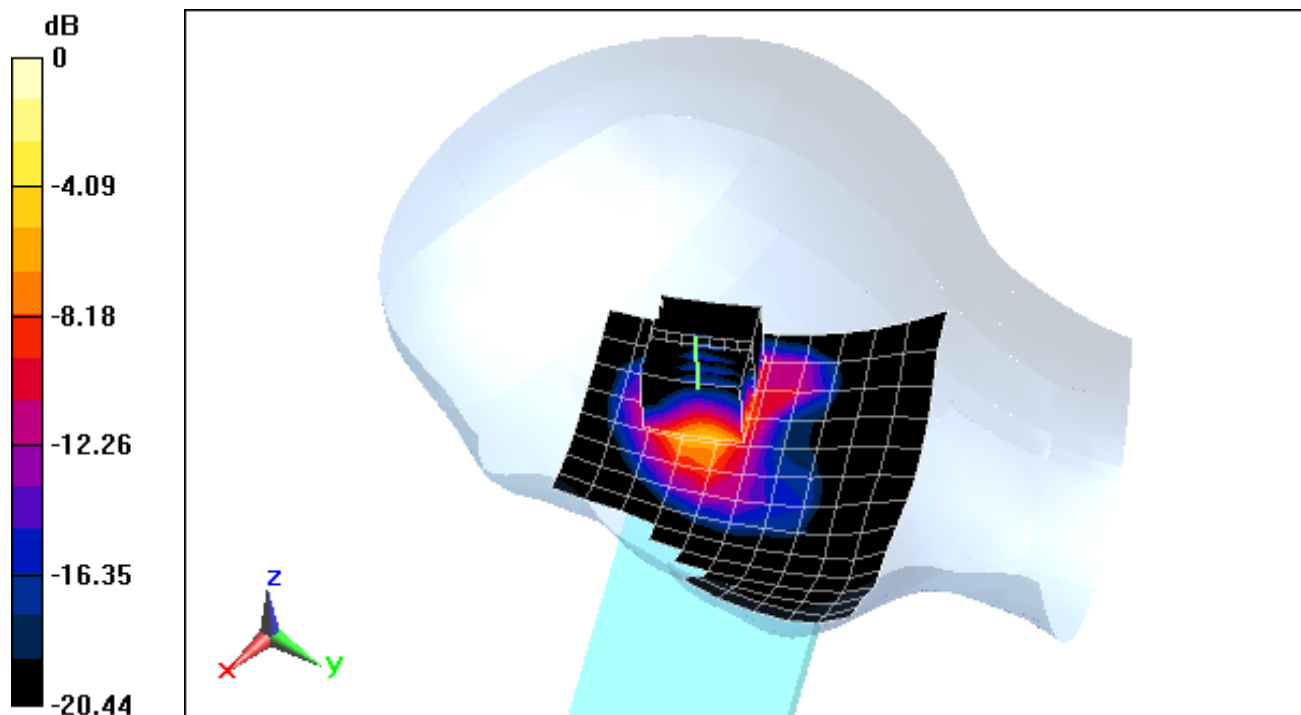
Area Scan (11x17x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 14.97 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.881 W/kg

SAR(1 g) = 0.367 W/kg



0 dB = 0.471 W/kg = -3.27 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051DC

Communication System: UID 0, 802.11ac 5.2-5.8 GHz Band; Frequency: 5290 MHz; Duty Cycle: 1:1

Medium: 5GHz Head Medium parameters used (interpolated):

$f = 5290 \text{ MHz}$; $\sigma = 4.696 \text{ S/m}$; $\epsilon_r = 35.51$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-12-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7357; ConvF(5.1, 5.1, 5.1); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/19/2016

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

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

**Mode: IEEE 802.11ac, U-NII-2A, 80 MHz Bandwidth, Antenna 2
Right Head, Cheek, Ch 58, 29.3 Mbps**

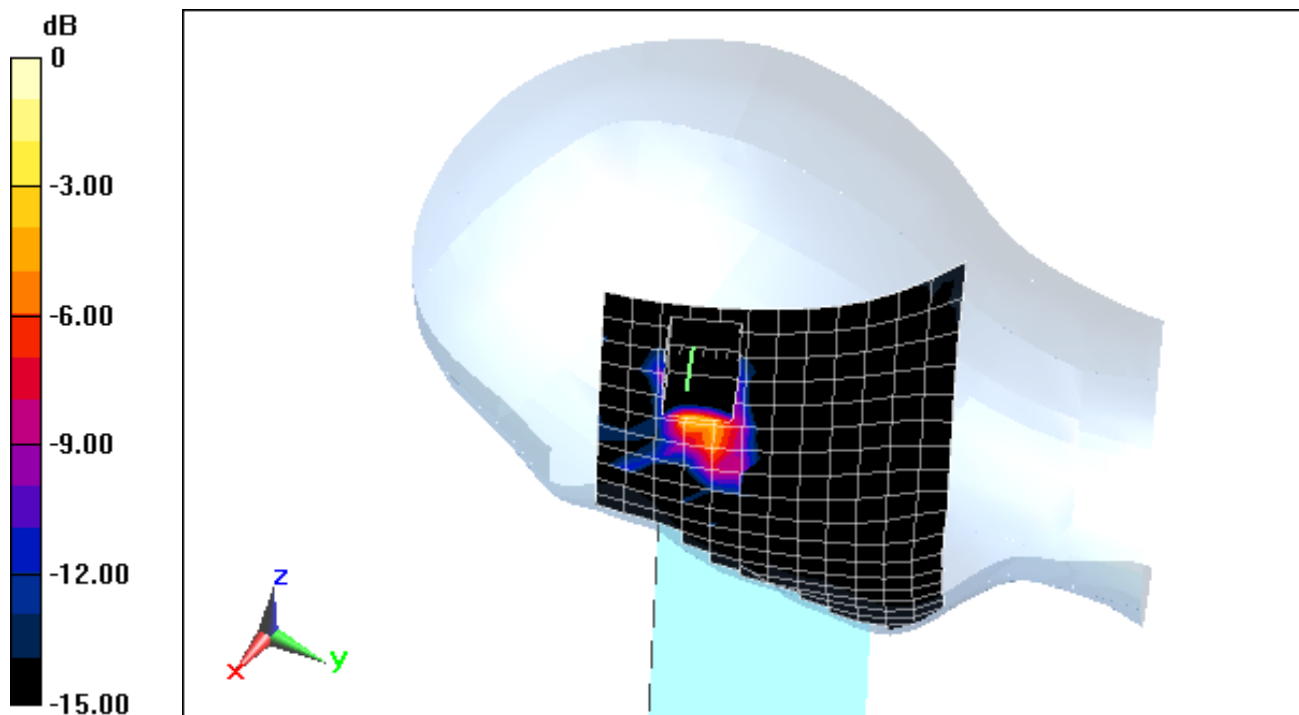
Area Scan (13x22x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

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

Reference Value = 1.100 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.716 W/kg

SAR(1 g) = 0.150 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051DC

Communication System: UID 0, Bluetooth; Frequency: 2402 MHz; Duty Cycle: 1:1.297

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2402 \text{ MHz}$; $\sigma = 1.816 \text{ S/m}$; $\epsilon_r = 38.377$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 01-22-2017; Ambient Temp: 23.2°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3287; ConvF(4.54, 4.54, 4.54); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

Mode: Bluetooth, Right Head, Cheek, Ch 0, 2 Mbps

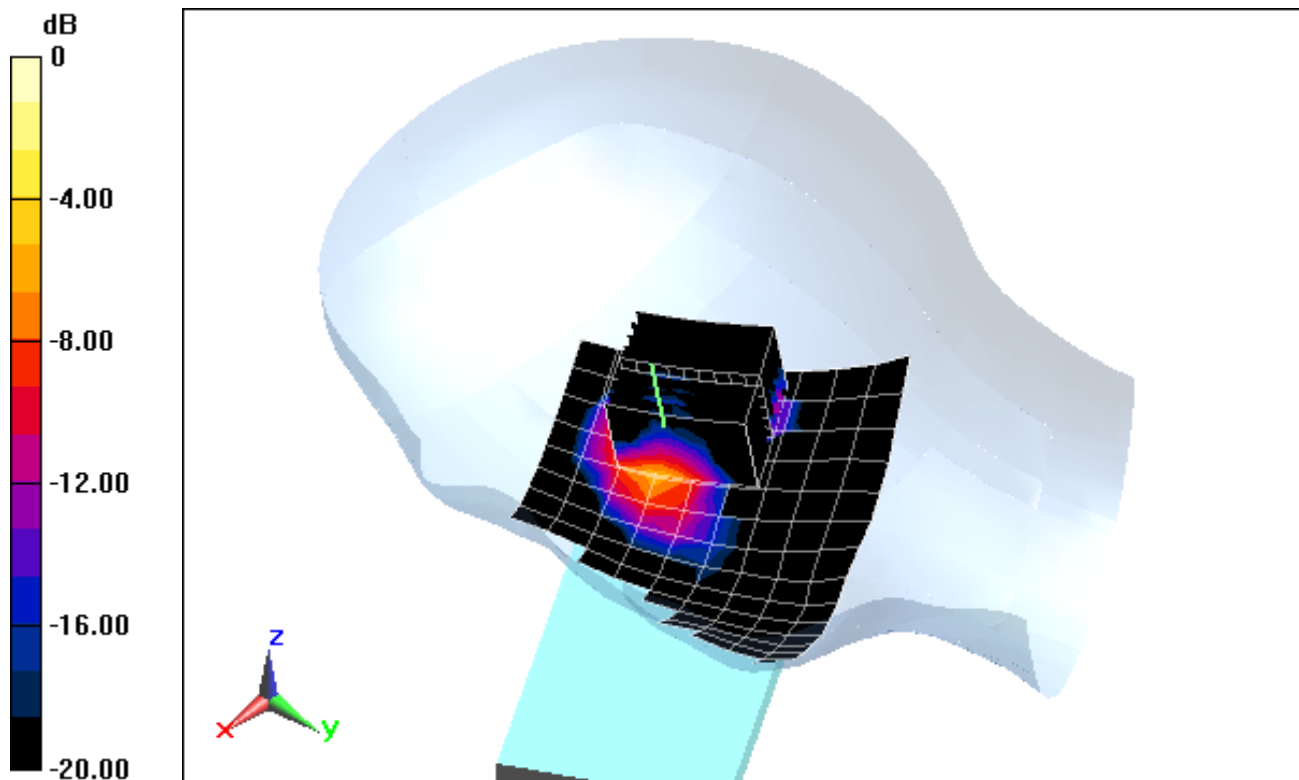
Area Scan (10x17x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

Zoom Scan (10x9x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 1.561 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.159 W/kg

SAR(1 g) = 0.067 W/kg



0 dB = 0.0933 W/kg = -10.30 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

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

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.522 \text{ S/m}$; $\epsilon_r = 51.112$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-11-2017; Ambient Temp: 23.7°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

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

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

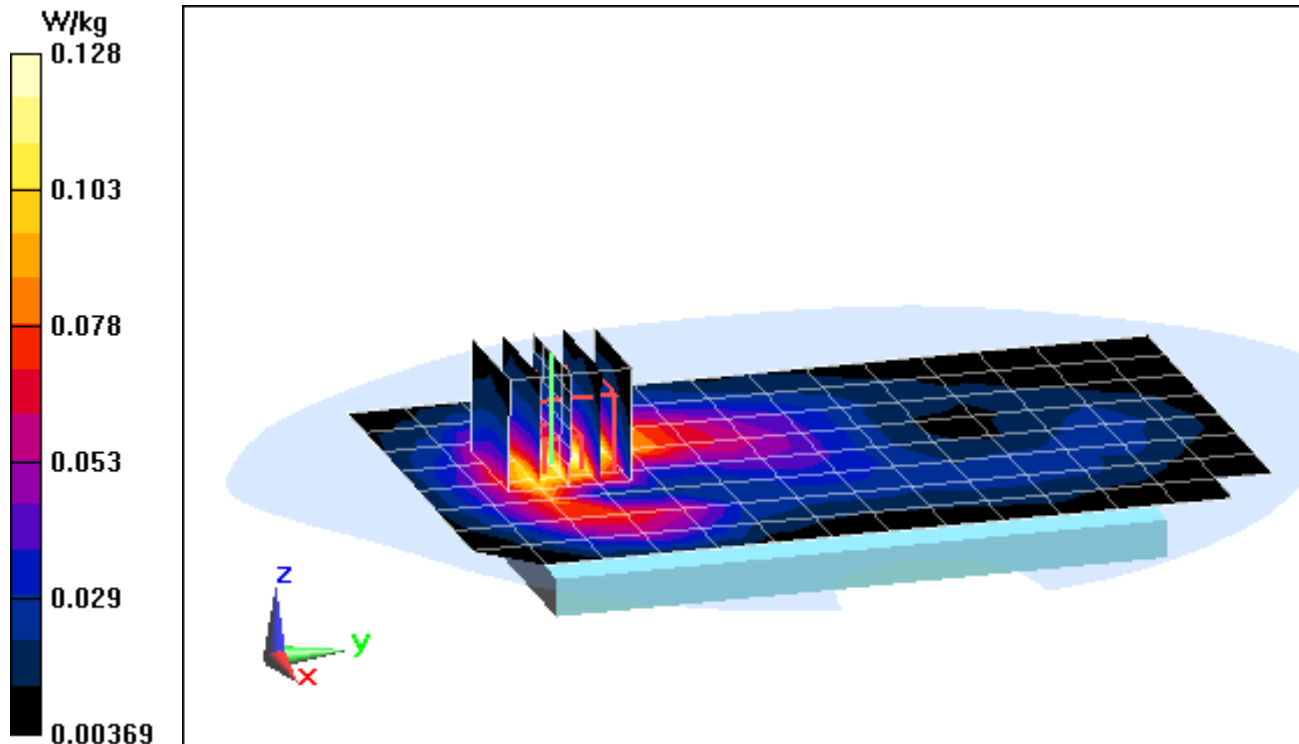
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 7.973 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.151 W/kg

SAR(1 g) = 0.091 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

Communication System: UID 0, GSM GPRS; 4 Tx slots; Frequency: 1880 MHz; Duty Cycle: 1:2.076

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.522 \text{ S/m}$; $\epsilon_r = 51.112$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-11-2017; Ambient Temp: 23.7°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

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

Mode: GPRS 1900, Body SAR, Bottom Edge, Mid.ch, 4 Tx Slots

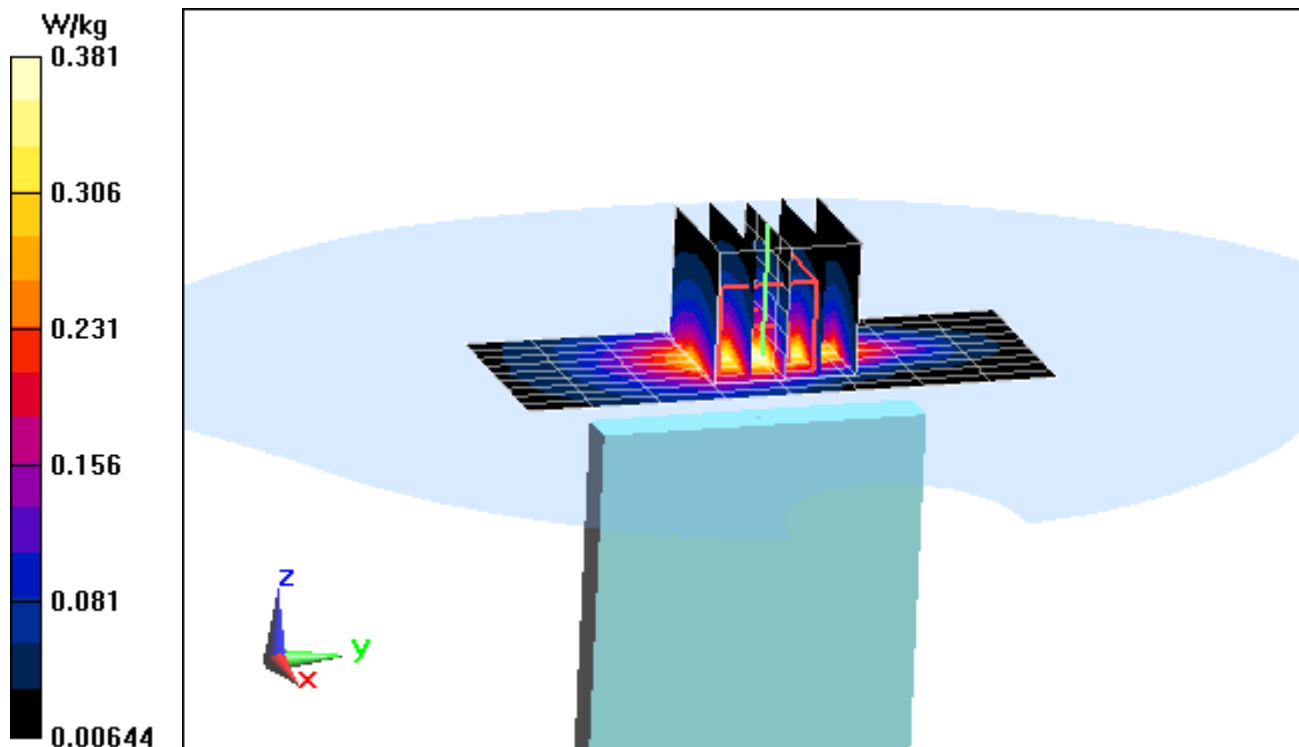
Area Scan (10x9x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 13.53 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.452 W/kg

SAR(1 g) = 0.257 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051C8

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

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.992 \text{ S/m}$; $\epsilon_r = 53.692$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-11-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

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

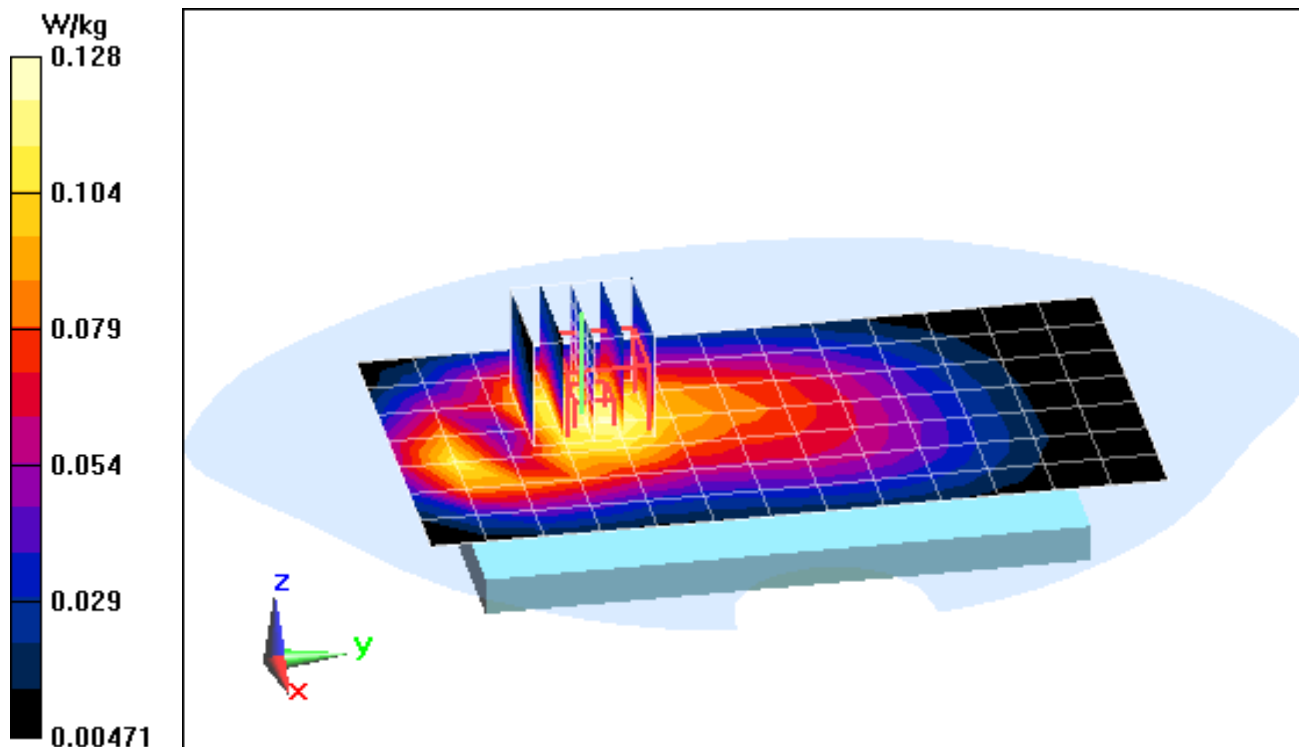
Area Scan (8x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 11.22 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.151 W/kg

SAR(1 g) = 0.115 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051C8

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

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.992 \text{ S/m}$; $\epsilon_r = 53.692$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-11-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

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

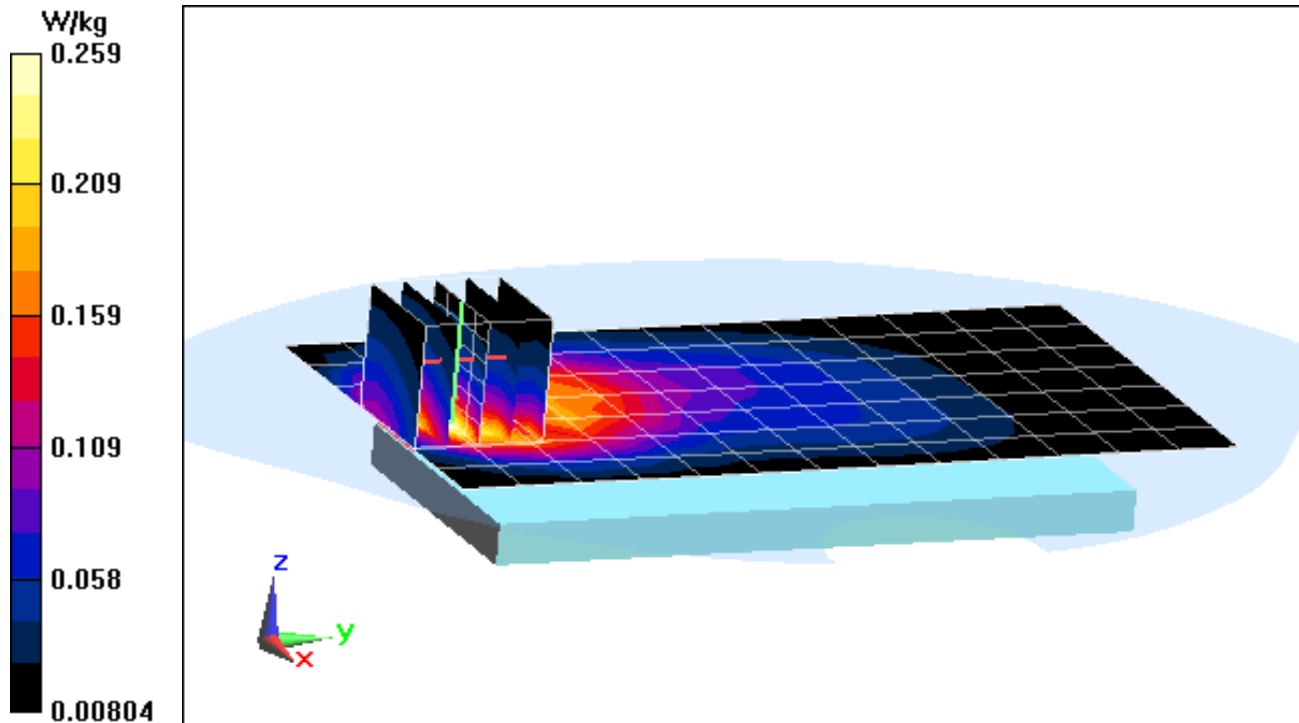
Area Scan (8x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 15.53 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.353 W/kg

SAR(1 g) = 0.211 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

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

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.522 \text{ S/m}$; $\epsilon_r = 51.112$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-11-2017; Ambient Temp: 23.7°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

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

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

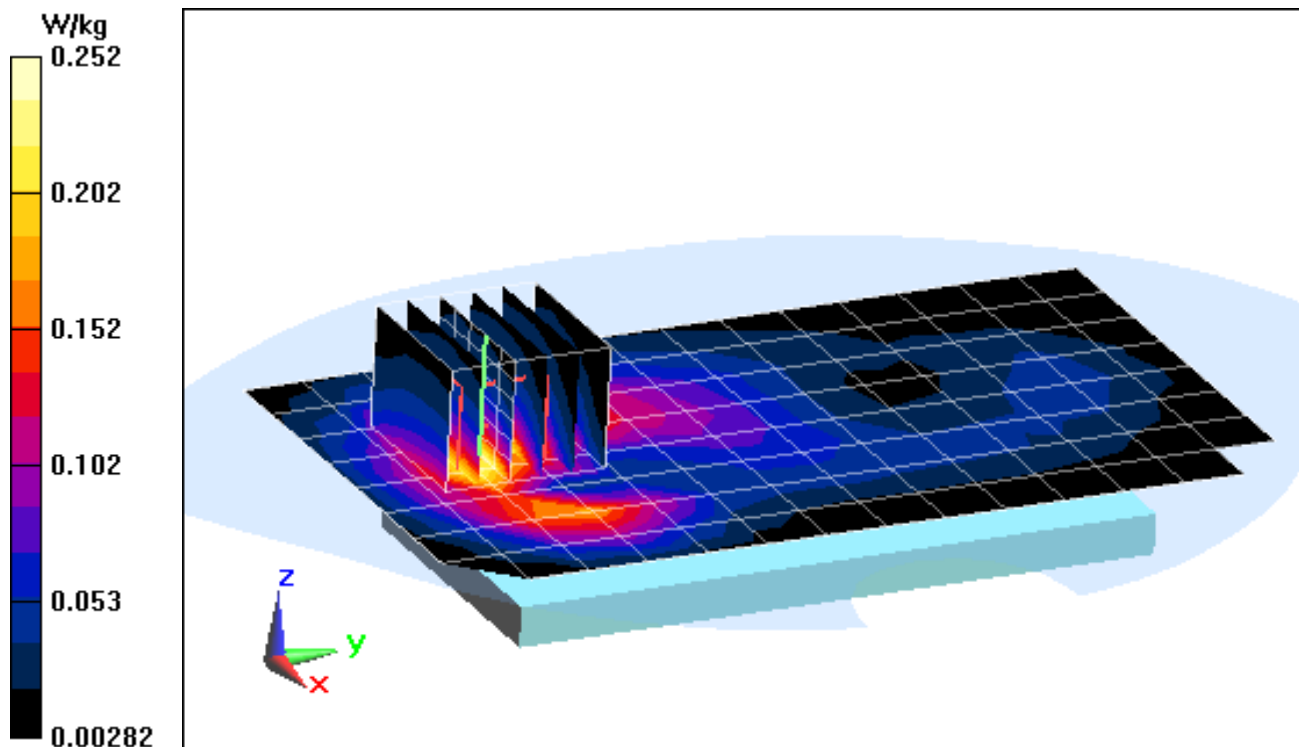
Area Scan (9x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 11.24 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.298 W/kg

SAR(1 g) = 0.178 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

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

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.522 \text{ S/m}$; $\epsilon_r = 51.112$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-11-2017; Ambient Temp: 23.7°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

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

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

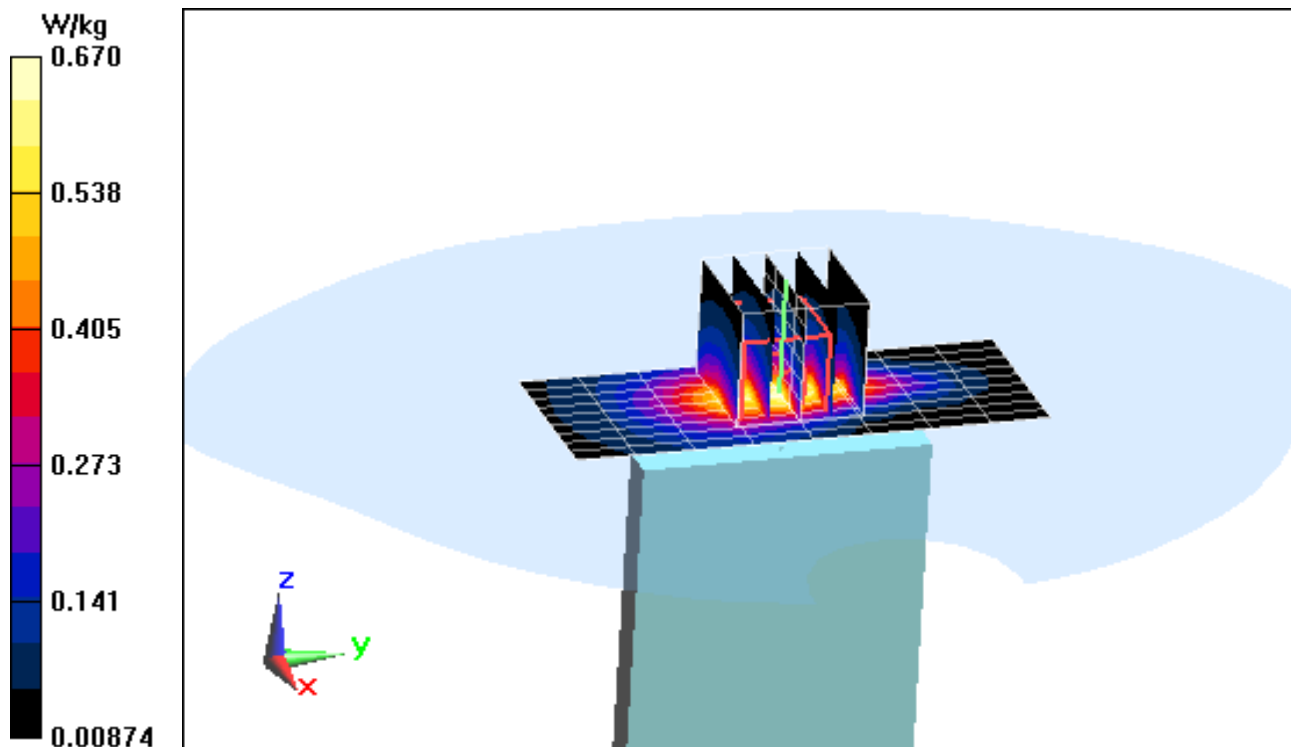
Area Scan (10x9x1): Measurement grid: $dx=5\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 18.10 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.793 W/kg

SAR(1 g) = 0.451 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

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

Medium: 750 Body Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.922 \text{ S/m}$; $\epsilon_r = 55.264$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-17-2017; Ambient Temp: 22.5°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3332; ConvF(6.7, 6.7, 6.7); Calibrated: 8/25/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/15/2016

Phantom: SAM Left; Type: SAM; Serial: 1688

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

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

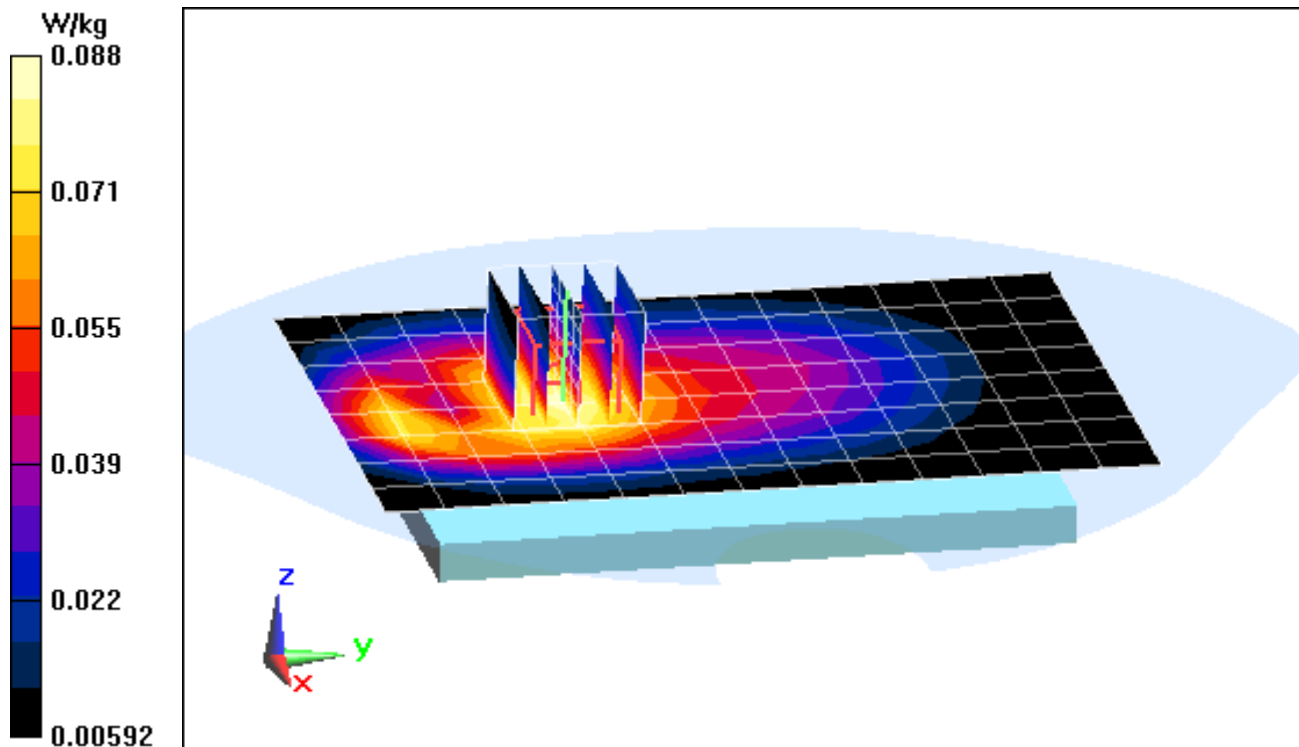
Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 9.552 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.105 W/kg

SAR(1 g) = 0.078 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

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

Medium: 750 Body Medium parameters used (interpolated):

$f = 707.5 \text{ MHz}$; $\sigma = 0.922 \text{ S/m}$; $\epsilon_r = 55.264$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-17-2017; Ambient Temp: 22.5°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3332; ConvF(6.7, 6.7, 6.7); Calibrated: 8/25/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/15/2016

Phantom: SAM Left; Type: SAM; Serial: 1688

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

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

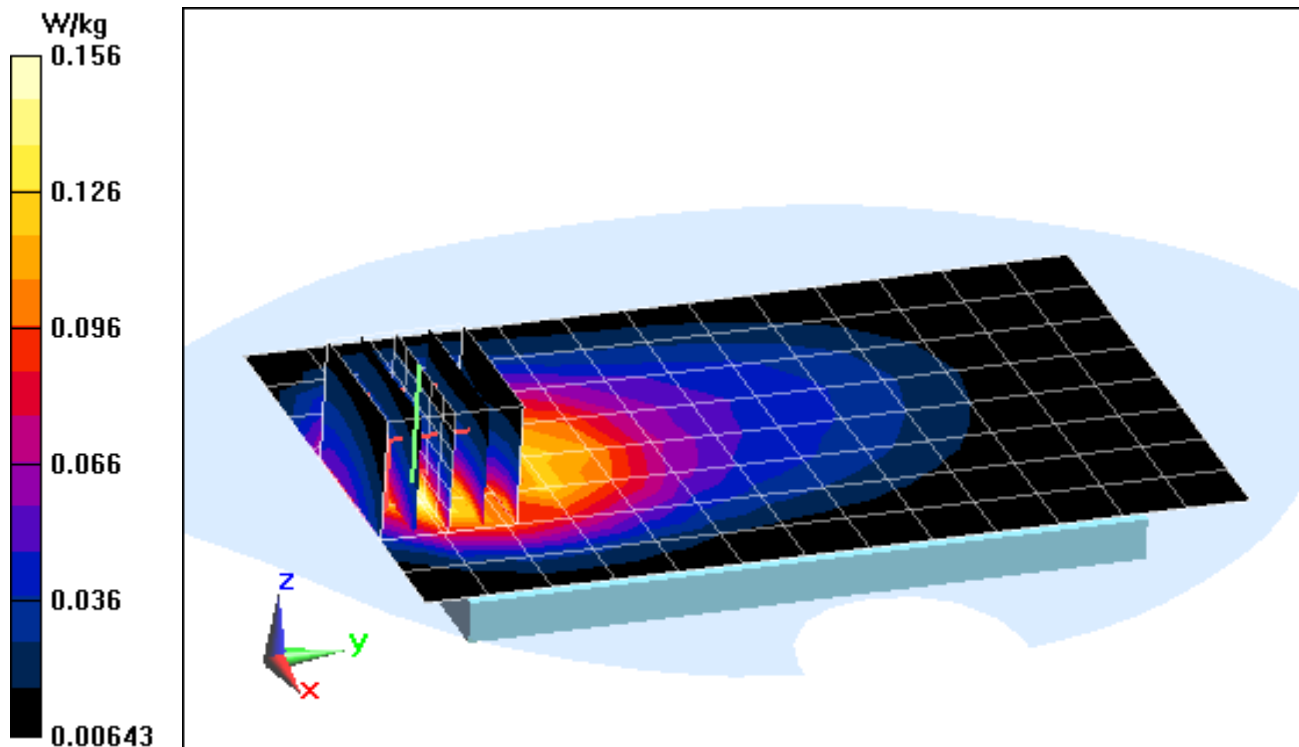
Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 2.622 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.209 W/kg

SAR(1 g) = 0.126 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1

Medium: 750 Body Medium parameters used (interpolated):

$f = 782 \text{ MHz}$; $\sigma = 0.983 \text{ S/m}$; $\epsilon_r = 54.524$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.5 cm

Test Date: 01-14-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3332; ConvF(6.7, 6.7, 6.7); Calibrated: 8/25/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/15/2016

Phantom: SAM Left; Type: SAM; Serial: 1688

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

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

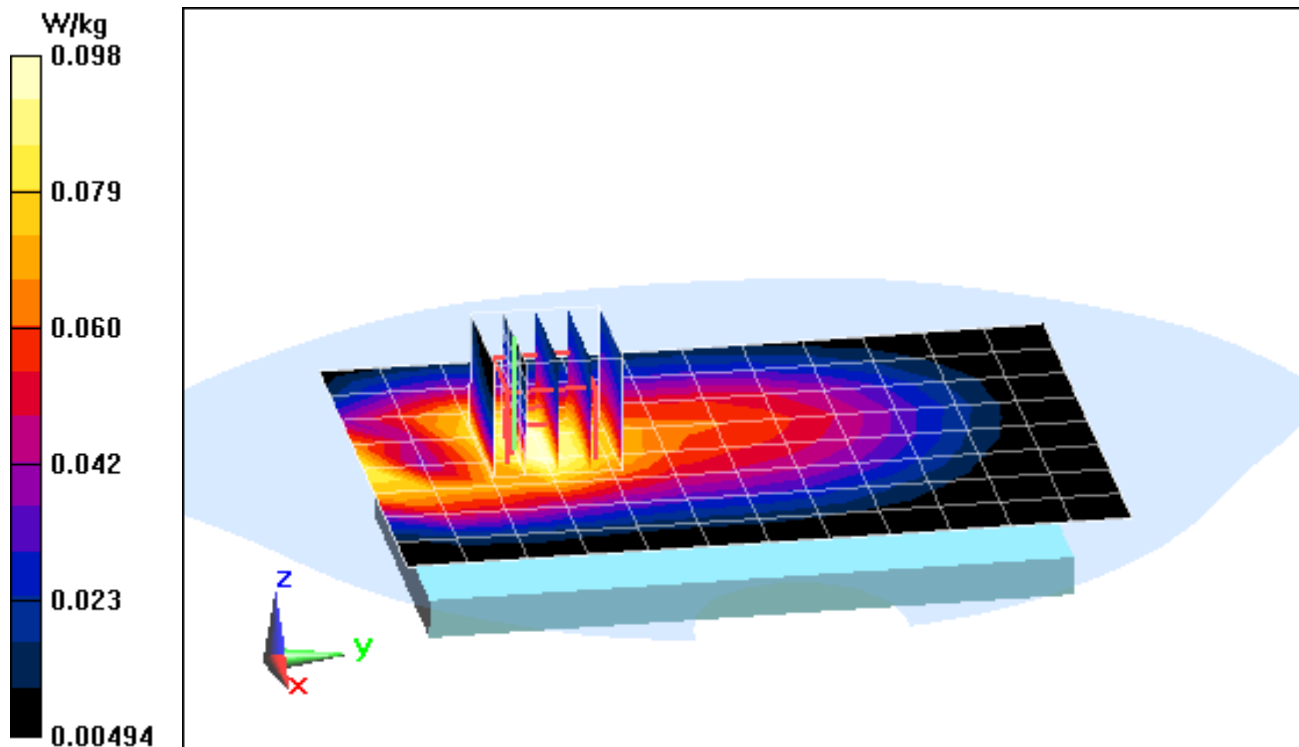
Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 9.797 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.121 W/kg

SAR(1 g) = 0.089 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

Communication System: UID 0, LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1

Medium: 750 Body Medium parameters used (interpolated):

$f = 782 \text{ MHz}$; $\sigma = 0.983 \text{ S/m}$; $\epsilon_r = 54.524$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-14-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3332; ConvF(6.7, 6.7, 6.7); Calibrated: 8/25/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/15/2016

Phantom: SAM Left; Type: SAM; Serial: 1688

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

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

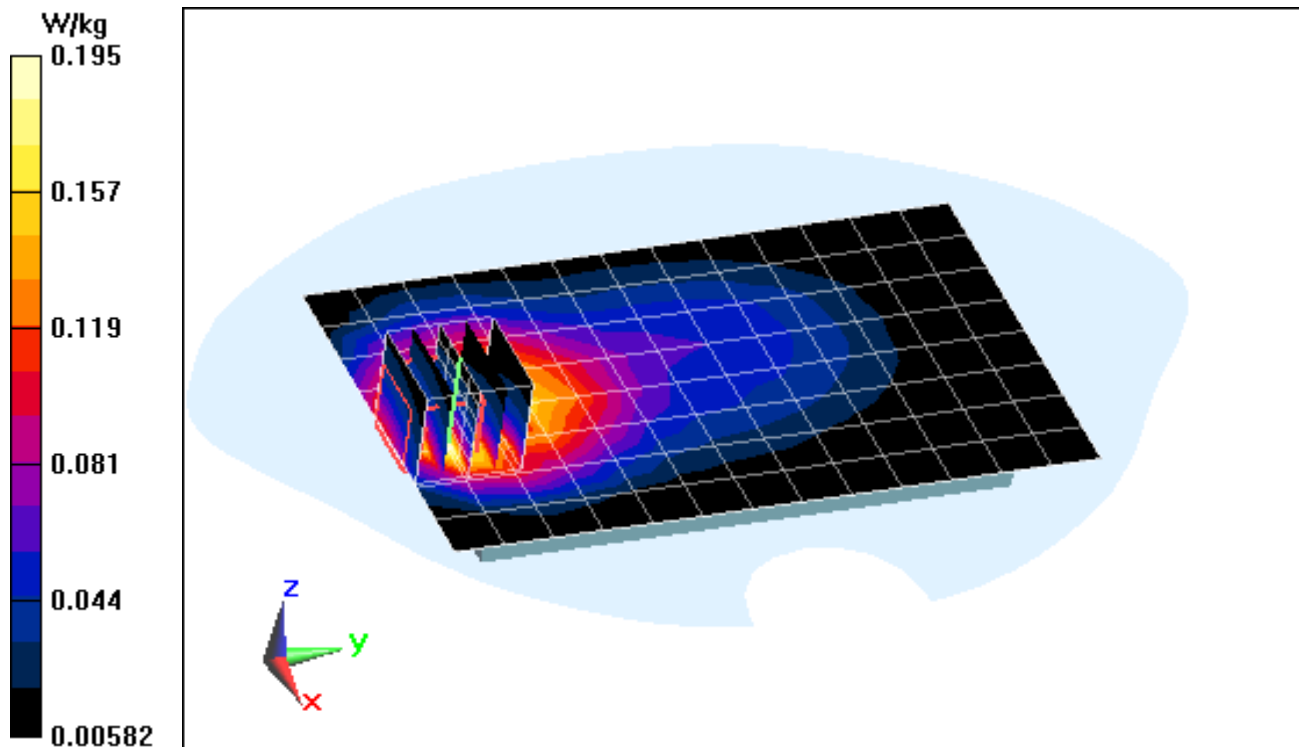
Area Scan (9x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 13.36 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.279 W/kg

SAR(1 g) = 0.163 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

Communication System: UID 0, LTE Band 26; Frequency: 831.5 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 831.5 \text{ MHz}$; $\sigma = 0.987 \text{ S/m}$; $\epsilon_r = 53.729$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-11-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

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

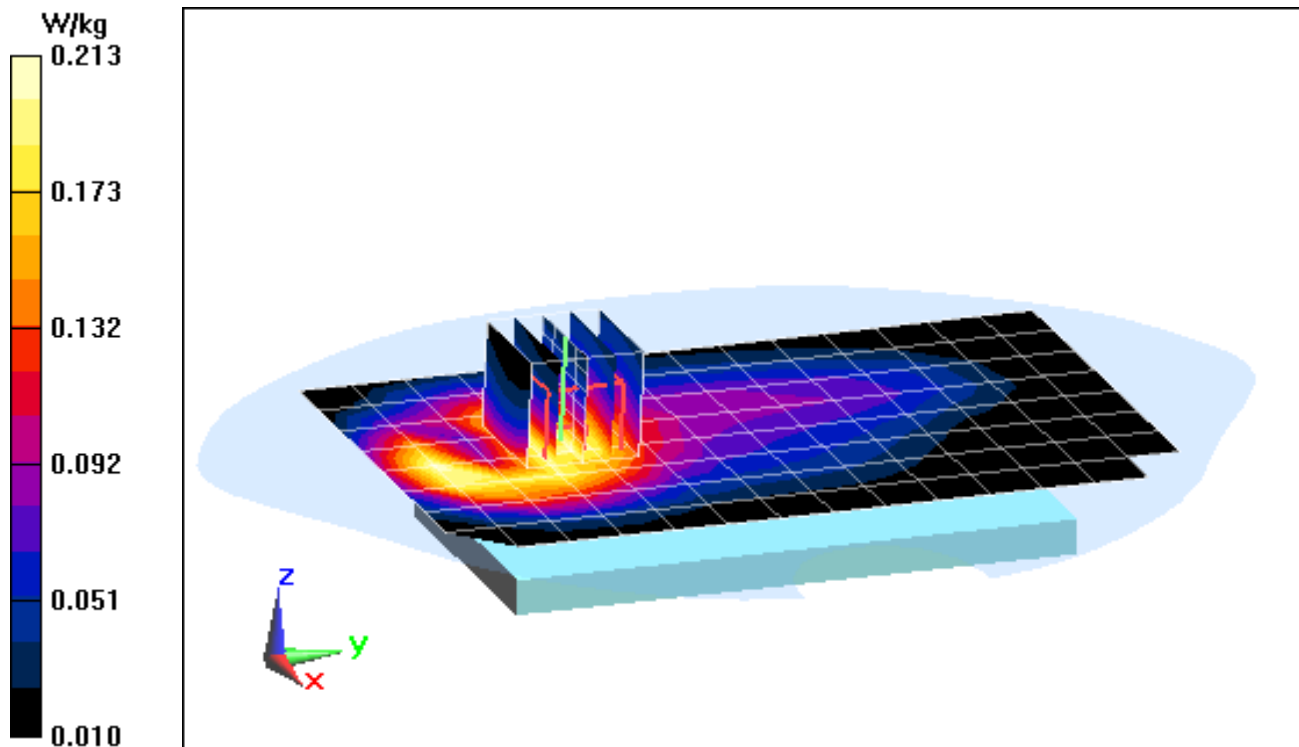
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 14.35 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.267 W/kg

SAR(1 g) = 0.188 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051D1

Communication System: UID 0, LTE Band 26; Frequency: 831.5 MHz; Duty Cycle: 1:1

Medium: 835 Body Medium parameters used (interpolated):

$f = 831.5 \text{ MHz}$; $\sigma = 0.987 \text{ S/m}$; $\epsilon_r = 53.729$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-11-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

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

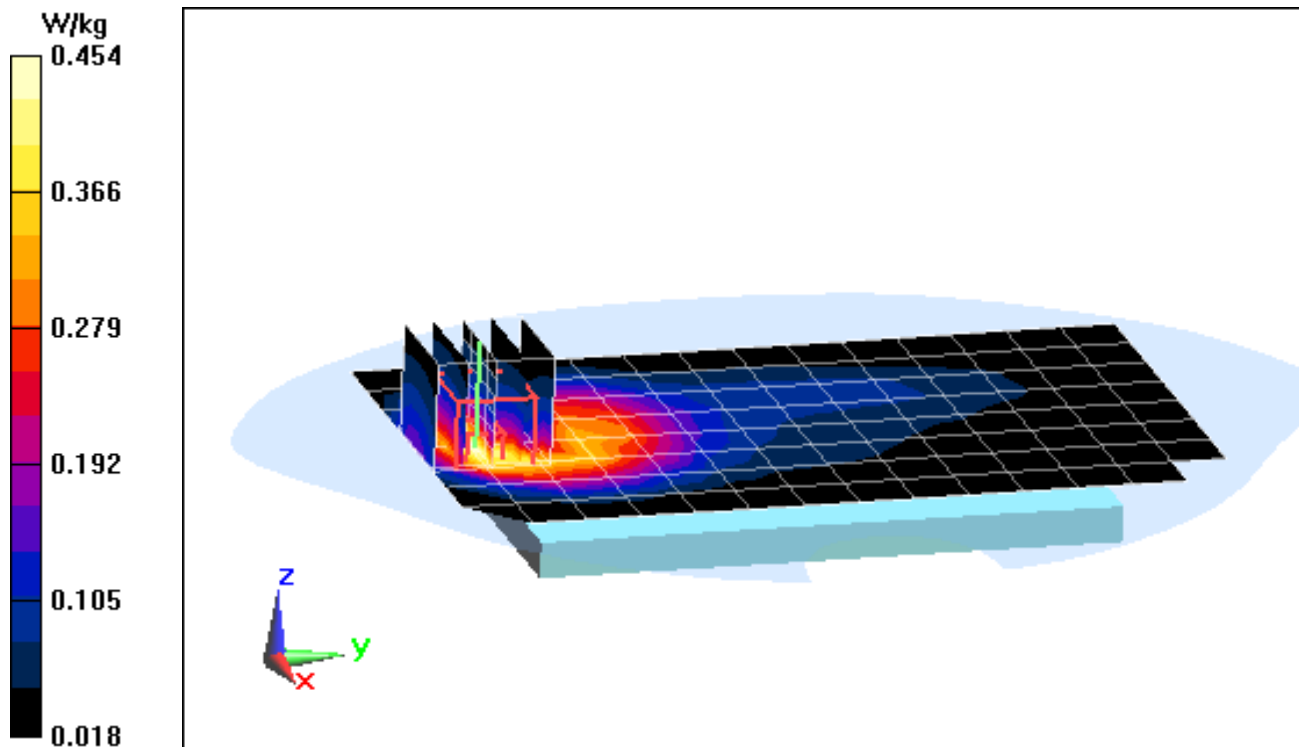
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

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

Peak SAR (extrapolated) = 0.616 W/kg

SAR(1 g) = 0.370 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051C8

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

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 1.009 \text{ S/m}$; $\epsilon_r = 54.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-21-2017; Ambient Temp: 21.2°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

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

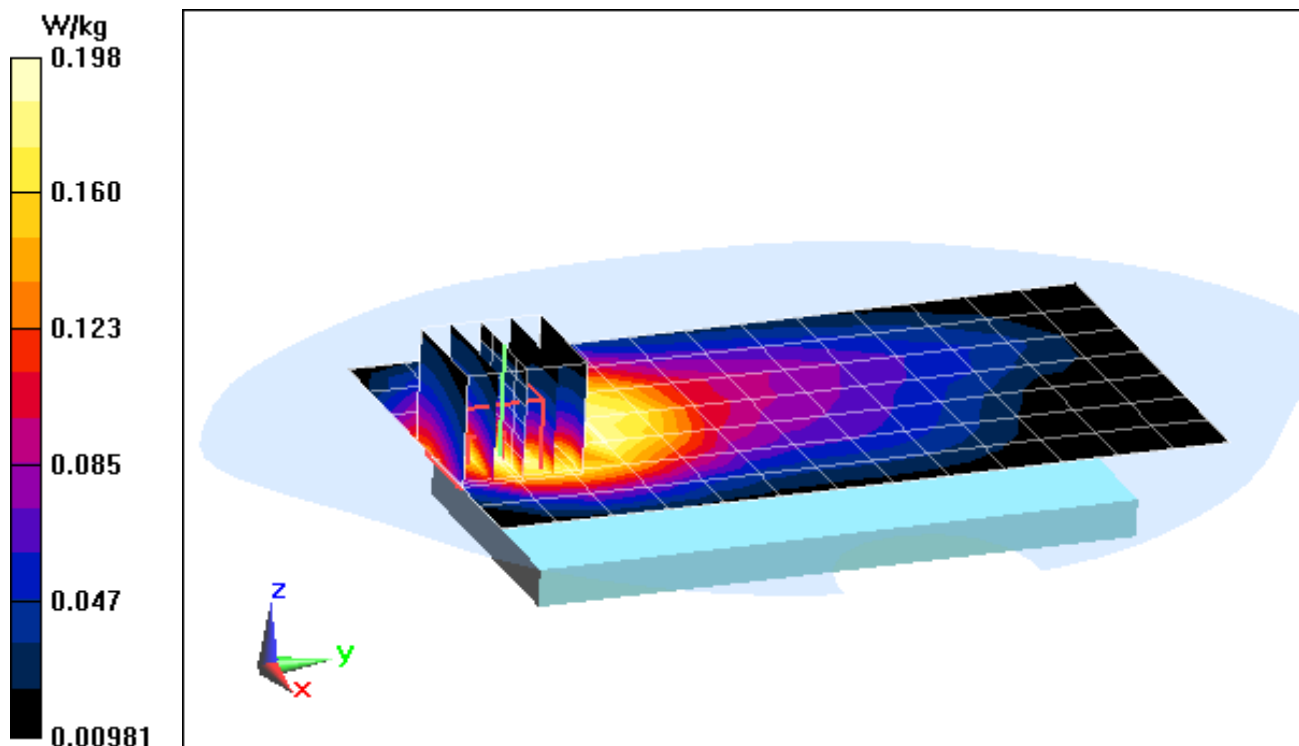
Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 14.21 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.268 W/kg

SAR(1 g) = 0.173 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051C8

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

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 1.009 \text{ S/m}$; $\epsilon_r = 54.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-21-2017; Ambient Temp: 21.2°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

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

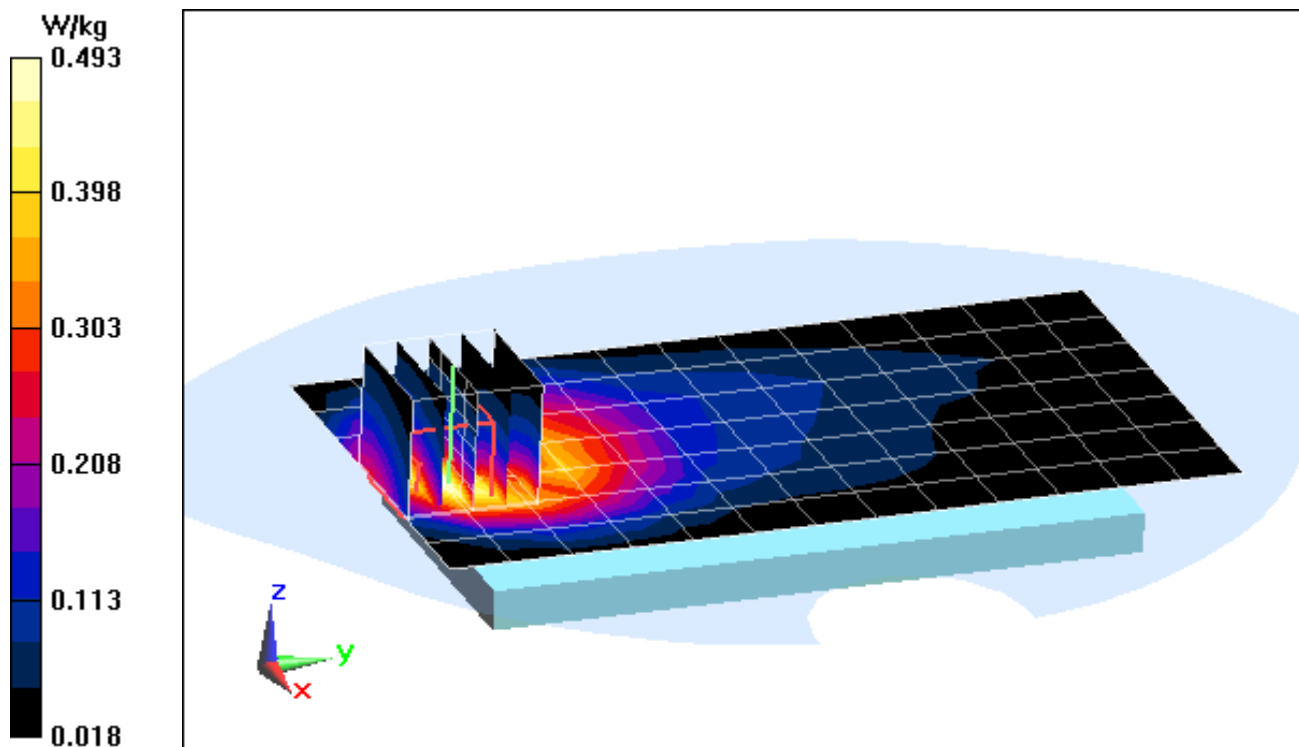
Area Scan (8x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 21.32 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.682 W/kg

SAR(1 g) = 0.414 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

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

Medium: 1750 Body Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.445 \text{ S/m}$; $\epsilon_r = 51.412$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-07-2017; Ambient Temp: 23.0°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3209; ConvF(4.99, 4.99, 4.99); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

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

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

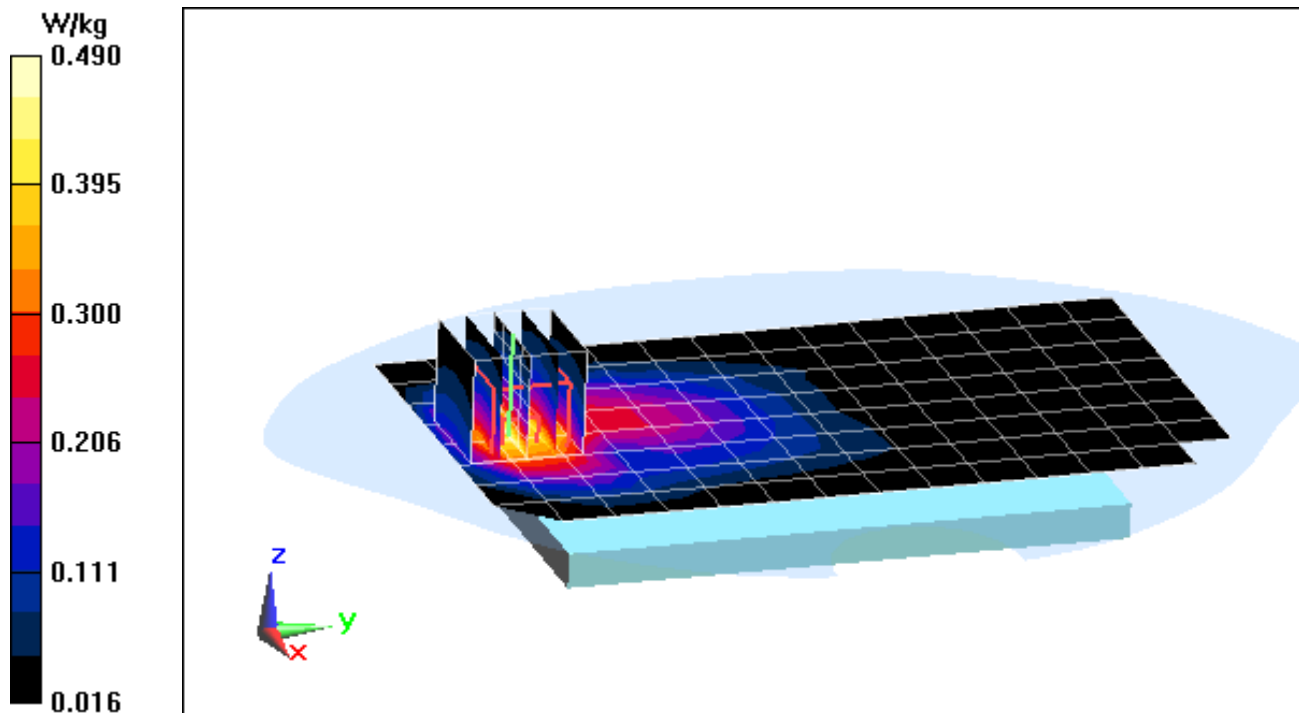
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 18.00 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.624 W/kg

SAR(1 g) = 0.417 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

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

Medium: 1750 Body Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.465 \text{ S/m}$; $\epsilon_r = 51.033$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-14-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3209; ConvF(4.99, 4.99, 4.99); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

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

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

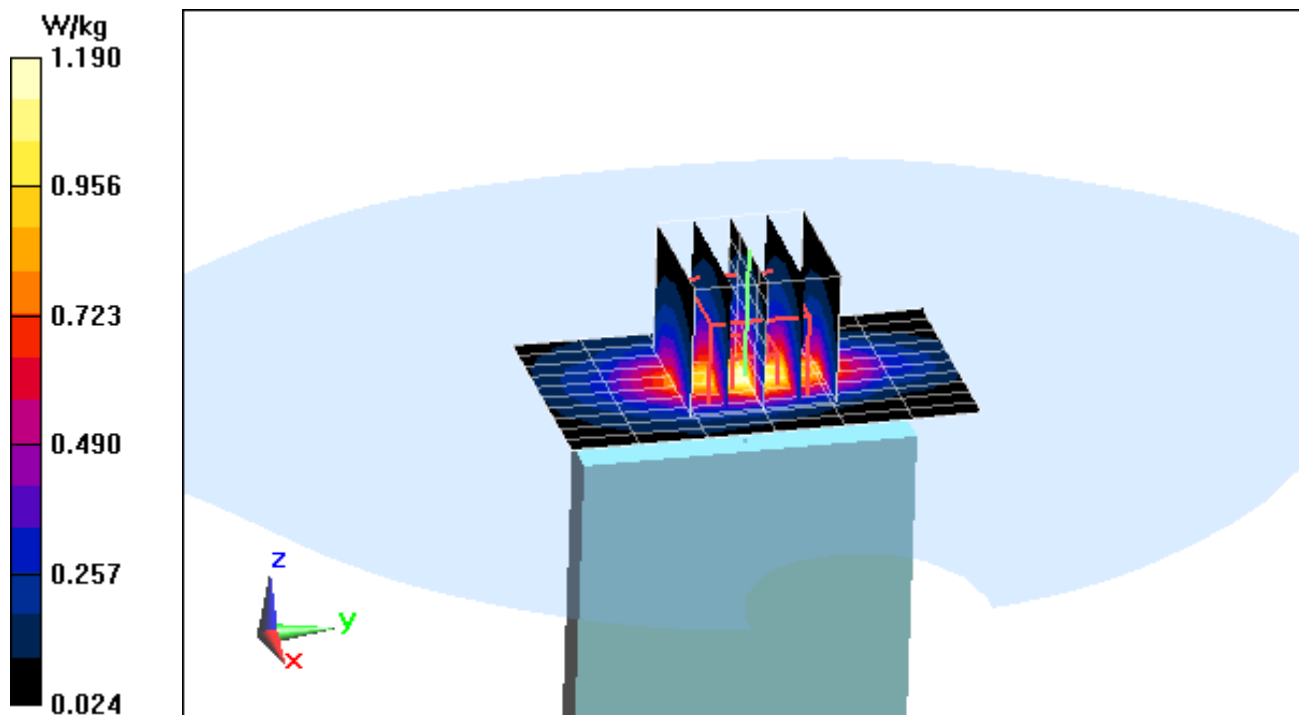
Area Scan (11x7x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 27.78 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.56 W/kg

SAR(1 g) = 0.972 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

Communication System: UID 0, LTE Band 25 (PCS); Frequency: 1905 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1905 \text{ MHz}$; $\sigma = 1.577 \text{ S/m}$; $\epsilon_r = 51.305$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-16-2017; Ambient Temp: 22.3°C; Tissue Temp: 22.7°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

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

**Mode: LTE Band 25 (PCS), Body SAR, Back side, High.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

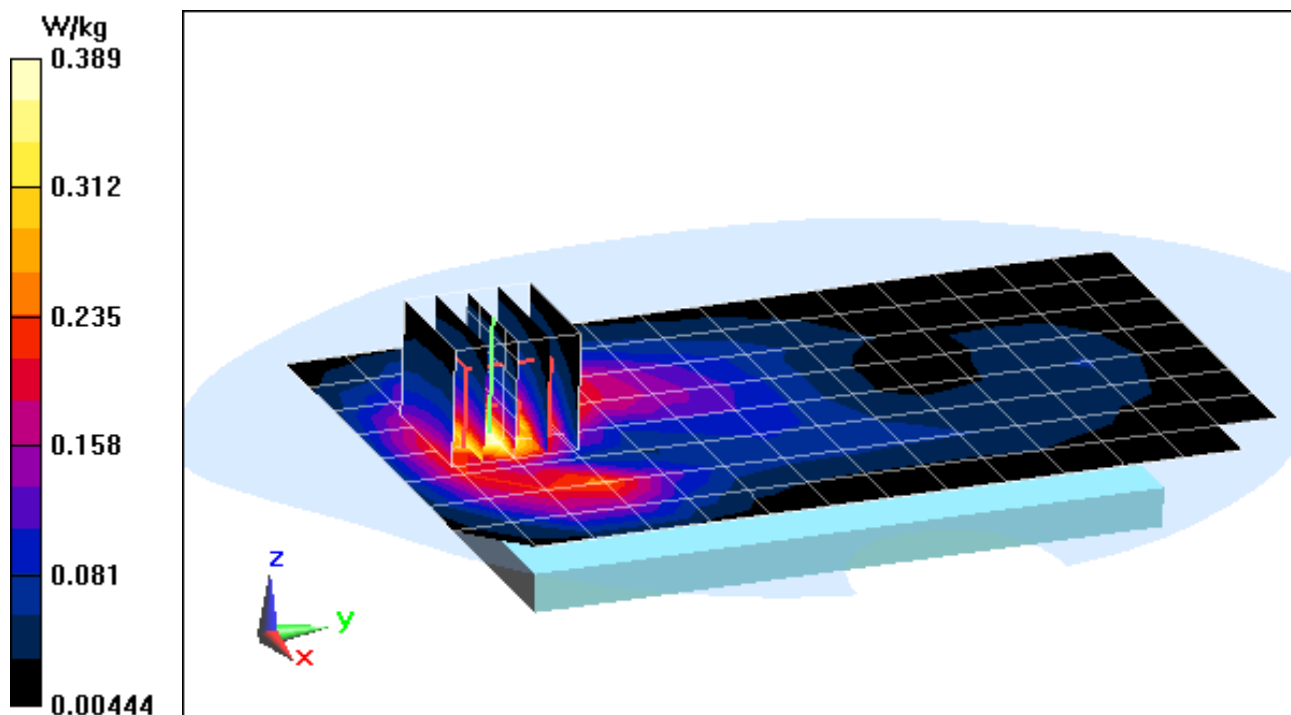
Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 13.79 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.457 W/kg

SAR(1 g) = 0.274 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

Communication System: UID 0, LTE Band 25 (PCS); Frequency: 1905 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1905 \text{ MHz}$; $\sigma = 1.546 \text{ S/m}$; $\epsilon_r = 51.074$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-11-2017; Ambient Temp: 23.7°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

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

**Mode: LTE Band 25 (PCS), Body SAR, Bottom Edge,
High.ch, 20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

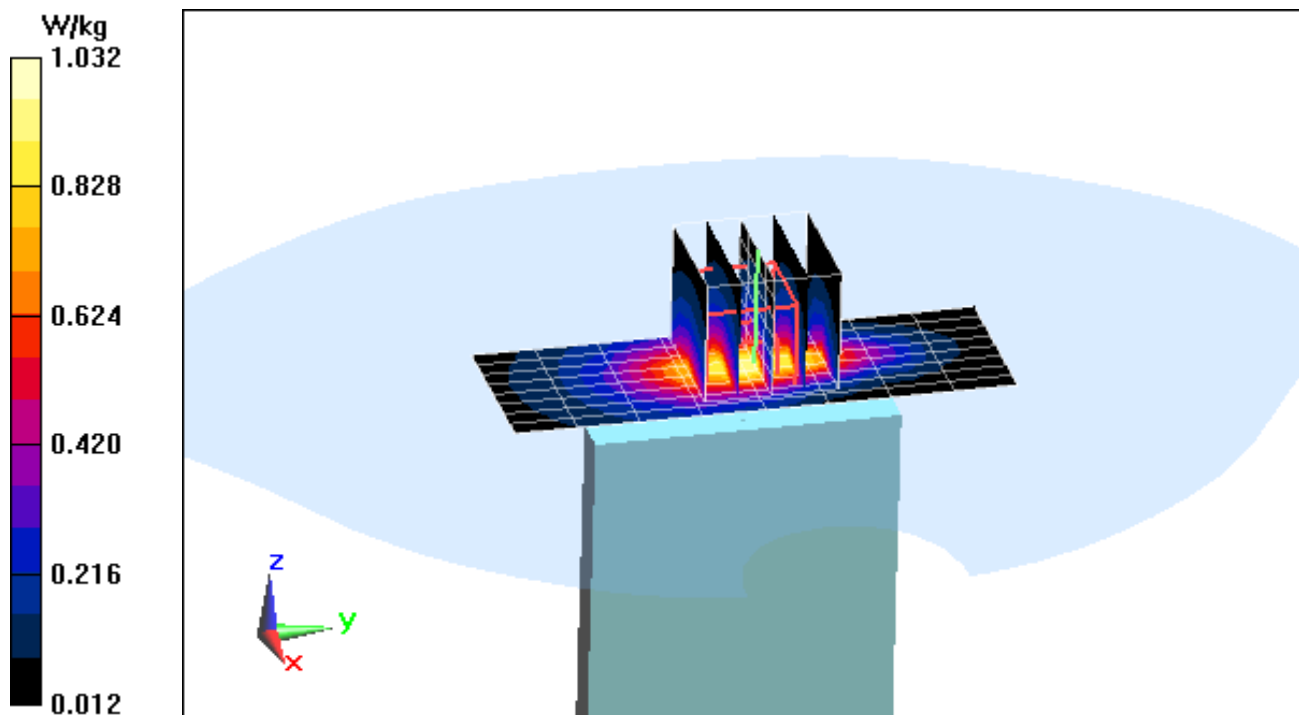
Area Scan (9x9x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 21.73 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 1.23 W/kg

SAR(1 g) = 0.677 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

Communication System: UID 0, LTE Band 41; Frequency: 2593 MHz; Duty Cycle: 1:1.58

Medium: 2600 Body Medium parameters used (interpolated):

$f = 2593 \text{ MHz}$; $\sigma = 2.233 \text{ S/m}$; $\epsilon_r = 50.252$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-12-2017; Ambient Temp: 24.5°C; Tissue Temp: 22.7°C

Probe: EX3DV4 - SN7406; ConvF(6.94, 6.94, 6.94); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

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

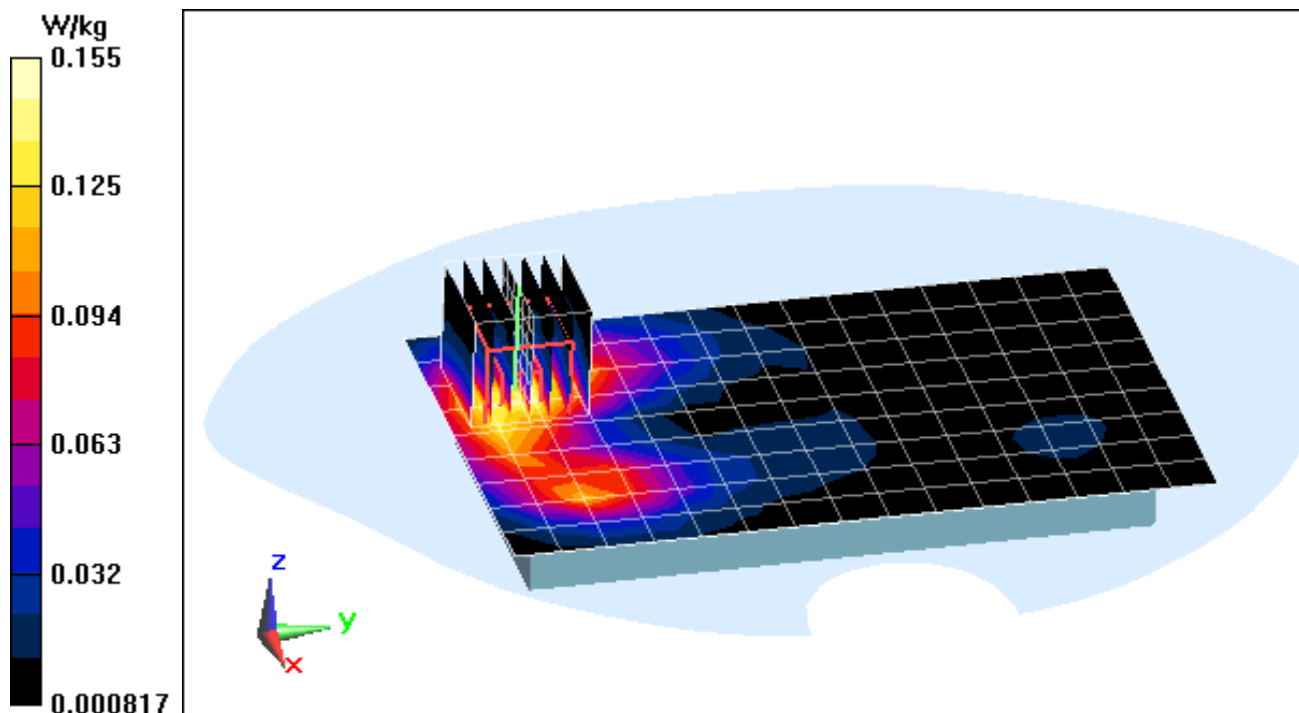
Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 6.947 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.194 W/kg

SAR(1 g) = 0.100 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051B0

Communication System: UID 0, LTE Band 41; Frequency: 2593 MHz; Duty Cycle: 1:1.58

Medium: 2600 Body Medium parameters used (interpolated):

$f = 2593 \text{ MHz}$; $\sigma = 2.233 \text{ S/m}$; $\epsilon_r = 50.252$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 01-12-2017; Ambient Temp: 24.5°C; Tissue Temp: 22.7°C

Probe: EX3DV4 - SN7406; ConvF(6.94, 6.94, 6.94); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

**Mode: LTE Band 41, Body SAR, Bottom Edge, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset**

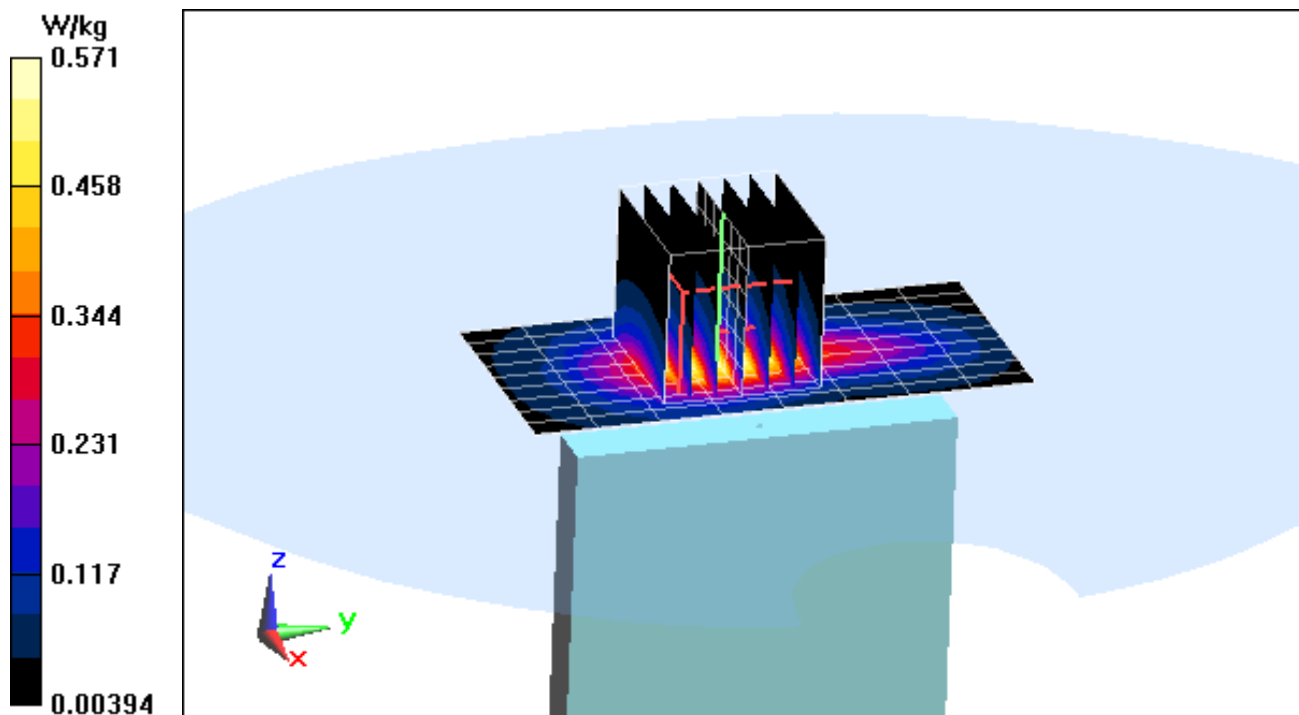
Area Scan (10x9x1): Measurement grid: dx=5mm, dy=12mm

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

Reference Value = 13.21 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.712 W/kg

SAR(1 g) = 0.350 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 1F3B2

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

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 2.016 \text{ S/m}$; $\epsilon_r = 50.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-12-2017; Ambient Temp: 24.5°C; Tissue Temp: 22.7°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

**Mode: IEEE 802.11b, 22 MHz Bandwidth, Antenna 2,
Body SAR, Ch 6, 1 Mbps, Back Side**

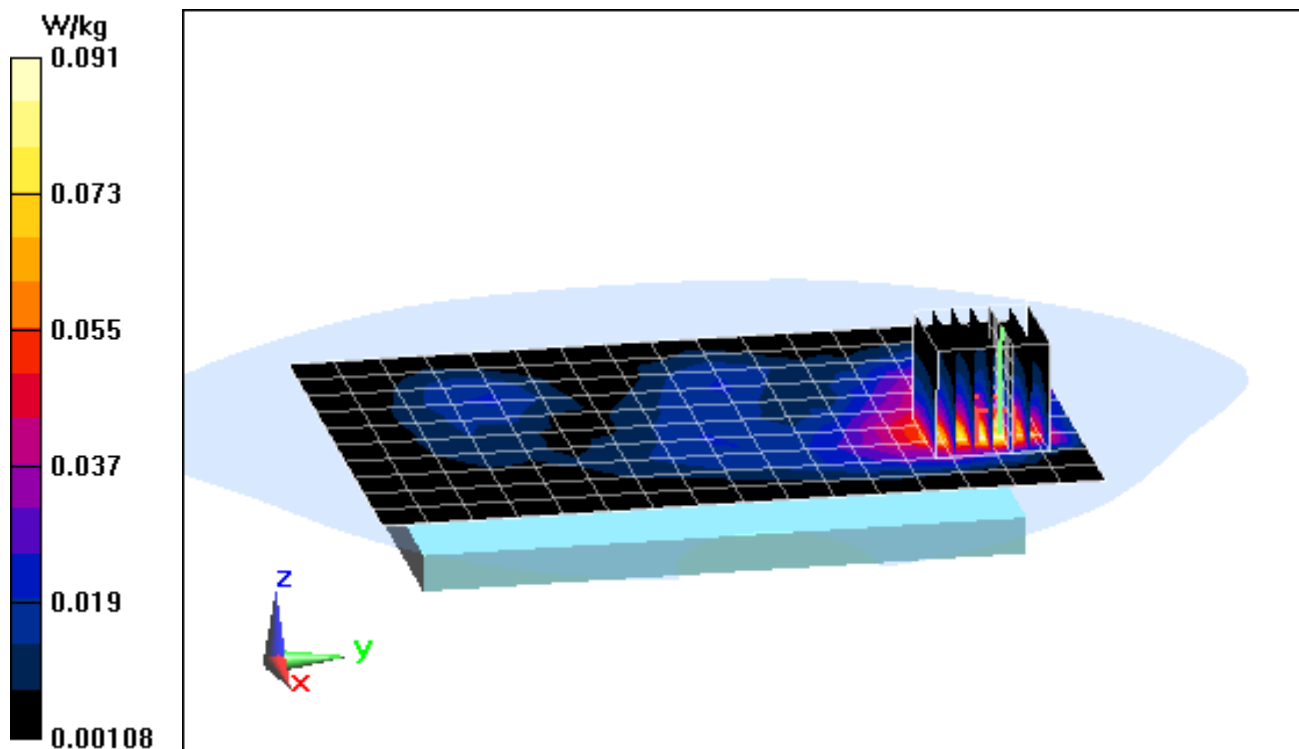
Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 5.711 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.111 W/kg

SAR(1 g) = 0.059 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 1F3B2

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

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 2.016 \text{ S/m}$; $\epsilon_r = 50.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2017; Ambient Temp: 24.5°C; Tissue Temp: 22.7°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

Mode: IEEE 802.11b, 22 MHz Bandwidth, Antenna 2

Body SAR, Ch 6, 1 Mbps, Back Side

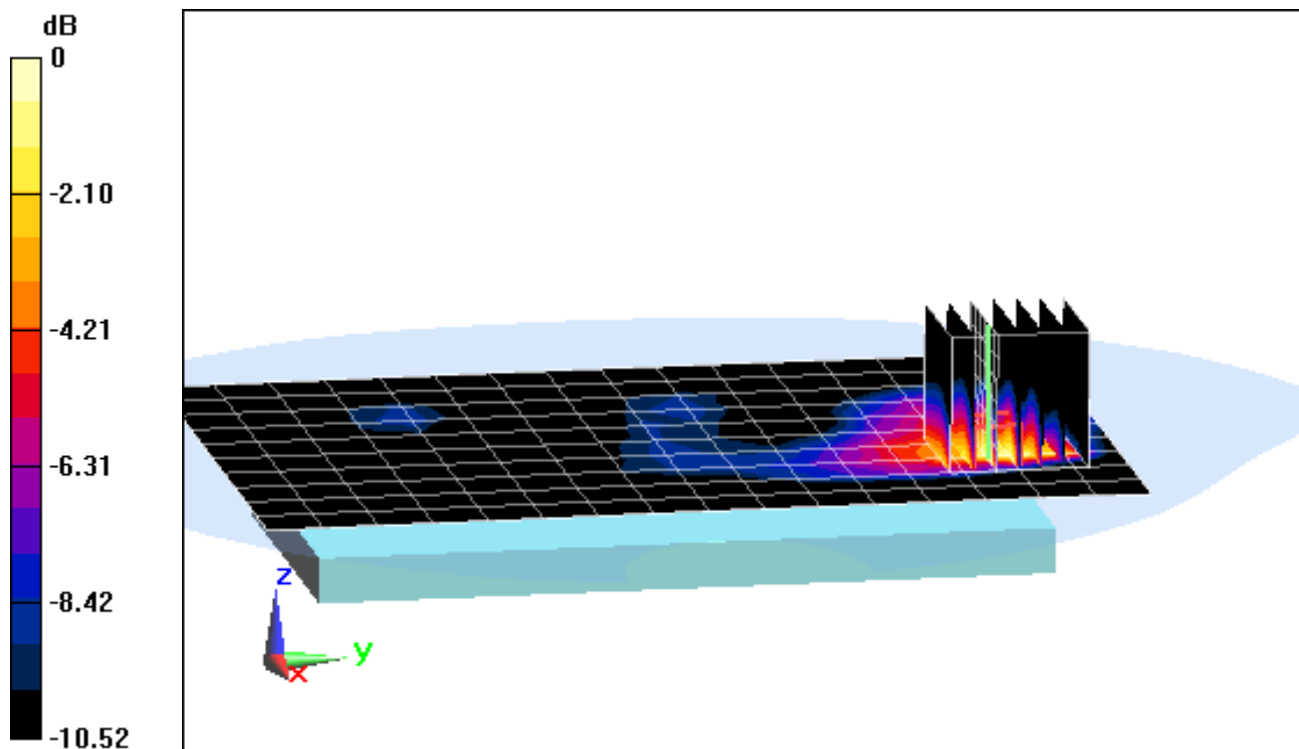
Area Scan (11x17x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 3.585 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.307 W/kg

SAR(1 g) = 0.150 W/kg



0 dB = 0.247 W/kg = -6.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051DC

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5785 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5785 \text{ MHz}$; $\sigma = 6.233 \text{ S/m}$; $\epsilon_r = 47.694$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-08-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.3°C

Probe: EX3DV4 - SN3914; ConvF(3.86, 3.86, 3.86); Calibrated: 2/22/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646

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

**Mode: IEEE 802.11a, UNII-3, 20 MHz Bandwidth, Antenna 1,
Body SAR, Ch 157, 6 Mbps, Back Side**

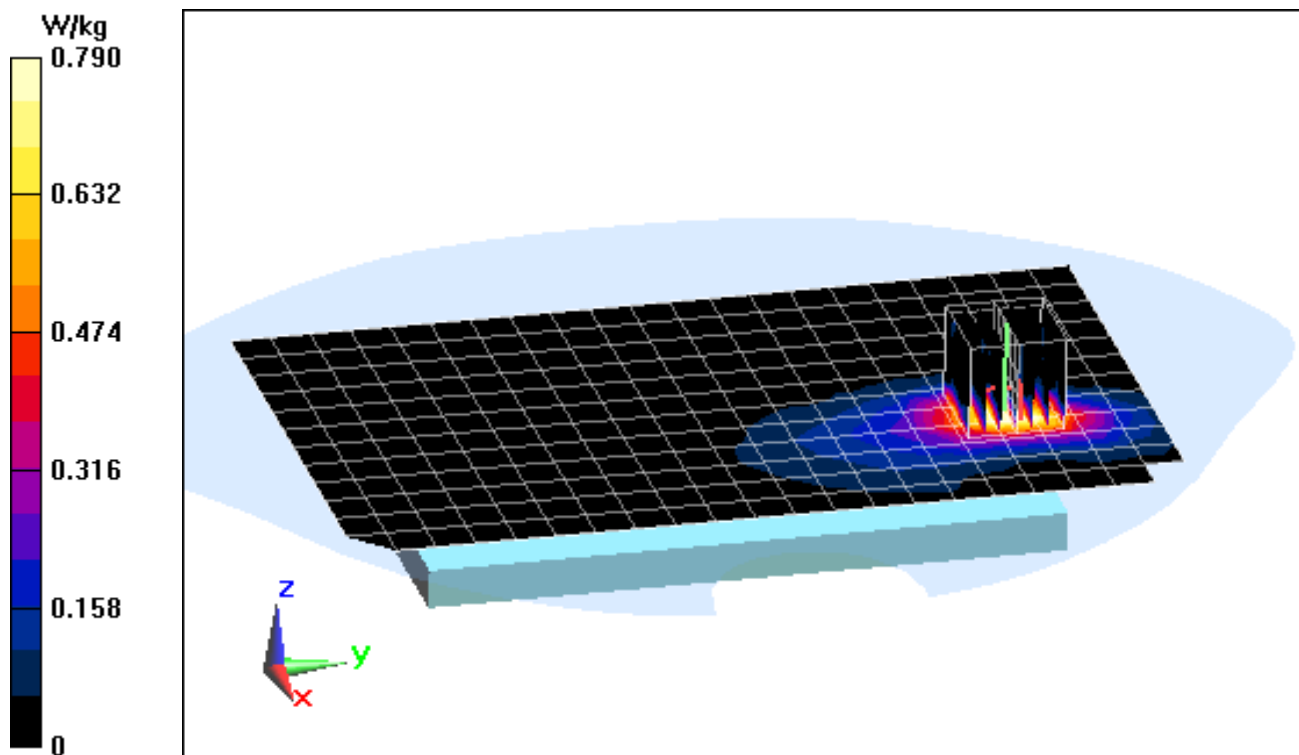
Area Scan (13x22x1): Measurement grid: dx=10mm, dy=10mm

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

Reference Value = 3.357 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.270 W/kg

SAR(1 g) = 0.065 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051DC

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5785 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5785 \text{ MHz}$; $\sigma = 6.233 \text{ S/m}$; $\epsilon_r = 47.694$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.3°C

Probe: EX3DV4 - SN3914; ConvF(3.86, 3.86, 3.86); Calibrated: 2/22/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646

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

Mode: IEEE 802.11a, UNII-3, 20 MHz Bandwidth, Antenna 1

Body SAR, Ch 157, 6 Mbps, Back Side

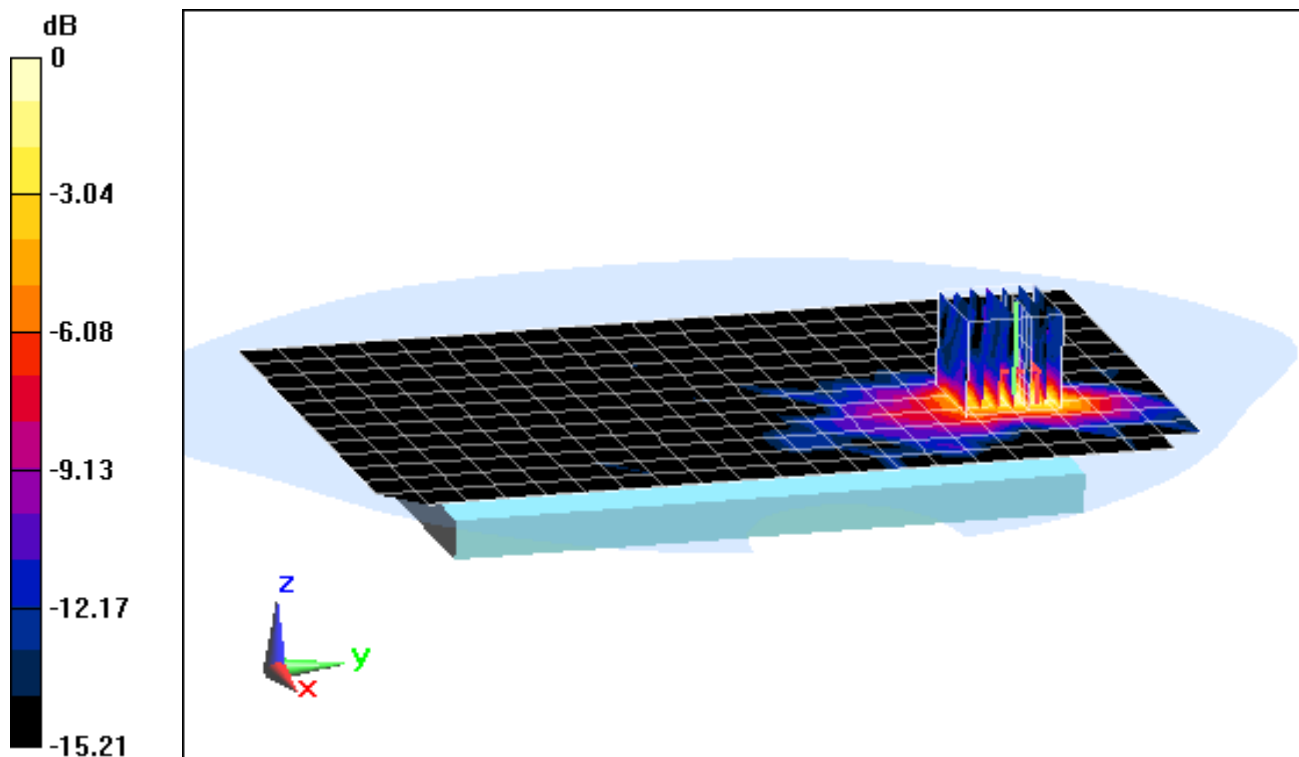
Area Scan (13x22x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

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

Reference Value = 3.940 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.398 W/kg

SAR(1 g) = 0.093 W/kg



0 dB = 0.214 W/kg = -6.70 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051DC

Communication System: UID 0, Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1.297

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2441 \text{ MHz}$; $\sigma = 1.948 \text{ S/m}$; $\epsilon_r = 51.169$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-14-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

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

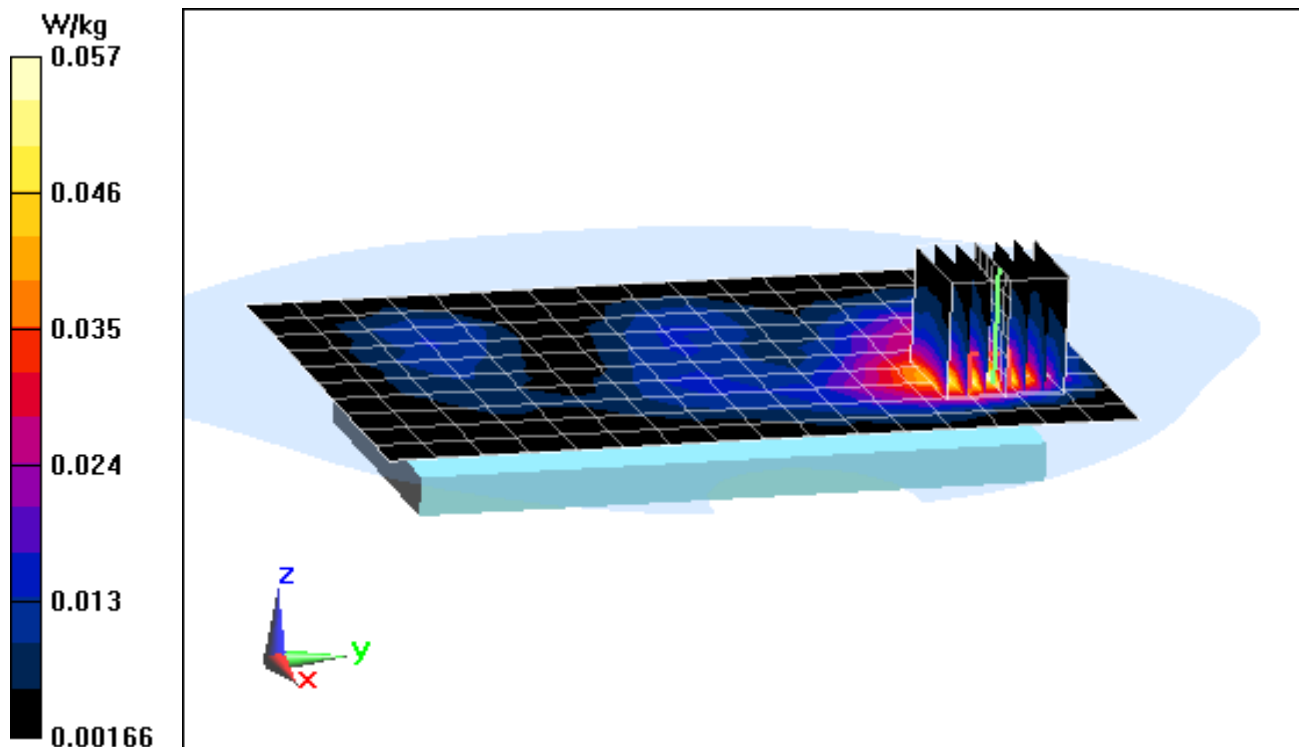
Area Scan (11x17x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 4.694 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 0.0710 W/kg

SAR(1 g) = 0.039 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051DC

Communication System: UID 0, Bluetooth; Frequency: 2402 MHz; Duty Cycle: 1:1.297

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2402 \text{ MHz}$; $\sigma = 1.954 \text{ S/m}$; $\epsilon_r = 52.044$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-24-2017; Ambient Temp: 22.4°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3319; ConvF(4.2, 4.2, 4.2); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

Mode: Bluetooth, Body SAR, Ch 0, 2 Mbps, Back Side

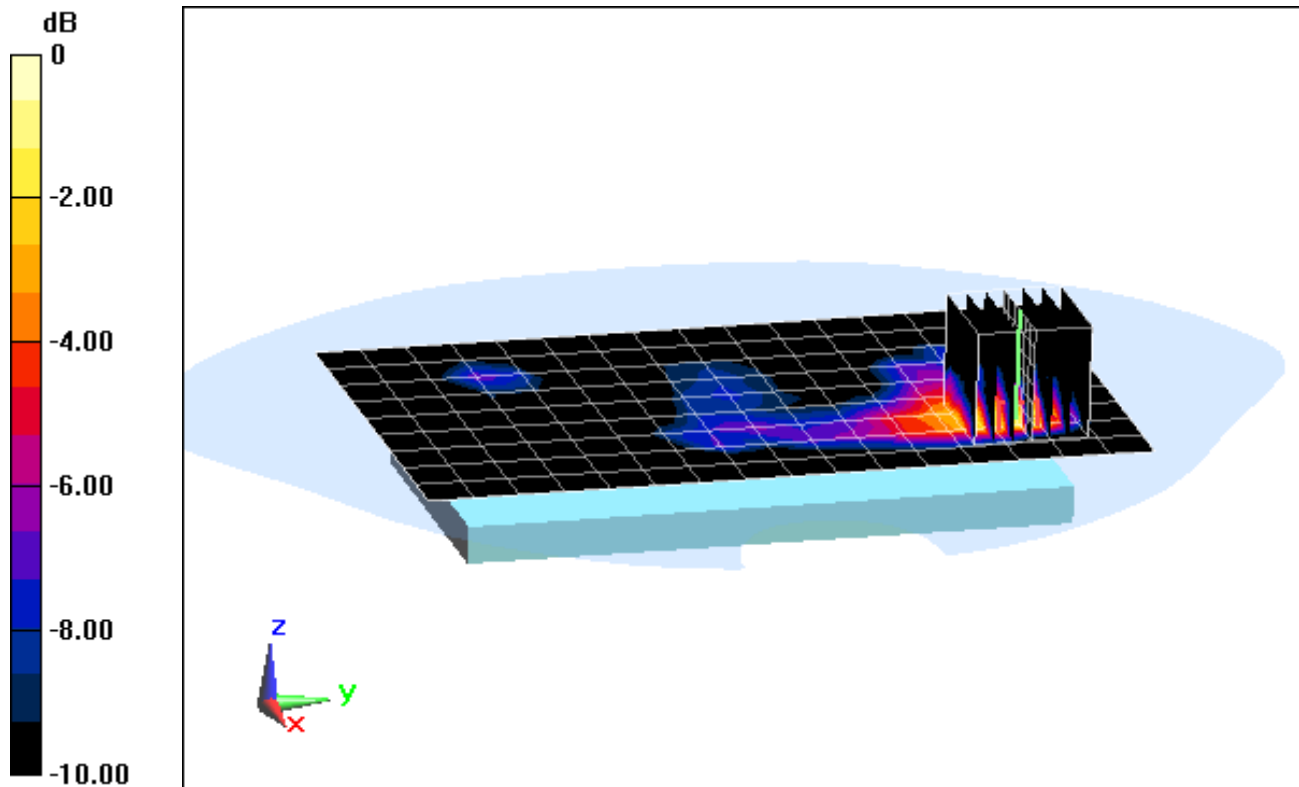
Area Scan (10x17x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 2.331 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.0250 W/kg

SAR(1 g) = 0.012 W/kg



0 dB = 0.0177 W/kg = -17.52 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051DC

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5720 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used (interpolated):

$f = 5720 \text{ MHz}$; $\sigma = 6.134 \text{ S/m}$; $\epsilon_r = 47.784$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 01-08-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.3°C

Probe: EX3DV4 - SN3914; ConvF(3.86, 3.86, 3.86); Calibrated: 2/22/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646

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

Mode: IEEE 802.11a, U-NII-2C, 20 MHz Bandwidth, Antenna 2

Phablet SAR, Ch 144, 6 Mbps, Back Side

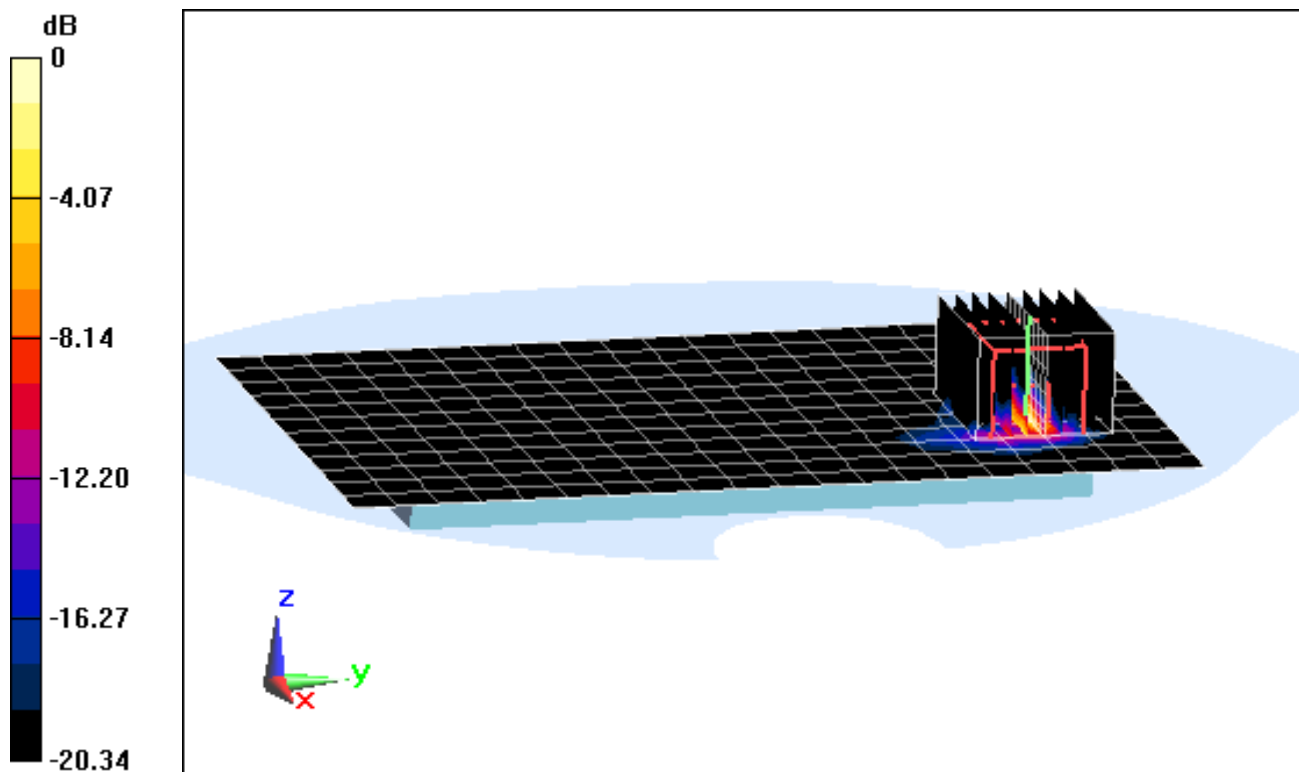
Area Scan (13x21x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Zoom Scan (10x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Reference Value = 15.18 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 6.43 W/kg

SAR(10 g) = 0.224 W/kg



0 dB = 3.57 W/kg = 5.53 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMG955N; Type: Portable Handset; Serial: 051DC

Communication System: UID 0, Bluetooth; Frequency: 2441 MHz; Duty Cycle: 1:1.297

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2441 \text{ MHz}$; $\sigma = 1.948 \text{ S/m}$; $\epsilon_r = 51.169$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 01-14-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

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

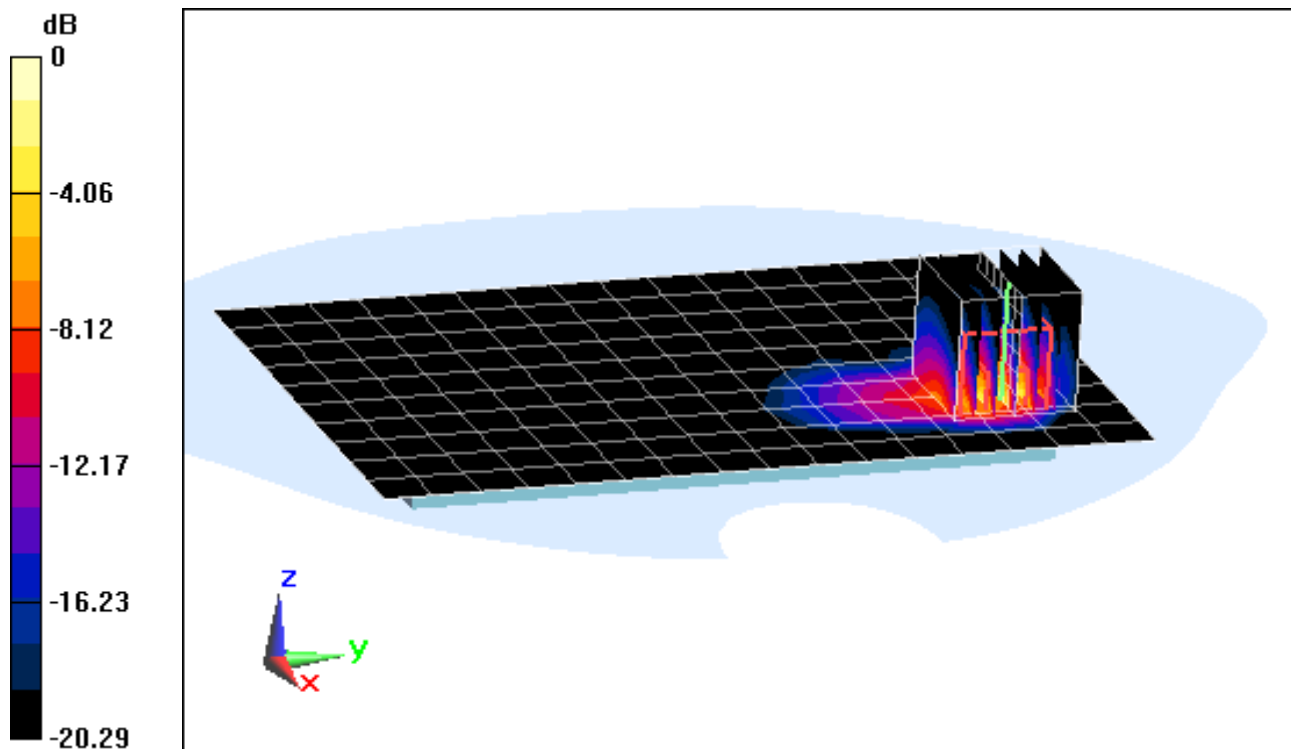
Area Scan (11x17x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 24.69 V/m; Power Drift = 0.16 dB

Peak SAR (extrapolated) = 5.12 W/kg

SAR(10 g) = 0.470 W/kg



0 dB = 3.74 W/kg = 5.73 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 750 Head Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.905 \text{ S/m}$; $\epsilon_r = 42.203$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-11-2017; Ambient Temp: 23.8°C; Tissue Temp: 23.8°C

Probe: ES3DV3 - SN3209; ConvF(6.6, 6.6, 6.6); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Right; Type: SAM; Serial: 1757

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

750 MHz System Verification at 23.0 dBm (200 mW)

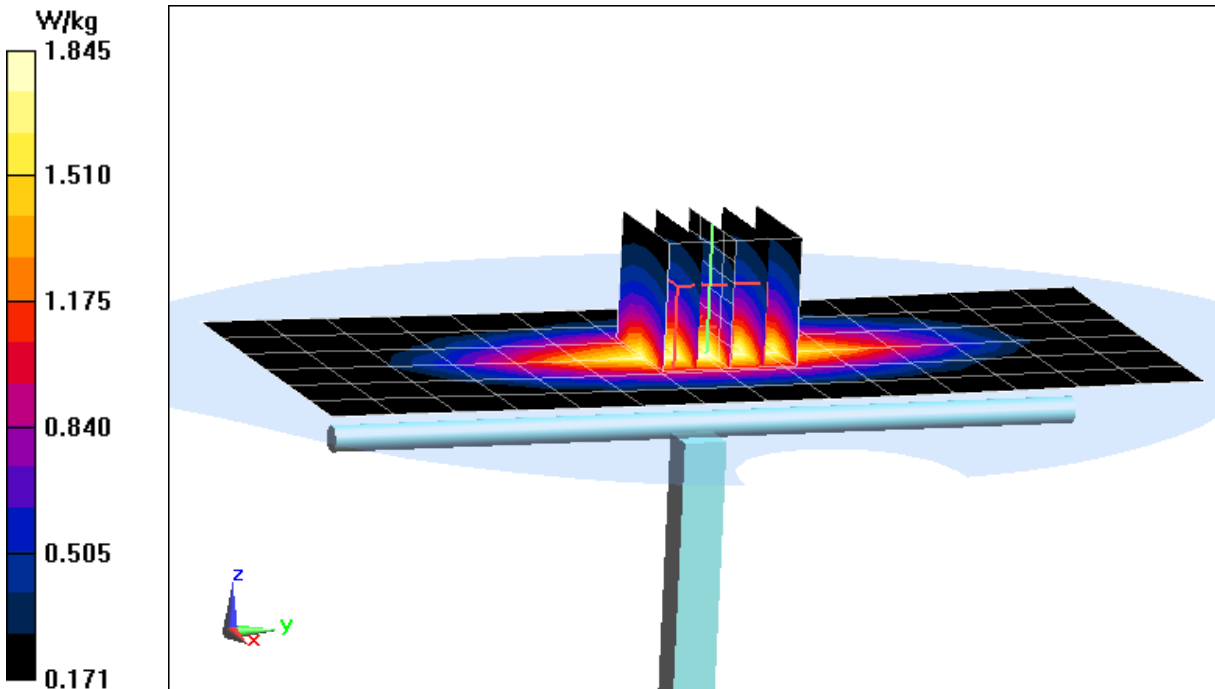
Area Scan (7x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.29 W/kg

SAR(1 g) = 1.58 W/kg

Deviation(1 g) = -3.30%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Head Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.911 \text{ S/m}$; $\epsilon_r = 41.612$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-09-2017; Ambient Temp: 22.2°C; Tissue Temp: 21.1°C

Probe: ES3DV3 - SN3319; ConvF(6.16, 6.16, 6.16); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP v5.0 (Right); Type: QD000P40CD; Serial: TP:1759

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

835 MHz System Verification at 23.0 dBm (200 mW)

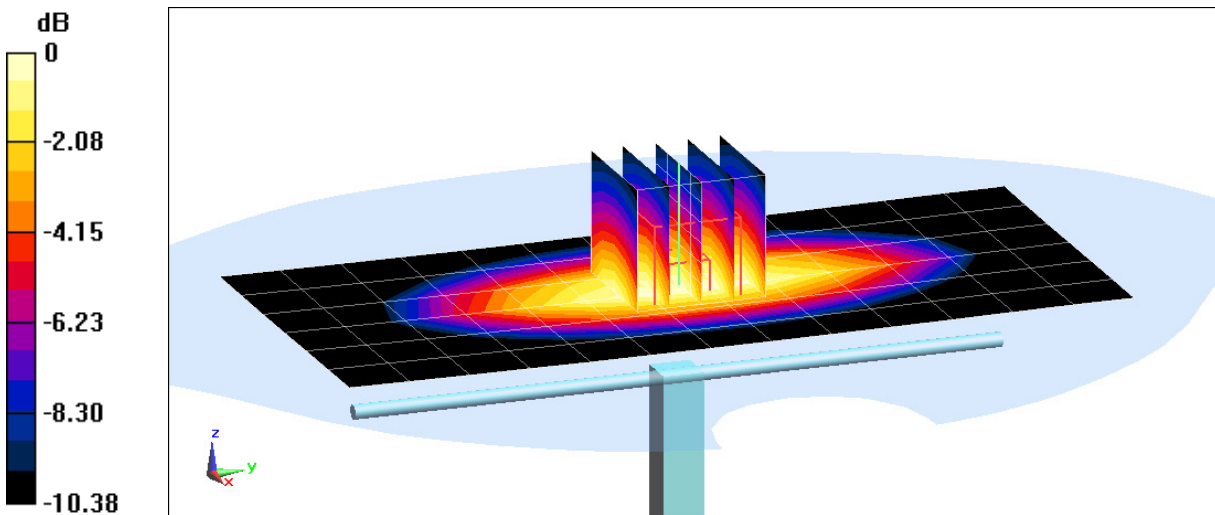
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.63 W/kg

SAR(1 g) = 1.85 W/kg

Deviation(1 g) = -0.75%



0 dB = 2.15 W/kg = 3.32 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1750 Head Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.342 \text{ S/m}$; $\epsilon_r = 39.159$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2017; Ambient Temp: 23.6°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3209; ConvF(5.28, 5.28, 5.28); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

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

1750 MHz System Verification at 20.0 dBm (100 mW)

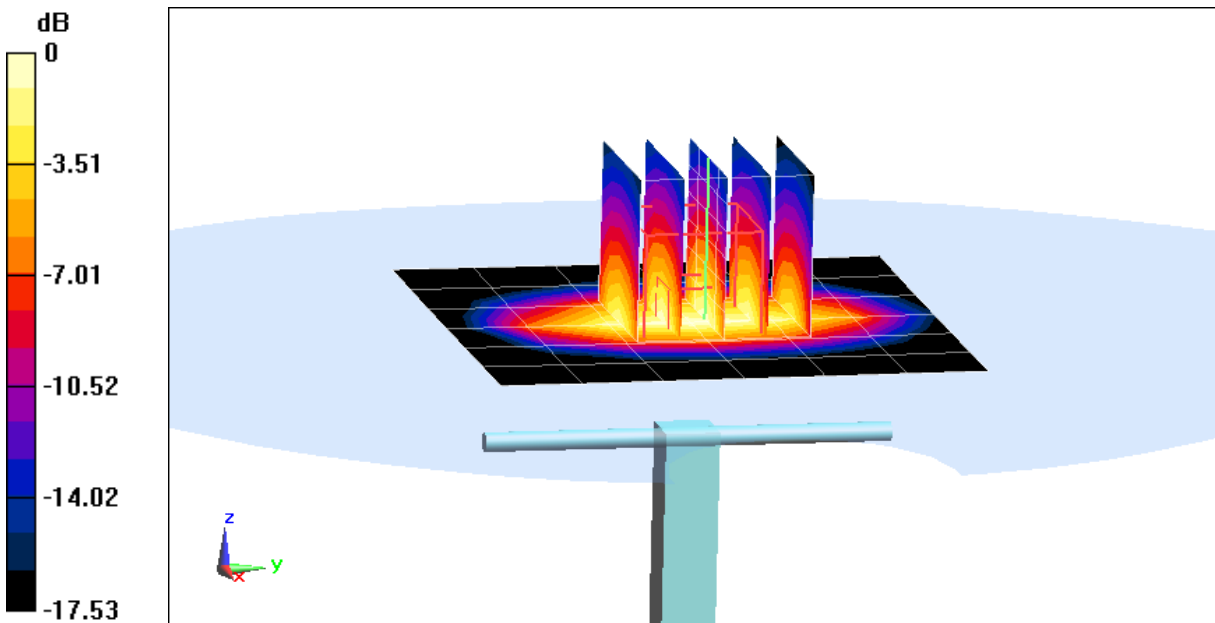
Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.69 W/kg

SAR(1 g) = 3.7 W/kg

Deviation(1 g) = 2.21%



0 dB = 4.65 W/kg = 6.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.449 \text{ S/m}$; $\epsilon_r = 39.367$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-16-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3287; ConvF(5.27, 5.27, 5.27); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

1900 MHz System Verification at 20.0 dBm (100 mW)

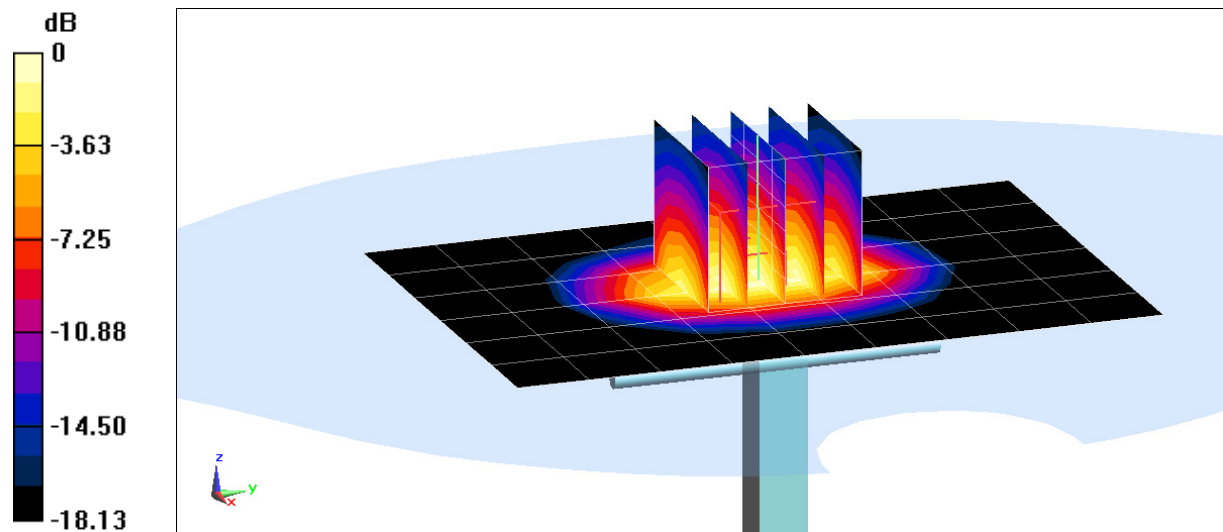
Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 7.51 W/kg

SAR(1 g) = 4.09 W/kg

Deviation(1 g) = 2.00%



0 dB = 5.21 W/kg = 7.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.856 \text{ S/m}$; $\epsilon_r = 39.156$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-13-2017; Ambient Temp: 21.9°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3287; ConvF(4.54, 4.54, 4.54); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

2450 MHz System Verification at 20.0 dBm (100 mW)

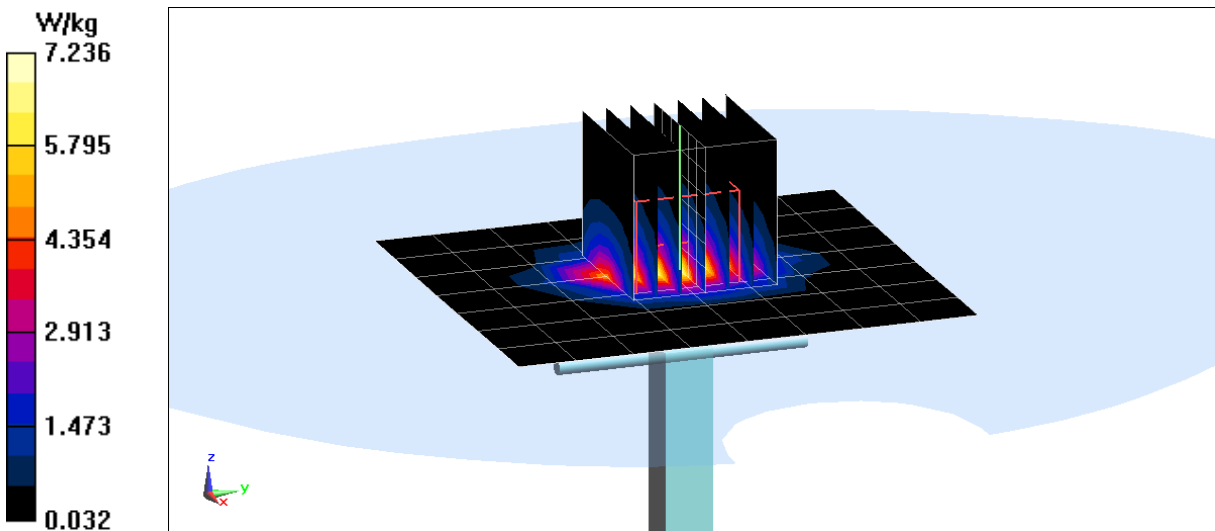
Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Peak SAR (extrapolated) = 11.7 W/kg

SAR(1 g) = 5.54 W/kg

Deviation(1 g) = 6.33%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981

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

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.869 \text{ S/m}$; $\epsilon_r = 38.155$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-22-2017; Ambient Temp: 23.2°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3287; ConvF(4.54, 4.54, 4.54); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

2450 MHz System Verification at 20.0 dBm (100 mW)

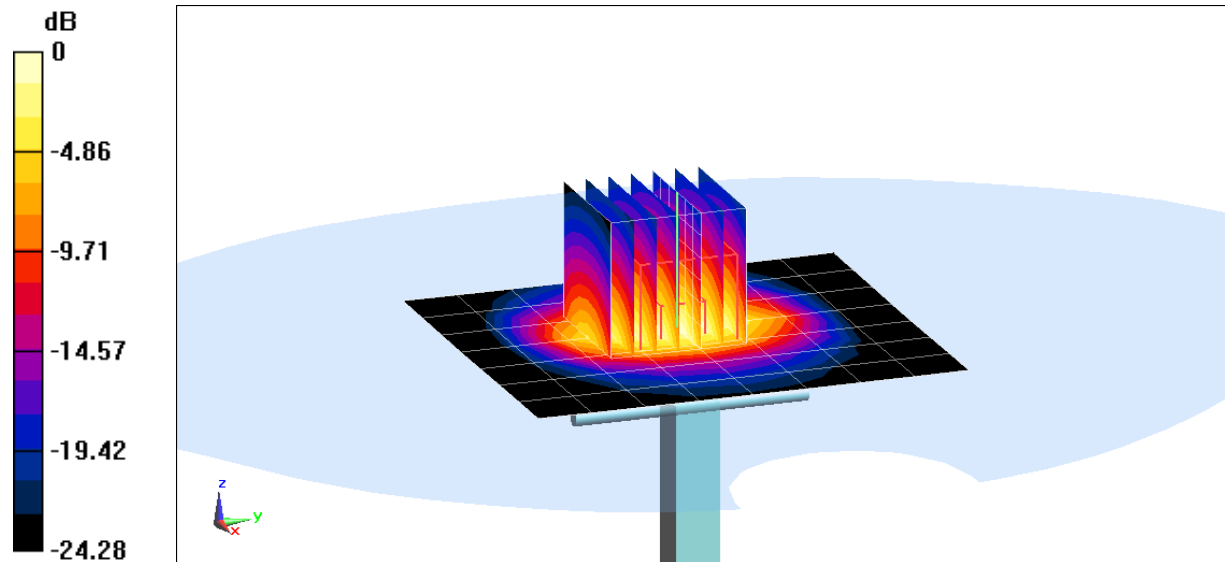
Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 11.9 W/kg

SAR(1 g) = 5.64 W/kg

Deviation(1 g) = 6.82%



0 dB = 7.52 W/kg = 8.76 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1126

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: 2600 Head Medium parameters used:

$f = 2600 \text{ MHz}$; $\sigma = 2.053 \text{ S/m}$; $\epsilon_r = 38.501$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-10-2017; Ambient Temp: 23.6°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3287; ConvF(4.41, 4.41, 4.41); Calibrated: 9/19/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 9/14/2016

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

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

2600 MHz System Verification at 20.0 dBm (100 mW)

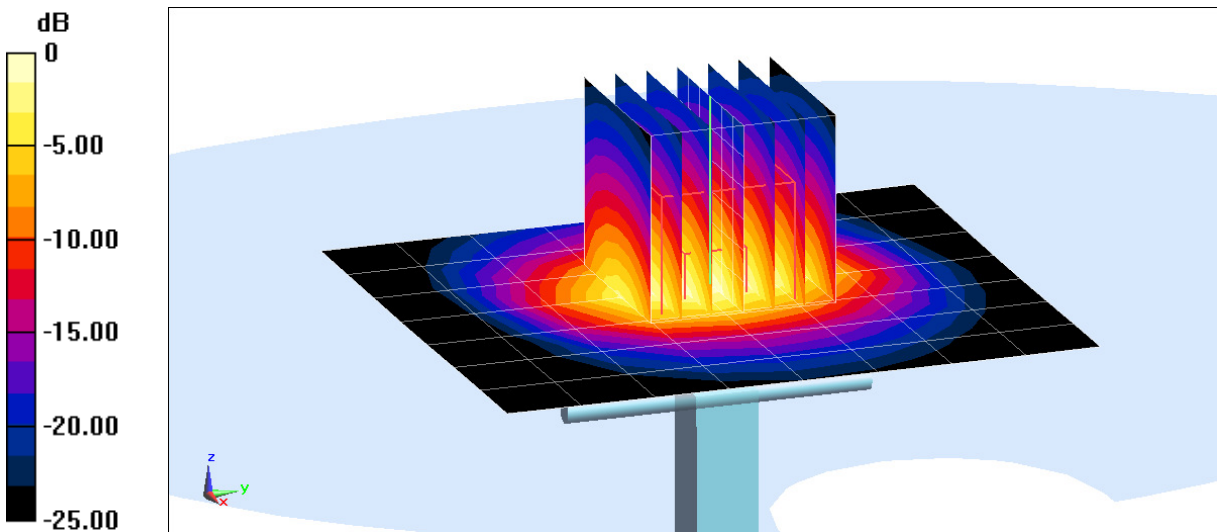
Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Peak SAR (extrapolated) = 13.3 W/kg

SAR(1 g) = 5.88 W/kg

Deviation(1 g) = 4.44%



0 dB = 7.93 W/kg = 8.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1191

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: 5GHz Head Medium parameters used (interpolated):

$f = 5250 \text{ MHz}$; $\sigma = 4.673 \text{ S/m}$; $\epsilon_r = 35.535$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7357; ConvF(5.1, 5.1, 5.1); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/19/2016

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

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

5250 MHz System Verification at 17.0 dBm (50 mW)

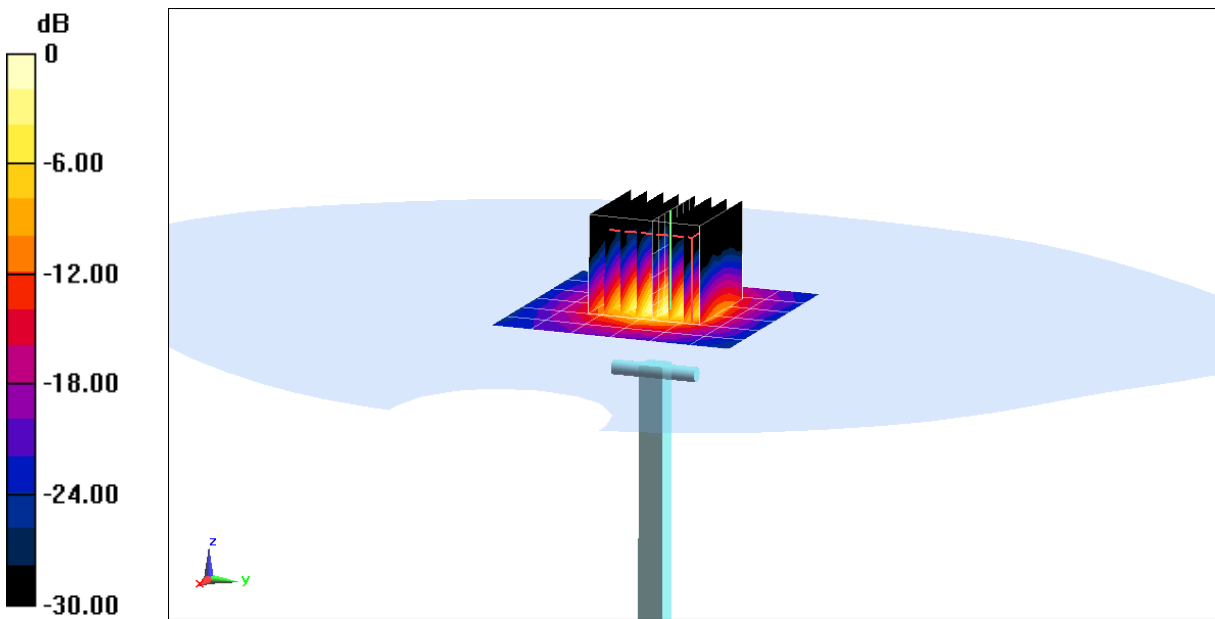
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 16.1 W/kg

SAR(1 g) = 3.89 W/kg

Deviation(1 g) = -1.39%



0 dB = 9.08 W/kg = 9.58 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1191

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

Medium: 5GHz Head Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.023 \text{ S/m}$; $\epsilon_r = 35.039$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7357; ConvF(4.41, 4.41, 4.41); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/19/2016

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

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

5600 MHz System Verification at 17.0 dBm (50 mW)

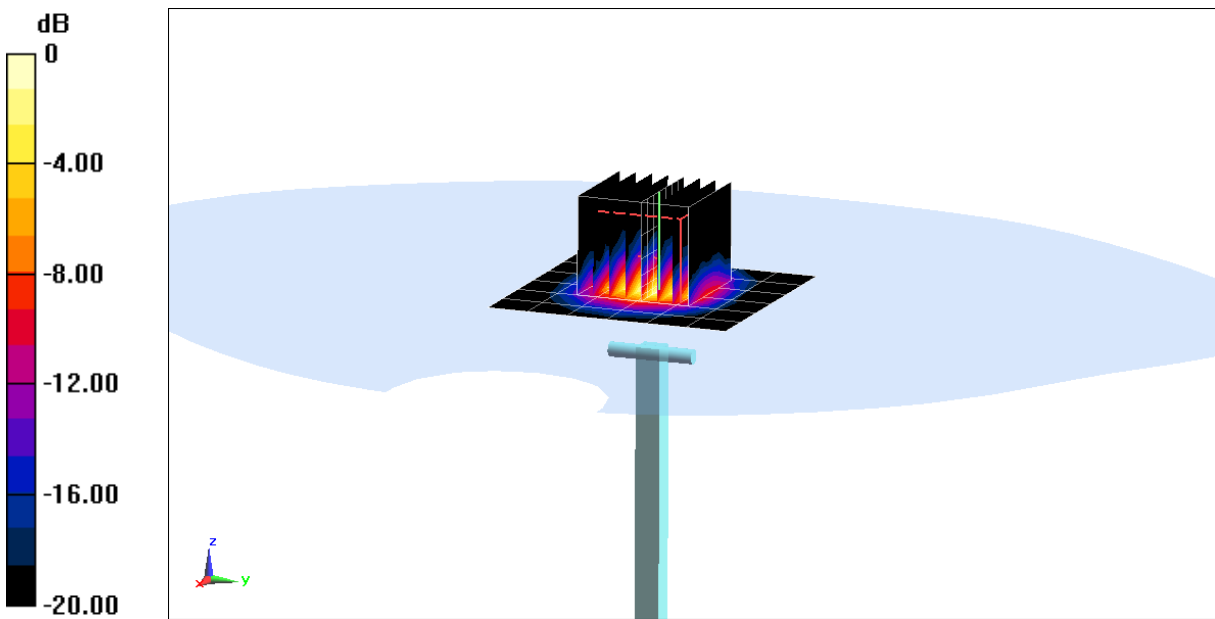
Area Scan (7x7x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Peak SAR (extrapolated) = 17.3 W/kg

SAR(1 g) = 4.1 W/kg

Deviation(1 g) = -1.91%



0 dB = 9.77 W/kg = 9.90 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5 GHz; Type: D5GHzV2; Serial: 1191

Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1

Medium: 5GHz Head Medium parameters used (interpolated):

$f = 5750 \text{ MHz}$; $\sigma = 5.182 \text{ S/m}$; $\epsilon_r = 34.865$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN7357; ConvF(4.65, 4.65, 4.65); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/19/2016

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

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

5750 MHz System Verification at 17.0 dBm (50 mW)

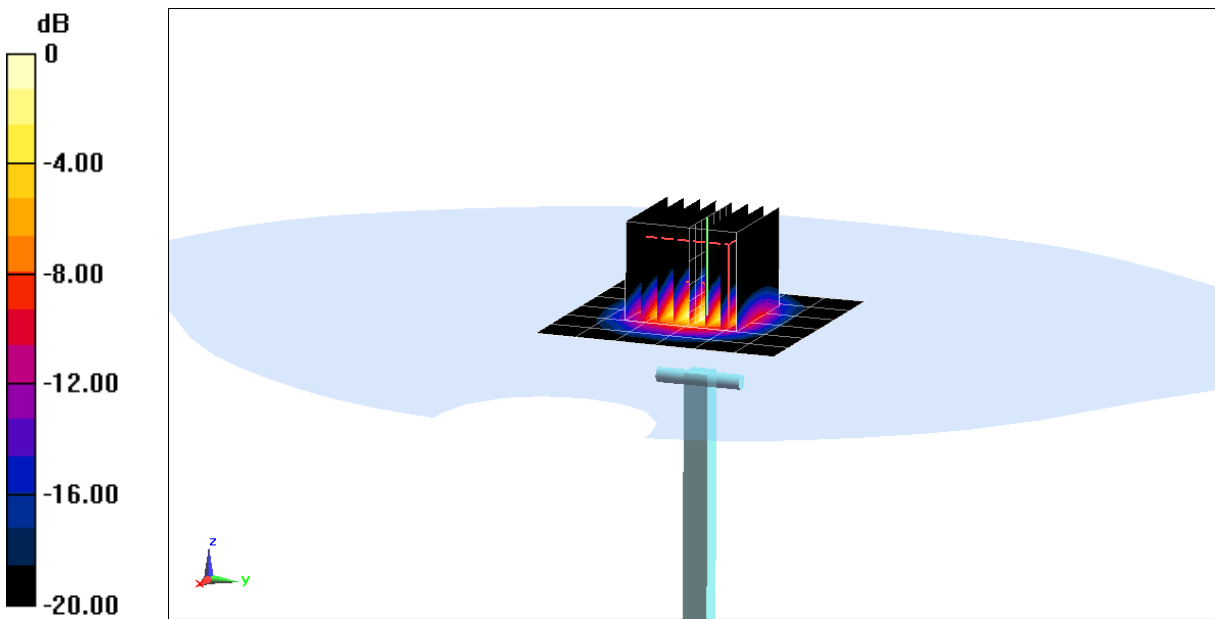
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 3.84 W/kg

Deviation(1 g) = -2.91%



0 dB = 9.27 W/kg = 9.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 750 Body Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.951 \text{ S/m}$; $\epsilon_r = 54.848$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-14-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3332; ConvF(6.7, 6.7, 6.7); Calibrated: 8/25/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1333; Calibrated: 9/15/2016

Phantom: SAM Left; Type: SAM; Serial: 1688

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

750 MHz System Verification at 23.0 dBm (200 mW)

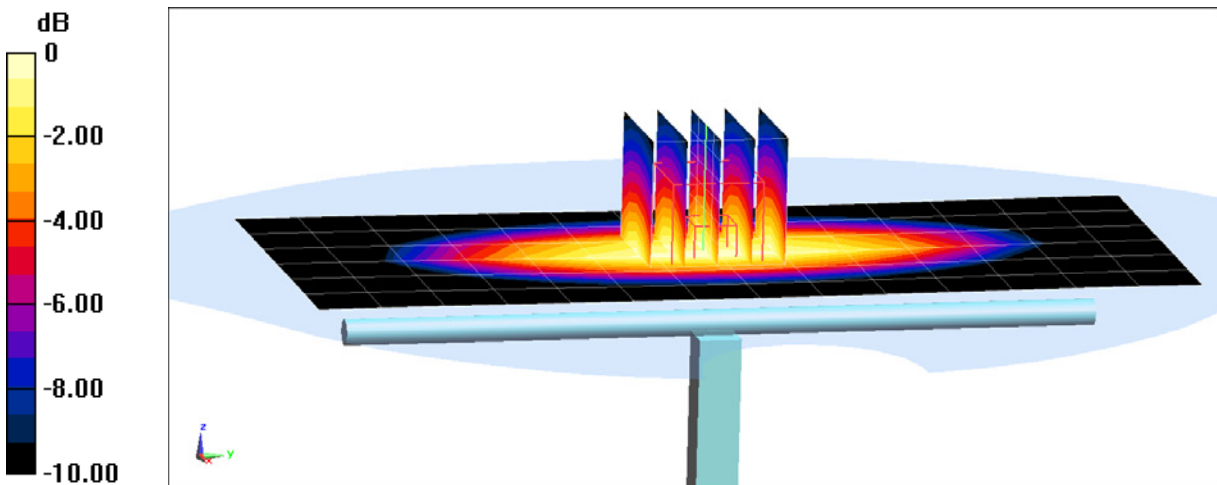
Area Scan (7x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.45 W/kg

SAR(1 g) = 1.67 W/kg

Deviation(1 g) = -2.45%



0 dB = 1.95 W/kg = 2.90 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.99 \text{ S/m}$; $\epsilon_r = 53.702$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-11-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

835 MHz System Verification at 23.0 dBm (200 mW)

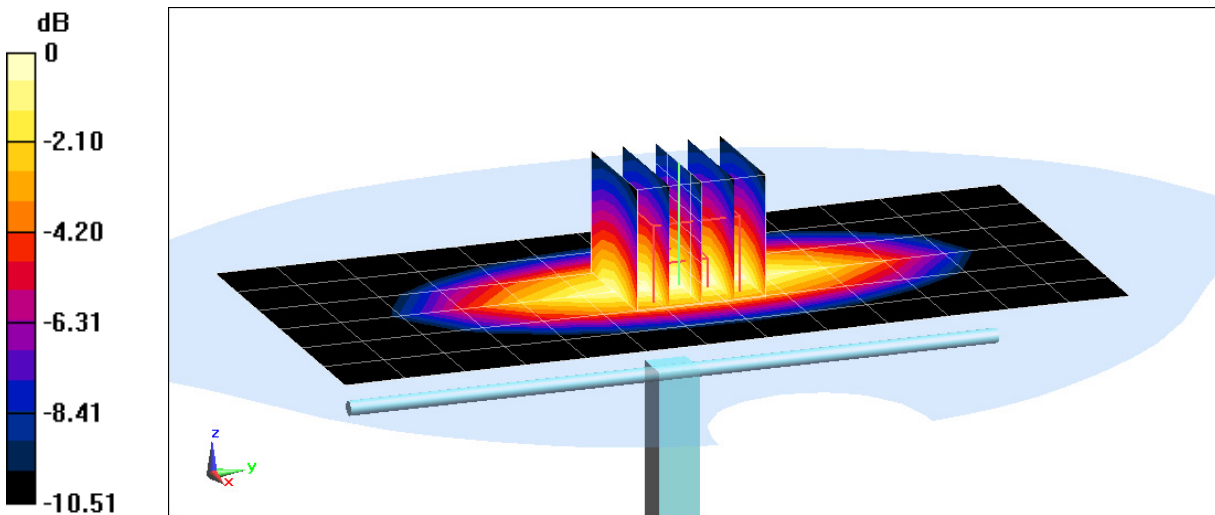
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.96 W/kg

SAR(1 g) = 2.01 W/kg

Deviation(1 g) = 5.79%



0 dB = 2.35 W/kg = 3.71 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d047

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

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 1.007 \text{ S/m}$; $\epsilon_r = 54.915$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 01-21-2017; Ambient Temp: 21.2°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3319; ConvF(6.04, 6.04, 6.04); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

835 MHz System Verification at 23.0 dBm (200 mW)

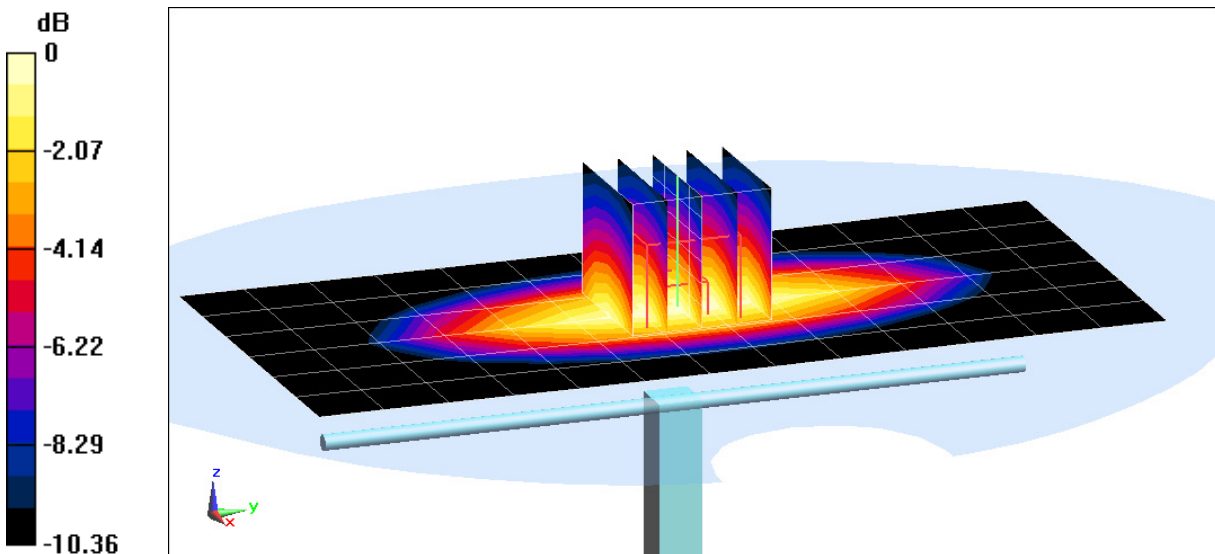
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.98 W/kg

SAR(1 g) = 2.01 W/kg

Deviation(1 g) = 5.02%



0 dB = 2.35 W/kg = 3.71 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.463 \text{ S/m}$; $\epsilon_r = 51.348$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-07-2017; Ambient Temp: 23.0°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3209; ConvF(4.99, 4.99, 4.99); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

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

1750 MHz System Verification at 20.0 dBm (100 mW)

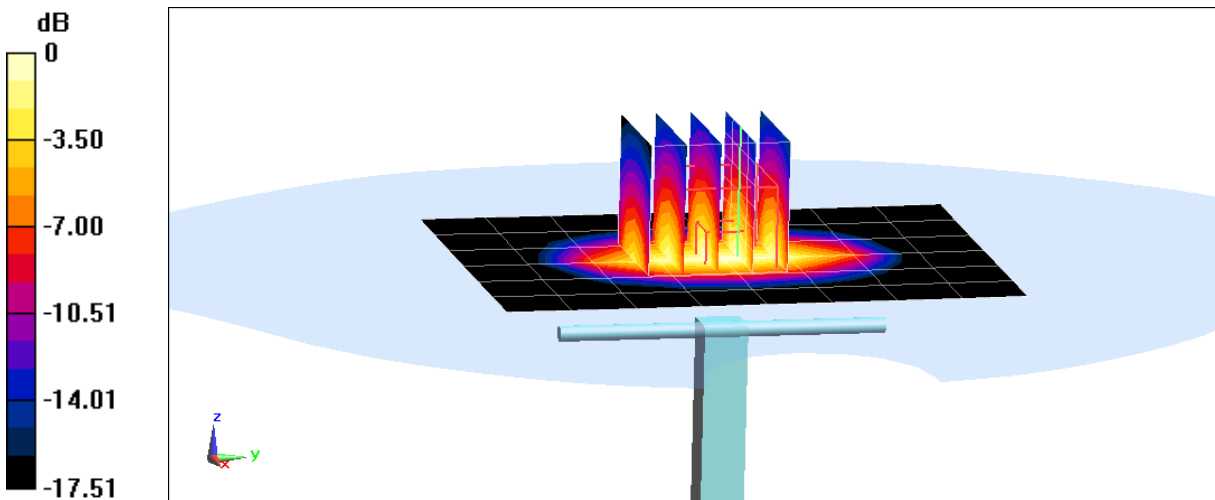
Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.64 W/kg

SAR(1 g) = 3.77 W/kg

Deviation(1 g) = 1.07%



0 dB = 4.66 W/kg = 6.68 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.484 \text{ S/m}$; $\epsilon_r = 50.912$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-14-2017; Ambient Temp: 23.3°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3209; ConvF(4.99, 4.99, 4.99); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 8/22/2016

Phantom: SAM Front; Type: QD000P40CD; Serial: TP:1758

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

1750 MHz System Verification at 20.0 dBm (100 mW)

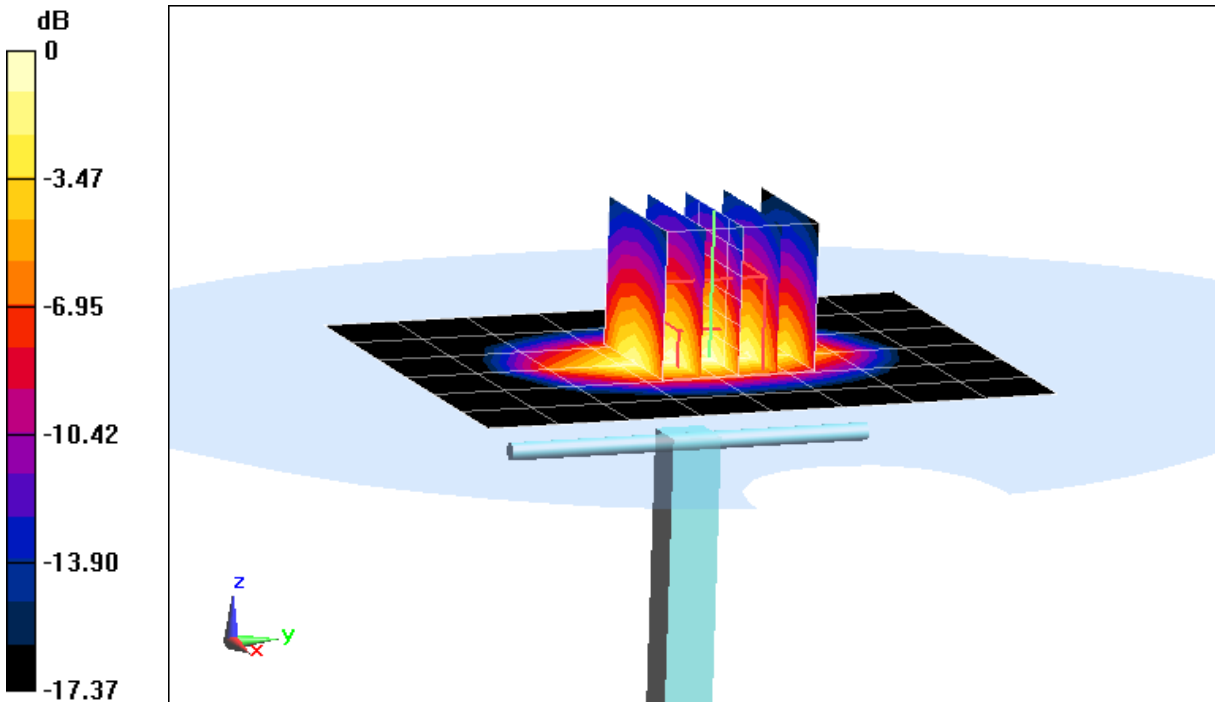
Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.21 W/kg

SAR(1 g) = 3.55 W/kg

Deviation(1 g) = -4.31%



0 dB = 4.39 W/kg = 6.42 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

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

$f = 1900 \text{ MHz}$; $\sigma = 1.541 \text{ S/m}$; $\epsilon_r = 51.081$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-11-2017; Ambient Temp: 23.7°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN7409; ConvF(7.47, 7.47, 7.47); Calibrated: 5/17/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn859; Calibrated: 5/11/2016

Phantom: SAM Left; Type: QD000P40CC; Serial: TP: 1375

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

1900 MHz System Verification at 20.0 dBm (100 mW)

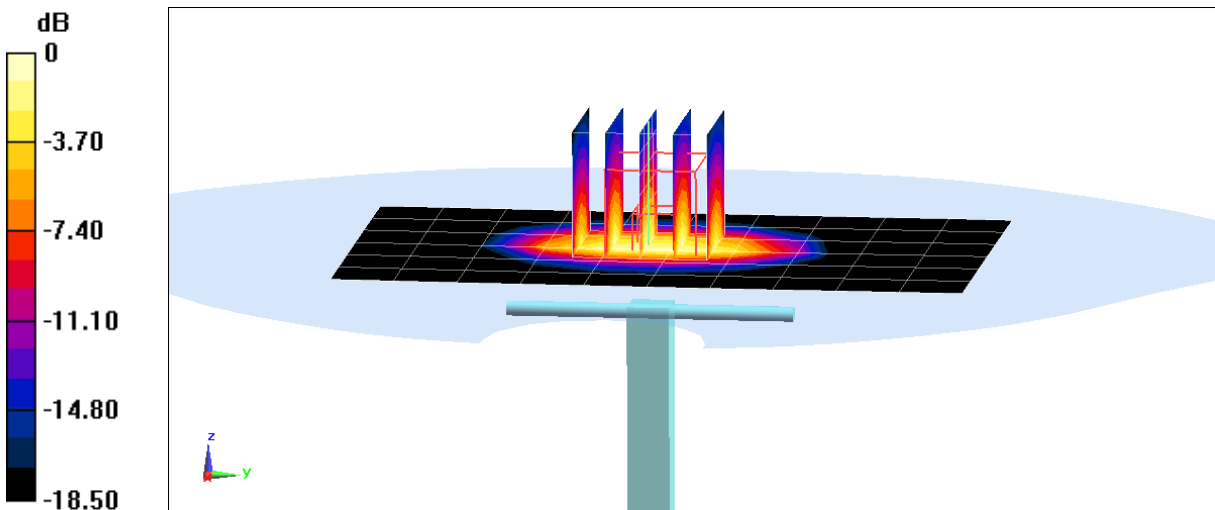
Area Scan (7x11x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 8.12 W/kg

SAR(1 g) = 4.18 W/kg

Deviation(1 g) = 4.76%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981

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

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.035 \text{ S/m}$; $\epsilon_r = 50.856$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2017; Ambient Temp: 24.5°C; Tissue Temp: 22.7°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

2450 MHz System Verification at 20.0 dBm (100 mW)

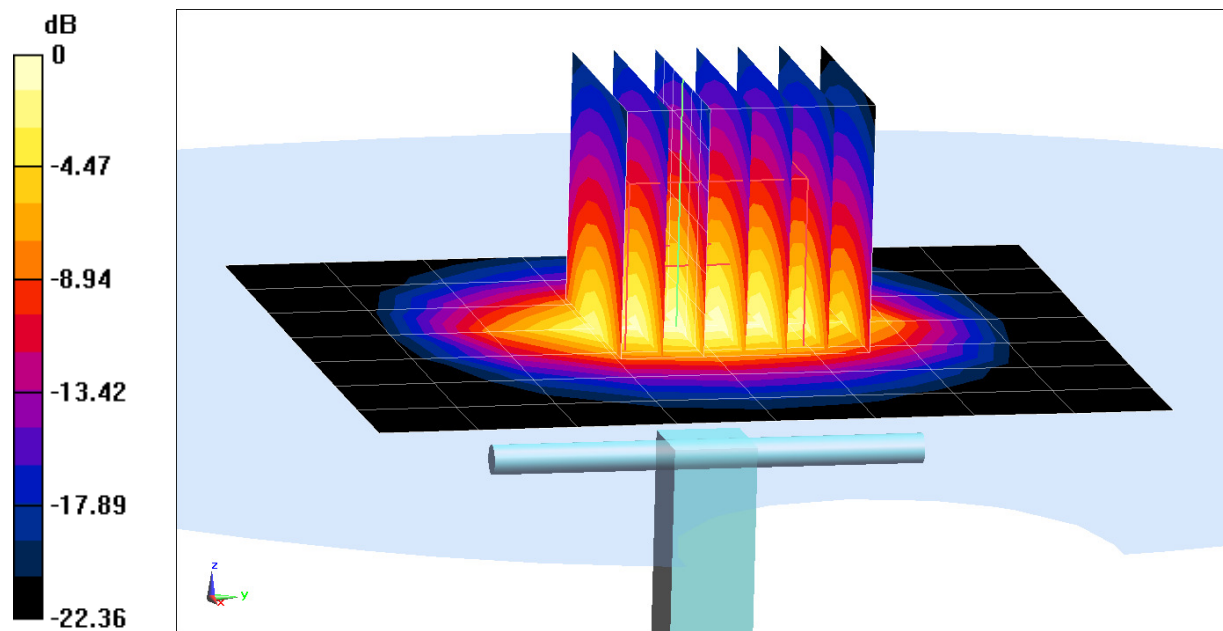
Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 10.9 W/kg

SAR(1 g) = 5.26 W/kg

Deviation(1 g) = 3.54%



0 dB = 8.69 W/kg = 9.39 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 981

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

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.96 \text{ S/m}$; $\epsilon_r = 51.131$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-14-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.5°C

Probe: EX3DV4 - SN7406; ConvF(7.24, 7.24, 7.24); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

2450 MHz System Verification at 20.0 dBm (100 mW)

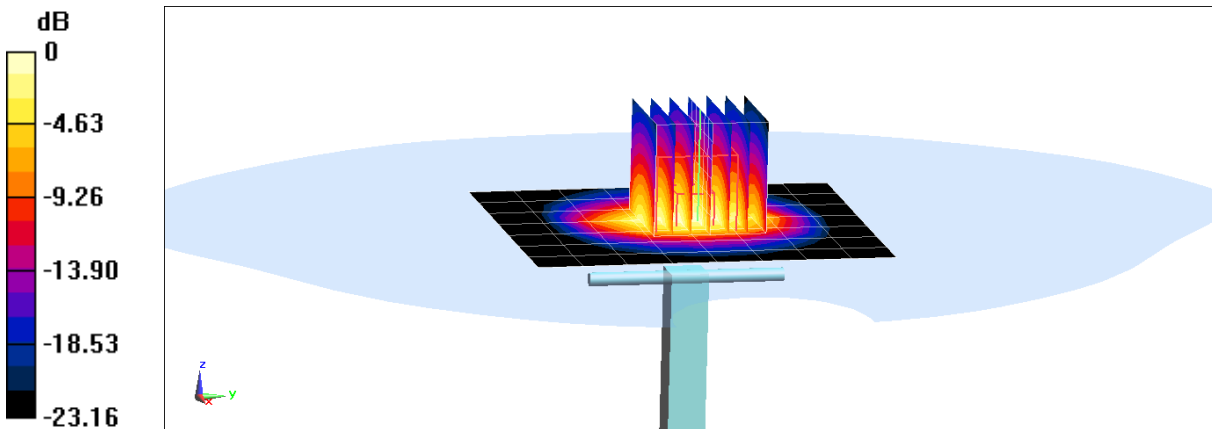
Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Peak SAR (extrapolated) = 10.7 W/kg

SAR(10 g) = 2.34 W/kg

Deviation(10 g) = -1.68%



0 dB = 8.53 W/kg = 9.31 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.014 \text{ S/m}$; $\epsilon_r = 51.856$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-24-2017; Ambient Temp: 22.4°C; Tissue Temp: 22.7°C

Probe: ES3DV3 - SN3319; ConvF(4.2, 4.2, 4.2); Calibrated: 3/18/2016;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/14/2016

Phantom: SAM with CRP (Left); Type: SAM; Serial: 1715

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

2450 MHz System Verification at 20.0 dBm (100 mW)

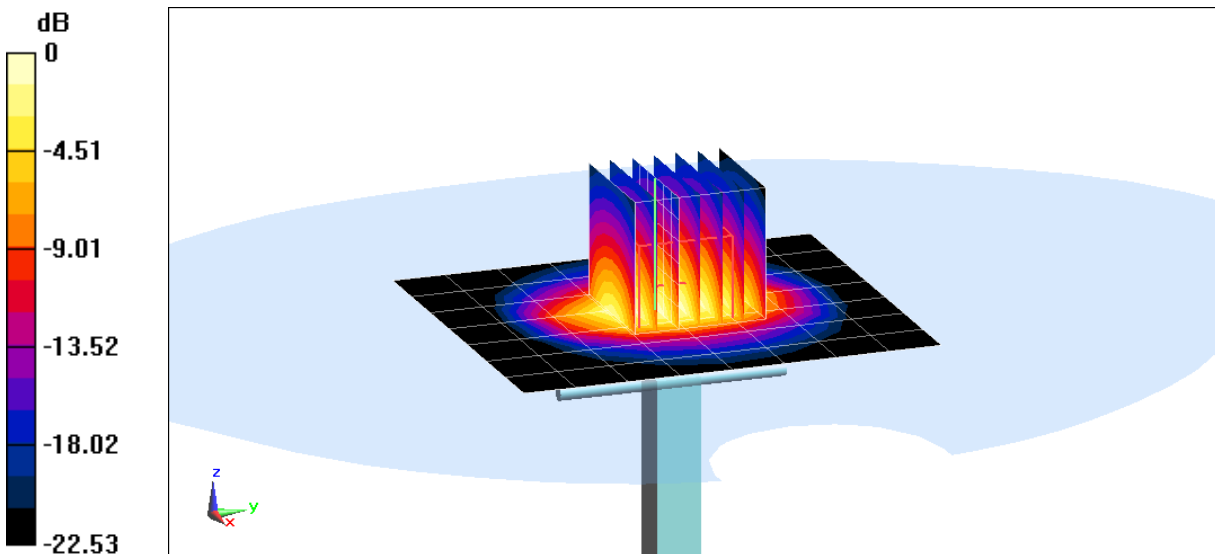
Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 10.9 W/kg

SAR(1 g) = 5.21 W/kg

Deviation(1 g) = 2.76%



0 dB = 6.85 W/kg = 8.36 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1071

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: 2600 Body Medium parameters used:

$f = 2600 \text{ MHz}$; $\sigma = 2.243 \text{ S/m}$; $\epsilon_r = 50.224$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-12-2017; Ambient Temp: 24.5°C; Tissue Temp: 22.7°C

Probe: EX3DV4 - SN7406; ConvF(6.94, 6.94, 6.94); Calibrated: 4/19/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/14/2016

Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648

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

2600 MHz System Verification at 20.0 dBm (100 mW)

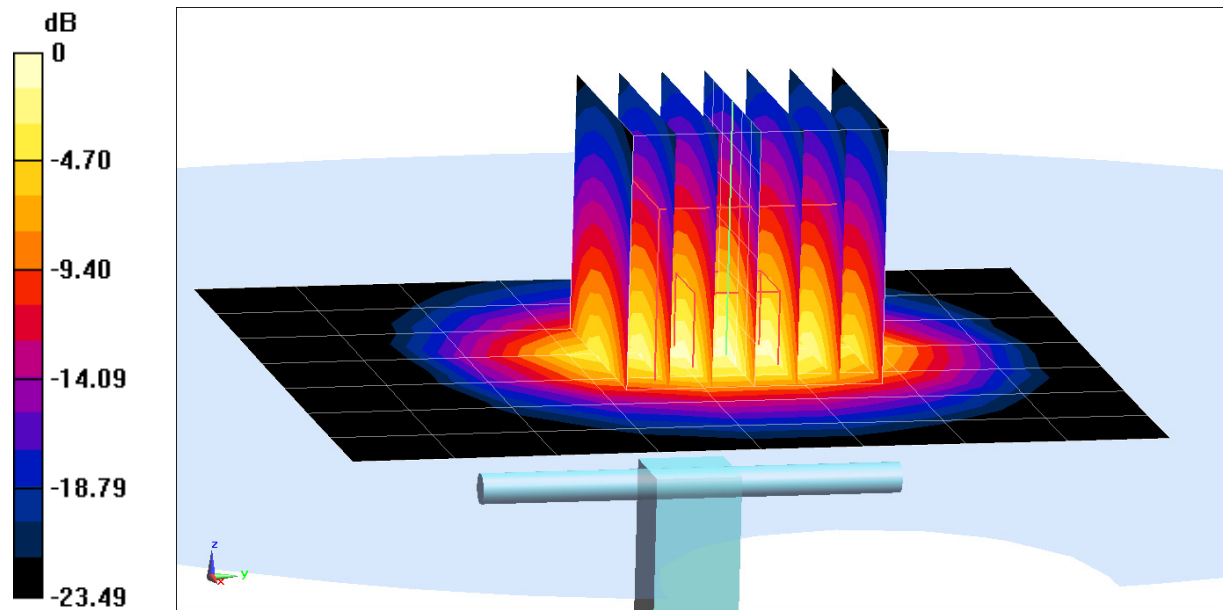
Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 12.8 W/kg

SAR(1 g) = 5.83 W/kg

Deviation(1 g) = 7.56%



0 dB = 10.1 W/kg = 10.04 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used (interpolated):

$f = 5250 \text{ MHz}$; $\sigma = 5.505 \text{ S/m}$; $\epsilon_r = 48.586$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.3°C

Probe: EX3DV4 - SN3914; ConvF(4.32, 4.32, 4.32); Calibrated: 2/22/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646

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

5250 MHz System Verification at 17.0 dBm (50 mW)

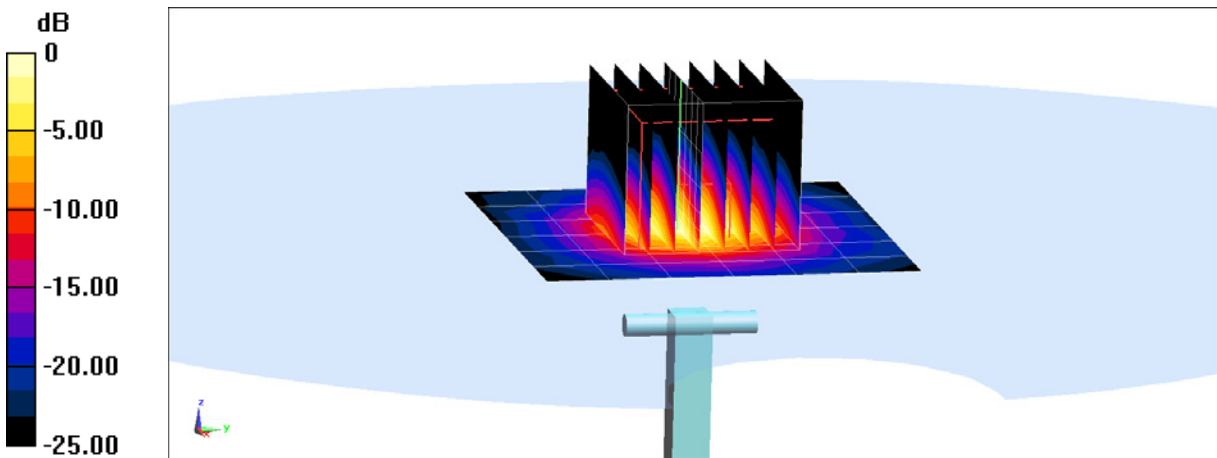
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 15.7 W/kg

SAR(1 g) = 3.64 W/kg; SAR(10 g) = 1.03 W/kg

Deviation(1 g) = -2.67%; Deviation(10 g) = -1.90%



0 dB = 8.93 W/kg = 9.51 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 5 GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.985 \text{ S/m}$; $\epsilon_r = 47.982$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.3°C

Probe: EX3DV4 - SN3914; ConvF(3.63, 3.63, 3.63); Calibrated: 2/22/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646

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

5600 MHz System Verification at 17.0 dBm (50 mW)

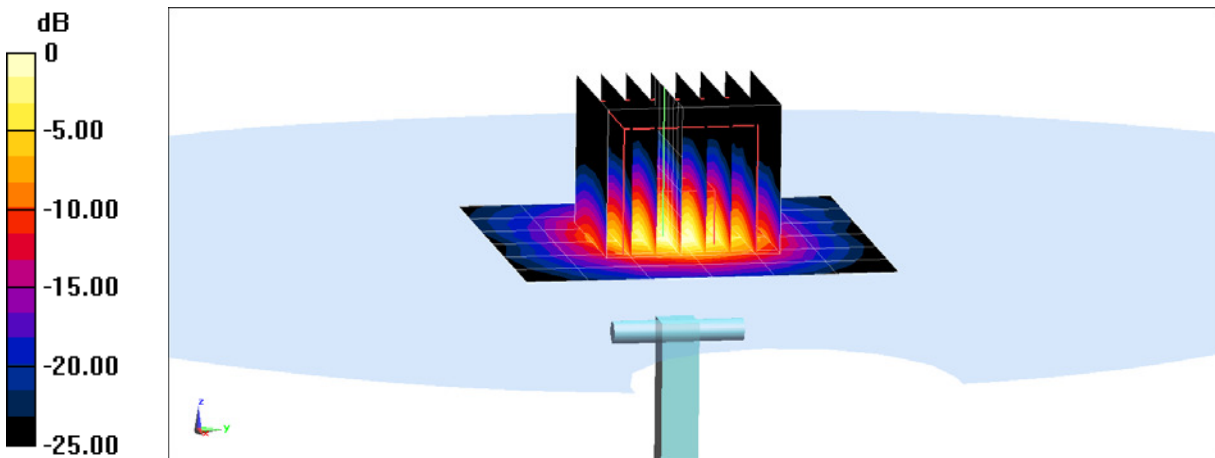
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 15.6 W/kg

SAR(1 g) = 3.77 W/kg; SAR(10 g) = 1.07 W/kg

Deviation(1 g) = -2.08%; Deviation(10 g) = -0.47%



0 dB = 8.86 W/kg = 9.47 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used (interpolated):

$f = 5750 \text{ MHz}$; $\sigma = 6.18 \text{ S/m}$; $\epsilon_r = 47.764$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 01-08-2017; Ambient Temp: 20.0°C; Tissue Temp: 20.3°C

Probe: EX3DV4 - SN3914; ConvF(3.86, 3.86, 3.86); Calibrated: 2/22/2016;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/18/2016

Phantom: SAM with CRP v5.0 Front; Type: QD000P40CD; Serial: 1646

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

5750 MHz System Verification at 17.0 dBm (50 mW)

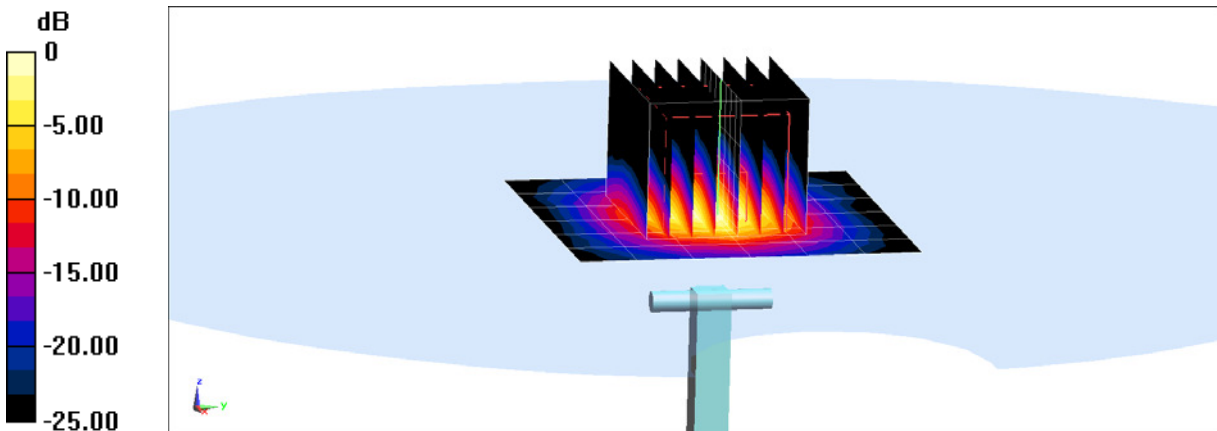
Area Scan (7x7x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Zoom Scan (9x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Peak SAR (extrapolated) = 15.5 W/kg

SAR(1 g) = 3.48 W/kg; SAR(10 g) = 0.979 W/kg

Deviation(1 g) = -7.69%; Deviation(10 g) = -6.32%



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

APPENDIX C: PROBE CALIBRATION



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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1750V2-1148_May16**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1148**

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

Calibration date: **May 09, 2016**

BNV
 5/17/2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Michael Weber** Function: **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** Technical Manager

Issued: May 11, 2016

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



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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.7 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.2 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.1 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.8 $\pm$ 6 %	1.50 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

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

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

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.221 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 30, 2014

DASY5 Validation Report for Head TSL

Date: 09.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 39.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

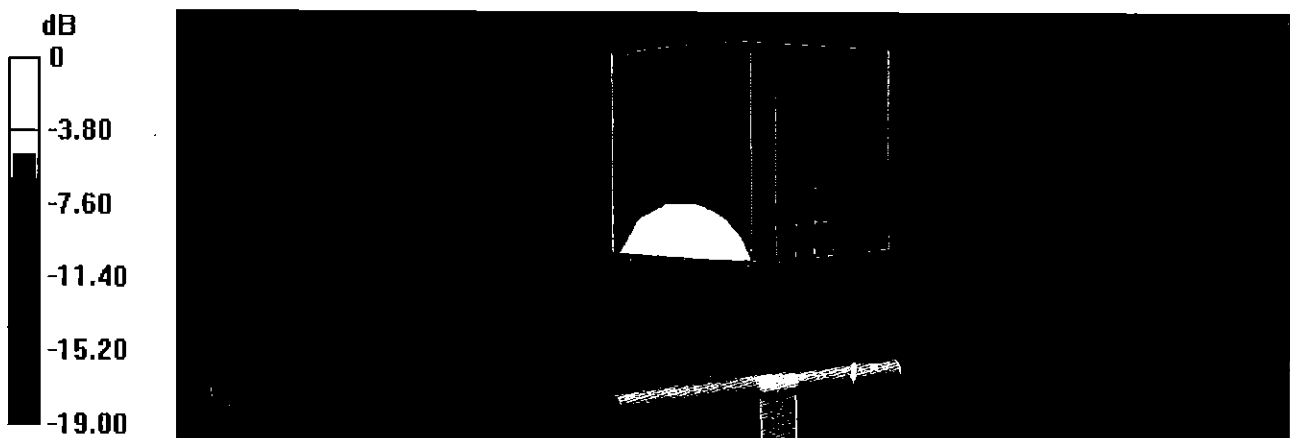
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.5 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 9.03 W/kg; SAR(10 g) = 4.78 W/kg

Maximum value of SAR (measured) = 13.6 W/kg

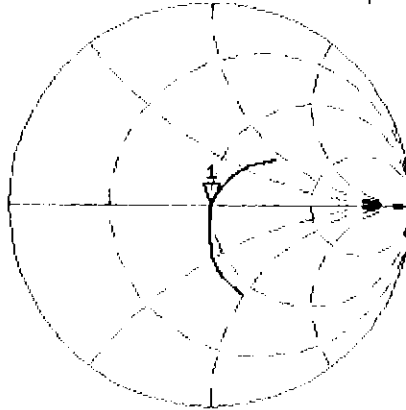


0 dB = 13.6 W/kg = 11.34 dBW/kg

Impedance Measurement Plot for Head TSL

9 May 2016 11:49:12
[CH1] S11 1 U FS 1: 49.912 Ω -679.69 m Ω 133.81 pF 1 750.000 000 MHz

*
De l
CA



Avg
16

H1d

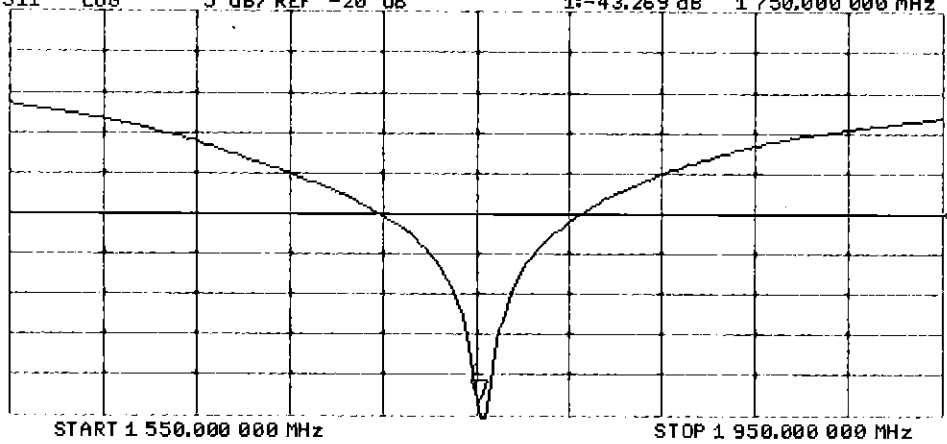
CH2 S11 LOG 5 dB/REF -20 dB 1: -43.269 dB 1 750.000 000 MHz

De l

CA

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 09.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.5$ S/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

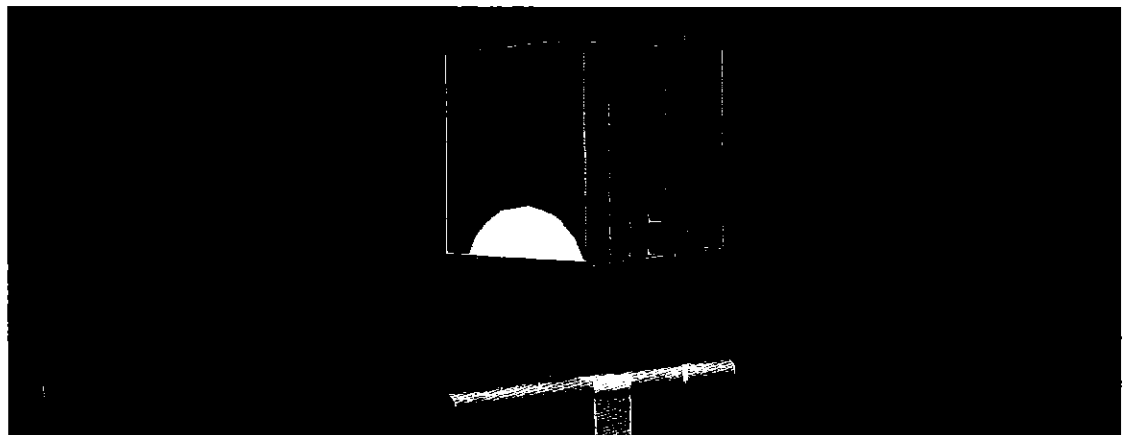
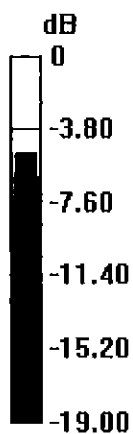
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.0 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 16.6 W/kg

SAR(1 g) = 9.3 W/kg; SAR(10 g) = 4.93 W/kg

Maximum value of SAR (measured) = 14.1 W/kg



0 dB = 14.1 W/kg = 11.49 dBW/kg

Impedance Measurement Plot for Body TSL

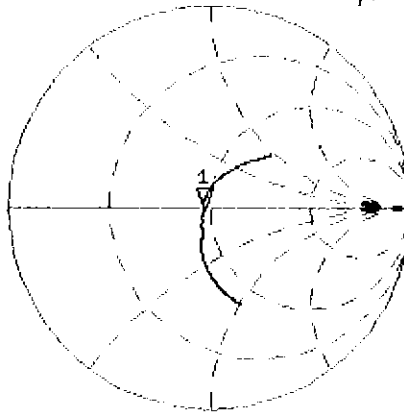
9 May 2016 11:48:41
[CH1] S11 1 U FS 1: 46.205 Ω -1.4258 Ω 63.787 pF 1 750.000 000 MHz

*
De1

CA

Avg
16

H1d



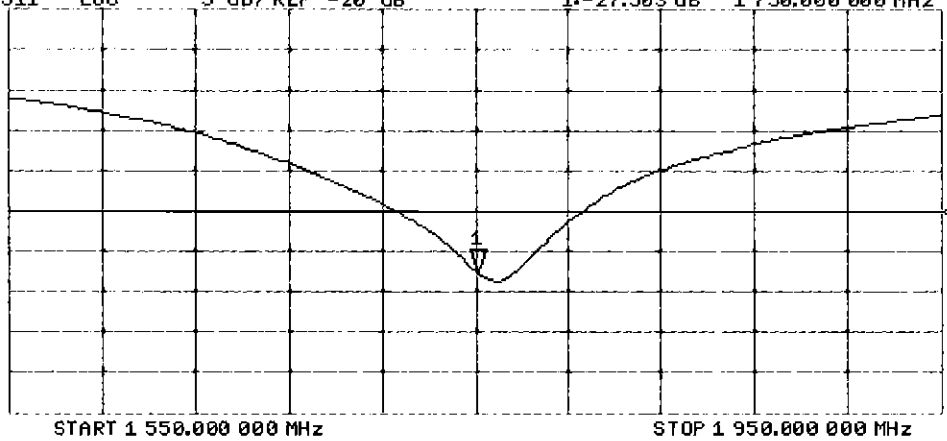
CH2 S11 LOG 5 dB/REF -20 dB 1: -27.503 dB 1 750.000 000 MHz

De1

CA

Avg
16

H1d





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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1765V2-1008_May16**

CALIBRATION CERTIFICATE

Object **D1765V2 - SN:1008**

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

*BNV
05/23/16*

Calibration date: **May 11, 2016**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Michael Weber** Name: **Michael Weber** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

M. Weber

Katja Pokovic

Issued: May 17, 2016

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.8 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.81 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.3 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.50 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.8 $\pm$ 6 %	1.50 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.30 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.8 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

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

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2005

DASY5 Validation Report for Head TSL

Date: 11.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 39.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

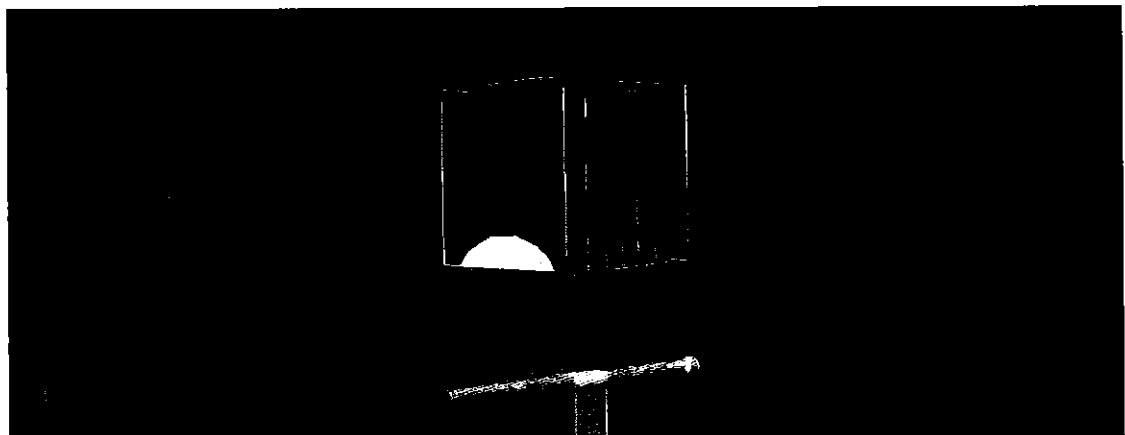
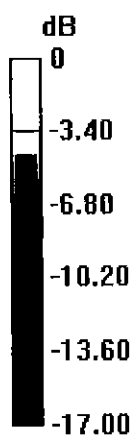
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.4 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 9.1 W/kg; SAR(10 g) = 4.81 W/kg

Maximum value of SAR (measured) = 13.7 W/kg



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

Impedance Measurement Plot for Head TSL

11 May 2016 13:10:14
[CH1] S11 1 U FS 1: 48.842 Ω -6.0117 Ω 15.128 pF 1 750.000 000 MHz

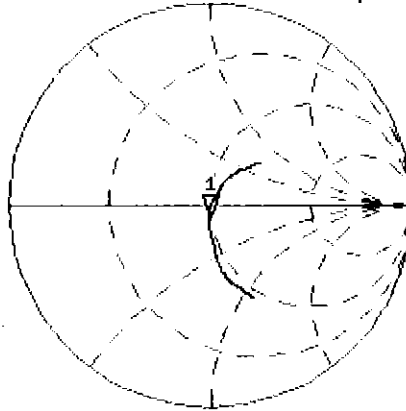
*

De1

Cor

Avg
16

H1d



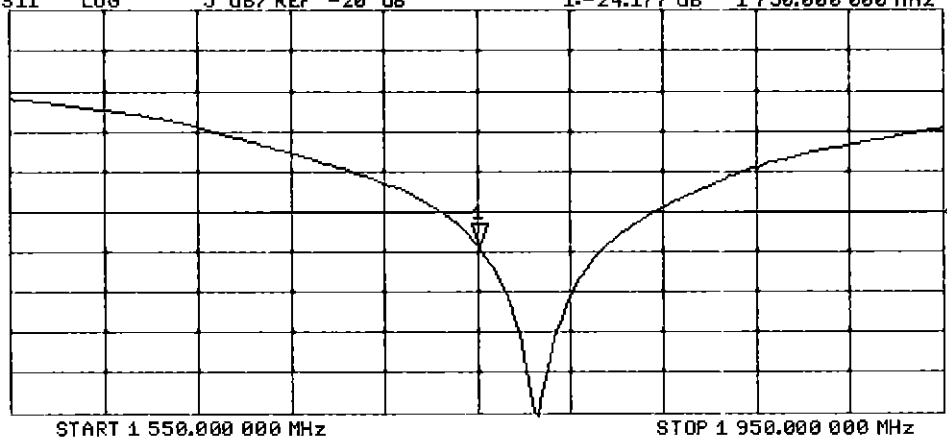
CH2 S11 LOG 5 dB/REF -20 dB 1:-24.177 dB 1 750.000 000 MHz

De1

Cor

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 11.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.5$ S/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

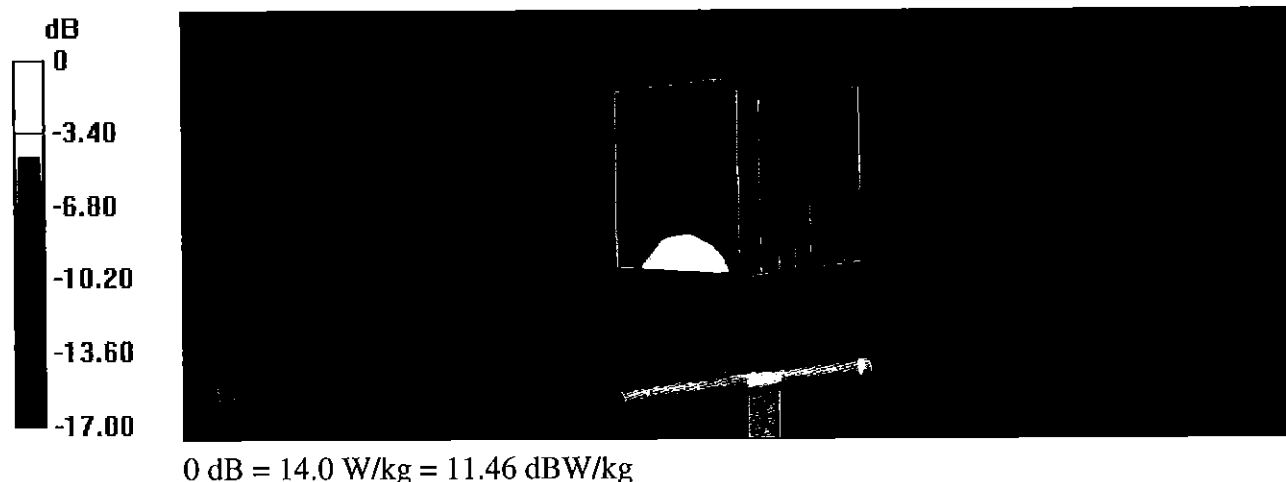
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.9 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 16.4 W/kg

SAR(1 g) = 9.3 W/kg; SAR(10 g) = 4.94 W/kg

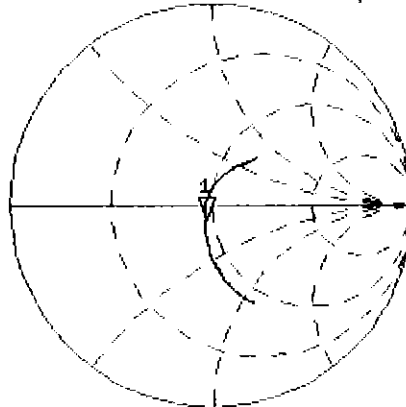
Maximum value of SAR (measured) = 14.0 W/kg



Impedance Measurement Plot for Body TSL

11 May 2016 13:08:31
 [CH1] S11 1 U FS 1: 45.803 Ω -6.7695 Ω 13.435 pF 1 750.000 000 MHz

*
 Del
 Cor



Avg
 16

H1d

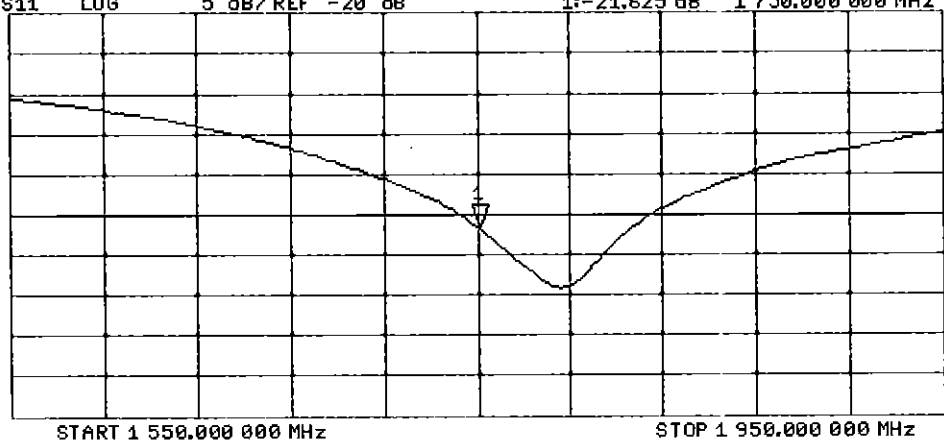
CH2 S11 LOG 5 dB/REF -20 dB 1:-21.625 dB 1 750.000 000 MHz

Del

Cor

Avg
 16

H1d





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1900V2-5d149_Jul16**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d149**

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

Calibration date: **July 15, 2016**

PNV
07/27/2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Claudio Leubler** Name **Laboratory Technician** Function

Approved by: **Katja Pokovic** Technical Manager

Signature *[Signature]*

[Signature]

Issued: July 19, 2016

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



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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.8 $\pm$ 6 %	1.38 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.96 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.0 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.7 $\pm$ 6 %	1.51 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

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

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

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.4 \Omega + 5.5 j\Omega$
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.6 \Omega + 7.0 j\Omega$
Return Loss	- 23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 15.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

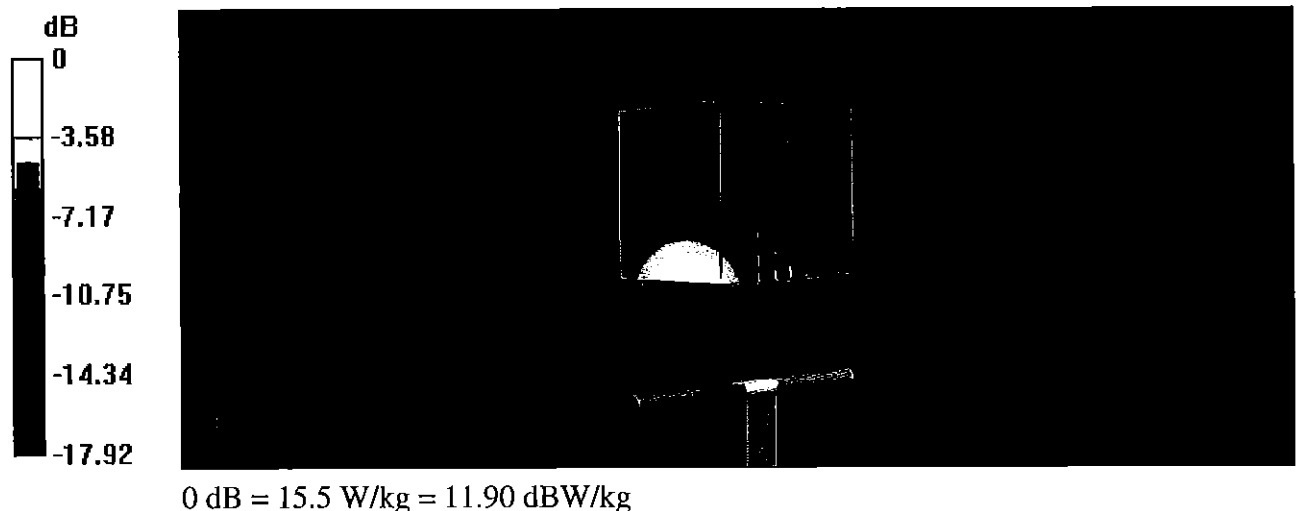
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.5 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 18.7 W/kg

SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.23 W/kg

Maximum value of SAR (measured) = 15.5 W/kg



Impedance Measurement Plot for Head TSL

15 Jul 2016 14:30:53
[CH1] S11 1 U FS 1: 52.393 Ω 5.5488 Ω 454.80 μ H 1 900.000 000 MHz

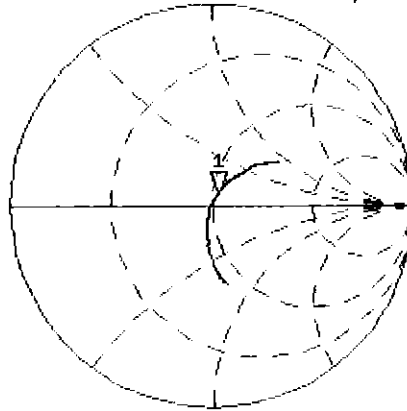
*

De1

CA

Avg
16

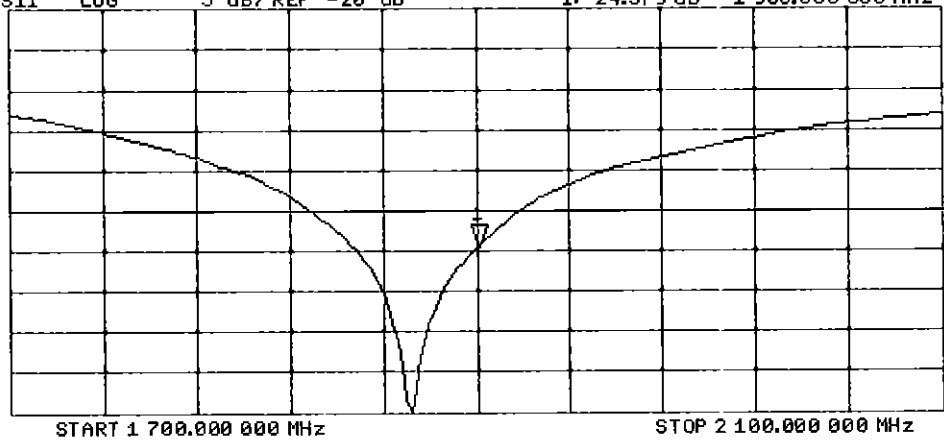
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-24.579 dB 1 900.000 000 MHz

CA

H1d



DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.51$ S/m; $\epsilon_r = 52.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

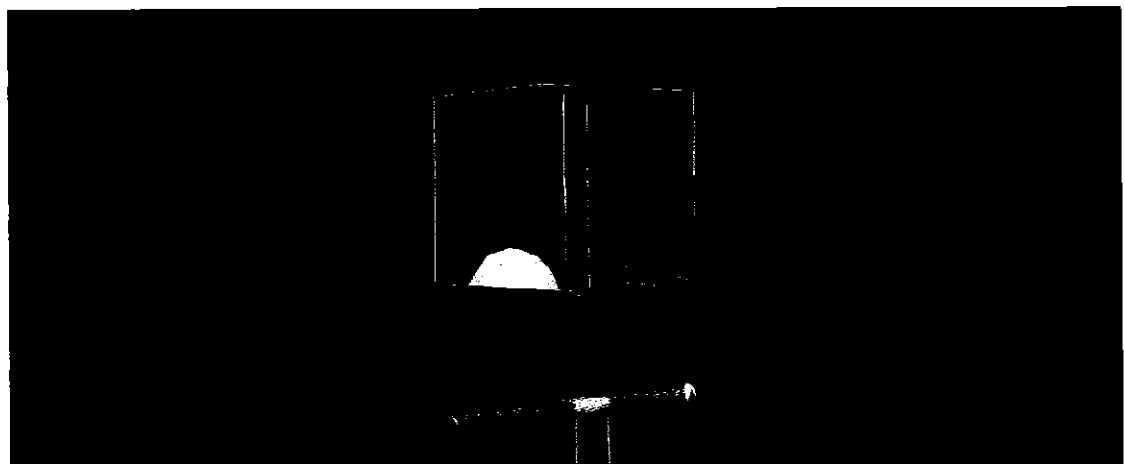
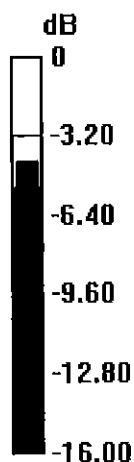
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.9 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 17.4 W/kg

SAR(1 g) = 9.95 W/kg; SAR(10 g) = 5.28 W/kg

Maximum value of SAR (measured) = 14.9 W/kg

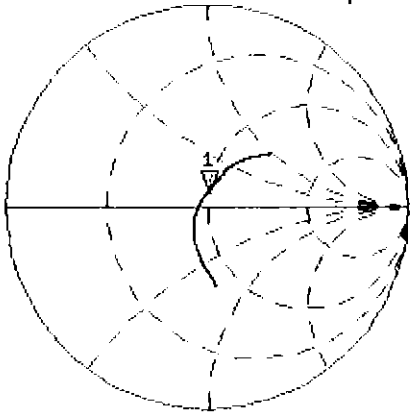


0 dB = 14.9 W/kg = 11.73 dBW/kg

Impedance Measurement Plot for Body TSL

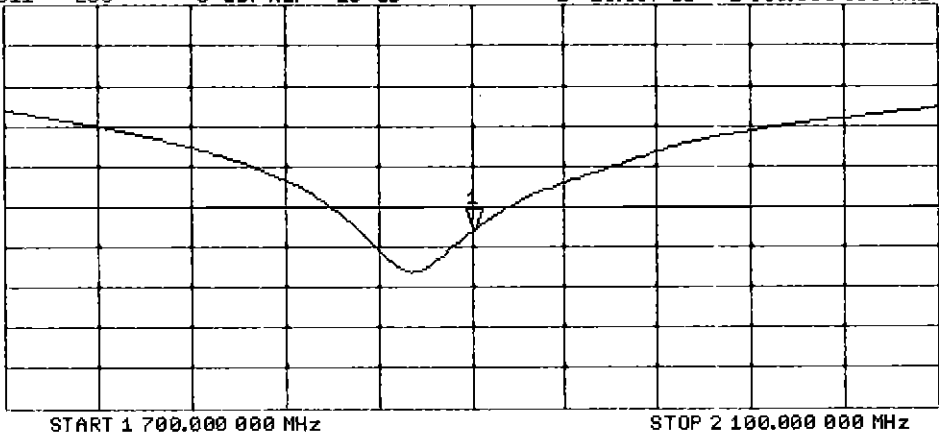
13 Jul 2016 16:29:36
CH1 S11 1 U FS 1: 49.625 Ω 6.9922 Ω 585.71 μ H 1 900.000 000 MHz

*
De1
Cor
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-23.087 dB 1 900.000 000 MHz

Cor
Avg
16
H1d





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2450V2-797_Sep16**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN:797**

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

BNV
09-28-2016

Calibration date: **September 13, 2016**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Calibrated by: **Jeton Kastrati** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: September 13, 2016

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.9 $\pm$ 6 %	1.88 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

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

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.6 $\pm$ 6 %	2.04 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.7 W/kg $\pm$ 17.0 % (k=2)

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

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.8 \Omega + 6.0 j\Omega$
Return Loss	- 23.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.8 \Omega + 8.0 j\Omega$
Return Loss	- 22.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 24, 2006

DASY5 Validation Report for Head TSL

Date: 13.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.88 \text{ S/m}$; $\epsilon_r = 37.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

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

Reference Value = 113.4 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 26.9 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.26 W/kg

Maximum value of SAR (measured) = 21.9 W/kg

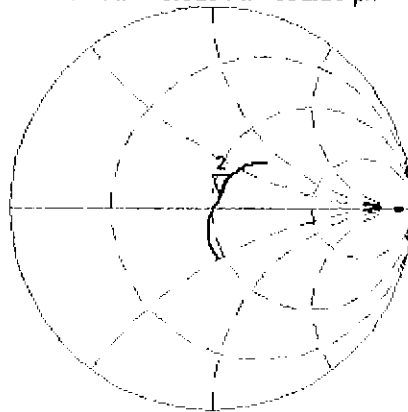


0 dB = 21.9 W/kg = 13.40 dBW/kg

Impedance Measurement Plot for Head TSL

12 Sep 2016 12:42:03
 CH1 S11 1 U FS 2: 53.771 Ω 6.0234 Ω 391.29 μH 2 450.000 000 MHz

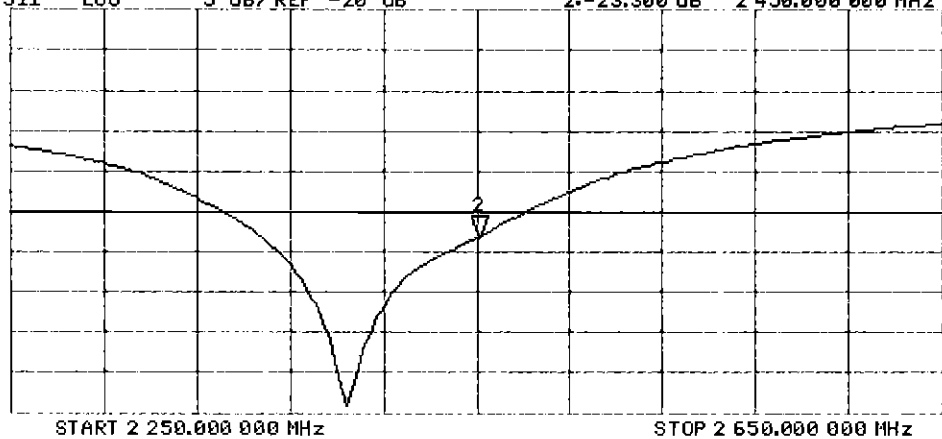
*
 De1
 CA



Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 2:-23.300 dB 2 450.000 000 MHz

CA
 Avg
 16
 H1d



DASY5 Validation Report for Body TSL

Date: 13.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.04$ S/m; $\epsilon_r = 51.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

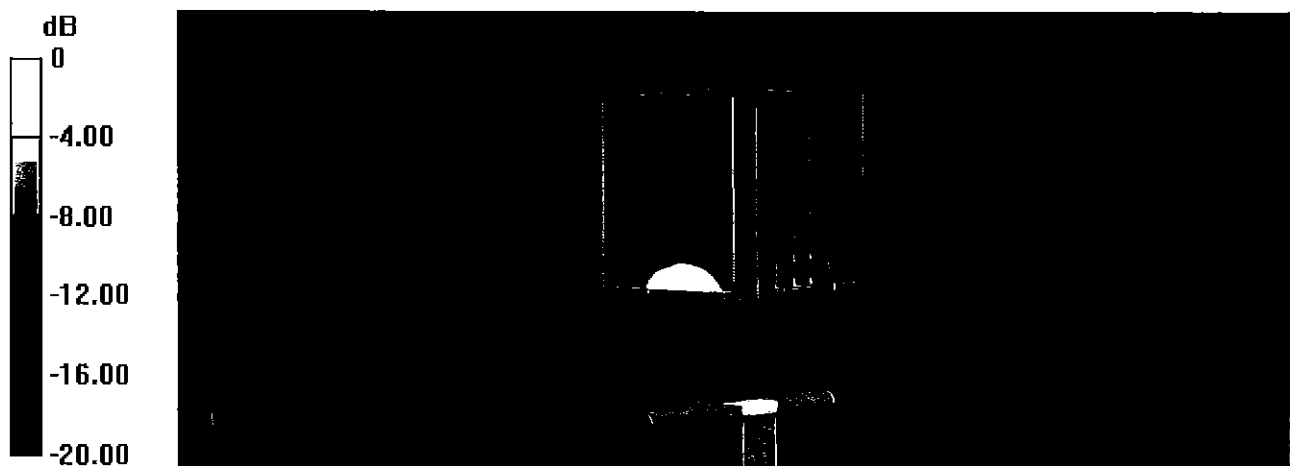
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.5 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 25.6 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.13 W/kg

Maximum value of SAR (measured) = 21.2 W/kg

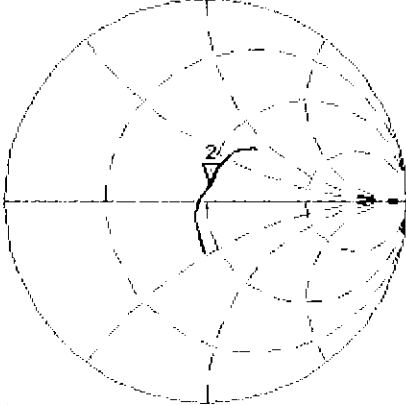


0 dB = 21.2 W/kg = 13.26 dBW/kg

Impedance Measurement Plot for Body TSL

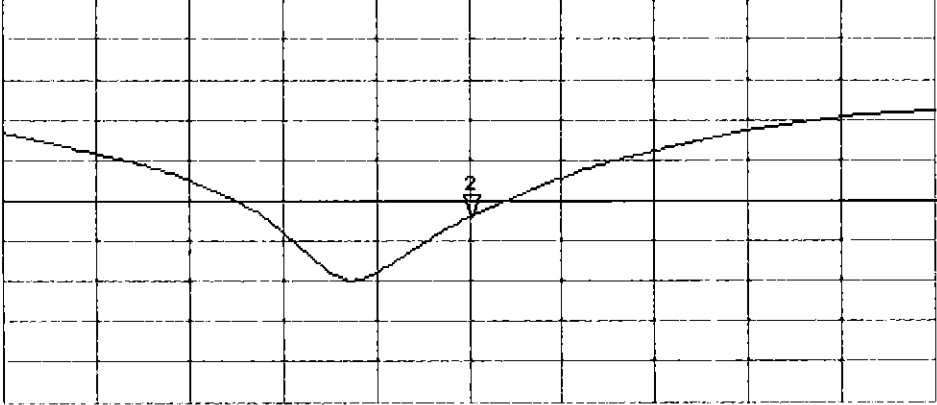
12 Sep 2016 12:40:39
[CH1] S11 1 U FS 2: 50.842 Ω 7.9531 Ω 516.64 μ H 2 450.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 2:-22.037 dB 2 450.000 000 MHz

CA
Avg
16
H1d



START 2 250.000 000 MHz STOP 2 650.000 000 MHz



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2450V2-981_Jul16**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN:981**

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

Calibration date: **July 25, 2016**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Calibrated by: **Michael Weber** Name: **Michael Weber** Function: **Laboratory Technician**

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

Signature

M. Weber
K. Pokovic

Issued: July 27, 2016

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.0 $\pm$ 6 %	1.86 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.7 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.8 $\pm$ 6 %	2.03 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.04 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.8 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.2 \Omega + 3.4 j\Omega$
Return Loss	- 26.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.2 \Omega + 4.5 j\Omega$
Return Loss	- 27.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.162 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	December 30, 2014

DASY5 Validation Report for Head TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:981

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.86$ S/m; $\epsilon_r = 38$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

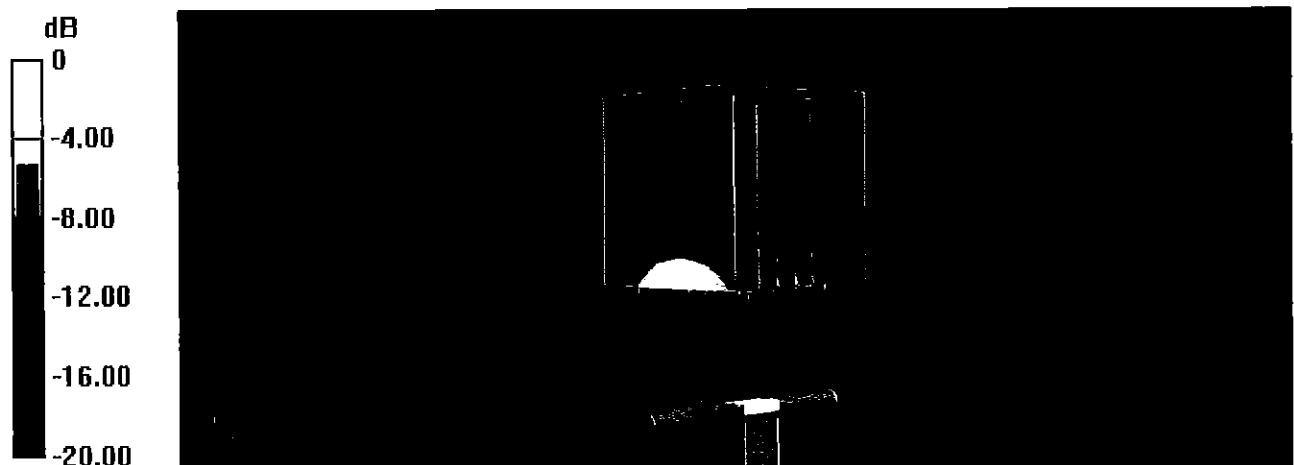
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 115.8 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 27.4 W/kg

SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.26 W/kg

Maximum value of SAR (measured) = 22.5 W/kg

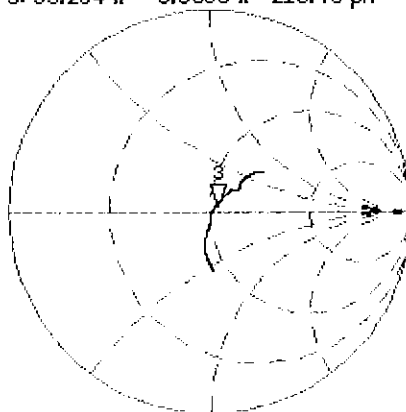


0 dB = 22.5 W/kg = 13.52 dBW/kg

Impedance Measurement Plot for Head TSL

13 Jul 2016 12:53:29
 CH1 S11 1 U FS 3: 53.234 Ω 3.3633 Ω 218.48 μH 2 450.000 000 MHz

*
 De l
 CA



AVG
 16

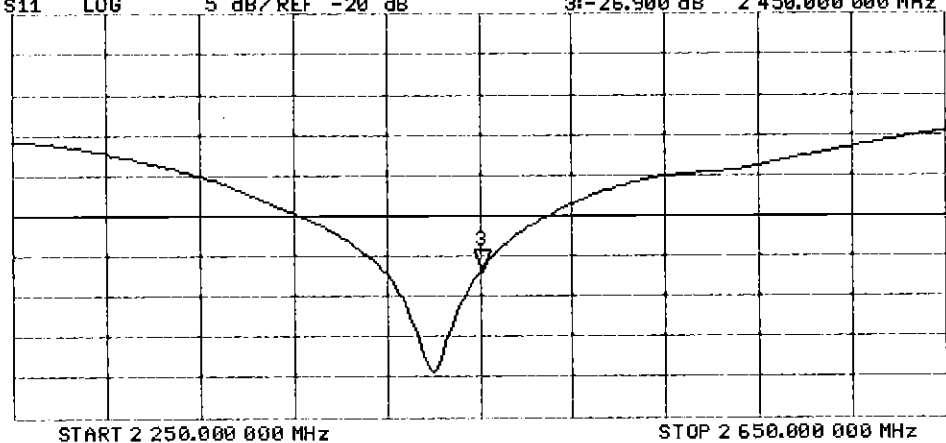
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-26.900 dB 2 450.000 000 MHz

CA

AVG
 16

H1d



DASY5 Validation Report for Body TSL

Date: 25.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:981

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 51.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

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

Reference Value = 107.1 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 26.0 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.04 W/kg

Maximum value of SAR (measured) = 21.4 W/kg

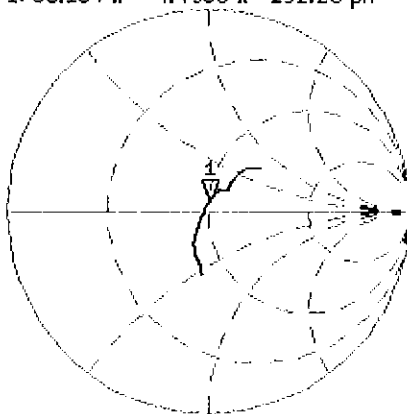


0 dB = 21.4 W/kg = 13.30 dBW/kg

Impedance Measurement Plot for Body TSL

25 Jul 2016 10:03:11
 CH1 S11 1 U FS 1: 50.184 Ω 4.4980 Ω 292.20 pH 2 450.000 000 MHz

*
 De1
 CA



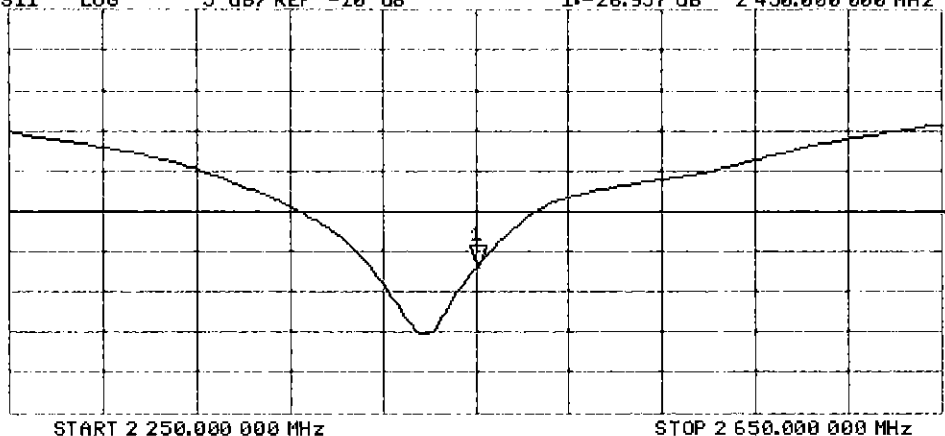
Avg
 16

H1 d

CH2 S11 LOG 5 dB/ REF -20 dB 1: -26.957 dB 2 450.000 000 MHz

CA

H1 d





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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2600V2-1071_Sep16**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1071**

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

BNV
 09-28-2016

Calibration date: **September 13, 2016**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Jeton Kastrati** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: September 13, 2016

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



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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.3 $\pm$ 6 %	2.05 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.3 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.1 $\pm$ 6 %	2.22 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	54.2 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.5 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.9 Ω - 6.7 j Ω
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.1 Ω - 2.1 j Ω
Return Loss	- 26.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.153 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: 13.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1071

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.05$ S/m; $\epsilon_r = 37.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.56, 7.56, 7.56); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

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

Reference Value = 115.1 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 30.4 W/kg

SAR(1 g) = 14.5 W/kg; SAR(10 g) = 6.45 W/kg

Maximum value of SAR (measured) = 24.6 W/kg

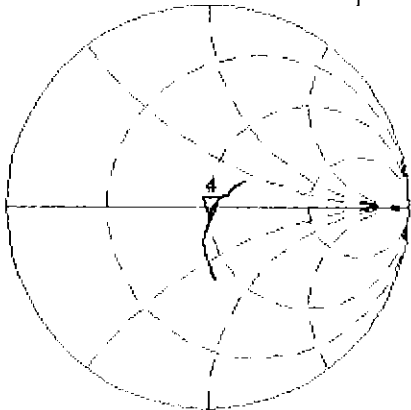


0 dB = 24.6 W/kg = 13.91 dBW/kg

Impedance Measurement Plot for Head TSL

12 Sep 2016 13:13:44
CH1 S11 1 U FS 4: 43.902 Ω -6.6523 Ω 9.2018 pF 2 600.000 000 MHz

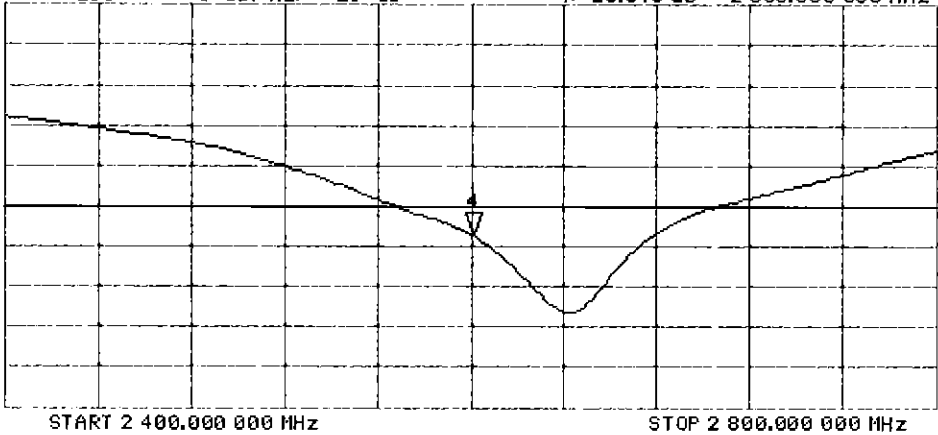
*
De l
CA



Avg
16
H1 d

CH2 S11 LOG 5 dB/ REF -20 dB 4:-23.548 dB 2 600.000 000 MHz

CA
Avg
16
H1 d



DASY5 Validation Report for Body TSL

Date: 13.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1071

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.22$ S/m; $\epsilon_r = 51.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.48, 7.48, 7.48); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

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

Reference Value = 107.7 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 28.3 W/kg

SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.2 W/kg

Maximum value of SAR (measured) = 23.3 W/kg

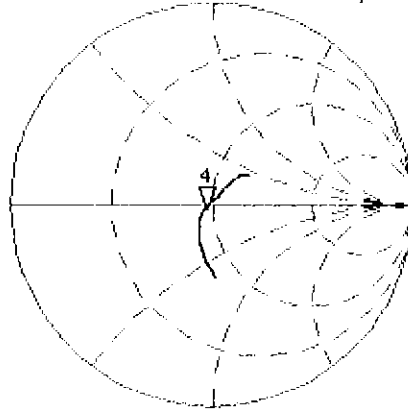


0 dB = 23.3 W/kg = 13.67 dBW/kg

Impedance Measurement Plot for Body TSL

12 Sep 2016 13:13:09
[CH1] S11 1 U FS 4: 46.078 Ω -2.0762 Ω 29.484 pF 2 600.000 000 MHz

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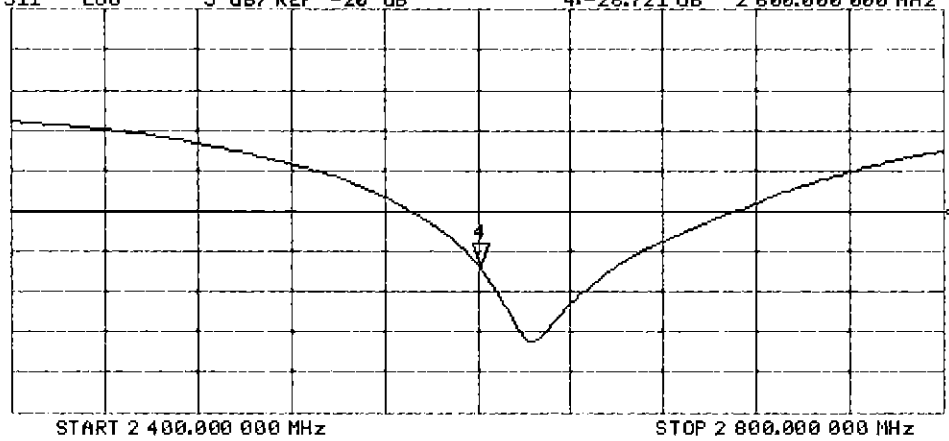
H1 d

CH2 S11 LOG 5 dB/REF -20 dB 4:-26.721 dB 2 600.000 000 MHz

Ca

Avg
16

H1 d





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2600V2-1126_Jul16**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN: 1126**

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

✓ PM
 8/9/16

Calibration date: **July 25, 2016**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

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

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

Calibrated by: **Michael Weber** Name: **Michael Weber** Function: **Laboratory Technician**

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

Signature

M. Weber

K. Pokovic

Issued: July 26, 2016

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	37.5 $\pm$ 6 %	2.02 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.3 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.1 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.4 $\pm$ 6 %	2.20 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	54.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.3 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.0 Ω - 7.4 j Ω
Return Loss	- 22.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.4 Ω - 6.2 j Ω
Return Loss	- 21.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 22, 2015

DASY5 Validation Report for Head TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1126

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.02$ S/m; $\epsilon_r = 37.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.56, 7.56, 7.56); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

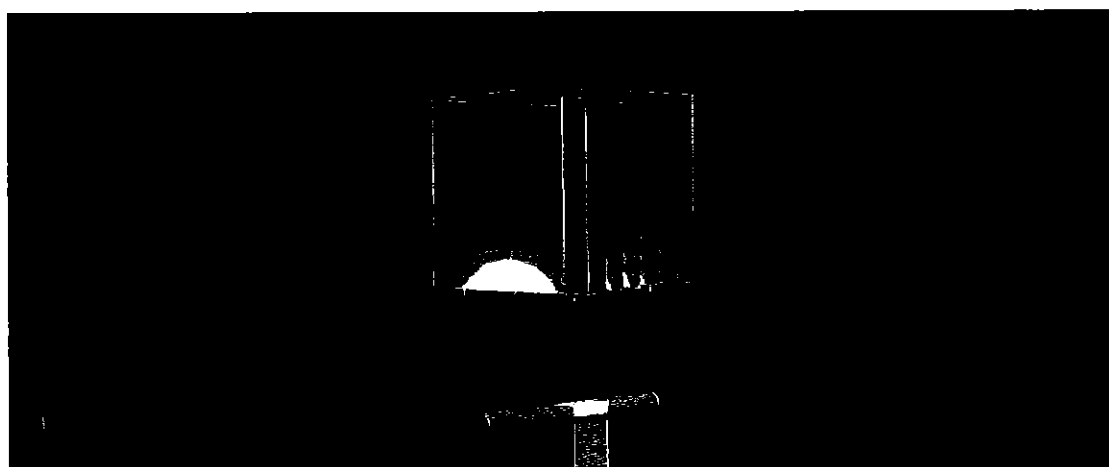
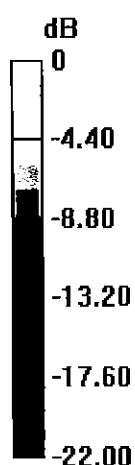
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.2 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 30.6 W/kg

SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.36 W/kg

Maximum value of SAR (measured) = 24.6 W/kg

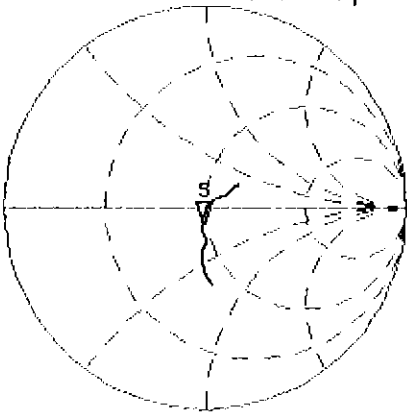


0 dB = 24.6 W/kg = 13.91 dBW/kg

Impedance Measurement Plot for Head TSL

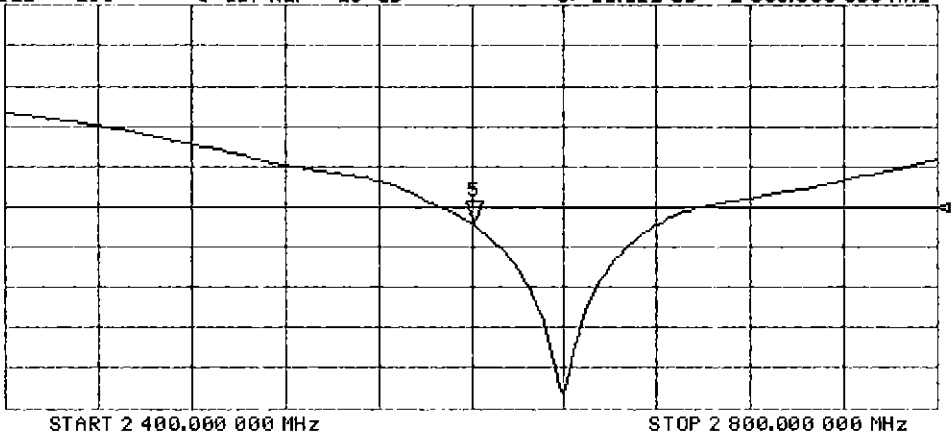
13 Jul 2016 15:46:28
[CH1] S11 1 U FS 5: 47.990 Ω -7.4297 Ω 8.2390 pF 2 600.000 000 MHz

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CH2 S11 LOG 5 dB/REF -20 dB 5:-22.121 dB 2 600.000 000 MHz

CΔ
Avg
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H1d



DASY5 Validation Report for Body TSL

Date: 22.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz D2600V2; Type: D2600V2; Serial: D2600V2 - SN:1126

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.2$ S/m; $\epsilon_r = 51.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.48, 7.48, 7.48); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

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

Reference Value = 107.5 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.5 W/kg

SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.12 W/kg

Maximum value of SAR (measured) = 23.0 W/kg

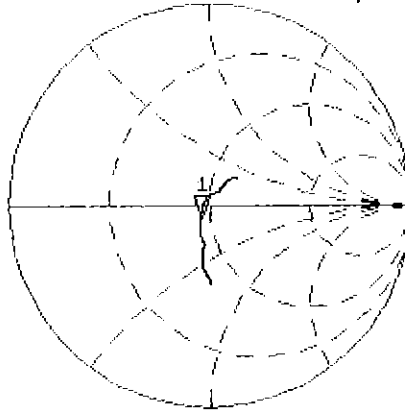


0 dB = 23.0 W/kg = 13.62 dBW/kg

Impedance Measurement Plot for Body TSL

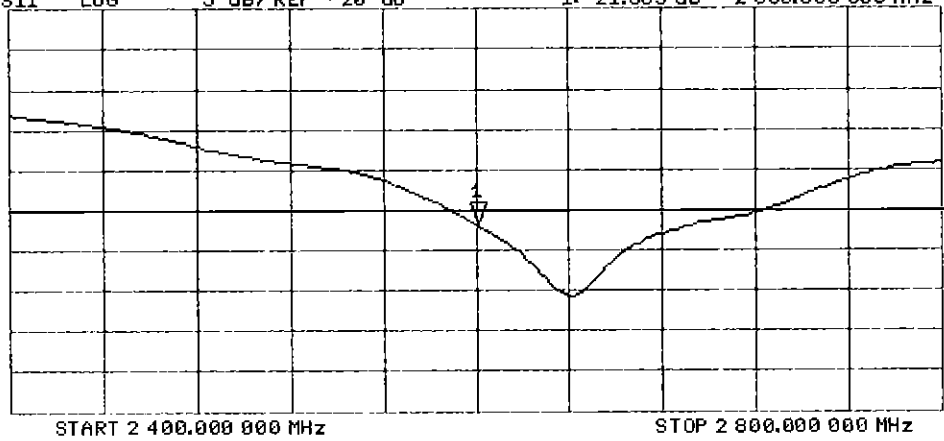
22 Jul 2016 08:31:57
 [CH1] S11 1 U FS 1: 45.354 Ω -6.1699 Ω 9.9213 pF 2 500.000 000 MHz

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 CA
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -21.863 dB 2 500.000 000 MHz

CA
 H1d





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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D5GHzV2-1191_Sep16**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1191**

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

BNV
09-28-2016

Calibration date: **September 21, 2016**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	30-Jun-16 (No. EX3-3503_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Leif Klysner** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature
Leif Klysner
Katja Pokovic

Issued: September 22, 2016

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-2, "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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom 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 $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5750 MHz $\pm$ 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 $\pm$ 0.2) °C	34.5 $\pm$ 6 %	4.59 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.96 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.9 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.6 W/kg $\pm$ 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	34.0 ± 6 %	4.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.6 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.8 ± 6 %	5.08 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.4 ± 6 %	5.52 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	7.74 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 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	46.8 ± 6 %	6.00 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	7.96 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	79.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.2 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	46.5 ± 6 %	6.21 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	7.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 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	55.7 Ω - 4.3 j Ω
Return Loss	- 23.4 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	58.3 Ω - 3.2 j Ω
Return Loss	- 21.8 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	58.1 Ω + 4.8 j Ω
Return Loss	- 21.2 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	56.1 Ω - 3.7 j Ω
Return Loss	- 23.4 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.9 Ω - 1.7 j Ω
Return Loss	- 21.7 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	59.5 Ω + 6.9 j Ω
Return Loss	- 19.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 21.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: $f = 5250$ MHz; $\sigma = 4.59$ S/m; $\epsilon_r = 34.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.93$ S/m; $\epsilon_r = 34$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5750$ MHz; $\sigma = 5.08$ S/m; $\epsilon_r = 33.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.42, 5.42, 5.42); Calibrated: 30.06.2016, ConvF(4.89, 4.89, 4.89); Calibrated: 30.06.2016, ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 68.49 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 28.6 W/kg

SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.29 W/kg

Maximum value of SAR (measured) = 18.2 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 = 69.34 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 32.9 W/kg

SAR(1 g) = 8.45 W/kg; SAR(10 g) = 2.41 W/kg

Maximum value of SAR (measured) = 20.0 W/kg

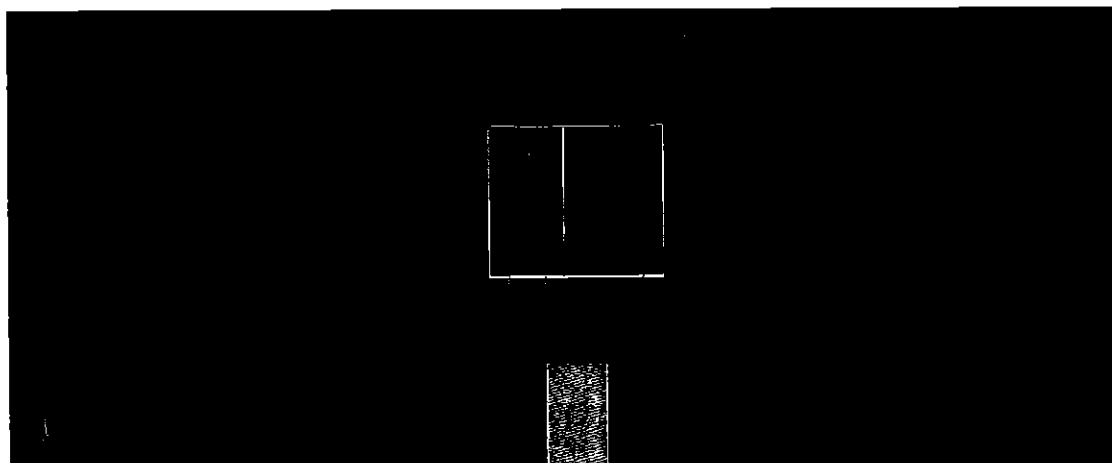
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 67.15 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 32.3 W/kg

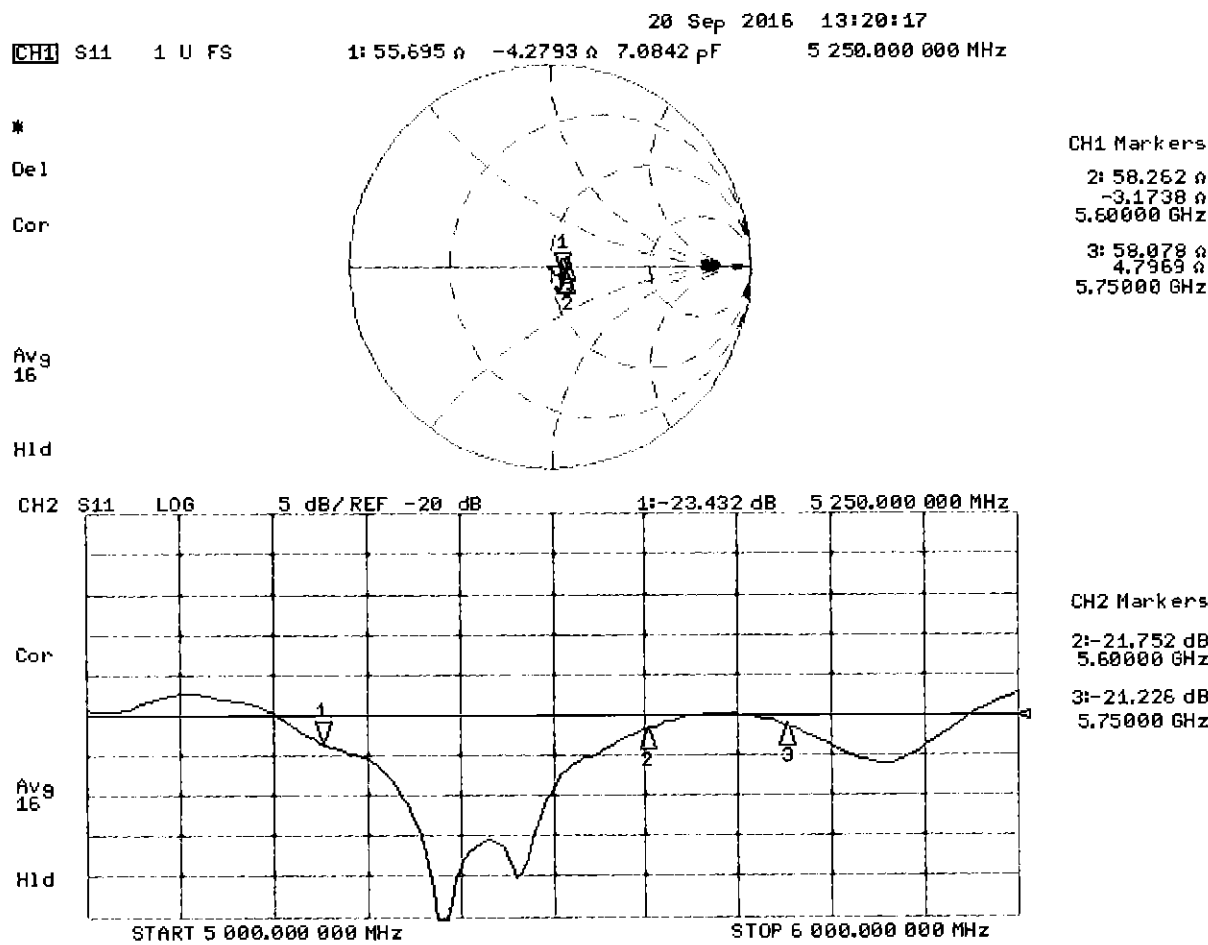
SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.27 W/kg

Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 18.2 W/kg = 12.60 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1191

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: $f = 5250$ MHz; $\sigma = 5.52$ S/m; $\epsilon_r = 47.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 6$ S/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5750$ MHz; $\sigma = 6.21$ S/m; $\epsilon_r = 46.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016, ConvF(4.35, 4.35, 4.35); Calibrated: 30.06.2016, ConvF(4.3, 4.3, 4.3); Calibrated: 30.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.49 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 29.1 W/kg

SAR(1 g) = 7.74 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 17.7 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 = 65.85 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 32.5 W/kg

SAR(1 g) = 7.96 W/kg; SAR(10 g) = 2.24 W/kg

Maximum value of SAR (measured) = 18.8 W/kg

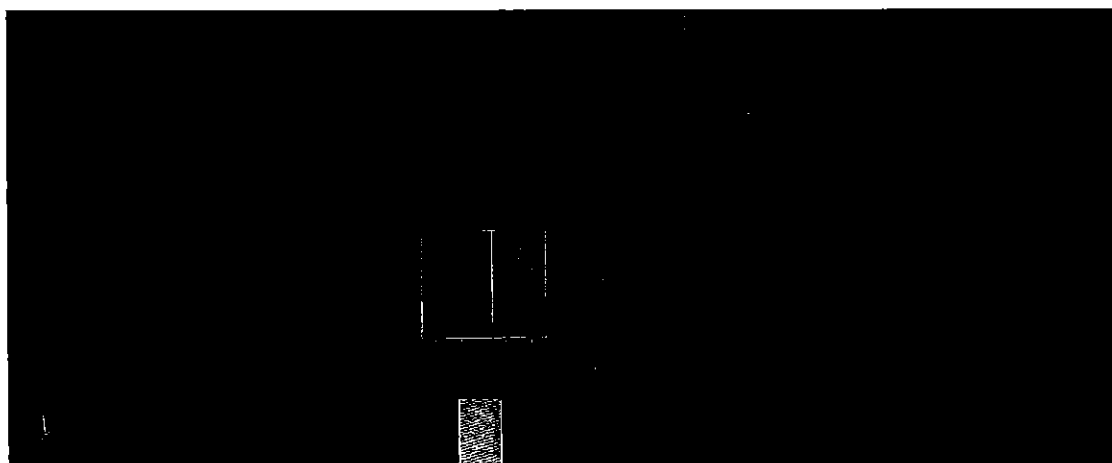
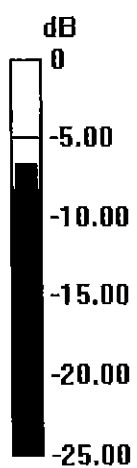
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.21 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 32.7 W/kg

SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

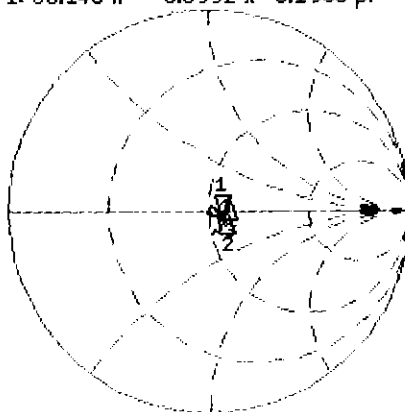


0 dB = 17.7 W/kg = 12.48 dBW/kg

Impedance Measurement Plot for Body TSL

20 Sep 2016 13:19:13
 CH1 S11 1 U FS 1: 56.143 Ω -3.6992 Ω 8.1950 pF 5 250.000 000 MHz

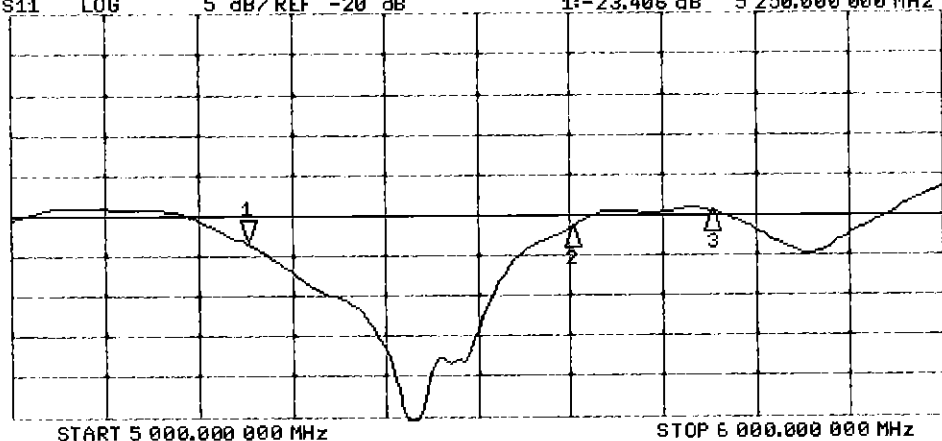
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 58.887 Ω
 -1.6504 Ω
 5.60000 GHz
 3: 59.510 Ω
 6.9121 Ω
 5.75000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -23.406 dB 5 250.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -21.616 dB
 5.60000 GHz
 3: -19.400 dB
 5.75000 GHz



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

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D5GHzV2-1237_Aug16**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1237**

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

✓PN
8/9/16

Calibration date: **August 02, 2016**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	30-Jun-16 (No. EX3-3503_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

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

Calibrated by: **Claudio Leubler** Name: **Claudio Leubler** Function: **Laboratory Technician**

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

Signature

Issued: August 4, 2016

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



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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-2, "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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom 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 $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5750 MHz $\pm$ 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 $\pm$ 0.2) °C	34.4 $\pm$ 6 %	4.52 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.2 W/kg $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.9 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.3 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.7 ± 6 %	5.02 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.42 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.54 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	5.88 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.76 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	6.11 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.9 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	48.6 Ω - 2.5 j Ω
Return Loss	- 30.7 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	50.9 Ω + 1.5 j Ω
Return Loss	- 35.3 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	53.8 Ω + 5.8 j Ω
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	47.0 Ω - 3.9 j Ω
Return Loss	- 25.9 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	51.5 Ω + 3.9 j Ω
Return Loss	- 27.7 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	53.8 Ω + 0.3 j Ω
Return Loss	- 28.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.193 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	May 04, 2015

DASY5 Validation Report for Head TSL

Date: 02.08.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.52$ S/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5600$ MHz; $\sigma = 4.86$ S/m; $\epsilon_r = 33.9$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.02$ S/m; $\epsilon_r = 33.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.42, 5.42, 5.42); Calibrated: 30.06.2016; ConvF(4.89, 4.89, 4.89); Calibrated: 30.06.2016, ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 74.10 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 29.5 W/kg

SAR(1 g) = 8 W/kg; SAR(10 g) = 2.3 W/kg

Maximum value of SAR (measured) = 18.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 73.55 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 32.9 W/kg

SAR(1 g) = 8.43 W/kg; SAR(10 g) = 2.42 W/kg

Maximum value of SAR (measured) = 19.7 W/kg

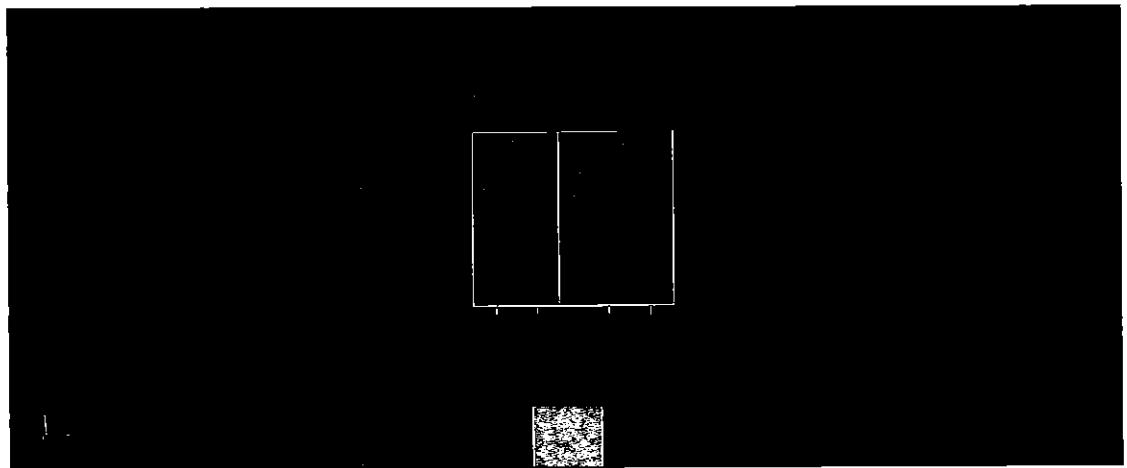
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.23 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 33.6 W/kg

SAR(1 g) = 8.25 W/kg; SAR(10 g) = 2.35 W/kg

Maximum value of SAR (measured) = 18.3 W/kg

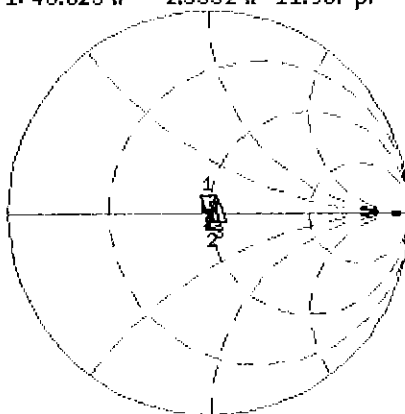


0 dB = 18.3 W/kg = 12.62 dBW/kg

Impedance Measurement Plot for Head TSL

2 Aug 2016 08:52:20
 [CH1] S11 1 U FS 1: 48.623 Ω -2.5332 Ω 11.967 pF 5 250.000 000 MHz

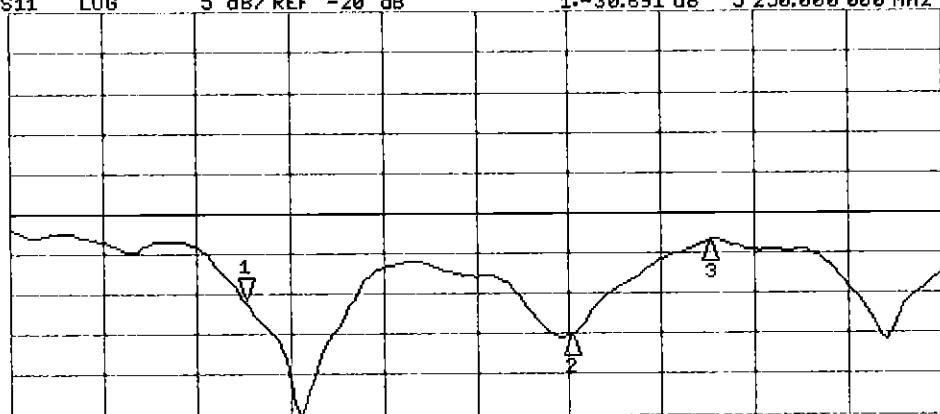
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 50.867 Ω
 1.4961 Ω
 5.60000 GHz
 3: 53.785 Ω
 5.8164 Ω
 5.75000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -30.691 dB 5 250.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -35.297 dB
 5.60000 GHz
 3: -23.501 dB
 5.75000 GHz

DASY5 Validation Report for Body TSL

Date: 02.08.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used: $f = 5250$ MHz; $\sigma = 5.42$ S/m; $\epsilon_r = 47.1$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.88$ S/m; $\epsilon_r = 46.5$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5750$ MHz; $\sigma = 6.11$ S/m; $\epsilon_r = 46.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016, ConvF(4.35, 4.35, 4.35); Calibrated: 30.06.2016, ConvF(4.3, 4.3, 4.3); Calibrated: 30.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 67.19 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.4 W/kg

SAR(1 g) = 7.54 W/kg; SAR(10 g) = 2.12 W/kg

Maximum value of SAR (measured) = 17.3 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.80 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.9 W/kg

SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 18.3 W/kg

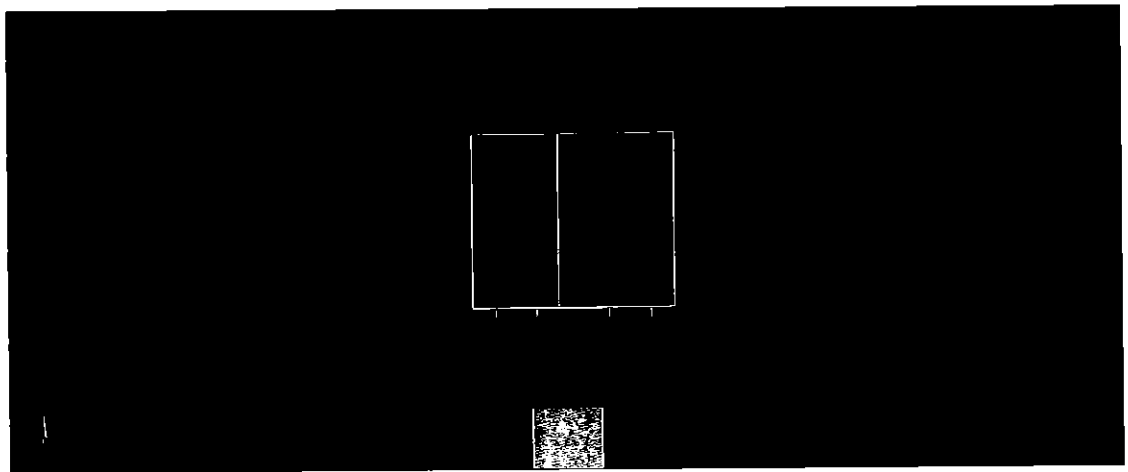
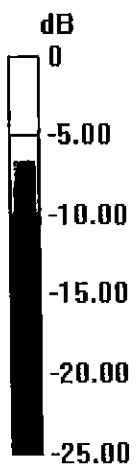
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.31 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 32.6 W/kg

SAR(1 g) = 7.6 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 18.4 W/kg

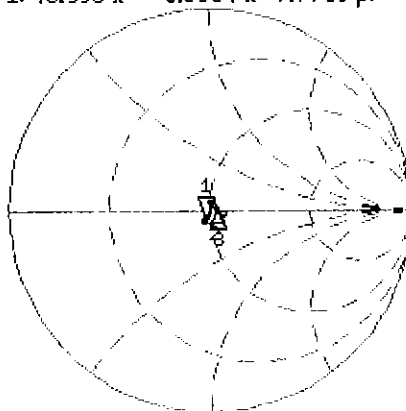


0 dB = 17.3 W/kg = 12.38 dBW/kg

Impedance Measurement Plot for Body TSL

2 Aug 2016 08:49:13
 CH1 S11 1 U FS 1: 46.998 Ω -3.8984 Ω 7.7763 pF 5 250.000 000 MHz

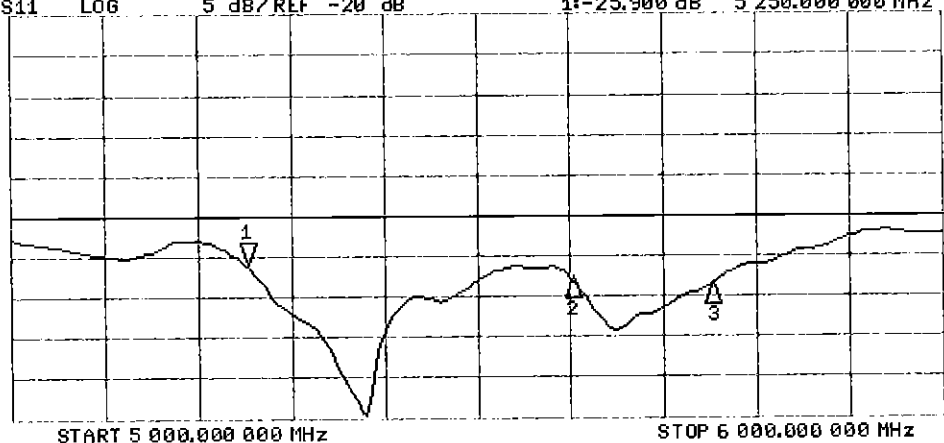
*
 Del
 Cor
 Avg
 16
 H1d



CH1 Markers
 2: 51.525 Ω
 3.8945 Ω
 5.60000 GHz
 3: 53.848 Ω
 0.2930 Ω
 5.75000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -25.900 dB 5 250.000 000 MHz

Cor
 Avg
 16
 H1d



CH2 Markers
 2: -27.699 dB
 5.60000 GHz
 3: -28.596 dB
 5.75000 GHz



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D750V3-1054_Mar16**

CALIBRATION CERTIFICATE

Object **D750V3 - SN:1054**

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

Calibration date: **March 16, 2016**

BN
03/30/2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	US37292783	07-Oct-15 (No. 217-02222)	Oct-16
Power sensor HP 8481A	MY41092317	07-Oct-15 (No. 217-02223)	Oct-16
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe EX3DV4	SN: 7349	31-Dec-15 (No. EX3-7349_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100972	15-Jun-15 (in house check Jun-15)	In house check: Jun-18
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: March 16, 2016

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.9 $\pm$ 6 %	0.91 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.22 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.41 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.7 $\pm$ 6 %	0.98 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.56 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.68 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.2 Ω - 0.9 j Ω
Return Loss	- 27.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 Ω - 2.3 j Ω
Return Loss	- 32.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.035 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 08, 2011

DASY5 Validation Report for Head TSL

Date: 16.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.91 \text{ S/m}$; $\epsilon_r = 41.9$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.28, 10.28, 10.28); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom Type: QD000P49AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue EX-Probe/Pin=250 mW, d=15mm/Zoom Scan

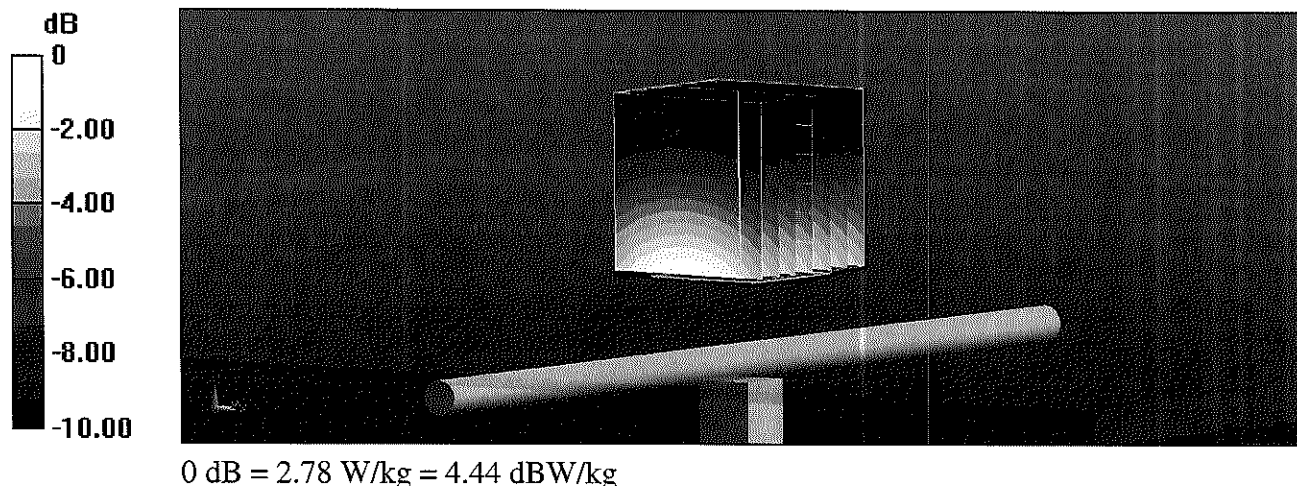
(7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 58.13 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.14 W/kg

SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.37 W/kg

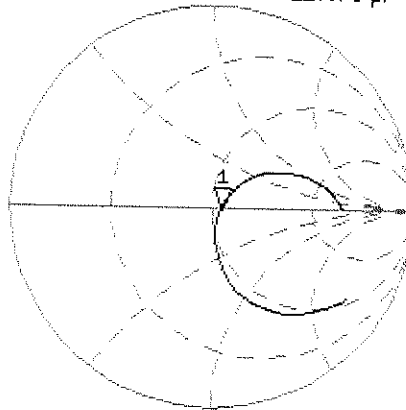
Maximum value of SAR (measured) = 2.78 W/kg



Impedance Measurement Plot for Head TSL

CH1 S11 1 U FS 15 Mar 2016 13:55:57
1: 54.217 Ω -931.64 $m\Omega$ 227.78 pF 750.000 000 MHz

*
De1
CA



Avg
16

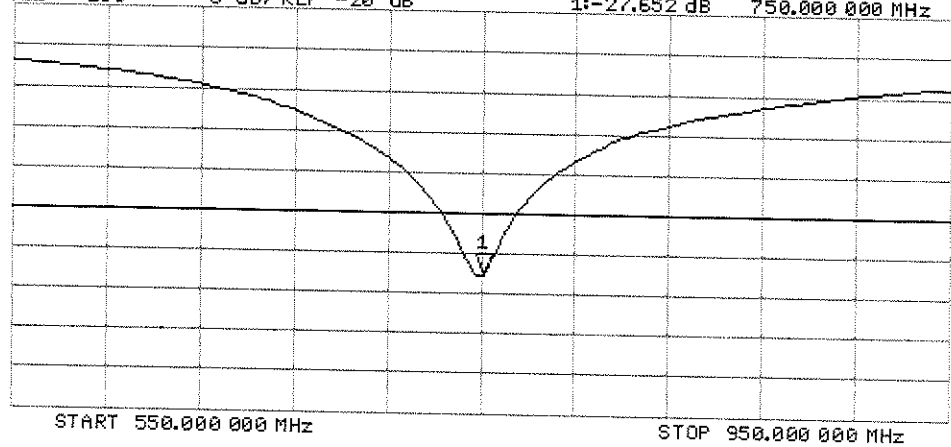
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-27.652 dB 750.000 000 MHz

CA

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 16.03.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.98 \text{ S/m}$; $\epsilon_r = 54.7$; $\rho = 1000 \text{ kg/m}^3$

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(9.99, 9.99, 9.99); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom Type: QD000P49AA
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue EX-Probe/Pin=250 mW, d=15mm/Zoom Scan

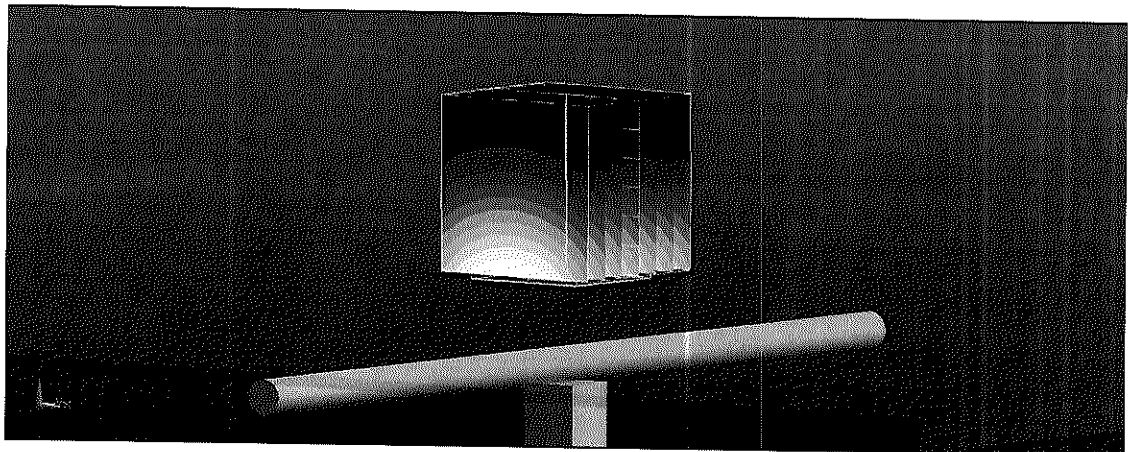
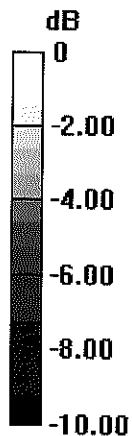
(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.90 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.24 W/kg

SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.44 W/kg

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



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

Impedance Measurement Plot for Body TSL

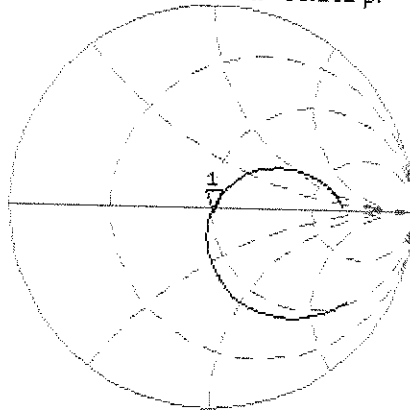
[CH1] S11 1 U FS 1: 50.104 Ω -2.2773 Ω 93.182 pF 16 Mar 2016 11:38:16 750.000 000 MHz

*
De1

CA

Avg
16

H1d

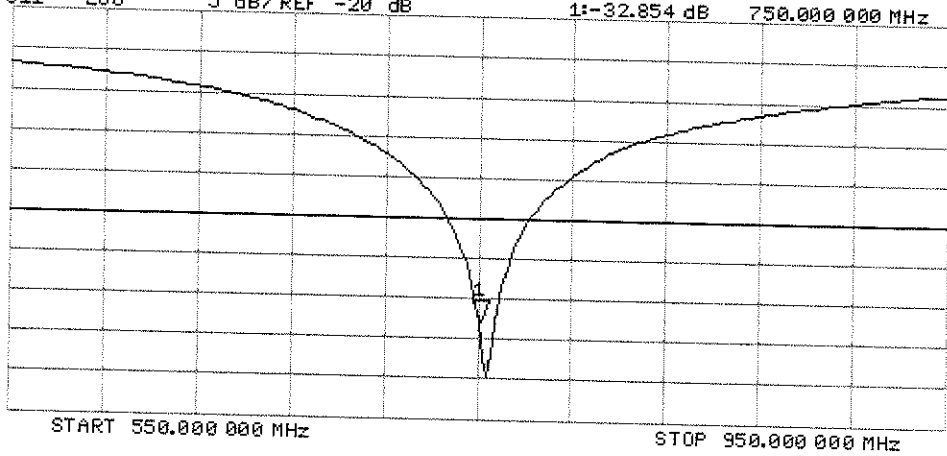


CH2 S11 L06 5 dB/REF -20 dB 1:-32.854 dB 750.000 000 MHz

CA

Avg
16

H1d





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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D750V3-1161_Jul16**

CALIBRATION CERTIFICATE

Object **D750V3 - SN:1161**

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

Calibration date: **July 13, 2016**

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&T'E critical for calibration)

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

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

Calibrated by: **Claudio Leubler** Name: **Claudio Leubler** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: July 13, 2016

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Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.9 $\pm$ 6 %	0.91 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.17 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.39 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	55.1 $\pm$ 6 %	0.99 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.43 W/kg $\pm$ 17.0 % (k=2)

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

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 19, 2015

DASY5 Validation Report for Head TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.91 \text{ S/m}$; $\epsilon_r = 40.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

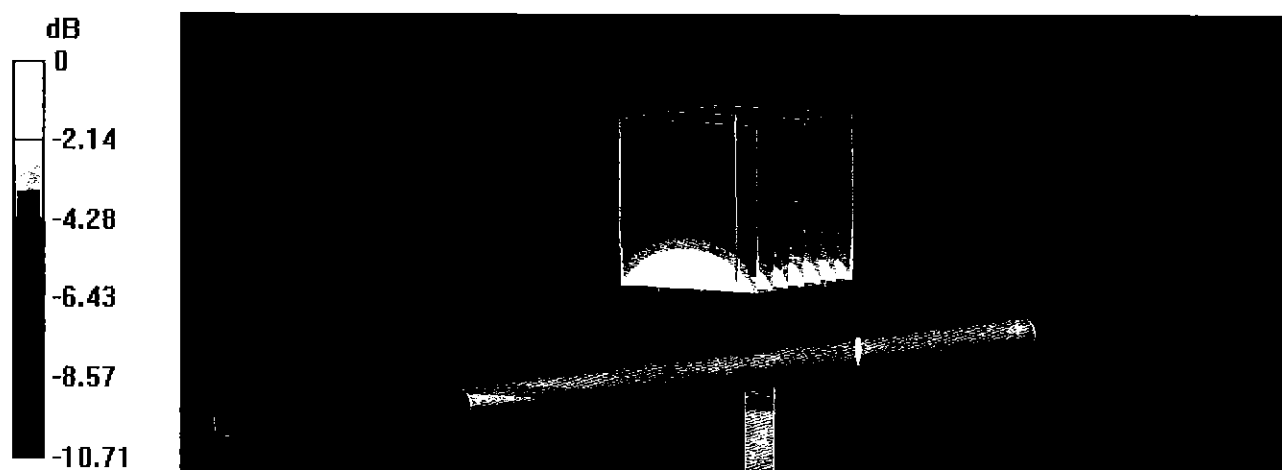
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 58.07 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.13 W/kg

SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.37 W/kg

Maximum value of SAR (measured) = 2.80 W/kg

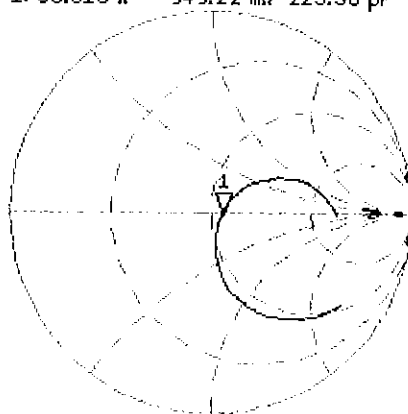


0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Head TSL

13 Jul 2016 09:55:53
[CH1] S11 1 U FS 1: 55.615 Ω -949.22 m Ω 223.56 pF 750.000 000 MHz

*
De1
CA



Avg
16

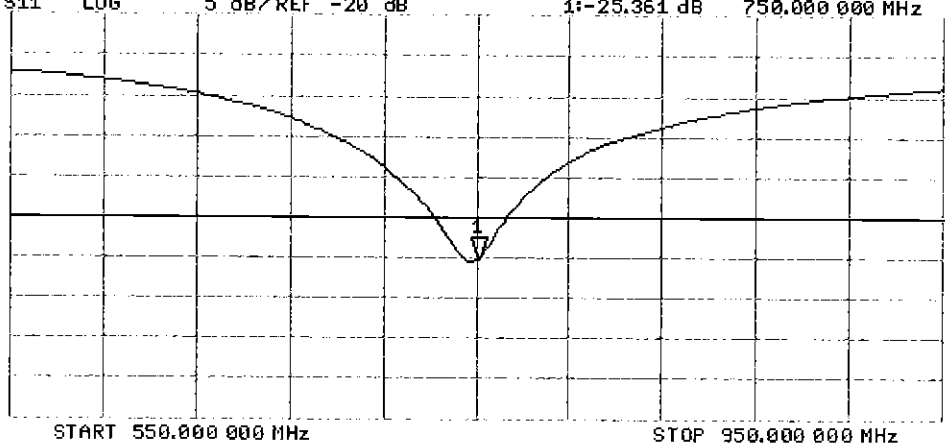
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.361 dB 750.000 000 MHz

CA

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.99 \text{ S/m}$; $\epsilon_r = 55.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

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

Reference Value = 56.33 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.22 W/kg

SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.41 W/kg

Maximum value of SAR (measured) = 2.87 W/kg

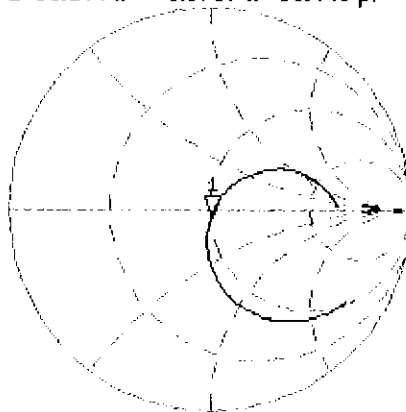


0 dB = 2.87 W/kg = 4.58 dBW/kg

Impedance Measurement Plot for Body TSL

13 Jul 2016 13:16:34
 [CH1] S11 1 U FS 1: 50.244 Ω -3.9707 Ω 53.443 pF 750.000 000 MHz

*
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 CA

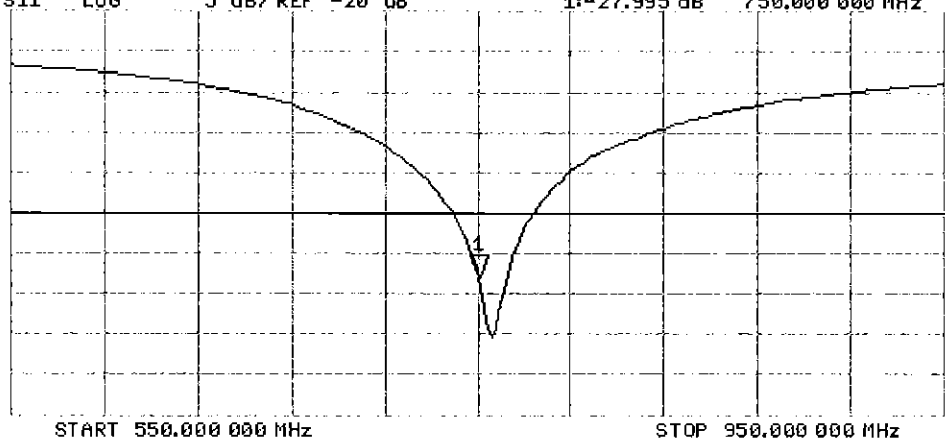


Avg
 16

H1d

CH2 S11 L06 5 dB/REF -20 dB 1:-27.995 dB 750.000 000 MHz

CA



H1d



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D835V2-4d047_Jul16**

CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d047**

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

Calibration date: **July 13, 2016**

BNV
 7/16/2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Jeton Kastrati** Name **Function**
Laboratory Technician

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

Signature

Issued: July 13, 2016

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.6 $\pm$ 6 %	0.94 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.13 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.95 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.9 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.57 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.24 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.8 Ω - 5.9 j Ω
Return Loss	- 24.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω - 8.2 j Ω
Return Loss	- 20.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	None ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 16, 2006

DASY5 Validation Report for Head TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:4d047

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 40.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

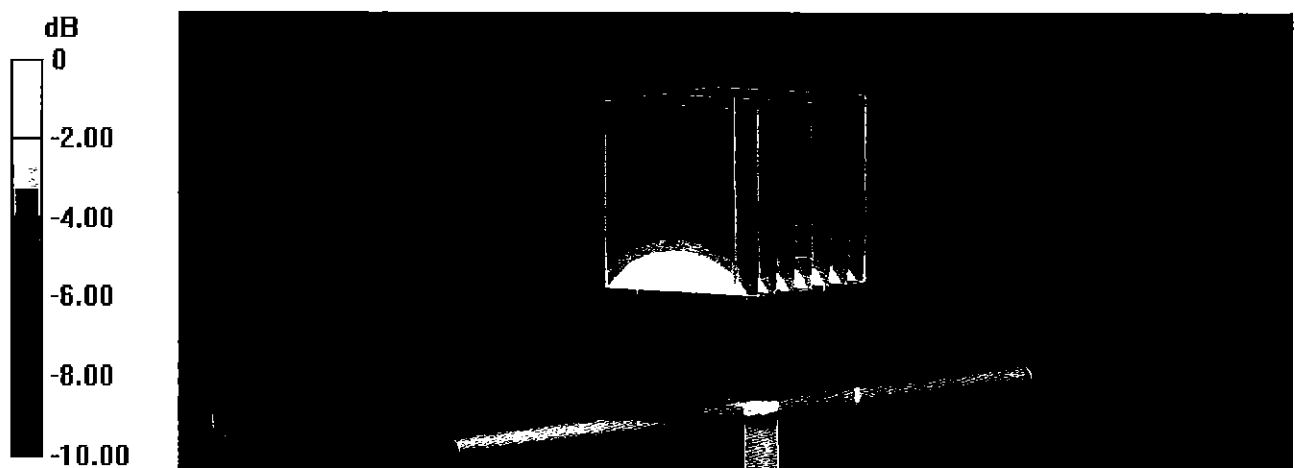
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 60.98 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.56 W/kg

SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.53 W/kg

Maximum value of SAR (measured) = 3.17 W/kg

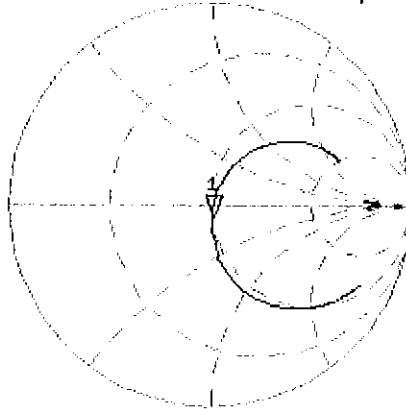


0 dB = 3.17 W/kg = 5.01 dBW/kg

Impedance Measurement Plot for Head TSL

13 Jul 2016 12:00:27
 CH1 S11 1 U FS 1: 49.820 Ω -5.9316 Ω 32.134 pF 835.000 000 MHz

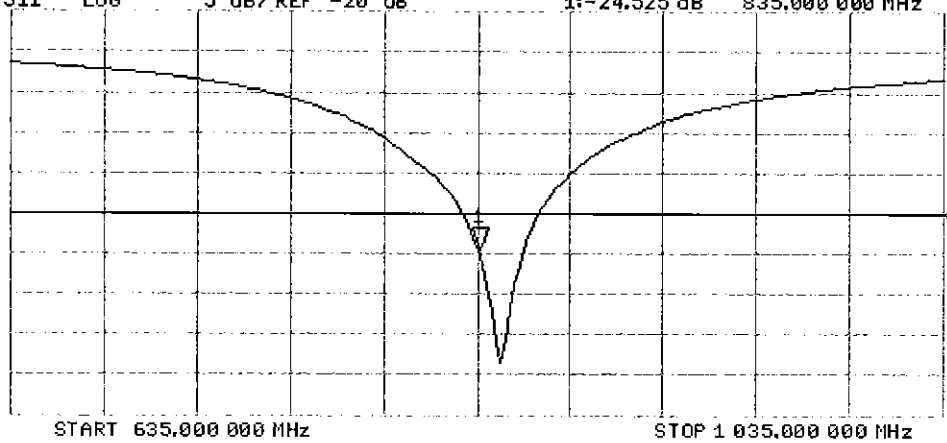
*
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Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-24.525 dB 835.000 000 MHz

CA



Avg
 16
 H1d

START 635.000 000 MHz

STOP 1 035.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:4d047

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

Medium parameters used: $f = 835$ MHz; $\sigma = 1.01$ S/m; $\epsilon_r = 54.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

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

Reference Value = 59.88 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.67 W/kg

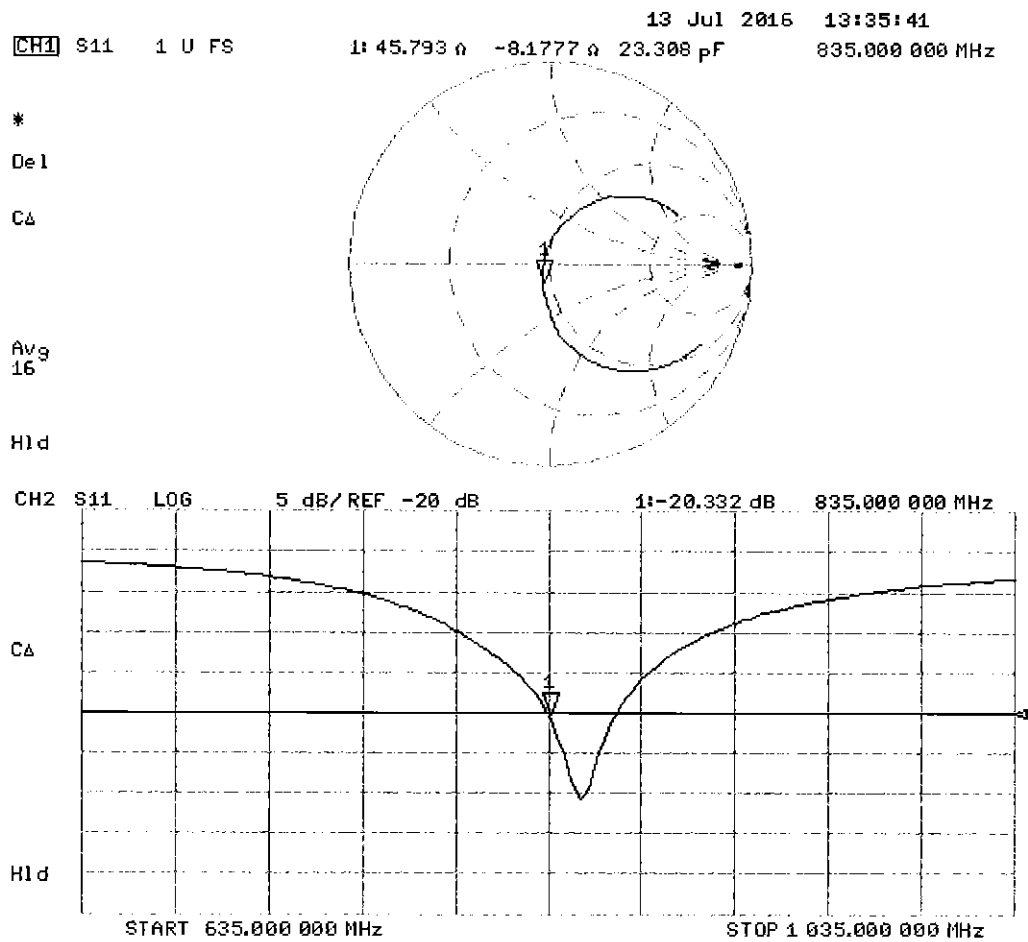
SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.6 W/kg

Maximum value of SAR (measured) = 3.27 W/kg



0 dB = 3.27 W/kg = 5.15 dBW/kg

Impedance Measurement Plot for Body TSL





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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D835V2-4d133_Jul16**

CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d133**

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

Calibration date: **July 14, 2016**

BN ✓
07/27/2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Jeton Kastrati**

Function
Laboratory Technician

Signature

Approved by: **Kalja Pokovic**

Technical Manager

Issued: July 14, 2016

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.6 $\pm$ 6 %	0.94 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.32 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.10 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.9 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.50 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.20 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

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

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.4 Ω - 7.5 j Ω
Return Loss	- 21.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.395 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 14.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 40.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

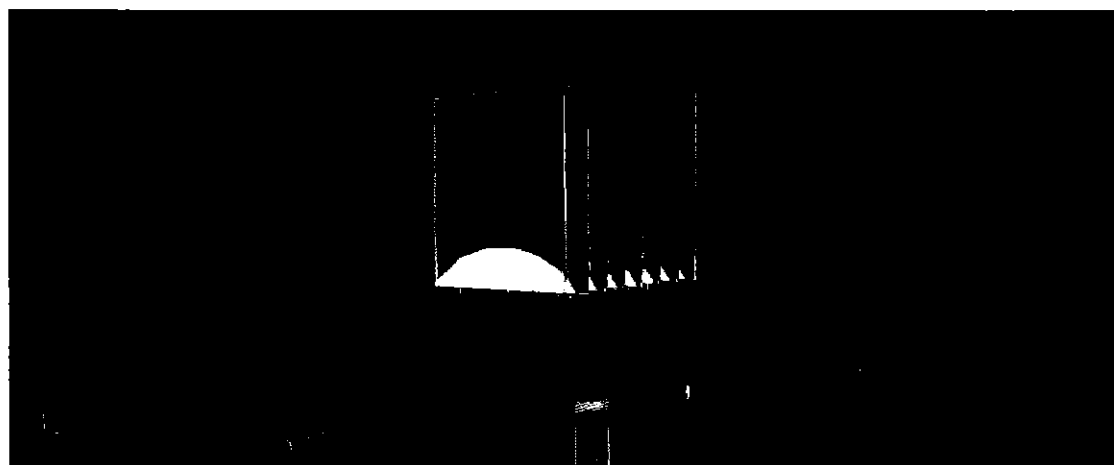
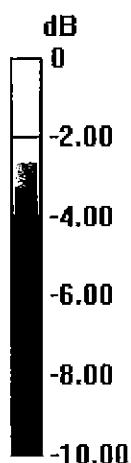
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 61.36 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.64 W/kg

SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.57 W/kg

Maximum value of SAR (measured) = 3.23 W/kg



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

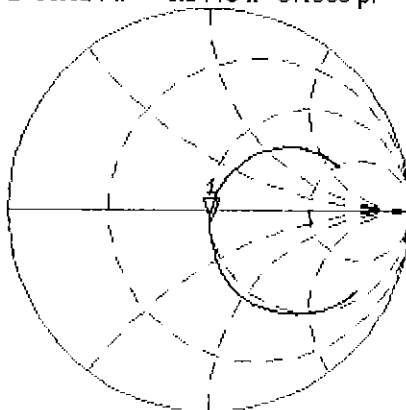
Impedance Measurement Plot for Head TSL

14 Jul 2016 11:38:16
 CH1 S11 1 U FS 1: 50.514 Ω -5.1445 Ω 37.050 pF 835.000 000 MHz

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 16

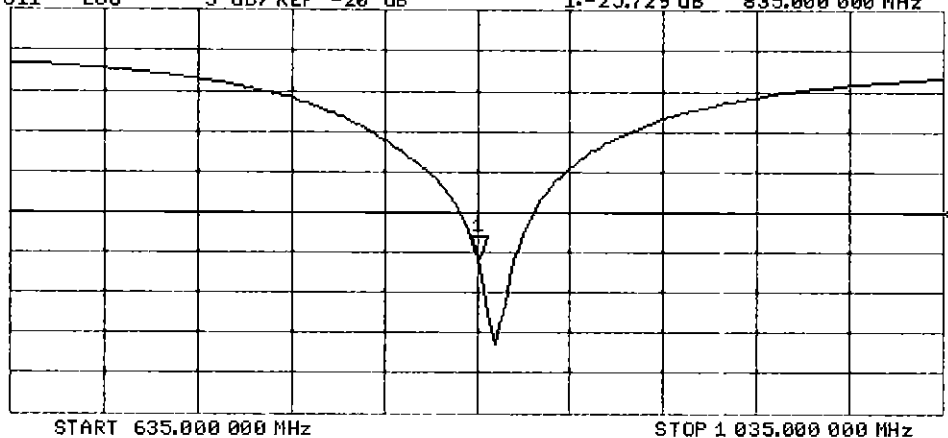
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-25.729 dB 835.000 000 MHz

Ca

H1d



DASY5 Validation Report for Body TSL

Date: 13.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.01 \text{ S/m}$; $\epsilon_r = 54.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

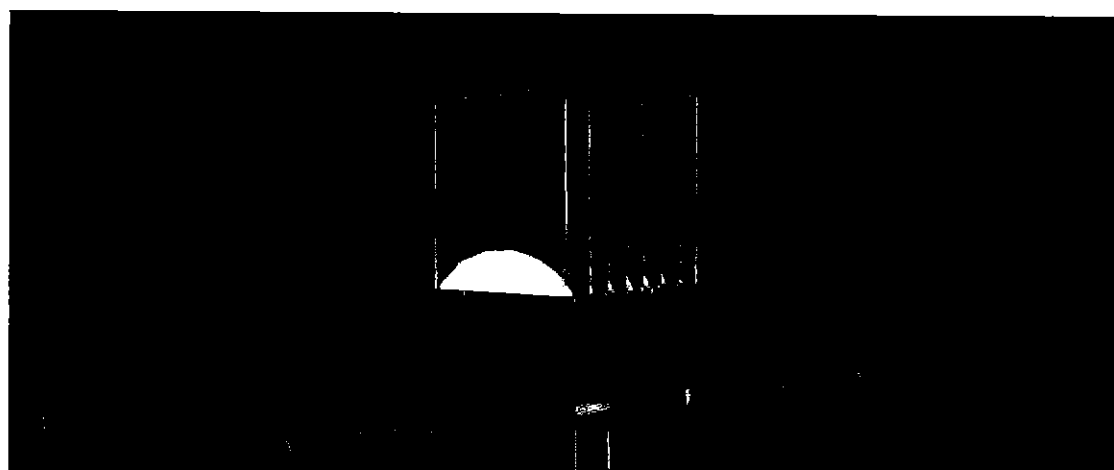
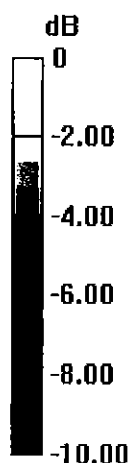
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 59.93 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.62 W/kg

SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 3.24 W/kg

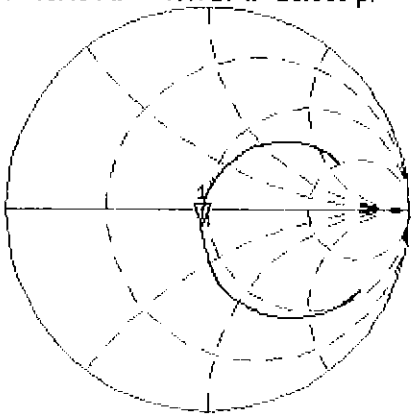


0 dB = 3.24 W/kg = 5.11 dBW/kg

Impedance Measurement Plot for Body TSL

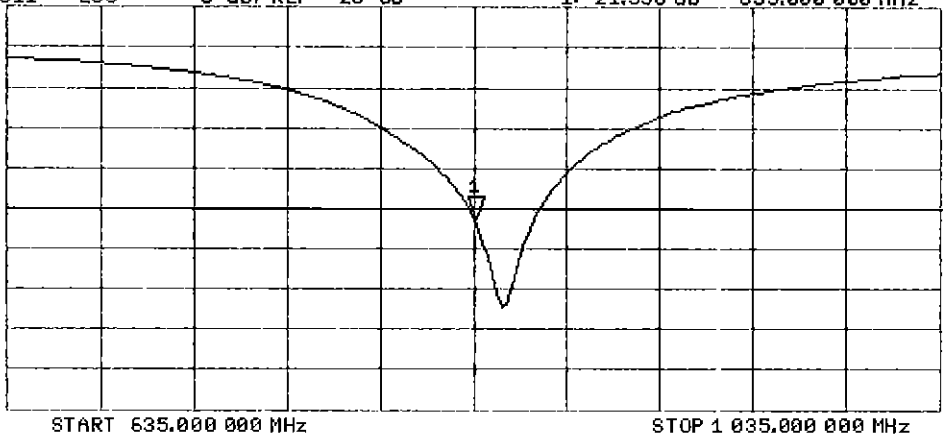
13 Jul 2016 09:27:58
[CH1] S11 1 U FS 1: 46.404 Ω -7.4727 Ω 25.505 pF 835.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-21.336 dB 835.000 000 MHz

CA
Avg
16
H1d





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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: **ES3-3209_Mar16**

CALIBRATION CERTIFICATE

Object

ES3DV3 - SN:3209

Calibration procedure(s)

QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

BN
3/30/2016

Calibration date:

March 18, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: March 22, 2016			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below **ConvF**).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of **ConvF**.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3209

Manufactured: October 14, 2008
Calibrated: March 18, 2016

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.33	1.31	1.12	$\pm 10.1 \%$
DCP (mV) ^B	101.7	103.5	101.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	220.0	$\pm 3.8 \%$
		Y	0.0	0.0	1.0		213.1	
		Z	0.0	0.0	1.0		195.4	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	2.09	61.8	11.1	10.00	43.7	$\pm 0.9 \%$
		Y	2.54	63.7	12.3		42.4	
		Z	9.74	76.2	16.0		38.8	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.73	68.3	18.8	1.87	133.3	$\pm 0.7 \%$
		Y	3.26	72.2	21.0		127.7	
		Z	2.80	68.4	18.6		116.7	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.61	68.5	20.5	5.67	147.6	$\pm 1.4 \%$
		Y	6.48	68.0	20.1		139.5	
		Z	6.30	67.2	19.6		127.7	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	9.09	74.0	25.9	9.29	124.5	$\pm 2.2 \%$
		Y	9.05	73.2	25.1		120.6	
		Z	8.51	71.7	24.5		107.7	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.45	68.0	20.4	5.80	144.1	$\pm 1.4 \%$
		Y	6.35	67.6	20.0		137.6	
		Z	6.17	66.8	19.5		124.8	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.52	73.1	25.6	9.28	119.2	$\pm 2.5 \%$
		Y	8.47	72.2	24.7		116.3	
		Z	9.20	75.3	26.7		148.4	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.14	67.6	20.2	5.75	140.1	$\pm 1.4 \%$
		Y	6.03	67.1	19.8		134.4	
		Z	5.89	66.4	19.4		121.9	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.57	68.0	20.3	5.82	145.9	$\pm 1.4 \%$
		Y	6.48	67.6	20.0		139.5	
		Z	6.32	67.0	19.6		126.7	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.84	66.7	19.9	5.73	121.1	$\pm 1.2 \%$
		Y	4.86	66.6	19.8		117.0	
		Z	5.16	67.8	20.4		148.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.43	77.3	28.3	9.21	131.4	$\pm 1.9 \%$
		Y	7.40	75.8	27.0		129.7	
		Z	6.83	73.7	26.0		116.1	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.75	66.3	19.7	5.72	114.6	$\pm 0.9 \%$
		Y	4.82	66.4	19.7		110.3	
		Z	5.16	67.8	20.4		147.4	

10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.82	66.6	19.9	5.72	119.3	±0.9 %
		Y	4.79	66.2	19.6		110.0	
		Z	5.15	67.8	20.3		147.0	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	7.37	76.9	28.1	9.21	130.4	±1.9 %
		Y	7.02	74.1	26.0		122.0	
		Z	6.83	73.6	25.9		115.6	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	7.85	72.0	25.2	9.24	112.3	±2.5 %
		Y	7.74	70.8	24.1		104.5	
		Z	8.42	73.9	26.1		138.6	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	8.43	72.7	25.4	9.30	116.9	±2.5 %
		Y	8.28	71.5	24.3		109.4	
		Z	9.17	75.2	26.7		147.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.48	68.1	20.5	5.81	141.5	±1.4 %
		Y	6.32	67.4	20.0		136.8	
		Z	6.17	66.8	19.6		123.8	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.07	68.8	20.8	6.06	146.9	±1.7 %
		Y	6.98	68.3	20.5		142.2	
		Z	6.77	67.5	20.0		128.8	

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

^A The uncertainties of Norm X,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 6 and 7).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	6.60	6.60	6.60	0.47	1.59	± 12.0 %
835	41.5	0.90	6.20	6.20	6.20	0.80	1.19	± 12.0 %
1750	40.1	1.37	5.28	5.28	5.28	0.54	1.35	± 12.0 %
1900	40.0	1.40	5.14	5.14	5.14	0.71	1.21	± 12.0 %
2300	39.5	1.67	4.82	4.82	4.82	0.74	1.26	± 12.0 %
2450	39.2	1.80	4.63	4.63	4.63	0.55	1.50	± 12.0 %
2600	39.0	1.96	4.48	4.48	4.48	0.78	1.25	± 12.0 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	55.5	0.96	6.19	6.19	6.19	0.53	1.42	± 12.0 %
835	55.2	0.97	6.19	6.19	6.19	0.62	1.30	± 12.0 %
1750	53.4	1.49	4.99	4.99	4.99	0.51	1.54	± 12.0 %
1900	53.3	1.52	4.77	4.77	4.77	0.56	1.52	± 12.0 %
2300	52.9	1.81	4.44	4.44	4.44	0.75	1.26	± 12.0 %
2450	52.7	1.95	4.31	4.31	4.31	0.74	1.26	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.80	1.20	± 12.0 %

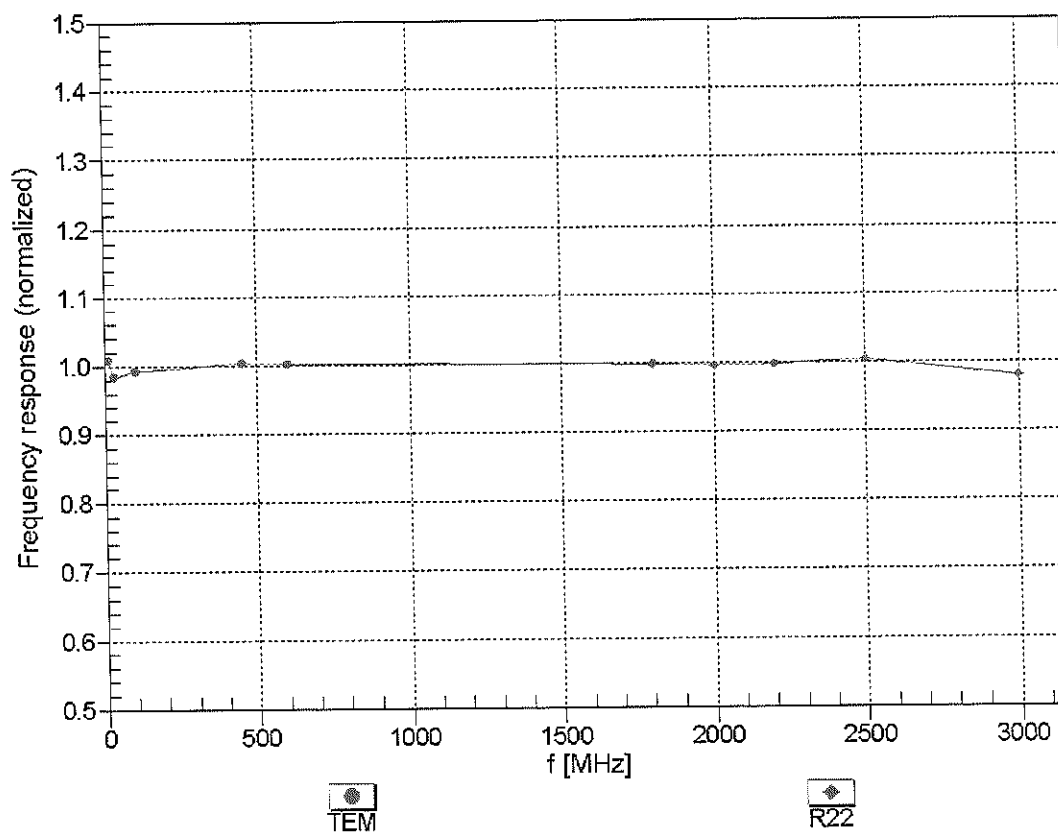
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

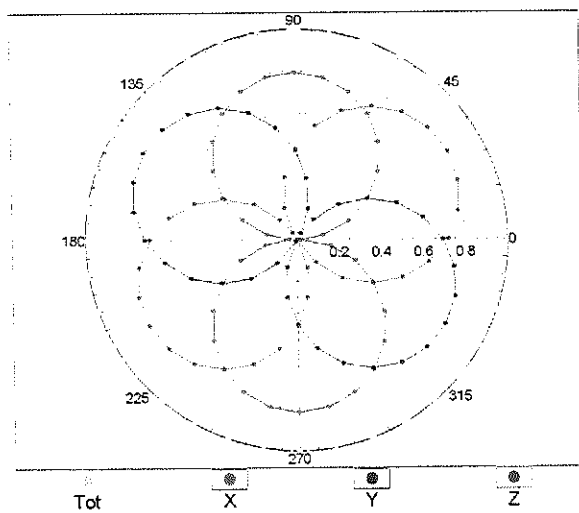
(TEM-Cell:ifi110 EXX, Waveguide: R22)



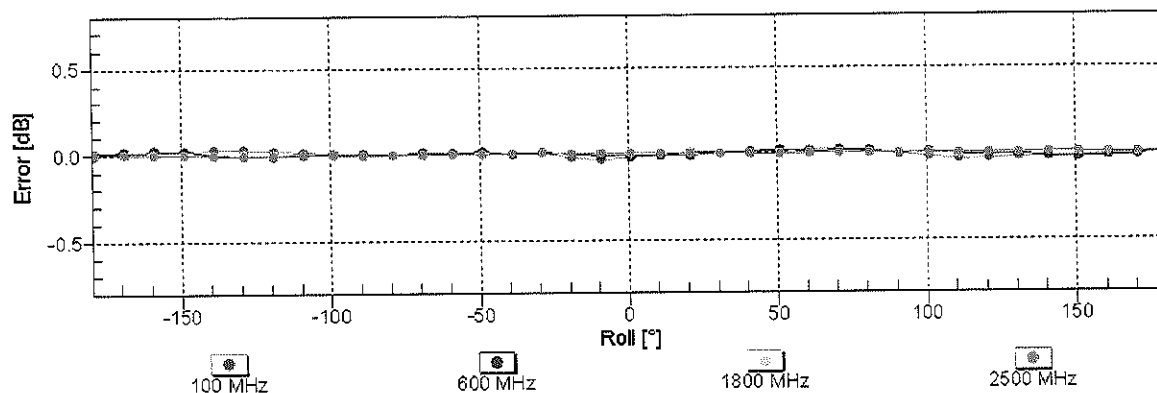
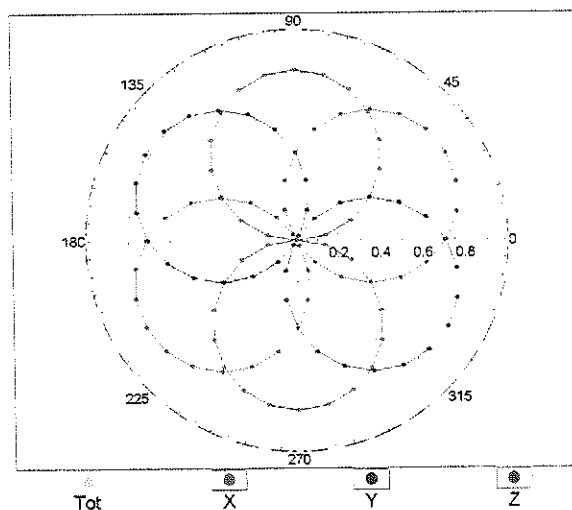
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM

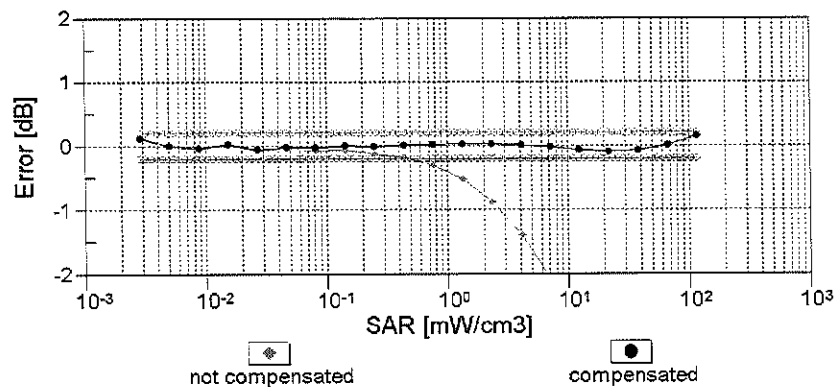
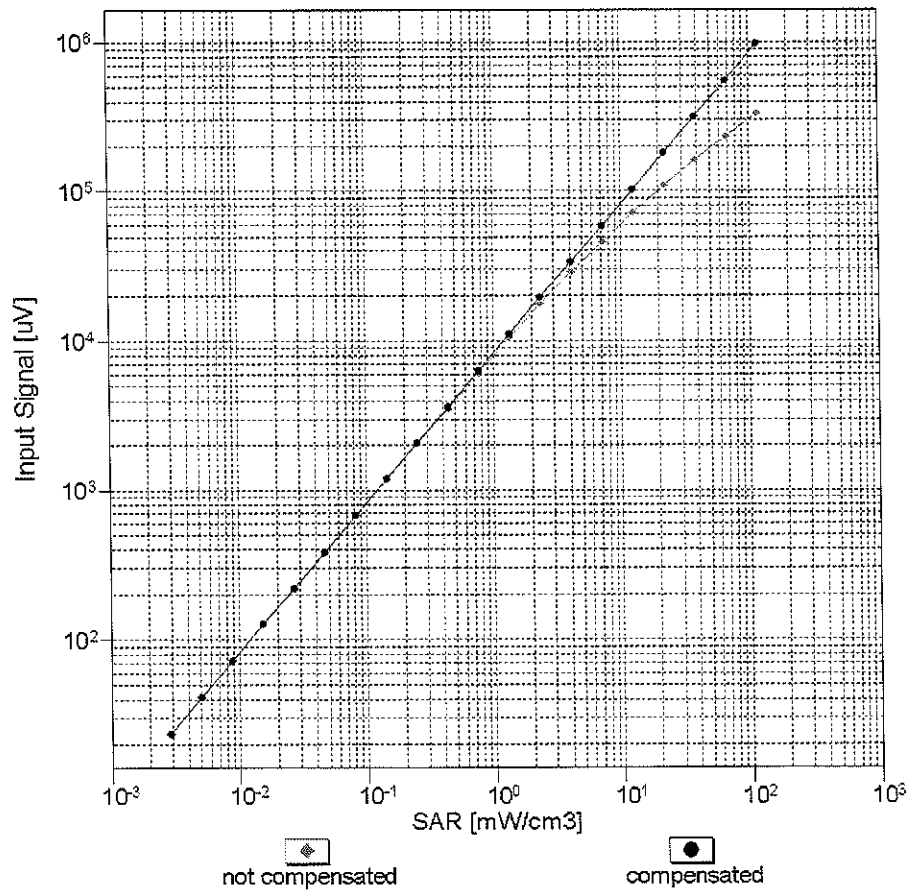


f=1800 MHz,R22



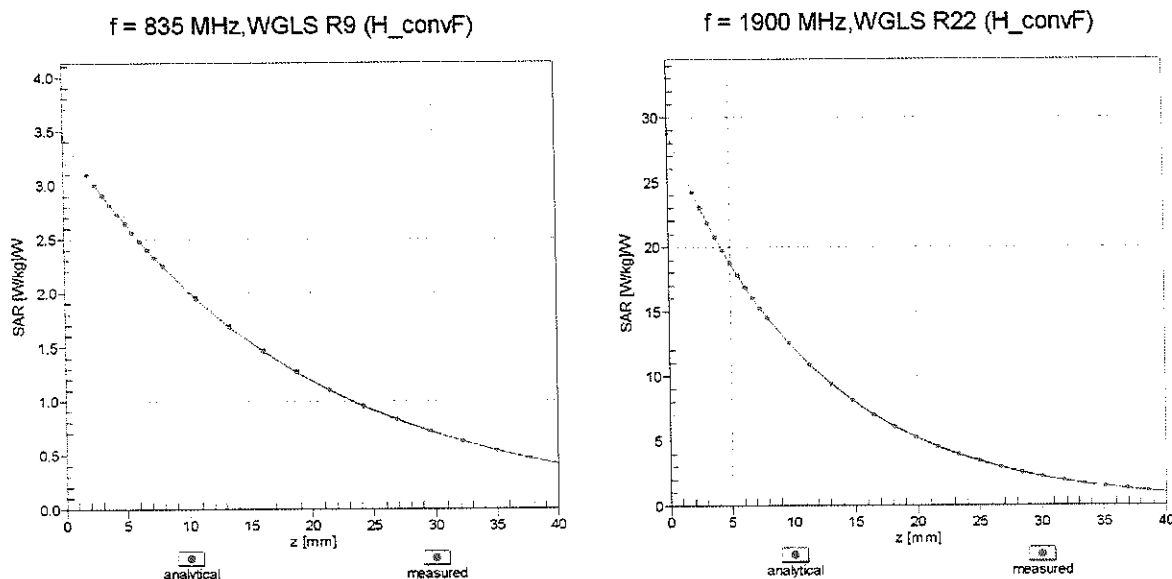
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f_{\text{eval}} = 1900 \text{ MHz}$)



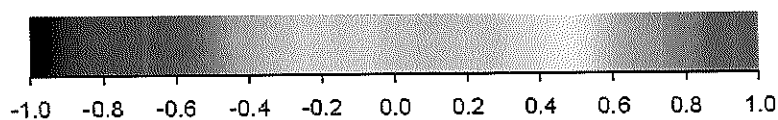
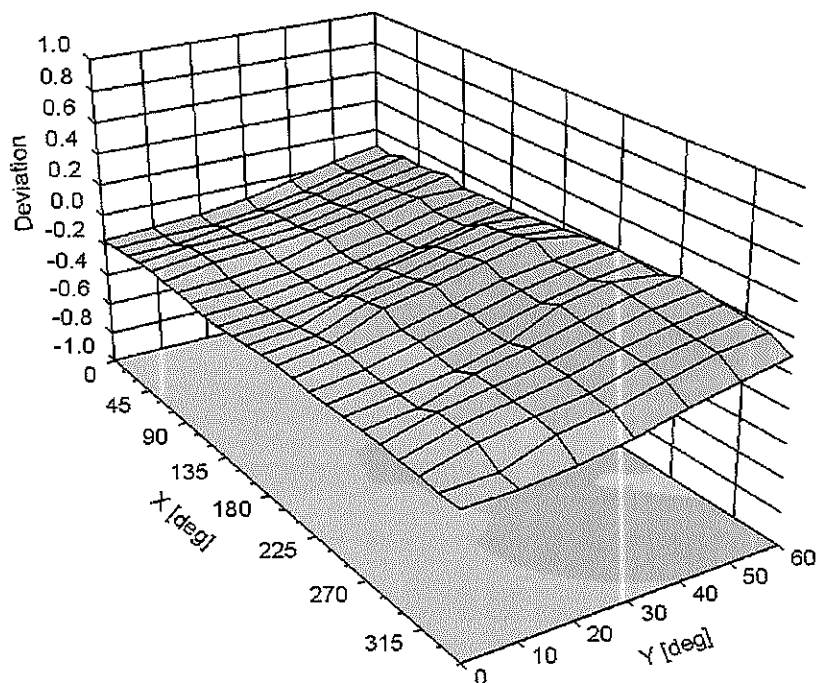
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3209

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	141
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm