



SAR EVALUATION REPORT

Applicant Name:

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Gyeonggi-do, 16677, Korea

Date of Testing:

06/24/17 - 07/24/17

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

1M1706210209-01.A3L

FCC ID:

A3LSMT385M

APPLICANT:

SAMSUNG ELECTRONICS CO., LTD.

DUT Type:

Portable Tablet

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model:

SM-T385M

Equipment Class	Band & Mode	Tx Frequency	SAR	
			1 gm Head (W/kg)	1 gm Body (W/kg)
PCB	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	0.68	1.10
PCB	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	0.53	0.74
PCB	UMTS 850	826.40 - 846.60 MHz	0.38	0.96
PCB	UMTS 1750	1712.4 - 1752.6 MHz	0.48	1.09
PCB	UMTS 1900	1852.4 - 1907.6 MHz	0.51	1.09
PCB	LTE Band 17	706.5 - 713.5 MHz	0.33	0.50
PCB	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.33	0.74
PCB	LTE Band 66 (AWS)	1710.7 - 1779.3 MHz	0.41	1.09
PCB	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	N/A	N/A
PCB	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.52	1.09
PCB	LTE Band 7	2502.5 - 2567.5 MHz	0.57	0.88
DTS	2.4 GHz WLAN	2412 - 2462 MHz	1.00	0.29
Nil	U-NII-1	5180 - 5240 MHz	N/A	N/A
Nil	U-NII-2A	5260 - 5320 MHz	0.62	0.94
Nil	U-NII-2C	5500 - 5720 MHz	0.32	0.64
Nil	U-NII-3	5745 - 5825 MHz	0.35	0.64
DSS/DTS	Bluetooth	2402 - 2480 MHz	0.18	0.42
Simultaneous SAR per KDB 690783 D01v01r03:			1.57	1.56

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

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


Randy Ortanez
President



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1750	Voice/Data	1712.4 - 1752.6 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 17	Voice/Data	706.5 - 713.5 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Voice/Data	1710.7 - 1779.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 7	Voice/Data	2502.5 - 2567.5 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2462 MHz
U-NII-1	Voice/Data	5180 - 5240 MHz
U-NII-2A	Voice/Data	5260 - 5320 MHz
U-NII-2C	Voice/Data	5500 - 5720 MHz
U-NII-3	Voice/Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
ANT+	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses independent power reduction mechanisms for PCB and WLAN SAR compliance. The power reduction mechanisms are activated when the device is used in close proximity to the user's body. FCC KDB Publication 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device.

The PCB power reduction mechanism is additionally used for Head SAR compliance, and is activated when the device is used for all voice or VoIP calls on the main antenna. The held-to-ear RF exposure conditions were evaluated at reduced power for the main antenna modes according to the Head SAR test positions described in IEEE 1528-2013.

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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.

Maximum Output Powers

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)					Burst Average 8-PSK (dBm)			
		1 TX Slot	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	
GSM/GPRS/EDGE 850	Maximum	33.5	33.5	31.5	29.0	28.0	27.5	26.0	24.0	23.0	
	Nominal	33.0	33.0	31.0	28.5	27.5	27.0	25.5	23.5	22.5	
GSM/GPRS/EDGE 1900	Maximum	30.5	30.5	29.0	26.5	25.0	26.0	24.5	22.5	21.0	
	Nominal	30.0	30.0	28.5	26.0	24.5	25.5	24.0	22.0	20.5	

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	3GPP HSDPA	3GPP HSUPA	3GPP DC-HSDPA
UMTS Band 5 (850 MHz)	Maximum	24.5	23.5	23.5	23.5
	Nominal	24.0	23.0	23.0	23.0
UMTS Band 4 (1750 MHz)	Maximum	23.5	22.5	22.5	22.5
	Nominal	23.0	22.0	22.0	22.0
UMTS Band 2 (1900 MHz)	Maximum	24.0	23.0	23.0	23.0
	Nominal	23.5	22.5	22.5	22.5

Mode / Band		Modulated Average (dBm)
LTE Band 17	Maximum	24.0
	Nominal	23.5
LTE Band 5 (Cell)	Maximum	24.5
	Nominal	24.0
LTE Band 66 (AWS)	Maximum	24.0
	Nominal	23.5
LTE Band 4 (AWS)	Maximum	24.0
	Nominal	23.5
LTE Band 2 (PCS)	Maximum	24.0
	Nominal	23.5
LTE Band 7	Maximum	24.8
	Nominal	24.3
Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	18.5
	Nominal	18.0
IEEE 802.11g (2.4 GHz)	Maximum	15.5
	Nominal	15.0
IEEE 802.11n (2.4 GHz)	Maximum	13.5
	Nominal	13.0
Bluetooth	Maximum	11.0
	Nominal	10.5
Bluetooth LE	Maximum	1.5
	Nominal	1.0

Mode / Band		Modulated Average (dBm)	
		20 MHz Bandwidth	40 MHz Bandwidth
IEEE 802.11a (5 GHz)	Maximum	14.5	
	Nominal	14.0	
IEEE 802.11n (5 GHz)	Maximum	13.5	13.5
	Nominal	13.0	13.0

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Reduced Output Powers

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)					Burst Average 8-PSK (dBm)			
			1 TX Slot	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots	1 TX Slots	2 TX Slots	3 TX Slots	4 TX Slots
GSM/GPRS/EDGE 850	Maximum	28.5	28.5	24.5	23.0	21.0	23.0	21.5	20.0	18.0	
	Nominal	28.0	28.0	24.0	22.5	20.5	22.5	21.0	19.5	17.5	
GSM/GPRS/EDGE 1900	Maximum	22.0	22.0	18.5	16.5	15.5	18.5	17.0	15.5	14.0	
	Nominal	21.5	21.5	18.0	16.0	15.0	18.0	16.5	15.0	13.5	

Mode / Band		Modulated Average (dBm)			
		3GPP WCDMA	3GPP HSDPA	3GPP HSUPA	3GPP DC-HSDPA
UMTS Band 5 (850 MHz)	Maximum	17.0	16.5	16.5	16.5
	Nominal	16.5	16.0	16.0	16.0
UMTS Band 4 (1750 MHz)	Maximum	13.0	12.5	12.5	12.5
	Nominal	12.5	12.0	12.0	12.0
UMTS Band 2 (1900 MHz)	Maximum	12.5	11.5	11.5	11.5
	Nominal	12.0	11.0	11.0	11.0

Mode / Band		Modulated Average (dBm)
LTE Band 17	Maximum	18.0
	Nominal	17.5
LTE Band 5 (Cell)	Maximum	17.0
	Nominal	16.5
LTE Band 66 (AWS)	Maximum	13.5
	Nominal	13.0
LTE Band 4 (AWS)	Maximum	13.5
	Nominal	13.0
LTE Band 2 (PCS)	Maximum	12.5
	Nominal	12.0
LTE Band 7	Maximum	13.5
	Nominal	13.0
Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	13.5
	Nominal	13.0
IEEE 802.11g (2.4 GHz)	Maximum	13.5
	Nominal	13.0
IEEE 802.11n (2.4 GHz)	Maximum	13.5
	Nominal	13.0

Mode / Band		Modulated Average (dBm)	
		20 MHz Bandwidth	40 MHz Bandwidth
IEEE 802.11a (5 GHz)	Maximum	10.5	
	Nominal	10.0	
IEEE 802.11n (5 GHz)	Maximum	10.5	10.5
	Nominal	10.0	10.0

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1.4 DUT Antenna Locations

The overall diagonal dimension of the device is > 200 mm. A diagram showing the locations of the device antennas can be found in Appendix F. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing.

Table 1-1
Device Edges/Sides for SAR Testing

Mode	Back	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	Yes
GPRS 1900	Yes	Yes	No	Yes	Yes
UMTS 850	Yes	Yes	No	Yes	Yes
UMTS 1750	Yes	Yes	No	Yes	Yes
UMTS 1900	Yes	Yes	No	Yes	Yes
LTE Band 17	Yes	Yes	No	Yes	Yes
LTE Band 5 (Cell)	Yes	Yes	No	Yes	Yes
LTE Band 66 (AWS)	Yes	Yes	No	Yes	Yes
LTE Band 2 (PCS)	Yes	Yes	No	Yes	Yes
LTE Band 7	Yes	Yes	No	Yes	Yes
2.4 GHz WLAN	Yes	Yes	No	No	Yes
5 GHz WLAN	Yes	Yes	No	No	Yes
Bluetooth	Yes	Yes	No	No	Yes

Note: Per FCC KDB 616217 D04v01, particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01v05.

1.5 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.

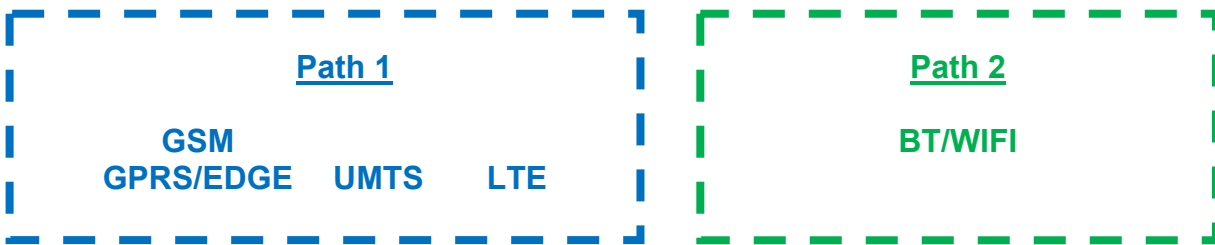


Figure 1-1
Simultaneous Transmission Paths

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	Notes
1	GSM Voice + 2.4 GHz Wi-Fi	Yes	Yes	
2	GSM Voice + 5 GHz Wi-Fi	Yes	Yes	
3	GSM Voice + 2.4 GHz Bluetooth	Yes ^	Yes	^ BT Tethering applications are considered
4	UMTS + 2.4 GHz Wi-Fi	Yes	Yes	
5	UMTS + 5 GHz Wi-Fi	Yes	Yes	
6	UMTS + 2.4 GHz Bluetooth	Yes ^	Yes	^ BT Tethering applications are considered
7	LTE + 2.4 GHz Wi-Fi	Yes	Yes	
8	LTE + 5 GHz Wi-Fi	Yes	Yes	
9	LTE + 2.4 GHz Bluetooth	Yes ^	Yes	^ BT Tethering applications are considered
10	GPRS/EDGE + 2.4 GHz Wi-Fi	N/A	Yes	
11	GPRS/EDGE + 5 GHz Wi-Fi	N/A	Yes	
12	GPRS/EDGE + 2.4 GHz Bluetooth	N/A	Yes	

- 2.4 GHz WLAN, 5 GHz WLAN, and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
- All licensed modes share the same antenna path and cannot transmit simultaneously.
- When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
- This device supports VOLTE and VOWIFI.
- This device supports Bluetooth tethering.

1.6 Miscellaneous SAR Test Considerations

(A) WIFI

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.

(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.

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

This device supports both LTE B66 and LTE B4. Since the supported frequency span for LTE B4 falls completely within the supported frequency span for LTE B66, both LTE bands have the same target power, and both LTE bands share the same transmission path, SAR was only assessed for LTE B66.

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1.7 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01, D05v02r04 (2G/3G/4G)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- October 2013 TCB Workshop Notes (GPRS Testing Considerations)
- FCC KDB Publication 616217D04v01r02 (Tablet SAR Considerations)

1.8 Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units. The power level was configured for testing via software only available to the manufacturer (end user cannot control power level) per KDB 616217.

	Head Serial Number	Body Max Power Serial Number	Body Reduced Power Serial Number
GSM/GPRS/EDGE 850	05185	05185	05185
GSM/GPRS/EDGE 1900	04766	05185	01812
UMTS 850	05185	04766	04766
UMTS 1750	03883	03883	03883
UMTS 1900	04766	05185	02836
LTE Band 17	05185	04766	04766
LTE Band 5 (Cell)	05185	05185	05185
LTE Band 66 (AWS)	05185	04766	04766
LTE Band 2 (PCS)	04766	05185	05185
LTE Band 7	04766	04766	01812
2.4 GHz WLAN	03073	03255	03255
5 GHz WLAN	01598	03255	03255
Bluetooth	04766	03255	-

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2 LTE INFORMATION

LTE Information			
FCC ID	A3LSMT385M		
Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 17 (706.5 - 713.5 MHz)		
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)		
	LTE Band 66 (AWS) (1710.7 - 1779.3 MHz)		
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)		
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
	LTE Band 7 (2502.5 - 2567.5 MHz)		
Channel Bandwidths	LTE Band 17: 5 MHz, 10 MHz		
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz		
	LTE Band 66 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 7: 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)	836.5 (20525)	848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)	836.5 (20525)	847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
LTE Band 66 (AWS): 1.4 MHz	1710.7 (131979)	1745 (132322)	1779.3 (132665)
LTE Band 66 (AWS): 3 MHz	1711.5 (131987)	1745 (132322)	1778.5 (132657)
LTE Band 66 (AWS): 5 MHz	1712.5 (131997)	1745 (132322)	1777.5 (132647)
LTE Band 66 (AWS): 10 MHz	1715 (132022)	1745 (132322)	1775 (132622)
LTE Band 66 (AWS): 15 MHz	1717.5 (132047)	1745 (132322)	1772.5 (132597)
LTE Band 66 (AWS): 20 MHz	1720 (132072)	1745 (132322)	1770 (132572)
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)
LTE Band 7: 5 MHz	2502.5 (20775)	2535 (21100)	2567.5 (21425)
LTE Band 7: 10 MHz	2505 (20800)	2535 (21100)	2565 (21400)
LTE Band 7: 15 MHz	2507.5 (20825)	2535 (21100)	2562.5 (21375)
LTE Band 7: 20 MHz	2510 (20850)	2535 (21100)	2560 (21350)
UE Category	4		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		
LTE Release 10 Additional Information	This device does not support full CA features on 3GPP Release 10. All uplink communications are identical to the Release 8 Specifications. The following LTE Release 10 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.

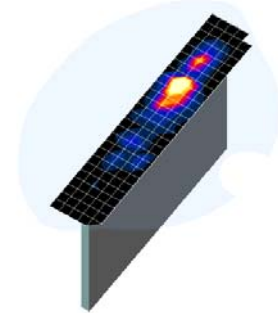


Figure 4-1
Sample SAR Area Scan

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	Graded Grid		
				$\Delta z_{\text{zoom}}(n)$	$\Delta z_{\text{zoom}}(1)^*$	
≤ 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 SAR TESTING PROCEDURES

5.1 SAR Testing for Tablet per KDB Publication 616217 D04v01

Per FCC KDB Publication 616217 D04, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v06 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

5.2 Proximity Sensor Considerations

This device uses a power reduction mechanism to reduce output powers in body (hand-held) use conditions when the device is used close the user's body.

When the device's antenna is within a certain distance of the user, the sensor activates and reduces the maximum allowed output power. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, additional evaluation is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level. FCC KDB Publication 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional test positions. Sensor triggering distance summary data is included in Appendix G.

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

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6 DEFINITION OF REFERENCE POINTS

6.1 EAR REFERENCE POINT

Figure 6-2 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 6-1. 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 6-1). 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].

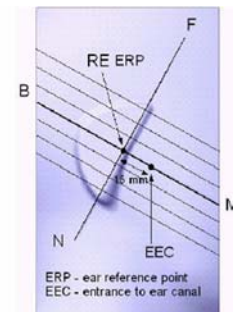


Figure 6-1
Close-Up Side view
of ERP

6.2 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 6-3). 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 6-2
Front, back and side view of SAM Twin Phantom

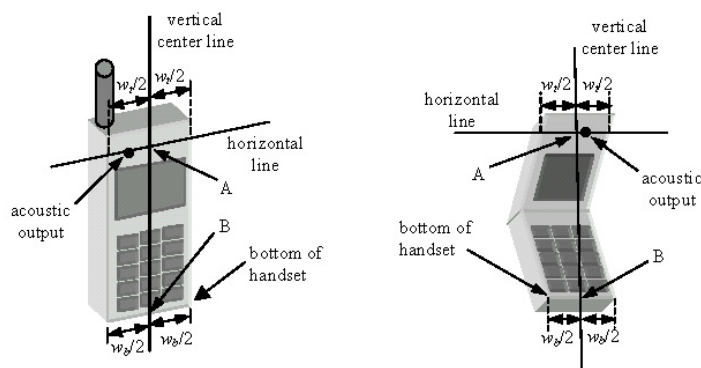


Figure 6-3
Handset Vertical Center & Horizontal Line Reference Points

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7 TEST CONFIGURATION POSITIONS

7.1 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 $\delta = 0.02$.

7.2 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 7-1), 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.

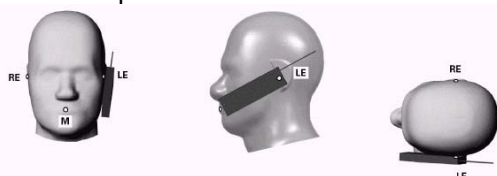


Figure 7-1 Front, Side and Top View of Cheek Position

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 7-2).

7.3 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 7-2).



Figure 7-2 Front, Side and Top View of Ear/15° Tilt Position

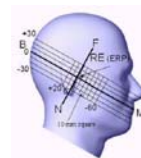


Figure 7-3 Side view w/ relevant markings

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8 RF EXPOSURE LIMITS

8.1 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.

8.2 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 8-1
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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9 FCC MEASUREMENT PROCEDURES

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

9.1 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.

9.2 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.

9.3 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.

9.4 SAR Measurement Conditions for UMTS

9.4.1 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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9.4.2 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.

9.4.3 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.

9.4.4 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.

9.4.5 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.

9.4.6 SAR Measurement Conditions for DC-HSDPA

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

9.5 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).

9.5.1 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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9.5.2 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.

9.5.3 A-MPR

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

9.5.4 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.

9.6 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.

9.6.1 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.

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9.6.2 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.

9.6.3 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.

9.6.4 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.

9.6.5 2.4 GHz SAR Test Requirements

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

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

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed. When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

9.6.6 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

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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.

9.6.7 Initial Test Configuration Procedure

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

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 9.6.6). When 10-g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

9.6.8 Subsequent Test Configuration Procedures

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

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10 RF CONDUCTED POWERS

10.1 GSM Conducted Powers

Max										
Maximum Burst-Averaged Output Power										
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	32.17	32.08	30.99	28.38	26.51	26.30	24.64	22.46	22.01
	190	32.29	32.26	30.91	28.64	26.39	26.34	24.73	22.36	22.09
	251	32.42	32.41	31.07	28.47	26.50	26.39	24.63	22.45	22.13
GSM 1900	512	30.12	30.15	28.35	26.21	24.69	25.80	24.07	22.37	20.52
	661	29.72	29.73	28.06	25.76	24.19	25.45	23.72	21.97	20.17
	810	30.13	30.13	28.42	26.04	24.96	25.73	24.01	22.17	20.13
Calculated Maximum Frame-Averaged Output Power										
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	23.14	23.05	24.97	24.12	23.50	17.27	18.62	18.20	19.00
	190	23.26	23.23	24.89	24.38	23.38	17.31	18.71	18.10	19.08
	251	23.39	23.38	25.05	24.21	23.49	17.36	18.61	18.19	19.12
GSM 1900	512	21.09	21.12	22.33	21.95	21.68	16.77	18.05	18.11	17.51
	661	20.69	20.70	22.04	21.50	21.18	16.42	17.70	17.71	17.16
	810	21.10	21.10	22.40	21.78	21.95	16.70	17.99	17.91	17.12
GSM 850	Frame	23.97	23.97	24.98	24.24	24.49	17.97	19.48	19.24	19.49
GSM 1900	Avg. Targets:	20.97	20.97	22.48	21.74	21.49	16.47	17.98	17.74	17.49

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Maximum Burst-Averaged Output Power										
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	27.34	27.05	23.56	22.06	19.60	22.79	20.70	18.60	16.71
	190	26.95	27.04	22.87	21.56	19.69	22.94	20.82	18.41	16.77
	251	27.29	27.52	23.61	21.84	19.37	22.98	20.92	18.47	16.87
GSM 1900	512	21.06	21.06	18.47	16.44	15.15	18.27	16.77	14.84	13.70
	661	21.39	21.38	17.88	16.00	14.53	18.03	16.48	14.73	13.42
	810	21.82	21.81	18.30	16.41	15.05	18.35	16.72	15.08	13.71
Calculated Maximum Frame-Averaged Output Power										
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
GSM 850	128	18.31	18.02	17.54	17.80	16.59	13.76	14.68	14.34	13.70
	190	17.92	18.01	16.85	17.30	16.68	13.91	14.80	14.15	13.76
	251	18.26	18.49	17.59	17.58	16.36	13.95	14.90	14.21	13.86
GSM 1900	512	12.03	12.03	12.45	12.18	12.14	9.24	10.75	10.58	10.69
	661	12.36	12.35	11.86	11.74	11.52	9.00	10.46	10.47	10.41
	810	12.79	12.78	12.28	12.15	12.04	9.32	10.70	10.82	10.70
GSM 850	Frame	18.97	18.97	17.98	18.24	17.49	13.47	14.98	15.24	14.49
GSM 1900	Avg. Targets:	12.47	12.47	11.98	11.74	11.99	8.97	10.48	10.74	10.49

Note:

- Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
- GPRS/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.
- 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 10-1
Power Measurement Setup

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10.2 UMTS Conducted Powers

Max

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	23.43	23.42	23.66	22.48	22.50	22.15	23.31	23.00	23.02	-
99		12.2 kbps AMR	23.24	23.42	23.71	22.65	22.75	22.12	23.27	22.95	23.13	-
6	HSDPA	Subtest 1	22.32	22.35	22.55	21.95	22.00	21.39	22.96	22.21	22.38	0
6		Subtest 2	22.47	22.39	22.66	22.00	22.05	21.33	22.52	22.30	22.43	0
6		Subtest 3	21.98	21.91	22.06	21.44	21.48	20.84	22.04	21.80	21.93	0.5
6		Subtest 4	21.89	21.92	22.13	21.47	21.55	20.91	22.09	21.81	21.91	0.5
6	HSUPA	Subtest 1	21.83	22.11	22.42	21.76	21.27	20.67	21.95	21.88	22.01	0
6		Subtest 2	20.33	20.88	21.26	20.46	20.43	20.12	20.98	20.84	20.95	2
6		Subtest 3	21.04	20.55	21.28	20.63	20.66	19.90	21.41	20.93	21.12	1
6		Subtest 4	21.16	21.22	21.46	20.43	20.24	20.01	20.22	20.96	20.74	2
6		Subtest 5	22.27	22.36	22.52	21.94	21.98	21.29	22.52	22.20	22.40	0
8	DC-HSDPA	Subtest 1	22.59	22.56	22.52	22.21	22.13	21.51	22.88	22.56	22.70	0
8		Subtest 2	22.67	22.79	22.90	22.19	22.17	21.59	22.86	22.57	22.75	0
8		Subtest 3	22.27	22.22	22.41	21.56	21.68	21.05	22.39	21.90	22.14	0.5
8		Subtest 4	22.22	22.27	22.37	21.70	21.67	21.12	22.34	21.97	22.13	0.5

Reduced

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			3GPP MPR [dB]
			4132	4183	4233	1312	1412	1513	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	16.05	16.04	16.30	11.82	12.48	11.59	11.92	12.45	12.17	-
99		12.2 kbps AMR	16.06	16.06	16.25	11.96	12.17	11.84	11.94	11.35	12.14	-
6	HSDPA	Subtest 1	15.17	15.11	15.12	10.86	11.38	11.17	10.63	10.42	11.20	0
6		Subtest 2	15.14	15.19	15.42	10.82	11.44	11.10	10.61	10.40	11.19	0
6		Subtest 3	14.77	14.84	15.09	10.34	10.97	10.60	10.15	9.91	10.71	0.5
6		Subtest 4	14.78	14.81	15.04	10.36	11.00	10.55	10.15	9.91	10.71	0.5
6	HSUPA	Subtest 1	14.92	14.95	14.89	10.58	11.24	10.84	10.64	10.53	11.30	0
6		Subtest 2	14.54	13.96	14.14	9.73	10.53	9.74	10.14	10.00	10.77	2
6		Subtest 3	13.26	14.13	14.03	9.97	10.52	9.31	10.62	10.49	10.55	1
6		Subtest 4	14.00	14.73	14.79	10.65	11.07	10.70	10.12	9.97	10.74	2
6		Subtest 5	14.35	14.41	14.65	11.28	11.66	11.18	10.53	10.41	11.26	0
8	DC-HSDPA	Subtest 1	15.10	15.18	15.36	10.85	11.48	11.23	10.99	10.71	10.87	0
8		Subtest 2	15.10	15.13	15.35	10.84	11.46	11.21	10.89	10.68	11.35	0
8		Subtest 3	14.68	14.66	14.85	10.40	11.02	10.74	10.39	10.21	10.89	0.5
8		Subtest 4	14.60	14.65	14.84	10.39	11.02	10.71	10.39	10.23	10.89	0.5

DC-HSDPA considerations

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

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



Figure 10-2
Power Measurement Setup

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10.3 LTE Conducted Powers

10.3.1 Max LTE Band 17

Table 10-1
LTE Band 17 Conducted Powers - 10 MHz Bandwidth

LTE Band 17 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23790 (710.0 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	23.02	0	0
	1	25	23.09		0
	1	49	22.99		0
	25	0	21.72	0-1	1
	25	12	21.84		1
	25	25	21.77		1
16QAM	50	0	21.76	0-1	1
	1	0	22.24		1
	1	25	22.21		1
	1	49	22.23	0-2	1
	25	0	20.83		2
	25	12	20.95		2
	25	25	21.02		2
	50	0	20.98		2

Note: LTE Band 17 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 10-2
LTE Band 17 Conducted Powers - 5 MHz Bandwidth

LTE Band 17 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23790 (710.0 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	22.77	0	0
	1	12	23.23		0
	1	24	22.65		0
	12	0	21.73	0-1	1
	12	6	21.80		1
	12	13	21.79		1
16QAM	25	0	21.83	0-1	1
	1	0	21.41		1
	1	12	21.52		1
	1	24	21.47	0-2	1
	12	0	20.81		2
	12	6	20.91		2
	12	13	20.82		2
	25	0	20.95		2

Note: LTE Band 17 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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Reduced LTE Band 17

Table 10-3
LTE Band 17 Conducted Powers - 10 MHz Bandwidth

LTE Band 17 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23790 (710.0 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	17.31	0	0
	1	25	17.30		0
	1	49	17.34		0
	25	0	17.23	0-1	0
	25	12	17.21		0
	25	25	17.27		0
	50	0	17.21		0
16QAM	1	0	17.23	0-1	0
	1	25	17.29		0
	1	49	17.39		0
	25	0	17.35	0-2	0
	25	12	17.30		0
	25	25	17.38		0
	50	0	17.31		0

Note: LTE Band 17 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 10-4
LTE Band 17 Conducted Powers - 5 MHz Bandwidth

LTE Band 17 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			23790 (710.0 MHz)		
			Conducted Power [dBm]		
QPSK	1	0	17.25	0	0
	1	12	17.47		0
	1	24	17.41		0
	12	0	17.22	0-1	0
	12	6	17.27		0
	12	13	17.31		0
	25	0	17.27		0
16QAM	1	0	17.23	0-1	0
	1	12	17.49		0
	1	24	17.43		0
	12	0	17.27	0-2	0
	12	6	17.37		0
	12	13	17.40		0
	25	0	17.28		0

Note: LTE Band 17 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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Max LTE Band 5 (Cell)

Table 10-5
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	23.80	0	0
	1	25	23.61		0
	1	49	23.64		0
	25	0	22.65	0-1	1
	25	12	22.59		1
	25	25	22.70		1
	50	0	22.57		1
16QAM	1	0	23.32	0-1	1
	1	25	23.38		1
	1	49	23.36		1
	25	0	21.62	0-2	2
	25	12	21.60		2
	25	25	21.74		2
	50	0	21.60		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 10-6
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	23.52	23.51	23.71	0	0
	1	12	23.85	23.76	23.93		0
	1	24	23.64	23.55	23.78		0
	12	0	22.66	22.53	22.77	0-1	1
	12	6	22.61	22.46	22.79		1
	12	13	22.68	22.54	22.81		1
	25	0	22.68	22.49	22.78		1
16QAM	1	0	22.67	22.16	22.27	0-1	1
	1	12	22.57	22.49	22.22		1
	1	24	22.74	22.19	22.60		1
	12	0	21.36	21.48	21.72	0-2	2
	12	6	21.42	21.53	21.73		2
	12	13	21.51	21.44	21.59		2
	25	0	21.59	21.58	21.73		2

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Table 10-7
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	23.16	23.52	23.51	0	0
	1	7	23.73	23.35	23.68		0
	1	14	23.33	23.34	23.43		0
	8	0	22.32	22.69	22.44	0-1	1
	8	4	22.33	22.57	22.49		1
	8	7	22.35	22.59	22.48		1
	15	0	22.31	22.55	22.49		1
16QAM	1	0	22.70	23.01	22.70	0-1	1
	1	7	22.60	23.11	22.62		1
	1	14	22.72	23.12	22.50		1
	8	0	21.14	21.37	21.14	0-2	2
	8	4	21.09	21.82	21.52		2
	8	7	21.30	21.58	21.57		2
	15	0	21.32	21.58	21.79		2

Table 10-8
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	23.23	23.24	23.46	0	0
	1	2	23.65	23.43	23.45		0
	1	5	23.40	23.48	23.48		0
	3	0	23.34	23.32	23.37		0
	3	2	23.23	23.29	23.32		0
	3	3	23.16	23.27	23.43		0
	6	0	22.31	22.18	22.33	0-1	1
16QAM	1	0	22.11	22.84	21.86	0-1	1
	1	2	21.83	22.64	22.26		1
	1	5	21.86	22.89	21.75		1
	3	0	22.37	22.09	22.41		1
	3	2	22.66	22.21	22.37		1
	3	3	22.54	22.35	22.54		1
	6	0	21.24	21.52	21.32	0-2	2

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Reduced LTE Band 5 (Cell)

Table 10-9
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	16.75	0	0
	1	25	16.85		0
	1	49	16.67		0
	25	0	16.66	0-1	0
	25	12	16.66		0
	25	25	16.67		0
	50	0	16.56		0
16QAM	1	0	16.82	0-1	0
	1	25	16.80		0
	1	49	16.95		0
	25	0	16.74	0-2	0
	25	12	16.75		0
	25	25	16.74		0
	50	0	16.62		0

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 10-10
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	16.64	16.42	16.62	0	0
	1	12	16.65	16.59	16.80		0
	1	24	16.55	16.52	16.79		0
	12	0	16.49	16.54	16.52	0-1	0
	12	6	16.54	16.51	16.55		0
	12	13	16.54	16.55	16.62		0
	25	0	16.47	16.56	16.67		0
16QAM	1	0	16.54	16.07	16.62	0-1	0
	1	12	16.62	16.13	16.82		0
	1	24	16.09	16.45	16.79		0
	12	0	16.37	16.50	16.51	0-2	0
	12	6	16.38	16.49	16.39		0
	12	13	16.38	16.41	16.61		0
	25	0	16.35	16.51	16.55		0

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Table 10-11
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	16.58	16.58	16.58	0	0
	1	7	16.60	16.61	16.75		0
	1	14	16.64	16.70	16.53		0
	8	0	16.64	16.52	16.75	0-1	0
	8	4	16.55	16.50	16.67		0
	8	7	16.52	16.57	16.63		0
	15	0	16.53	16.59	16.65		0
16QAM	1	0	16.63	16.34	16.34	0-1	0
	1	7	16.60	16.62	16.61		0
	1	14	16.56	16.59	16.43		0
	8	0	16.19	16.59	16.66	0-2	0
	8	4	16.39	16.71	16.69		0
	8	7	16.36	16.84	16.65		0
	15	0	16.61	16.62	16.61		0

Table 10-12
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	16.53	16.67	16.59	0	0
	1	2	16.76	16.72	16.69		0
	1	5	16.55	16.74	16.29		0
	3	0	16.65	16.55	16.78		0
	3	2	16.67	16.66	16.76		0
	3	3	16.60	16.63	16.68		0
	6	0	16.55	16.60	16.66	0-1	0
16QAM	1	0	16.69	16.38	16.25	0-1	0
	1	2	16.80	16.33	16.35		0
	1	5	16.62	16.27	16.82		0
	3	0	16.44	16.38	16.42		0
	3	2	16.58	16.62	16.46		0
	3	3	16.63	16.51	16.55		0
	6	0	16.68	16.56	16.83	0-2	0

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Max LTE Band 66 (AWS)

Table 10-13
LTE Band 66 (AWS) Conducted Powers - 20 MHz Bandwidth

LTE Band 66 (AWS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			132072 (1720.0 MHz)	132322 (1745.0 MHz)	132572 (1770.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.59	22.85	23.01	0	0
	1	50	22.84	22.72	23.34		0
	1	99	22.95	22.71	23.32		0
	50	0	22.04	22.13	22.06	0-1	1
	50	25	22.08	22.10	22.07		1
	50	50	22.08	22.10	22.03		1
	100	0	21.98	22.11	22.10		1
16QAM	1	0	22.36	22.09	21.79	0-1	1
	1	50	22.41	21.63	22.09		1
	1	99	22.25	22.38	22.03		1
	50	0	20.97	21.27	21.09	0-2	2
	50	25	21.13	21.20	20.98		2
	50	50	20.85	21.16	21.00		2
	100	0	21.00	21.17	21.07		2

Table 10-14
LTE Band 66 (AWS) Conducted Powers - 15 MHz Bandwidth

LTE Band 66 (AWS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			132047 (1717.5 MHz)	132322 (1745.0 MHz)	132597 (1772.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.11	22.73	22.63	0	0
	1	36	22.50	22.66	22.76		0
	1	74	22.86	22.54	22.66		0
	36	0	21.42	21.72	21.63	0-1	1
	36	18	21.48	21.62	21.68		1
	36	37	21.62	21.65	21.60		1
	75	0	21.54	21.56	21.59		1
16QAM	1	0	21.16	21.30	21.69	0-1	1
	1	36	21.13	21.04	21.61		1
	1	74	21.18	21.44	21.64		1
	36	0	20.29	20.72	20.61	0-2	2
	36	18	20.38	20.55	20.66		2
	36	37	20.63	20.68	20.71		2
	75	0	20.54	20.65	20.69		2

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Table 10-15
LTE Band 66 (AWS) Conducted Powers - 10 MHz Bandwidth

LTE Band 66 (AWS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			132022 (1715.0 MHz)	132322 (1745.0 MHz)	132622 (1775.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.06	22.87	22.72	0	0
	1	25	22.47	22.64	23.04		0
	1	49	22.73	22.63	22.73		0
	25	0	21.33	21.74	21.75	0-1	1
	25	12	21.49	21.71	21.69		1
	25	25	21.46	21.71	21.71		1
	50	0	21.47	21.77	21.74		1
16QAM	1	0	21.01	21.24	21.37	0-1	1
	1	25	21.15	21.37	21.25		1
	1	49	21.11	21.21	21.23		1
	25	0	20.28	20.72	20.78	0-2	2
	25	12	20.46	20.70	20.74		2
	25	25	20.53	20.61	20.66		2
	50	0	20.40	20.83	20.74		2

Table 10-16
LTE Band 66 (AWS) Conducted Powers - 5 MHz Bandwidth

LTE Band 66 (AWS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			131997 (1712.5 MHz)	132322 (1745.0 MHz)	132647 (1777.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.28	22.66	22.75	0	0
	1	12	22.34	22.76	22.61		0
	1	24	22.46	22.85	22.73		0
	12	0	21.33	21.67	21.75	0-1	1
	12	6	21.37	21.65	21.73		1
	12	13	21.37	21.69	21.72		1
	25	0	21.47	21.79	21.69		1
16QAM	1	0	21.82	21.30	21.03	0-1	1
	1	12	21.10	21.49	21.76		1
	1	24	21.03	21.51	21.19		1
	12	0	20.11	20.53	20.37	0-2	2
	12	6	20.35	20.48	20.52		2
	12	13	20.43	20.53	20.62		2
	25	0	20.35	20.67	20.59		2

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Table 10-17
LTE Band 66 (AWS) Conducted Powers - 3 MHz Bandwidth

LTE Band 66 (AWS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			131987 (1711.5 MHz)	132322 (1745.0 MHz)	132657 (1778.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.07	22.54	22.75	0	0
	1	7	22.24	22.57	22.74		0
	1	14	22.14	22.57	22.87		0
	8	0	21.07	21.65	21.74	0-1	1
	8	4	21.05	21.71	21.71		1
	8	7	21.10	21.55	21.66		1
	15	0	21.11	21.49	21.80		1
16QAM	1	0	21.23	21.00	21.47	0-1	1
	1	7	21.24	21.14	21.36		1
	1	14	21.49	21.21	21.15		1
	8	0	20.18	20.40	20.75	0-2	2
	8	4	20.17	20.48	20.59		2
	8	7	20.24	20.53	20.60		2
	15	0	20.15	20.57	20.78		2

Table 10-18
LTE Band 66 (AWS) Conducted Powers -1.4 MHz Bandwidth

LTE Band 66 (AWS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Low-Mid Channel	Mid-High	MPR Allowed per 3GPP [dB]	MPR [dB]
			131979 (1710.7 MHz)	132322 (1745.0 MHz)	132665 (1779.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.01	22.46	22.73	0	0
	1	2	22.03	22.59	22.60		0
	1	5	22.02	22.33	22.72		0
	3	0	22.03	22.50	22.67		0
	3	2	22.10	22.57	22.70		0
	3	3	22.02	22.53	22.65		0
	6	0	21.00	21.55	21.71	0-1	1
16QAM	1	0	21.02	21.38	21.40	0-1	1
	1	2	21.28	21.29	21.38		1
	1	5	21.00	21.03	21.36		1
	3	0	21.04	21.56	21.96		1
	3	2	21.17	21.62	22.12		1
	3	3	21.26	21.60	22.10	1	
	6	0	20.11	20.65	20.91	0-2	2

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Reduced LTE Band 66 (AWS)

Table 10-19
LTE Band 66 (AWS) Conducted Powers - 20 MHz Bandwidth

LTE Band 66 (AWS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			132072 (1720.0 MHz)	132322 (1745.0 MHz)	132572 (1770.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.11	12.61	12.48	0	0
	1	50	12.48	12.61	12.60		0
	1	99	12.23	12.03	12.53		0
	50	0	12.12	12.74	12.29	0-1	0
	50	25	12.21	12.54	12.42		0
	50	50	12.27	12.05	12.44		0
	100	0	12.21	12.33	12.14		0
16QAM	1	0	12.33	12.80	12.50	0-1	0
	1	50	12.73	12.80	12.71		0
	1	99	12.27	12.11	12.58		0
	50	0	12.14	12.71	12.13	0-2	0
	50	25	12.46	12.58	12.47		0
	50	50	12.31	12.08	12.48		0
	100	0	12.24	12.41	12.24		0

Table 10-20
LTE Band 66 (AWS) Conducted Powers - 15 MHz Bandwidth

LTE Band 66 (AWS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			132047 (1717.5 MHz)	132322 (1745.0 MHz)	132597 (1772.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.50	12.09	11.65	0	0
	1	36	11.61	11.81	12.08		0
	1	74	11.81	11.50	12.02		0
	36	0	11.69	12.20	11.85	0-1	0
	36	18	11.55	11.91	12.09		0
	36	37	11.90	11.69	12.12		0
	75	0	11.72	11.91	12.05		0
16QAM	1	0	12.02	12.04	11.66	0-1	0
	1	36	12.25	11.81	12.10		0
	1	74	12.23	11.50	12.11		0
	36	0	11.71	12.17	11.93	0-2	0
	36	18	11.79	11.93	12.09		0
	36	37	11.90	11.77	12.17		0
	75	0	11.69	11.95	12.08		0

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Table 10-21
LTE Band 66 (AWS) Conducted Powers - 10 MHz Bandwidth

LTE Band 66 (AWS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			132022 (1715.0 MHz)	132322 (1745.0 MHz)	132622 (1775.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.54	11.93	11.76	0	0
	1	25	11.51	11.84	12.05		0
	1	49	11.54	11.50	11.84		0
	25	0	11.59	12.04	11.94	0-1	0
	25	12	11.50	11.80	12.02		0
	25	25	11.59	11.65	11.99		0
	50	0	11.63	11.84	12.02		0
16QAM	1	0	11.50	12.21	12.41	0-1	0
	1	25	11.87	11.90	12.51		0
	1	49	11.71	12.10	12.52		0
	25	0	11.51	12.06	11.99	0-2	0
	25	12	11.65	11.87	12.06		0
	25	25	11.55	11.76	12.08		0
	50	0	11.63	11.98	12.04		0

Table 10-22
LTE Band 66 (AWS) Conducted Powers - 5 MHz Bandwidth

LTE Band 66 (AWS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			131997 (1712.5 MHz)	132322 (1745.0 MHz)	132647 (1777.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.87	12.40	12.44	0	0
	1	12	11.69	11.86	12.08		0
	1	24	11.89	12.07	12.34		0
	12	0	11.84	12.15	12.30	0-1	0
	12	6	11.59	11.93	12.14		0
	12	13	11.99	11.98	12.31		0
	25	0	11.86	12.05	12.25		0
16QAM	1	0	11.85	12.61	12.81	0-1	0
	1	12	11.90	12.13	12.28		0
	1	24	11.85	12.38	12.32		0
	12	0	11.86	12.24	12.35	0-2	0
	12	6	11.83	12.03	12.17		0
	12	13	12.04	12.13	12.34		0
	25	0	11.80	12.14	12.31		0

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Table 10-23
LTE Band 66 (AWS) Conducted Powers - 3 MHz Bandwidth

LTE Band 66 (AWS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			131987 (1711.5 MHz)	132322 (1745.0 MHz)	132657 (1778.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.55	12.49	12.41	0	0
	1	7	11.77	12.16	12.38		0
	1	14	11.98	12.12	12.49		0
	8	0	11.65	12.08	12.19	0-1	0
	8	4	11.75	12.06	12.31		0
	8	7	11.60	12.02	12.27		0
	15	0	11.80	12.02	12.28		0
16QAM	1	0	11.90	12.37	12.77	0-1	0
	1	7	12.08	12.13	12.66		0
	1	14	12.17	12.40	12.85		0
	8	0	11.67	12.27	12.34	0-2	0
	8	4	11.78	12.12	12.44		0
	8	7	11.85	12.02	12.35		0
	15	0	11.73	12.10	12.24		0

Table 10-24
LTE Band 66 (AWS) Conducted Powers -1.4 MHz Bandwidth

LTE Band 66 (AWS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Low-Mid Channel	Mid-High	MPR Allowed per 3GPP [dB]	MPR [dB]
			131979 (1710.7 MHz)	132322 (1745.0 MHz)	132665 (1779.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.50	11.95	12.00	0	0
	1	2	11.71	12.04	12.27		0
	1	5	11.53	11.81	12.14		0
	3	0	11.52	11.97	12.18		0
	3	2	11.64	12.05	12.27		0
	3	3	11.67	11.92	12.25		0
	6	0	11.57	11.94	12.22	0-1	0
16QAM	1	0	11.54	12.10	12.29	0-1	0
	1	2	11.93	12.02	12.54		0
	1	5	11.99	11.81	12.42		0
	3	0	11.58	12.07	12.40		0
	3	2	11.68	12.17	12.44		0
	3	3	11.70	12.04	12.34	0	
	6	0	11.68	11.94	12.25	0-2	0

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Max LTE Band 2 (PCS)

Table 10-25
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

LTE Band 2 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18700 (1860.0 MHz)	18900 (1880.0 MHz)	19100 (1900.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.33	23.01	23.67	0	0
	1	50	23.21	23.08	23.60		0
	1	99	22.57	23.25	23.45		0
	50	0	22.21	22.20	22.54	0-1	1
	50	25	22.13	22.03	22.48		1
	50	50	22.06	21.94	22.51		1
	100	0	22.15	22.07	22.53		1
16QAM	1	0	22.39	21.95	22.26	0-1	1
	1	50	22.32	21.87	22.02		1
	1	99	21.83	22.51	22.05		1
	50	0	21.22	21.18	21.33	0-2	2
	50	25	21.08	21.03	21.35		2
	50	50	20.99	21.02	21.43		2
	100	0	21.18	21.06	21.59		2

Table 10-26
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

LTE Band 2 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18675 (1857.5 MHz)	18900 (1880.0 MHz)	19125 (1902.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.48	23.19	23.06	0	0
	1	36	22.83	22.83	22.91		0
	1	74	22.74	23.25	23.21		0
	36	0	22.20	22.13	22.28	0-1	1
	36	18	22.27	21.85	22.29		1
	36	37	22.20	22.06	22.28		1
	75	0	22.27	21.96	22.27		1
16QAM	1	0	22.50	22.25	22.60	0-1	1
	1	36	22.47	22.09	22.57		1
	1	74	22.51	21.97	22.48		1
	36	0	21.22	21.00	21.32	0-2	2
	36	18	21.15	21.01	21.28		2
	36	37	21.11	20.91	21.24		2
	75	0	21.39	21.03	21.39		2

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Table 10-27
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

LTE Band 2 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18650 (1855.0 MHz)	18900 (1880.0 MHz)	19150 (1905.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.66	22.96	23.47	0	0
	1	25	23.33	22.82	23.40		0
	1	49	23.34	23.27	23.47		0
	25	0	22.29	21.96	22.32	0-1	1
	25	12	22.37	21.82	22.17		1
	25	25	22.42	21.96	22.42		1
	50	0	22.36	22.06	22.31		1
16QAM	1	0	22.75	22.56	22.45	0-1	1
	1	25	22.07	22.41	22.13		1
	1	49	22.33	22.61	22.17		1
	25	0	21.27	21.12	21.44	0-2	2
	25	12	21.34	21.00	21.34		2
	25	25	21.35	21.05	21.53		2
	50	0	21.34	21.17	21.36		2

Table 10-28
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth

LTE Band 2 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18625 (1852.5 MHz)	18900 (1880.0 MHz)	19175 (1907.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.57	22.76	23.37	0	0
	1	12	23.64	22.75	23.42		0
	1	24	23.44	23.01	23.47		0
	12	0	22.48	21.93	22.29	0-1	1
	12	6	22.42	21.90	22.41		1
	12	13	22.41	22.03	22.35		1
	25	0	22.38	21.98	22.46		1
16QAM	1	0	22.68	22.00	22.29	0-1	1
	1	12	22.85	21.97	22.95		1
	1	24	22.82	22.36	22.53		1
	12	0	21.21	20.90	21.19	0-2	2
	12	6	21.20	20.99	21.31		2
	12	13	21.16	20.82	21.45		2
	25	0	21.09	21.03	21.26		2

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Table 10-29
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

LTE Band 2 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18615 (1851.5 MHz)	18900 (1880.0 MHz)	19185 (1908.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.37	23.05	23.51	0	0
	1	7	23.42	22.92	23.30		0
	1	14	23.22	22.87	23.28		0
	8	0	22.50	21.86	22.34	0-1	1
	8	4	22.38	21.84	22.44		1
	8	7	22.38	21.84	22.39		1
	15	0	22.42	21.88	22.40		1
16QAM	1	0	22.47	21.83	22.10	0-1	1
	1	7	22.70	22.57	22.23		1
	1	14	22.33	22.10	22.49		1
	8	0	21.20	20.95	21.07	0-2	2
	8	4	21.12	20.83	21.23		2
	8	7	21.01	20.86	21.09		2
	15	0	21.26	20.92	21.19		2

Table 10-30
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth

LTE Band 2 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18607 (1850.7 MHz)	18900 (1880.0 MHz)	19193 (1909.3 MHz)		
QPSK	1	0	23.67	23.22	23.61	0	0
	1	2	23.49	23.10	23.26		0
	1	5	23.69	23.25	23.57		0
	3	0	23.36	22.92	23.31		0
	3	2	23.53	22.93	23.25		0
	3	3	23.49	22.86	23.17		0
	6	0	22.44	21.90	22.26	0-1	1
16QAM	1	0	22.20	21.59	22.47	0-1	1
	1	2	22.63	21.61	22.49		1
	1	5	22.09	21.56	22.43		1
	3	0	22.46	21.97	22.29		1
	3	2	22.35	21.89	22.48		1
	3	3	22.53	21.52	22.91	1	
	6	0	21.43	21.21	21.51	0-2	2

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Reduced LTE Band 2 (PCS)

Table 10-31
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

LTE Band 2 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18700 (1860.0 MHz)	18900 (1880.0 MHz)	19100 (1900.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.85	11.56	11.66	0	0
	1	50	12.38	11.72	12.00		0
	1	99	11.82	11.63	11.69		0
	50	0	12.49	11.81	11.94	0-1	0
	50	25	12.38	11.93	11.77		0
	50	50	12.12	11.86	11.78		0
	100	0	12.35	11.83	11.76		0
16QAM	1	0	12.12	11.93	11.72	0-1	0
	1	50	12.50	12.18	12.19		0
	1	99	12.15	11.73	11.77		0
	50	0	12.22	11.70	11.62	0-2	0
	50	25	12.48	11.96	11.95		0
	50	50	12.15	11.60	11.64		0
	100	0	12.02	11.55	11.60		0

Table 10-32
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

LTE Band 2 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18675 (1857.5 MHz)	18900 (1880.0 MHz)	19125 (1902.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.40	11.63	11.46	0	0
	1	36	11.52	11.55	12.08		0
	1	74	11.56	11.58	11.54		0
	36	0	11.89	11.65	11.55	0-1	0
	36	18	11.77	11.53	11.88		0
	36	37	11.76	11.45	11.83		0
	75	0	11.82	11.51	11.71		0
16QAM	1	0	11.79	11.84	11.69	0-1	0
	1	36	12.17	11.77	12.26		0
	1	74	12.02	11.50	11.77		0
	36	0	11.61	11.32	11.61	0-2	0
	36	18	11.83	11.48	11.93		0
	36	37	11.78	11.14	11.68		0
	75	0	11.56	11.26	11.68		0

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Table 10-33
LTE Band 2 (PCS) Conducted Powers - 10 MHz Bandwidth

LTE Band 2 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18650 (1855.0 MHz)	18900 (1880.0 MHz)	19150 (1905.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.24	11.36	11.63	0	0
	1	25	11.51	11.39	11.90		0
	1	49	11.44	11.33	11.41		0
	25	0	11.81	11.44	11.97	0-1	0
	25	12	11.65	11.30	11.87		0
	25	25	11.84	11.34	11.86		0
	50	0	11.80	11.38	11.87		0
16QAM	1	0	11.76	11.62	11.81	0-1	0
	1	25	12.00	11.71	12.05		0
	1	49	11.73	11.30	11.63		0
	25	0	11.55	11.24	11.99	0-2	0
	25	12	11.72	11.39	11.86		0
	25	25	11.58	11.14	11.68		0
	50	0	11.50	11.17	11.69		0

Table 10-34
LTE Band 2 (PCS) Conducted Powers - 5 MHz Bandwidth

LTE Band 2 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18625 (1852.5 MHz)	18900 (1880.0 MHz)	19175 (1907.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.66	11.77	12.05	0	0
	1	12	11.49	11.34	11.55		0
	1	24	11.94	11.76	11.72		0
	12	0	11.85	11.60	12.01	0-1	0
	12	6	11.98	11.37	11.73		0
	12	13	12.06	11.54	11.70		0
	25	0	11.85	11.56	11.89		0
16QAM	1	0	12.20	11.65	12.32	0-1	0
	1	12	12.13	11.54	11.86		0
	1	24	12.21	11.63	12.04		0
	12	0	11.89	11.38	11.90	0-2	0
	12	6	12.03	11.46	11.87		0
	12	13	11.85	11.33	11.82		0
	25	0	11.82	11.24	11.65		0

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Table 10-35
LTE Band 2 (PCS) Conducted Powers - 3 MHz Bandwidth

LTE Band 2 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18615 (1851.5 MHz)	18900 (1880.0 MHz)	19185 (1908.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	11.65	11.91	11.88	0	0
	1	7	11.64	11.56	11.77		0
	1	14	11.91	11.83	11.62		0
	8	0	12.04	11.42	11.63	0-1	0
	8	4	12.05	11.46	11.88		0
	8	7	11.99	11.38	11.91		0
	15	0	12.01	11.45	11.67		0
16QAM	1	0	12.17	11.90	12.08	0-1	0
	1	7	12.24	11.87	12.19		0
	1	14	12.16	11.81	12.11		0
	8	0	12.02	11.55	11.60	0-2	0
	8	4	12.03	11.58	11.79		0
	8	7	11.98	11.51	11.81		0
	15	0	11.96	11.59	11.62		0

Table 10-36
LTE Band 2 (PCS) Conducted Powers -1.4 MHz Bandwidth

LTE Band 2 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			18607 (1850.7 MHz)	18900 (1880.0 MHz)	19193 (1909.3 MHz)		
QPSK	1	0	11.57	11.42	11.71	0	0
	1	2	11.70	11.62	11.85		0
	1	5	11.41	11.42	11.52		0
	3	0	11.97	11.37	11.77		0
	3	2	12.02	11.35	11.79		0
	3	3	12.02	11.31	11.70		0
	6	0	11.95	11.34	11.76	0-1	0
16QAM	1	0	12.20	11.62	12.08	0-1	0
	1	2	12.19	11.83	12.23		0
	1	5	12.20	11.63	11.89		0
	3	0	12.13	11.58	11.94		0
	3	2	12.19	11.58	11.95		0
	3	3	12.20	11.53	11.87	0	
	6	0	11.92	11.53	11.73	0-2	0

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Max LTE Band 7

Table 10-37
LTE Band 7 Conducted Powers - 20 MHz Bandwidth

LTE Band 7 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20850 (2510.0 MHz)	21100 (2535.0 MHz)	21350 (2560.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	24.43	24.19	24.43	0	0
	1	50	24.51	24.33	24.51		0
	1	99	24.64	24.33	24.46		0
	50	0	23.48	23.09	23.20	0-1	1
	50	25	23.23	23.07	23.36		1
	50	50	23.19	23.02	23.39		1
	100	0	23.32	23.03	23.22		1
16QAM	1	0	23.16	22.91	22.81	0-1	1
	1	50	23.07	22.75	23.33		1
	1	99	23.01	22.55	23.03		1
	50	0	22.31	22.02	22.05	0-2	2
	50	25	22.26	22.12	22.13		2
	50	50	22.32	22.12	22.37		2
	100	0	22.35	22.13	22.30		2

Table 10-38
LTE Band 7 Conducted Powers - 15 MHz Bandwidth

LTE Band 7 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20825 (2507.5 MHz)	21100 (2535.0 MHz)	21375 (2562.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	24.09	23.85	23.90	0	0
	1	36	23.55	23.43	23.91		0
	1	74	23.60	23.54	23.91		0
	36	0	22.74	22.48	22.72	0-1	1
	36	18	22.57	22.48	22.77		1
	36	37	22.65	22.44	22.89		1
	75	0	22.65	22.26	22.66		1
16QAM	1	0	23.28	22.62	23.00	0-1	1
	1	36	22.79	22.38	23.04		1
	1	74	22.80	22.37	23.17		1
	36	0	21.74	21.30	21.76	0-2	2
	36	18	21.54	21.31	21.78		2
	36	37	21.69	21.41	21.78		2
	75	0	21.64	21.57	21.60		2

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Table 10-39
LTE Band 7 Conducted Powers - 10 MHz Bandwidth

LTE Band 7 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20800 (2505.0 MHz)	21100 (2535.0 MHz)	21400 (2565.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	24.04	23.69	23.82	0	0
	1	25	23.97	23.55	23.83		0
	1	49	23.83	23.61	24.06		0
	25	0	22.87	22.53	22.70	0-1	1
	25	12	22.74	22.39	22.77		1
	25	25	22.65	22.41	22.91		1
16QAM	50	0	22.86	22.40	22.76	0-1	1
	1	0	23.10	22.67	22.71		1
	1	25	22.87	23.09	22.88		1
	1	49	22.55	23.07	22.79	0-2	1
	25	0	21.98	21.70	21.83		2
	25	12	21.84	21.57	21.80		2
	25	25	21.69	21.47	21.84		2
	50	0	21.61	21.52	21.71		2

Table 10-40
LTE Band 7 Conducted Powers - 5 MHz Bandwidth

LTE Band 7 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20775 (2502.5 MHz)	21100 (2535.0 MHz)	21425 (2567.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	24.12	23.71	23.58	0	0
	1	12	24.24	23.46	23.72		0
	1	24	24.11	23.32	23.64		0
	12	0	23.00	22.50	22.78	0-1	1
	12	6	22.91	22.51	22.67		1
	12	13	22.83	22.52	22.68		1
	25	0	22.82	22.52	22.71		1
16QAM	1	0	22.95	22.97	22.79	0-1	1
	1	12	23.03	22.56	22.66		1
	1	24	22.81	22.71	22.69		1
	12	0	21.95	21.55	21.83	0-2	2
	12	6	21.85	21.52	21.62		2
	12	13	21.87	21.48	21.75		2
	25	0	21.88	21.55	21.79		2

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Reduced LTE Band 7

Table 10-41
LTE Band 7 Conducted Powers - 20 MHz Bandwidth

LTE Band 7 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20850 (2510.0 MHz)	21100 (2535.0 MHz)	21350 (2560.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.50	12.54	12.49	0	0
	1	50	13.07	12.51	12.63		0
	1	99	12.84	12.43	12.70		0
	50	0	12.75	12.60	12.38	0-1	0
	50	25	13.09	12.67	12.68		0
	50	50	12.95	12.53	12.54		0
	100	0	12.88	12.57	12.66		0
16QAM	1	0	12.81	12.90	12.69	0-1	0
	1	50	13.20	12.89	12.93		0
	1	99	13.05	12.70	12.94		0
	50	0	12.73	12.48	12.36	0-2	0
	50	25	13.06	12.57	12.69		0
	50	50	12.93	12.41	12.54		0
	100	0	12.85	12.34	12.45		0

Table 10-42
LTE Band 7 Conducted Powers - 15 MHz Bandwidth

LTE Band 7 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20825 (2507.5 MHz)	21100 (2535.0 MHz)	21375 (2562.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.73	12.67	13.18	0	0
	1	36	12.71	12.42	13.19		0
	1	74	12.86	12.46	12.87		0
	36	0	12.75	12.51	13.12	0-1	0
	36	18	12.84	12.52	13.20		0
	36	37	12.95	12.55	13.08		0
	75	0	12.86	12.45	13.10		0
16QAM	1	0	12.69	12.91	13.34	0-1	0
	1	36	12.88	12.83	13.38		0
	1	74	12.85	12.97	13.05		0
	36	0	12.74	12.47	13.15	0-2	0
	36	18	12.81	12.56	13.28		0
	36	37	12.88	12.57	13.18		0
	75	0	12.89	12.44	13.15		0

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Table 10-43
LTE Band 7 Conducted Powers - 10 MHz Bandwidth

LTE Band 7 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20800 (2505.0 MHz)	21100 (2535.0 MHz)	21400 (2565.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.33	12.26	12.74	0	0
	1	25	12.76	12.48	12.99		0
	1	49	12.52	12.14	12.38		0
	25	0	12.65	12.45	13.14	0-1	0
	25	12	12.81	12.49	13.15		0
	25	25	12.87	12.43	12.92		0
	50	0	12.70	12.40	12.97		0
16QAM	1	0	12.83	12.63	13.01	0-1	0
	1	25	12.97	12.88	13.31		0
	1	49	12.67	12.57	12.68		0
	25	0	12.70	12.45	13.15	0-2	0
	25	12	12.83	12.50	13.14		0
	25	25	12.84	12.44	12.93		0
	50	0	12.75	12.43	13.05		0

Table 10-44
LTE Band 7 Conducted Powers - 5 MHz Bandwidth

LTE Band 7 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20775 (2502.5 MHz)	21100 (2535.0 MHz)	21425 (2567.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	12.92	12.55	13.09	0	0
	1	12	12.80	12.42	12.91		0
	1	24	12.87	12.53	12.83		0
	12	0	12.78	12.50	13.10	0-1	0
	12	6	12.85	12.54	13.09		0
	12	13	12.74	12.53	12.95		0
	25	0	12.72	12.52	12.98		0
16QAM	1	0	13.28	12.97	13.50	0-1	0
	1	12	13.25	12.89	13.42		0
	1	24	13.26	12.96	13.34		0
	12	0	12.82	12.52	13.15	0-2	0
	12	6	12.93	12.60	13.11		0
	12	13	12.85	12.56	13.00		0
	25	0	12.75	12.54	13.11		0

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10.4 WLAN Conducted Powers

Table 10-45
2.4 GHz Average RF Maximum Output Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11b	802.11g	802.11n
2412	1	18.24	14.61	12.76
2437	6	18.36	15.05	13.21
2462	11	17.95	14.73	12.74

Table 10-46
5 GHz Average RF Maximum Output Power

Freq [MHz]	Channel	5GHz (20MHz) Conducted Power [dBm]
		IEEE Transmission Mode
		802.11a
5180	36	14.04
5200	40	13.68
5220	44	14.24
5240	48	14.24
5260	52	14.34
5280	56	14.44
5300	60	14.45
5320	64	14.16
5500	100	13.87
5600	120	13.84
5620	124	14.30
5720	144	14.30
5745	149	13.94
5785	157	13.77
5825	165	14.14

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Table 10-47
2.4 GHz Average RF Reduced Output Power

Freq [MHz]	Channel	2.4GHz Conducted Power [dBm]		
		IEEE Transmission Mode		
		802.11b	802.11g	802.11n
2412	1	13.11	12.84	12.76
2437	6	13.05	13.24	13.21
2462	11	13.17	13.16	12.74

Table 10-48
5 GHz Average RF Reduced Output Power

Freq [MHz]	Channel	5GHz (40MHz) Conducted Power [dBm]
		IEEE Transmission Mode
		802.11n
5190	38	10.40
5230	46	9.57
5270	54	9.76
5310	62	10.49
5510	102	10.28
5590	118	9.90
5630	126	9.81
5710	142	10.24
5755	151	9.96
5795	159	9.79

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.

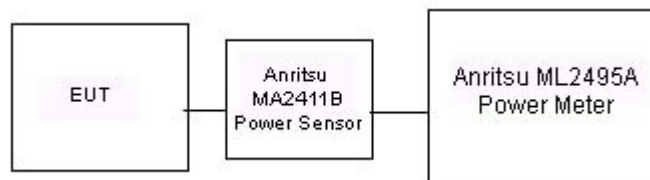


Figure 10-3
Power Measurement Setup

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10.5 Bluetooth Conducted Powers

Table 10-49
Bluetooth Average RF Power

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1.0	0	10.48	11.180
2441	1.0	39	10.33	10.789
2480	1.0	78	10.91	12.329
2402	2.0	0	8.18	6.576
2441	2.0	39	8.07	6.406
2480	2.0	78	8.59	7.236
2402	3.0	0	8.24	6.672
2441	3.0	39	8.13	6.504
2480	3.0	78	8.66	7.353

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

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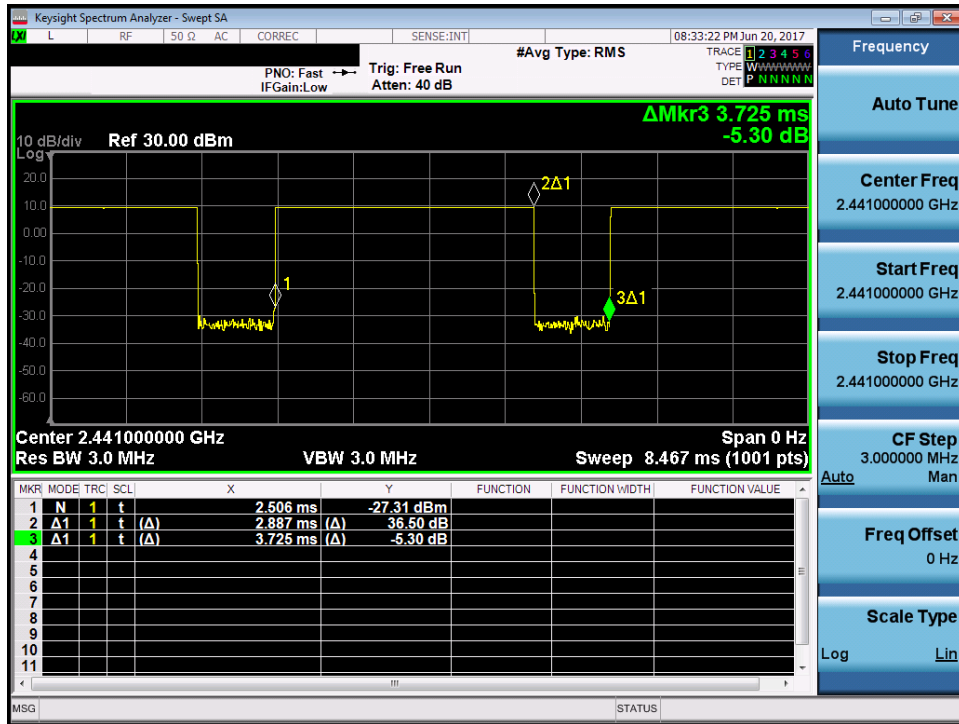


Figure 10-4
Bluetooth Transmission Plot

Equation 2
Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = Pulse\ \frac{Width}{Period} * 100\% = \frac{2.887ms}{3.725ms} * 100\% = 77.5\%$$

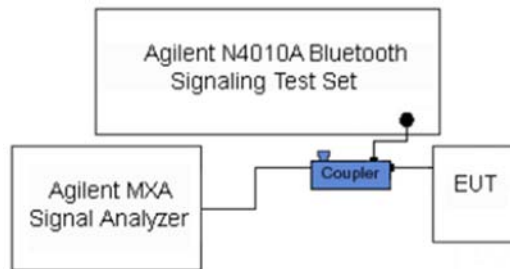


Figure 10-5
Power Measurement Setup

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11 SYSTEM VERIFICATION

11.1 Tissue Verification

Table 11-1
Head Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (°C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
7/5/2017	750H	21.5	710	0.867	42.438	0.890	42.149	-2.58%	0.69%
			740	0.895	42.090	0.893	41.994	0.22%	0.23%
			755	0.909	41.890	0.894	41.916	1.68%	-0.06%
7/11/2017	835H	20.5	820	0.885	40.581	0.899	41.578	-1.56%	-2.40%
			835	0.897	40.348	0.900	41.500	-0.33%	-2.78%
			850	0.914	40.194	0.916	41.500	-0.22%	-3.15%
7/7/2017	1750H	20.0	1710	1.365	38.967	1.348	40.142	1.26%	-2.93%
			1750	1.404	38.783	1.371	40.079	2.41%	-3.23%
			1790	1.441	38.559	1.394	40.016	3.37%	-3.64%
7/18/2017	1750H	22.0	1710	1.369	39.059	1.348	40.142	1.56%	-2.70%
			1750	1.412	38.858	1.371	40.079	2.99%	-3.05%
			1790	1.451	38.670	1.394	40.016	4.09%	-3.36%
7/3/2017	1900H	21.3	1850	1.398	40.491	1.400	40.000	-0.14%	1.23%
			1880	1.431	40.389	1.400	40.000	2.21%	0.97%
			1910	1.464	40.271	1.400	40.000	4.57%	0.68%
7/10/2017	2450H	21.6	2400	1.818	38.561	1.756	39.289	3.53%	-1.85%
			2450	1.876	38.375	1.800	39.200	4.22%	-2.10%
			2500	1.931	38.166	1.855	39.136	4.10%	-2.48%
			2550	1.984	37.978	1.909	39.073	3.93%	-2.80%
			2600	2.041	37.802	1.964	39.009	3.92%	-3.09%
7/13/2017	2450H	23.2	2400	1.796	38.254	1.756	39.289	2.28%	-2.63%
			2450	1.853	38.062	1.800	39.200	2.94%	-2.90%
			2500	1.904	37.855	1.855	39.136	2.64%	-3.27%
7/19/2017	2450H	21.4	2400	1.817	38.751	1.756	39.289	3.47%	-1.37%
			2450	1.880	38.552	1.800	39.200	4.44%	-1.65%
			2500	1.932	38.355	1.855	39.136	4.15%	-2.00%
07/03/2017	5200H-5800H	21.8	5180	4.455	35.302	4.635	36.009	-3.88%	-1.96%
			5200	4.481	35.245	4.655	35.986	-3.74%	-2.06%
			5220	4.511	35.189	4.676	35.963	-3.53%	-2.15%
			5240	4.520	35.180	4.696	35.940	-3.75%	-2.11%
			5260	4.536	35.170	4.717	35.917	-3.84%	-2.08%
			5300	4.573	35.076	4.758	35.871	-3.89%	-2.22%
			5600	4.880	34.654	5.065	35.529	-3.65%	-2.46%
			5620	4.886	34.662	5.086	35.506	-3.93%	-2.38%
			5745	5.019	34.491	5.214	35.363	-3.74%	-2.47%
			5765	5.048	34.444	5.234	35.340	-3.55%	-2.54%
			5825	5.111	34.383	5.296	35.271	-3.49%	-2.52%

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Table 11-2
Body Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (°C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
7/4/2017	750B	24.2	710	0.925	55.775	0.960	55.687	-3.65%	0.16%
			740	0.954	55.578	0.963	55.570	-0.93%	0.01%
			755	0.970	55.462	0.964	55.512	0.62%	-0.09%
7/10/2017	835B	18.4	820	0.985	55.087	0.969	55.258	1.65%	-0.31%
			835	1.000	54.936	0.970	55.200	3.09%	-0.48%
			850	1.014	54.779	0.988	55.154	2.63%	-0.68%
7/13/2017	835B	19.7	820	0.996	55.092	0.969	55.258	2.79%	-0.30%
			835	1.008	54.953	0.970	55.200	3.92%	-0.45%
			850	1.027	54.776	0.988	55.154	3.95%	-0.69%
7/10/2017	1750B	19.2	1710	1.471	51.926	1.463	53.537	0.55%	-3.01%
			1750	1.517	51.765	1.488	53.432	1.95%	-3.12%
			1790	1.562	51.586	1.514	53.326	3.17%	-3.26%
7/17/2017	1750B	20.3	1710	1.475	51.653	1.463	53.537	0.82%	-3.52%
			1750	1.520	51.488	1.488	53.432	2.15%	-3.64%
			1790	1.562	51.345	1.514	53.326	3.17%	-3.71%
7/4/2017	1900B	23.1	1850	1.482	52.168	1.520	53.300	-2.50%	-2.12%
			1880	1.512	51.971	1.520	53.300	-0.53%	-2.49%
			1910	1.560	51.971	1.520	53.300	2.63%	-2.49%
7/18/2017	1900B	22.1	1850	1.521	52.226	1.520	53.300	0.07%	-2.02%
			1880	1.557	52.126	1.520	53.300	2.43%	-2.20%
			1910	1.593	52.032	1.520	53.300	4.80%	-2.38%
7/24/2017	1900B	22.5	1850	1.520	52.244	1.520	53.300	0.00%	-1.98%
			1880	1.555	52.201	1.520	53.300	2.30%	-2.06%
			1910	1.589	52.141	1.520	53.300	4.54%	-2.17%
6/24/2017	2450B	23.0	2400	1.929	51.976	1.902	52.767	1.42%	-1.50%
			2450	1.990	51.841	1.950	52.700	2.05%	-1.63%
			2500	2.058	51.574	2.021	52.636	1.83%	-2.02%
7/19/2017	2450B	21.7	2450	2.033	51.829	1.950	52.700	4.26%	-1.65%
			2500	2.108	51.639	2.021	52.636	4.30%	-1.89%
			2550	2.183	51.445	2.092	52.573	4.35%	-2.15%
			2600	2.250	51.239	2.163	52.509	4.02%	-2.42%
			5240	5.421	47.777	5.346	48.960	1.40%	-2.42%
07/10/2017	5200B-5800B	21.5	5260	5.446	47.733	5.369	48.933	1.43%	-2.45%
			5280	5.478	47.705	5.393	48.906	1.58%	-2.46%
			5300	5.500	47.663	5.416	48.879	1.55%	-2.49%
			5320	5.527	47.606	5.439	48.851	1.62%	-2.55%
			5500	5.770	47.330	5.650	48.607	2.12%	-2.63%
			5520	5.804	47.313	5.673	48.580	2.31%	-2.61%
			5600	5.912	47.149	5.766	48.471	2.53%	-2.73%
			5620	5.924	47.154	5.790	48.444	2.31%	-2.66%
			5745	6.105	46.941	5.936	48.275	2.85%	-2.76%
			5765	6.148	46.911	5.959	48.248	3.17%	-2.77%
			5825	6.214	46.798	6.029	48.166	3.07%	-2.84%

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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11.2 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 11-3
System Verification Results

SAR System #	Tissue Frequency (MHz)	Tissue Type	Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Source SN	Probe SN	Measured SAR _{1g} (W/kg)	1 W Target SAR _{1g} (W/kg)	1 W Normalized SAR _{1g} (W/kg)	Deviation _{1g} (%)
H	750	HEAD	07/05/2017	21.5	21.5	0.200	1003	3318	1.730	8.390	8.650	3.10%
J	835	HEAD	07/11/2017	21.0	20.5	0.200	4d047	3209	1.950	9.130	9.750	6.79%
J	1750	HEAD	07/07/2017	20.6	20.4	0.100	1150	3209	3.570	36.100	35.700	-1.11%
H	1750	HEAD	07/18/2017	24.2	22.0	0.100	1092	3318	3.820	36.400	38.200	4.95%
J	1900	HEAD	07/03/2017	21.0	20.8	0.100	5d080	3209	3.880	39.300	38.800	-1.27%
I	2450	HEAD	07/10/2017	22.0	21.0	0.100	945	3213	5.410	51.300	54.100	5.46%
I	2450	HEAD	07/13/2017	23.0	21.7	0.100	945	3213	5.390	51.300	53.900	5.07%
I	2450	HEAD	07/19/2017	22.6	21.4	0.100	945	3213	5.420	51.300	54.200	5.65%
I	2600	HEAD	07/10/2017	22.0	21.0	0.100	1004	3213	6.240	57.600	62.400	8.33%
H	5250	HEAD	07/03/2017	21.5	21.7	0.050	1237	3914	3.700	79.200	74.000	-6.57%
H	5600	HEAD	07/03/2017	21.5	21.7	0.050	1237	3914	4.020	83.300	80.400	-3.48%
H	5750	HEAD	07/03/2017	21.5	21.7	0.050	1237	3914	3.770	81.500	75.400	-7.48%
E	750	BODY	07/04/2017	22.9	23.5	0.200	1161	3319	1.750	8.430	8.750	3.80%
K	835	BODY	07/10/2017	20.6	18.3	0.200	4d047	7406	2.030	9.570	10.150	6.06%
K	835	BODY	07/13/2017	21.1	20.0	0.200	4d180	7406	2.060	9.610	10.300	7.18%
H	1750	BODY	07/10/2017	21.0	19.2	0.100	1092	3318	3.650	37.000	36.500	-1.35%
H	1750	BODY	07/17/2017	22.4	20.3	0.100	1092	3318	3.880	37.000	38.800	4.86%
J	1900	BODY	07/04/2017	21.1	21.7	0.100	5d148	3209	3.920	40.900	39.200	-4.16%
I	1900	BODY	07/18/2017	22.0	20.4	0.100	5d026	3213	4.070	40.300	40.700	0.99%
E	1900	BODY	07/24/2017	22.7	22.5	0.100	5d148	3319	4.270	40.900	42.700	4.40%
K	2450	BODY	06/24/2017	23.5	23.0	0.100	797	7406	5.140	50.700	51.400	1.38%
K	2450	BODY	07/19/2017	22.9	21.7	0.100	797	7406	5.220	50.700	52.200	2.96%
K	2600	BODY	07/19/2017	22.9	21.7	0.100	1071	7406	5.640	54.200	56.400	4.06%
D	5250	BODY	07/10/2017	22.1	21.3	0.050	1123	3589	3.610	75.900	72.200	-4.87%
D	5600	BODY	07/10/2017	22.1	21.3	0.050	1123	3589	3.970	78.900	79.400	0.63%
D	5750	BODY	07/10/2017	22.1	21.3	0.050	1123	3589	3.570	76.300	71.400	-6.42%

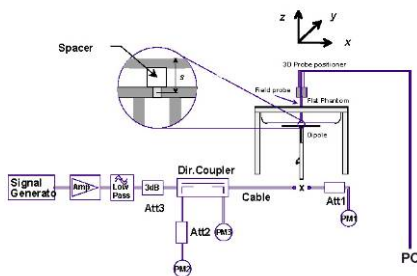


Figure 11-1
System Verification Setup Diagram



Figure 11-2
System Verification Setup Photo

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12 SAR DATA SUMMARY

12.1 Standalone Head SAR Data

Table 12-1
GSM 850 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	# of Time Slots	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	28.5	26.95	0.01	Right	Cheek	05185	1	1:8.3	0.314	1.429	0.449	
836.60	190	GSM 850	GSM	28.5	26.95	0.01	Right	Tilt	05185	1	1:8.3	0.234	1.429	0.334	
836.60	190	GSM 850	GSM	28.5	26.95	-0.02	Left	Cheek	05185	1	1:8.3	0.474	1.429	0.677	A1
836.60	190	GSM 850	GSM	28.5	26.95	-0.02	Left	Tilt	05185	1	1:8.3	0.328	1.429	0.469	
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 12-2
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	# of Time Slots	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
1909.80	810	GSM 1900	GSM	22.0	21.82	-0.03	Right	Cheek	04766	1	1:8.3	0.138	1.042	0.144	
1909.80	810	GSM 1900	GSM	22.0	21.82	0.00	Right	Tilt	04766	1	1:8.3	0.112	1.042	0.117	
1909.80	810	GSM 1900	GSM	22.0	21.82	0.02	Left	Cheek	04766	1	1:8.3	0.509	1.042	0.530	A2
1909.80	810	GSM 1900	GSM	22.0	21.82	0.13	Left	Tilt	04766	1	1:8.3	0.379	1.042	0.395	
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 12-3
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	17.0	16.04	0.04	Right	Cheek	05185	1:1	0.182	1.247	0.227	
836.60	4183	UMTS 850	RMC	17.0	16.04	-0.05	Right	Tilt	05185	1:1	0.135	1.247	0.168	
836.60	4183	UMTS 850	RMC	17.0	16.04	0.00	Left	Cheek	05185	1:1	0.302	1.247	0.377	A3
836.60	4183	UMTS 850	RMC	17.0	16.04	-0.01	Left	Tilt	05185	1:1	0.220	1.247	0.274	
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 12-4
UMTS 1750 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1732.40	1412	UMTS 1750	RMC	13.0	12.48	0.00	Right	Cheek	03883	1:1	0.123	1.127	0.139	
1732.40	1412	UMTS 1750	RMC	13.0	12.48	0.02	Right	Tilt	03883	1:1	0.120	1.127	0.135	
1732.40	1412	UMTS 1750	RMC	13.0	12.48	0.10	Left	Cheek	03883	1:1	0.427	1.127	0.481	A4
1732.40	1412	UMTS 1750	RMC	13.0	12.48	0.01	Left	Tilt	03883	1:1	0.343	1.127	0.387	
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 12-5
UMTS 1900 Head SAR

MEASUREMENT RESULTS														
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	12.5	12.45	-0.01	Right	Cheek	04766	1:1	0.146	1.012	0.148	
1880.00	9400	UMTS 1900	RMC	12.5	12.45	-0.01	Right	Tilt	04766	1:1	0.121	1.012	0.122	
1880.00	9400	UMTS 1900	RMC	12.5	12.45	0.02	Left	Cheek	04766	1:1	0.502	1.012	0.508	A5
1880.00	9400	UMTS 1900	RMC	12.5	12.45	0.00	Left	Tilt	04766	1:1	0.371	1.012	0.375	
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 12-6
LTE Band 17 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)		
710.00	23790	Mid	LTE Band 17	10	18.0	17.34	0.05	0	Right	Cheek	QPSK	1	49	05185	1:1	0.147	1.164	0.171	
710.00	23790	Mid	LTE Band 17	10	18.0	17.27	0.03	0	Right	Cheek	QPSK	25	25	05185	1:1	0.151	1.183	0.179	
710.00	23790	Mid	LTE Band 17	10	18.0	17.34	0.02	0	Right	Tilt	QPSK	1	49	05185	1:1	0.123	1.164	0.143	
710.00	23790	Mid	LTE Band 17	10	18.0	17.27	0.02	0	Right	Tilt	QPSK	25	25	05185	1:1	0.126	1.183	0.149	
710.00	23790	Mid	LTE Band 17	10	18.0	17.34	-0.06	0	Left	Cheek	QPSK	1	49	05185	1:1	0.271	1.164	0.315	
710.00	23790	Mid	LTE Band 17	10	18.0	17.27	0.01	0	Left	Cheek	QPSK	25	25	05185	1:1	0.281	1.183	0.332	A6
710.00	23790	Mid	LTE Band 17	10	18.0	17.34	0.10	0	Left	Tilt	QPSK	1	49	05185	1:1	0.215	1.164	0.250	
710.00	23790	Mid	LTE Band 17	10	18.0	17.27	-0.01	0	Left	Tilt	QPSK	25	25	05185	1:1	0.219	1.183	0.259	
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 12-7
LTE Band 5 (Cell) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.85	-0.03	0	Right	Cheek	QPSK	1	25	05185	1:1	0.189	1.035	0.196	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.67	-0.09	0	Right	Cheek	QPSK	25	25	05185	1:1	0.179	1.079	0.193	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.85	0.10	0	Right	Tilt	QPSK	1	25	05185	1:1	0.135	1.035	0.140	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.67	0.00	0	Right	Tilt	QPSK	25	25	05185	1:1	0.133	1.079	0.144	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.85	-0.12	0	Left	Cheek	QPSK	1	25	05185	1:1	0.305	1.035	0.316	A7
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.67	0.03	0	Left	Cheek	QPSK	25	25	05185	1:1	0.301	1.079	0.325	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.85	-0.03	0	Left	Tilt	QPSK	1	25	05185	1:1	0.211	1.035	0.218	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.67	0.03	0	Left	Tilt	QPSK	25	25	05185	1:1	0.209	1.079	0.226	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 12-8
LTE Band 66 (AWS) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.61	0.02	0	Right	Cheek	QPSK	1	0	05185	1:1	0.106	1.227	0.130	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.74	-0.01	0	Right	Cheek	QPSK	50	0	05185	1:1	0.109	1.191	0.130	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.61	-0.05	0	Right	Tilt	QPSK	1	0	05185	1:1	0.098	1.227	0.120	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.74	-0.01	0	Right	Tilt	QPSK	50	0	05185	1:1	0.099	1.191	0.118	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.61	-0.02	0	Left	Cheek	QPSK	1	0	05185	1:1	0.335	1.227	0.411	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.74	0.01	0	Left	Cheek	QPSK	50	0	05185	1:1	0.346	1.191	0.412	A8
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.61	-0.03	0	Left	Tilt	QPSK	1	0	05185	1:1	0.262	1.227	0.321	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.74	-0.02	0	Left	Tilt	QPSK	50	0	05185	1:1	0.276	1.191	0.329	
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 12-9
LTE Band 2 (PCS) Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.	(W/kg)														(W/kg)			
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.38	-0.02	0	Right	Cheek	QPSK	1	50	04766	1:1	0.134	1.028	0.138	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.49	-0.04	0	Right	Cheek	QPSK	50	0	04766	1:1	0.124	1.002	0.124	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.38	0.00	0	Right	Tilt	QPSK	1	50	04766	1:1	0.116	1.028	0.119	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.49	-0.02	0	Right	Tilt	QPSK	50	0	04766	1:1	0.104	1.002	0.104	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.38	0.08	0	Left	Cheek	QPSK	1	50	04766	1:1	0.504	1.028	0.518	A9
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.49	0.06	0	Left	Cheek	QPSK	50	0	04766	1:1	0.454	1.002	0.455	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.38	0.09	0	Left	Tilt	QPSK	1	50	04766	1:1	0.371	1.028	0.381	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.49	0.04	0	Left	Tilt	QPSK	50	0	04766	1:1	0.335	1.002	0.336	
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 12-10
LTE Band 7 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)		
2510.00	20850	Low	LTE Band 7	20	13.5	13.07	0.08	0	Right	Cheek	QPSK	1	50	04766	1:1	0.444	1.104	0.490	
2510.00	20850	Low	LTE Band 7	20	13.5	13.09	0.00	0	Right	Cheek	QPSK	50	25	04766	1:1	0.455	1.099	0.500	
2510.00	20850	Low	LTE Band 7	20	13.5	13.07	-0.04	0	Right	Tilt	QPSK	1	50	04766	1:1	0.353	1.104	0.390	
2510.00	20850	Low	LTE Band 7	20	13.5	13.09	0.01	0	Right	Tilt	QPSK	50	25	04766	1:1	0.358	1.099	0.393	
2510.00	20850	Low	LTE Band 7	20	13.5	13.07	0.01	0	Left	Cheek	QPSK	1	50	04766	1:1	0.501	1.104	0.553	
2510.00	20850	Low	LTE Band 7	20	13.5	13.09	0.02	0	Left	Cheek	QPSK	50	25	04766	1:1	0.517	1.099	0.568	A10
2510.00	20850	Low	LTE Band 7	20	13.5	13.07	0.03	0	Left	Tilt	QPSK	1	50	04766	1:1	0.395	1.104	0.436	
2510.00	20850	Low	LTE Band 7	20	13.5	13.09	0.03	0	Left	Tilt	QPSK	50	25	04766	1:1	0.401	1.099	0.441	
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 12-11
DTS Head SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2412	1	802.11b	DSSS	22	18.5	18.24	0.17	Right	Cheek	03073	1	99.7	0.890	0.719	1.062	1.003	0.766	
2437	6	802.11b	DSSS	22	18.5	18.36	0.00	Right	Cheek	03073	1	99.7	1.428	0.963	1.033	1.003	0.998	A11
2437	6	802.11b	DSSS	22	18.5	18.36	0.14	Right	Tilt	03073	1	99.7	0.886	0.663	1.033	1.003	0.687	
2437	6	802.11b	DSSS	22	18.5	18.36	-0.18	Left	Cheek	03073	1	99.7	0.263	0.221	1.033	1.003	0.229	
2437	6	802.11b	DSSS	22	18.5	18.36	-0.21	Left	Tilt	03073	1	99.7	0.240	-	1.033	1.003	-	
2437	6	802.11b	DSSS	22	18.5	18.36	0.03	Right	Cheek	03073	1	99.7	1.197	0.884	1.033	1.003	0.916	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram									

Note: Blue entry represents variability measurement.

Table 12-12
NII Head SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
5300	60	802.11a	OFDM	20	14.5	14.45	0.20	Right	Cheek	01598	6	99.6	1.134	0.606	1.012	1.004	0.616	A12
5300	60	802.11a	OFDM	20	14.5	14.45	0.13	Right	Tilt	01598	6	99.6	0.853	0.542	1.012	1.004	0.551	
5300	60	802.11a	OFDM	20	14.5	14.45	0.14	Left	Cheek	01598	6	99.6	0.251	-	1.012	1.004	-	
5300	60	802.11a	OFDM	20	14.5	14.45	0.15	Left	Tilt	01598	6	99.6	0.281	-	1.012	1.004	-	
5620	124	802.11a	OFDM	20	14.5	14.30	-0.15	Right	Cheek	01598	6	99.6	0.597	0.307	1.047	1.004	0.323	
5620	124	802.11a	OFDM	20	14.5	14.30	0.14	Right	Tilt	01598	6	99.6	0.472	-	1.047	1.004	-	
5620	124	802.11a	OFDM	20	14.5	14.30	0.21	Left	Cheek	01598	6	99.6	0.147	-	1.047	1.004	-	
5620	124	802.11a	OFDM	20	14.5	14.30	0.15	Left	Tilt	01598	6	99.6	0.170	-	1.047	1.004	-	
5825	165	802.11a	OFDM	20	14.5	14.14	0.15	Right	Cheek	01598	6	99.6	0.605	-	1.086	1.004	-	
5825	165	802.11a	OFDM	20	14.5	14.14	0.21	Right	Tilt	01598	6	99.6	0.665	0.322	1.086	1.004	0.351	
5825	165	802.11a	OFDM	20	14.5	14.14	0.17	Left	Cheek	01598	6	99.6	0.161	-	1.086	1.004	-	
5825	165	802.11a	OFDM	20	14.5	14.14	0.12	Left	Tilt	01598	6	99.6	0.177	-	1.086	1.004	-	
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 12-13
Bluetooth Head SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate	Duty Cycle (%)	SAR (1g)	Scaling Factor (Conducted powers)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.											(W/kg)			(W/kg)	
2480.00	78	Bluetooth	FHSS	11.0	10.91	0.01	Right	Cheek	04766	1	77.5	0.140	1.021	1.290	0.184	A13
2480.00	78	Bluetooth	FHSS	11.0	10.91	0.01	Right	Tilt	04766	1	77.5	0.096	1.021	1.290	0.126	
2480.00	78	Bluetooth	FHSS	11.0	10.91	0.15	Left	Cheek	04766	1	77.5	0.030	1.021	1.290	0.040	
2480.00	78	Bluetooth	FHSS	11.0	10.91	0.09	Left	Tilt	04766	1	77.5	0.024	1.021	1.290	0.032	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram								

12.2 Standalone Body SAR Data

Table 12-14
GSM Body SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Reported SAR (1g) (W/kg)	Plot #
MHz	Ch.											(W/kg)			
836.60	190	GSM 850	GPRS	31.5	30.91	-0.06	14 mm	05185	2	1:4.15	back	0.637	1.146	0.730	
836.60	190	GSM 850	GPRS	31.5	30.91	0.03	14 mm	05185	2	1:4.15	top	0.352	1.146	0.403	
824.20	128	GSM 850	GPRS	31.5	30.99	-0.07	1 mm	05185	2	1:4.15	right	0.977	1.125	1.099	A14
836.60	190	GSM 850	GPRS	31.5	30.91	-0.06	1 mm	05185	2	1:4.15	right	0.864	1.146	0.990	
848.80	251	GSM 850	GPRS	31.5	31.07	-0.10	1 mm	05185	2	1:4.15	right	0.766	1.104	0.846	
836.60	190	GSM 850	GPRS	31.5	30.91	0.01	0 mm	05185	2	1:4.15	left	0.225	1.146	0.258	
836.60	190	GSM 850	GPRS	28.5	27.04	-0.02	0 mm	05185	1	1:8.3	back	0.558	1.400	0.781	
836.60	190	GSM 850	GPRS	28.5	27.04	0.14	0 mm	05185	1	1:8.3	top	0.168	1.400	0.235	
836.60	190	GSM 850	GPRS	28.5	27.04	-0.03	0 mm	05185	1	1:8.3	right	0.225	1.400	0.315	
824.20	128	GSM 850	GPRS	31.5	30.99	-0.08	1 mm	05185	2	1:4.15	right	0.865	1.125	0.973	
1880.00	661	GSM 1900	GPRS	29.0	28.06	-0.07	14 mm	05185	2	1:4.15	back	0.437	1.242	0.543	
1880.00	661	GSM 1900	GPRS	29.0	28.06	-0.09	14 mm	05185	2	1:4.15	top	0.399	1.242	0.496	
1880.00	661	GSM 1900	GPRS	29.0	28.06	-0.01	1 mm	05185	2	1:4.15	right	0.344	1.242	0.427	
1880.00	661	GSM 1900	GPRS	29.0	28.06	0.17	0 mm	05185	2	1:4.15	left	0.195	1.242	0.242	
1909.80	810	GSM 1900	GPRS	22.0	21.81	-0.05	0 mm	01812	1	1:8.3	back	0.705	1.045	0.737	A15
1909.80	810	GSM 1900	GPRS	22.0	21.81	0.16	0 mm	01812	1	1:8.3	top	0.412	1.045	0.431	
1909.80	810	GSM 1900	GPRS	22.0	21.81	-0.01	0 mm	01812	1	1:8.3	right	0.060	1.045	0.063	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note: Blue entry represents variability measurement.

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Table 12-15
UMTS Body SAR Data

MEASUREMENT RESULTS														
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.										(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	24.5	23.42	0.00	14 mm	04766	1:1	back	0.476	1.282	0.610	
836.60	4183	UMTS 850	RMC	24.5	23.42	0.03	14 mm	04766	1:1	top	0.363	1.282	0.465	
826.40	4132	UMTS 850	RMC	24.5	23.43	-0.04	1 mm	04766	1:1	right	0.624	1.279	0.798	
836.60	4183	UMTS 850	RMC	24.5	23.42	0.02	1 mm	04766	1:1	right	0.747	1.282	0.958	A16
846.60	4233	UMTS 850	RMC	24.5	23.66	-0.03	1 mm	04766	1:1	right	0.734	1.213	0.890	
836.60	4183	UMTS 850	RMC	24.5	23.42	-0.05	0 mm	04766	1:1	left	0.184	1.282	0.236	
836.60	4183	UMTS 850	RMC	17.0	16.04	0.06	0 mm	04766	1:1	back	0.407	1.247	0.508	
836.60	4183	UMTS 850	RMC	17.0	16.04	0.00	0 mm	04766	1:1	top	0.149	1.247	0.186	
836.60	4183	UMTS 850	RMC	17.0	16.04	-0.02	0 mm	04766	1:1	right	0.144	1.247	0.180	
1712.40	1312	UMTS 1750	RMC	23.5	22.48	-0.05	14 mm	03883	1:1	back	0.778	1.265	0.984	
1732.40	1412	UMTS 1750	RMC	23.5	22.50	-0.01	14 mm	03883	1:1	back	0.760	1.259	0.957	
1752.60	1513	UMTS 1750	RMC	23.5	22.15	0.00	14 mm	03883	1:1	back	0.801	1.365	1.093	A17
1732.40	1412	UMTS 1750	RMC	23.5	22.50	0.01	14 mm	03883	1:1	top	0.576	1.259	0.725	
1732.40	1412	UMTS 1750	RMC	23.5	22.50	-0.03	1 mm	03883	1:1	right	0.632	1.259	0.796	
1732.40	1412	UMTS 1750	RMC	23.5	22.50	-0.03	0 mm	03883	1:1	left	0.317	1.259	0.399	
1732.40	1412	UMTS 1750	RMC	13.0	12.48	0.00	0 mm	03883	1:1	back	0.707	1.127	0.797	
1732.40	1412	UMTS 1750	RMC	13.0	12.48	0.00	0 mm	03883	1:1	top	0.360	1.127	0.406	
1732.40	1412	UMTS 1750	RMC	13.0	12.48	0.04	0 mm	03883	1:1	right	0.079	1.127	0.089	
1880.00	9400	UMTS 1900	RMC	24.0	23.00	-0.03	14 mm	05185	1:1	back	0.620	1.259	0.781	
1880.00	9400	UMTS 1900	RMC	24.0	23.00	-0.03	14 mm	05185	1:1	top	0.596	1.259	0.750	
1880.00	9400	UMTS 1900	RMC	24.0	23.00	0.01	1 mm	05185	1:1	right	0.497	1.259	0.626	
1880.00	9400	UMTS 1900	RMC	24.0	23.00	-0.11	0 mm	05185	1:1	left	0.289	1.259	0.364	
1852.40	9262	UMTS 1900	RMC	12.5	11.92	-0.08	0 mm	02836	1:1	back	0.957	1.143	1.094	A18
1880.00	9400	UMTS 1900	RMC	12.5	12.45	-0.08	0 mm	02836	1:1	back	0.851	1.012	0.861	
1907.60	9538	UMTS 1900	RMC	12.5	12.17	-0.06	0 mm	02836	1:1	back	0.666	1.079	0.719	
1880.00	9400	UMTS 1900	RMC	12.5	12.45	-0.03	0 mm	02836	1:1	top	0.561	1.012	0.568	
1880.00	9400	UMTS 1900	RMC	12.5	12.45	-0.01	0 mm	02836	1:1	right	0.063	1.012	0.064	
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 12-16
LTE Band 17 Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
710.00	23790	Mid	LTE Band 17	10	24.0	23.09	0.12	0	04766	QPSK	1	25	14 mm	back	1:1	0.273	1.233	0.337	
710.00	23790	Mid	LTE Band 17	10	23.0	21.84	0.04	1	04766	QPSK	25	12	14 mm	back	1:1	0.214	1.306	0.279	
710.00	23790	Mid	LTE Band 17	10	24.0	23.09	0.11	0	04766	QPSK	1	25	14 mm	top	1:1	0.183	1.233	0.226	
710.00	23790	Mid	LTE Band 17	10	23.0	21.84	-0.05	1	04766	QPSK	25	12	14 mm	top	1:1	0.137	1.306	0.179	
710.00	23790	Mid	LTE Band 17	10	24.0	23.09	-0.09	0	04766	QPSK	1	25	1 mm	right	1:1	0.308	1.233	0.380	
710.00	23790	Mid	LTE Band 17	10	23.0	21.84	0.08	1	04766	QPSK	25	12	1 mm	right	1:1	0.238	1.306	0.311	
710.00	23790	Mid	LTE Band 17	10	24.0	23.09	-0.05	0	04766	QPSK	1	25	0 mm	left	1:1	0.120	1.233	0.148	
710.00	23790	Mid	LTE Band 17	10	23.0	21.84	-0.01	1	04766	QPSK	25	12	0 mm	left	1:1	0.095	1.306	0.124	
710.00	23790	Mid	LTE Band 17	10	18.0	17.34	-0.03	0	04766	QPSK	1	49	0 mm	back	1:1	0.425	1.164	0.495	A19
710.00	23790	Mid	LTE Band 17	10	18.0	17.27	0.15	0	04766	QPSK	25	25	0 mm	back	1:1	0.415	1.183	0.491	
710.00	23790	Mid	LTE Band 17	10	18.0	17.34	0.01	0	04766	QPSK	1	49	0 mm	top	1:1	0.194	1.164	0.226	
710.00	23790	Mid	LTE Band 17	10	18.0	17.27	0.03	0	04766	QPSK	25	25	0 mm	top	1:1	0.190	1.183	0.225	
710.00	23790	Mid	LTE Band 17	10	18.0	17.34	-0.13	0	04766	QPSK	1	49	0 mm	right	1:1	0.132	1.164	0.154	
710.00	23790	Mid	LTE Band 17	10	18.0	17.27	0.12	0	04766	QPSK	25	25	0 mm	right	1:1	0.128	1.183	0.151	
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 12-17
LTE Band 5 (Cell) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.80	-0.04	0	05185	QPSK	1	0	14 mm	back	1:1	0.524	1.175	0.616	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.70	0.01	1	05185	QPSK	25	25	14 mm	back	1:1	0.387	1.202	0.465	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.80	-0.01	0	05185	QPSK	1	0	14 mm	top	1:1	0.359	1.175	0.422	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.70	-0.04	1	05185	QPSK	25	25	14 mm	top	1:1	0.252	1.202	0.303	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.80	-0.05	0	05185	QPSK	1	0	1 mm	right	1:1	0.631	1.175	0.741	A20
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.70	0.08	1	05185	QPSK	25	25	1 mm	right	1:1	0.435	1.202	0.523	
836.50	20525	Mid	LTE Band 5 (Cell)	10	24.5	23.80	0.01	0	05185	QPSK	1	0	0 mm	left	1:1	0.197	1.175	0.231	
836.50	20525	Mid	LTE Band 5 (Cell)	10	23.5	22.70	-0.03	1	05185	QPSK	25	25	0 mm	left	1:1	0.125	1.202	0.150	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.85	-0.16	0	05185	QPSK	1	25	0 mm	back	1:1	0.434	1.035	0.449	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.67	-0.05	0	05185	QPSK	25	25	0 mm	back	1:1	0.413	1.079	0.446	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.85	-0.05	0	05185	QPSK	1	25	0 mm	top	1:1	0.152	1.035	0.157	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.67	0.14	0	05185	QPSK	25	25	0 mm	top	1:1	0.145	1.079	0.156	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.85	-0.12	0	05185	QPSK	1	25	0 mm	right	1:1	0.158	1.035	0.164	
836.50	20525	Mid	LTE Band 5 (Cell)	10	17.0	16.67	-0.01	0	05185	QPSK	25	25	0 mm	right	1:1	0.149	1.079	0.161	
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 12-18
LTE Band 66 (AWS) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1720.00	132072	Low	LTE Band 66 (AWS)	20	24.0	22.95	-0.14	0	04766	QPSK	1	99	14 mm	back	1:1	0.696	1.274	0.887	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	24.0	22.85	-0.18	0	04766	QPSK	1	0	14 mm	back	1:1	0.748	1.303	0.975	
1770.00	132572	High	LTE Band 66 (AWS)	20	24.0	23.34	0.00	0	04766	QPSK	1	50	14 mm	back	1:1	0.741	1.164	0.863	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	23.0	22.13	0.01	1	04766	QPSK	50	0	14 mm	back	1:1	0.530	1.222	0.648	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	23.0	22.11	0.03	1	04766	QPSK	100	0	14 mm	back	1:1	0.580	1.227	0.712	
1770.00	132572	High	LTE Band 66 (AWS)	20	24.0	23.34	-0.01	0	04766	QPSK	1	50	14 mm	top	1:1	0.621	1.164	0.723	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	23.0	22.13	0.01	1	04766	QPSK	50	0	14 mm	top	1:1	0.454	1.222	0.555	
1770.00	132572	High	LTE Band 66 (AWS)	20	24.0	23.34	-0.09	0	04766	QPSK	1	50	1 mm	right	1:1	0.524	1.164	0.610	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	23.0	22.13	0.03	1	04766	QPSK	50	0	1 mm	right	1:1	0.400	1.222	0.489	
1770.00	132572	High	LTE Band 66 (AWS)	20	24.0	23.34	-0.02	0	04766	QPSK	1	50	0 mm	left	1:1	0.291	1.164	0.339	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	23.0	22.13	-0.01	1	04766	QPSK	50	0	0 mm	left	1:1	0.225	1.222	0.275	
1720.00	132072	Low	LTE Band 66 (AWS)	20	13.5	12.48	-0.02	0	04766	QPSK	1	50	0 mm	back	1:1	0.783	1.265	0.990	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.61	0.01	0	04766	QPSK	1	0	0 mm	back	1:1	0.682	1.227	0.837	
1770.00	132572	High	LTE Band 66 (AWS)	20	13.5	12.60	0.02	0	04766	QPSK	1	50	0 mm	back	1:1	0.887	1.230	1.091	A21
1720.00	132072	Low	LTE Band 66 (AWS)	20	13.5	12.27	-0.03	0	04766	QPSK	50	50	0 mm	back	1:1	0.706	1.327	0.937	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.74	-0.01	0	04766	QPSK	50	0	0 mm	back	1:1	0.719	1.191	0.856	
1770.00	132572	High	LTE Band 66 (AWS)	20	13.5	12.44	0.00	0	04766	QPSK	50	50	0 mm	back	1:1	0.811	1.276	1.035	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.33	0.00	0	04766	QPSK	100	0	0 mm	back	1:1	0.716	1.309	0.937	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.61	-0.02	0	04766	QPSK	1	0	0 mm	top	1:1	0.385	1.227	0.472	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.74	0.00	0	04766	QPSK	50	0	0 mm	top	1:1	0.428	1.191	0.510	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.61	0.04	0	04766	QPSK	1	0	0 mm	right	1:1	0.066	1.227	0.081	
1745.00	132322	Mid	LTE Band 66 (AWS)	20	13.5	12.74	0.09	0	04766	QPSK	50	0	0 mm	right	1:1	0.061	1.191	0.073	
1770.00	132572	High	LTE Band 66 (AWS)	20	13.5	12.60	-0.01	0	04766	QPSK	1	50	0 mm	back	1:1	0.811	1.230	0.998	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Note: Blue entry represents variability measurement.

Table 12-19
LTE Band 2 (PCS) Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.67	0.04	0	05185	QPSK	1	0	14 mm	back	1:1	0.682	1.079	0.736	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.54	0.01	1	05185	QPSK	50	0	14 mm	back	1:1	0.555	1.112	0.617	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.67	-0.03	0	05185	QPSK	1	0	14 mm	top	1:1	0.616	1.079	0.665	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.54	-0.02	1	05185	QPSK	50	0	14 mm	top	1:1	0.480	1.112	0.534	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.67	0.16	0	05185	QPSK	1	0	1 mm	right	1:1	0.620	1.079	0.669	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.54	0.00	1	05185	QPSK	50	0	1 mm	right	1:1	0.516	1.112	0.574	
1900.00	19100	High	LTE Band 2 (PCS)	20	24.0	23.67	0.01	0	05185	QPSK	1	0	0 mm	left	1:1	0.303	1.079	0.327	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.0	22.54	-0.05	1	05185	QPSK	50	0	0 mm	left	1:1	0.235	1.112	0.261	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.38	0.07	0	05185	QPSK	1	50	0 mm	back	1:1	1.060	1.028	1.090	A22
1880.00	18900	Mid	LTE Band 2 (PCS)	20	12.5	11.72	-0.10	0	05185	QPSK	1	50	0 mm	back	1:1	0.578	1.197	0.692	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.00	-0.09	0	05185	QPSK	1	50	0 mm	back	1:1	0.968	1.122	1.086	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.49	-0.13	0	05185	QPSK	50	0	0 mm	back	1:1	0.989	1.002	0.991	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	12.5	11.93	-0.08	0	05185	QPSK	50	25	0 mm	back	1:1	0.586	1.140	0.668	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	11.94	-0.11	0	05185	QPSK	50	0	0 mm	back	1:1	0.948	1.138	1.079	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.35	-0.10	0	05185	QPSK	100	0	0 mm	back	1:1	0.926	1.035	0.958	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.38	-0.11	0	05185	QPSK	1	50	0 mm	top	1:1	0.401	1.028	0.412	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.49	-0.13	0	05185	QPSK	50	0	0 mm	top	1:1	0.408	1.002	0.409	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.38	-0.21	0	05185	QPSK	1	50	0 mm	right	1:1	0.084	1.028	0.086	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.49	0.14	0	05185	QPSK	50	0	0 mm	right	1:1	0.069	1.002	0.069	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.38	-0.11	0	05185	QPSK	1	50	0 mm	back	1:1	1.040	1.028	1.069	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body											
Spatial Peak								1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population								averaged over 1 gram											

Note: Blue entry represents variability measurement.

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Table 12-20
LTE Band 7 Body SAR

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
2510.00	20850	Low	LTE Band 7	20	24.8	24.64	-0.01	0	04766	QPSK	1	99	14 mm	back	1:1	0.415	1.038	0.431	
2510.00	20850	Low	LTE Band 7	20	23.8	23.48	-0.15	1	04766	QPSK	50	0	14 mm	back	1:1	0.351	1.076	0.378	
2510.00	20850	Low	LTE Band 7	20	24.8	24.64	-0.03	0	04766	QPSK	1	99	14 mm	top	1:1	0.475	1.038	0.493	
2510.00	20850	Low	LTE Band 7	20	23.8	23.48	-0.03	1	04766	QPSK	50	0	14 mm	top	1:1	0.393	1.076	0.423	
2510.00	20850	Low	LTE Band 7	20	24.8	24.64	-0.01	0	04766	QPSK	1	99	1 mm	right	1:1	0.592	1.038	0.614	
2510.00	20850	Low	LTE Band 7	20	23.8	23.48	-0.05	1	04766	QPSK	50	0	1 mm	right	1:1	0.464	1.076	0.499	
2510.00	20850	Low	LTE Band 7	20	24.8	24.64	-0.01	0	04766	QPSK	1	99	0 mm	left	1:1	0.248	1.038	0.257	
2510.00	20850	Low	LTE Band 7	20	23.8	23.48	-0.13	1	04766	QPSK	50	0	0 mm	left	1:1	0.211	1.076	0.227	
2510.00	20850	Low	LTE Band 7	20	13.5	13.07	-0.18	0	01812	QPSK	1	50	0 mm	back	1:1	0.739	1.104	0.816	A23
2535.00	21100	Mid	LTE Band 7	20	13.5	12.54	-0.20	0	01812	QPSK	1	0	0 mm	back	1:1	0.703	1.247	0.877	
2560.00	21350	High	LTE Band 7	20	13.5	12.70	-0.14	0	01812	QPSK	1	99	0 mm	back	1:1	0.664	1.202	0.798	
2510.00	20850	Low	LTE Band 7	20	13.5	13.09	-0.19	0	01812	QPSK	50	25	0 mm	back	1:1	0.725	1.099	0.797	
2510.00	20850	Low	LTE Band 7	20	13.5	12.88	-0.17	0	01812	QPSK	100	0	0 mm	back	1:1	0.714	1.153	0.823	
2510.00	20850	Low	LTE Band 7	20	13.5	13.07	0.00	0	01812	QPSK	1	50	0 mm	top	1:1	0.254	1.104	0.280	
2510.00	20850	Low	LTE Band 7	20	13.5	13.09	-0.04	0	01812	QPSK	50	25	0 mm	top	1:1	0.249	1.099	0.274	
2510.00	20850	Low	LTE Band 7	20	13.5	13.07	0.20	0	01812	QPSK	1	50	0 mm	right	1:1	0.057	1.104	0.063	
2510.00	20850	Low	LTE Band 7	20	13.5	13.09	0.04	0	01812	QPSK	50	25	0 mm	right	1:1	0.054	1.099	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											

Table 12-21
2.4GHz WLAN Body SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
2437	6	802.11b	DSSS	22	18.5	18.36	0.00	11 mm	03255	1	back	99.7	0.419	0.268	1.033	1.003	0.278	
2437	6	802.11b	DSSS	22	18.5	18.36	-0.01	9 mm	03255	1	top	99.7	0.239	0.153	1.033	1.003	0.159	
2437	6	802.11b	DSSS	22	18.5	18.36	-0.13	3 mm	03255	1	left	99.7	0.524	0.282	1.033	1.003	0.292	A24
2462	11	802.11b	DSSS	22	13.5	13.17	-0.12	0 mm	03255	1	back	99.7	0.453	0.266	1.079	1.003	0.288	
2462	11	802.11b	DSSS	22	13.5	13.17	-0.01	0 mm	03255	1	top	99.7	0.147	0.079	1.079	1.003	0.085	
2462	11	802.11b	DSSS	22	13.5	13.17	0.15	0 mm	03255	1	left	99.7	0.094	0.054	1.079	1.003	0.058	
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 12-22
5GHz WLAN Body SAR

MEASUREMENT RESULTS																		
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												W/kg	(W/kg)			(W/kg)	
5300	60	802.11a	OFDM	20	14.5	14.45	-0.08	11 mm	03255	6	back	99.6	0.383	0.155	1.012	1.004	0.157	
5300	60	802.11a	OFDM	20	14.5	14.45	-0.17	9 mm	03255	6	top	99.6	0.708	0.310	1.012	1.004	0.315	
5300	60	802.11a	OFDM	20	14.5	14.45	0.03	3 mm	03255	6	left	99.6	0.432	0.196	1.012	1.004	0.199	
5270	54	802.11n	OFDM	40	10.5	9.76	-0.16	0 mm	03255	13.5	back	98.3	1.115	0.708	1.186	1.017	0.854	
5310	62	802.11n	OFDM	40	10.5	10.49	0.21	0 mm	03255	13.5	back	98.3	1.957	0.922	1.002	1.017	0.940	A25
5310	62	802.11n	OFDM	40	10.5	10.49	-0.03	0 mm	03255	13.5	top	98.3	1.442	0.566	1.002	1.017	0.577	
5310	62	802.11n	OFDM	40	10.5	10.49	0.19	0 mm	03255	13.5	left	98.3	0.352	0.147	1.002	1.017	0.150	
5620	124	802.11a	OFDM	20	14.5	14.30	0.13	11 mm	03255	6	back	99.6	0.189	0.067	1.047	1.004	0.070	
5620	124	802.11a	OFDM	20	14.5	14.30	0.11	9 mm	03255	6	top	99.6	0.377	0.143	1.047	1.004	0.150	
5620	124	802.11a	OFDM	20	14.5	14.30	0.13	3 mm	03255	6	left	99.6	0.273	0.100	1.047	1.004	0.105	
5510	102	802.11n	OFDM	40	10.5	10.28	0.17	0 mm	03255	13.5	back	98.3	1.192	0.595	1.052	1.017	0.637	
5510	102	802.11n	OFDM	40	10.5	10.28	0.18	0 mm	03255	13.5	top	98.3	0.978	0.471	1.052	1.017	0.504	
5510	102	802.11n	OFDM	40	10.5	10.28	0.21	0 mm	03255	13.5	left	98.3	0.180	0.068	1.052	1.017	0.073	
5825	165	802.11a	OFDM	20	14.5	14.14	0.01	11 mm	03255	6	back	99.6	0.166	0.067	1.086	1.004	0.073	
5825	165	802.11a	OFDM	20	14.5	14.14	0.04	9 mm	03255	6	top	99.6	0.395	0.171	1.086	1.004	0.186	
5825	165	802.11a	OFDM	20	14.5	14.14	0.21	3 mm	03255	6	left	99.6	0.195	0.067	1.086	1.004	0.073	
5755	151	802.11n	OFDM	40	10.5	9.96	0.20	0 mm	03255	13.5	back	98.3	1.284	0.559	1.132	1.017	0.644	
5755	151	802.11n	OFDM	40	10.5	9.96	0.16	0 mm	03255	13.5	top	98.3	0.821	0.422	1.132	1.017	0.486	
5755	151	802.11n	OFDM	40	10.5	9.96	0.17	0 mm	03255	13.5	left	98.3	0.217	0.078	1.132	1.017	0.090	
5310	62	802.11n	OFDM	40	10.5	10.49	0.14	0 mm	03255	13.5	back	98.3	2.430	0.918	1.002	1.017	0.935	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT								Body										
Spatial Peak								1.6 W/kg (mW/g)										
Uncontrolled Exposure/General Population								averaged over 1 gram										

Note: Blue entry represents variability measurement.

Table 12-23
Bluetooth Body 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)	
2480	78	Bluetooth	FHSS	11.0	10.91	-0.01	0 mm	03255	77.5	back	1:1	0.320	1.021	1.290	0.421	A26
2480	78	Bluetooth	FHSS	11.0	10.91	0.00	0 mm	03255	77.5	top	1:1	0.106	1.021	1.290	0.140	
2480	78	Bluetooth	FHSS	11.0	10.91	-0.18	0 mm	03255	77.5	left	1:1	0.087	1.021	1.290	0.115	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT							Body									
Spatial Peak							1.6 W/kg (mW/g)									
Uncontrolled Exposure/General Population							averaged over 1 gram									

12.3 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, FCC KDB Publication 616217 D04v01r02, 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.

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5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. 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 14 for variability analysis.
7. FCC KDB Publication 616217 D04v01r02 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v06 was applied to determine SAR test exclusion for adjacent edge configurations.
8. Head SAR testing was required for this tablet because it has a speaker/receiver and microphone positioning that allows for a held-to-ear configuration usage. Head SAR tests were performed at reduced power levels for all licensed modes.

GSM Test Notes:

1. 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.
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.

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 9.5.4.
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).

WLAN Notes:

1. For held-to-ear 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

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the maximum allowed powers and the highest reported DSSS SAR. See Section 9.6.5 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 9.6.6 for more information.
4. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.

Bluetooth Note:

1. Bluetooth SAR was measured with the device connected to a call box with hopping disabled with DH5 operation and Tx Tests test mode type. Per October 2016 TCB Workshop Notes, the reported SAR was scaled to the 100% transmission duty factor to determine compliance. See Section 10.5 for the time-domain plot and calculation for the duty factor of the device.

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13 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

13.1 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.

13.2 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.

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

13.3 Head SAR Simultaneous Transmission Analysis

Table 13-1
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.677	0.998	See Table Below
	GSM 1900	0.530	0.998	1.528
	UMTS 850	0.377	0.998	1.375
	UMTS 1750	0.481	0.998	1.479
	UMTS 1900	0.508	0.998	1.506
	LTE Band 17	0.332	0.998	1.330
	LTE Band 5 (Cell)	0.325	0.998	1.323
	LTE Band 66 (AWS)	0.412	0.998	1.410
	LTE Band 2 (PCS)	0.518	0.998	1.516
	LTE Band 7	0.568	0.998	1.566
Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.449	0.998	1.447
	Right Tilt	0.334	0.687	1.021
	Left Cheek	0.677	0.229	0.906
	Left Tilt	0.469	0.998*	1.467

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Table 13-2
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	GSM 850	0.677	0.616	1.293
	GSM 1900	0.530	0.616	1.146
	UMTS 850	0.377	0.616	0.993
	UMTS 1750	0.481	0.616	1.097
	UMTS 1900	0.508	0.616	1.124
	LTE Band 17	0.332	0.616	0.948
	LTE Band 5 (Cell)	0.325	0.616	0.941
	LTE Band 66 (AWS)	0.412	0.616	1.028
	LTE Band 2 (PCS)	0.518	0.616	1.134
	LTE Band 7	0.568	0.616	1.184

Table 13-3
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)
Head SAR	GSM 850	0.677	0.184	0.861
	GSM 1900	0.530	0.184	0.714
	UMTS 850	0.377	0.184	0.561
	UMTS 1750	0.481	0.184	0.665
	UMTS 1900	0.508	0.184	0.692
	LTE Band 17	0.332	0.184	0.516
	LTE Band 5 (Cell)	0.325	0.184	0.509
	LTE Band 66 (AWS)	0.412	0.184	0.596
	LTE Band 2 (PCS)	0.518	0.184	0.702
	LTE Band 7	0.568	0.184	0.752

13.4 Body SAR Simultaneous Transmission Analysis

Table 13-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN Body SAR

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	GPRS 850	1.099	0.400	1.499
	GPRS 1900	0.737	0.400	1.137
	UMTS 850	0.958	0.400	1.358
	UMTS 1750	1.093	0.400	1.493
	UMTS 1900	1.094	0.400	1.494
	LTE Band 17	0.495	0.400	0.895
	LTE Band 5 (Cell)	0.741	0.400	1.141
	LTE Band 66 (AWS)	1.091	0.400	1.491
	LTE Band 2 (PCS)	1.090	0.400	1.490
	LTE Band 7	0.877	0.400	1.277

Since all reported SAR for 2.4 GHz WIFI was less than 0.4 W/kg on required test positions an estimated SAR of 0.4 W/kg (representing edges where the antenna separation distance was > 50 mm) was used to determine the simultaneous transmission SAR exclusion.

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Table 13-5
Simultaneous Transmission Scenario with 5 GHz WLAN Body SAR

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.781	0.940	See Note 1	0.02
	Top	0.403	0.577	0.980	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	1.099	0.400	1.499	N/A
	Left	0.258	0.199	0.457	N/A
Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.610	0.940	1.550	
	Top	0.465	0.577	1.042	
	Bottom	0.400	0.400	0.800	
	Right	0.958	0.400	1.358	
	Left	0.236	0.199	0.435	
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.094	0.940	See Note 1	0.03
	Top	0.750	0.577	1.327	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.626	0.400	1.026	N/A
	Left	0.364	0.199	0.563	N/A
Simult Tx	Configuration	LTE Band 5 (Cell) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.616	0.940	1.556	
	Top	0.422	0.577	0.999	
	Bottom	0.400	0.400	0.800	
	Right	0.741	0.400	1.141	
	Left	0.231	0.199	0.430	
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.090	0.940	See Note 1	0.03
	Top	0.665	0.577	1.242	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.669	0.400	1.069	N/A
	Left	0.327	0.199	0.526	N/A

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.737	0.940	See Note 1	0.03
	Top	0.496	0.577	1.073	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.427	0.400	0.827	N/A
	Left	0.242	0.199	0.441	N/A
Simult Tx	Configuration	UMTS 1750 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.093	0.940	See Note 1	0.03
	Top	0.725	0.577	1.302	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.796	0.400	1.196	N/A
	Left	0.399	0.199	0.598	N/A
Simult Tx	Configuration	LTE Band 17 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.495	0.940	1.435	
	Top	0.226	0.577	0.803	
	Bottom	0.400	0.400	0.800	
	Right	0.380	0.400	0.780	
	Left	0.148	0.199	0.347	
Simult Tx	Configuration	LTE Band 66 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.091	0.940	See Note 1	0.03
	Top	0.723	0.577	1.300	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.610	0.400	1.010	N/A
	Left	0.339	0.199	0.538	N/A
Simult Tx	Configuration	LTE Band 7 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.877	0.940	See Note 1	0.04
	Top	0.493	0.577	1.070	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.614	0.400	1.014	N/A
	Left	0.257	0.199	0.456	N/A

Table 13-6
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth Body SAR

Exposure Condition	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Body SAR	GPRS 850	1.099	0.421	1.520
	GPRS 1900	0.737	0.421	1.158
	UMTS 850	0.958	0.421	1.379
	UMTS 1750	1.093	0.421	1.514
	UMTS 1900	1.094	0.421	1.515
	LTE Band 17	0.495	0.421	0.916
	LTE Band 5 (Cell)	0.741	0.421	1.162
	LTE Band 66 (AWS)	1.091	0.421	1.512
	LTE Band 2 (PCS)	1.090	0.421	1.511
	LTE Band 7	0.877	0.421	1.298

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Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not greater than 0.04 per FCC KDB 447498 D01v05. See Section 13.5 for detailed SPLS ratio analysis.
2. For SAR summation the highest reported SAR across all test distances was used as the most conservative evaluation for simultaneous transmission analysis for each device edge.
3. When the antenna separation distance was > 50 mm, an estimated SAR of 0.4 W/kg was used to determine the simultaneous transmission SAR exclusion, for configurations excluded per FCC KDB Publication 447498 D01v06.

13.5 SPLSR Evaluation and Analysis

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

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

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

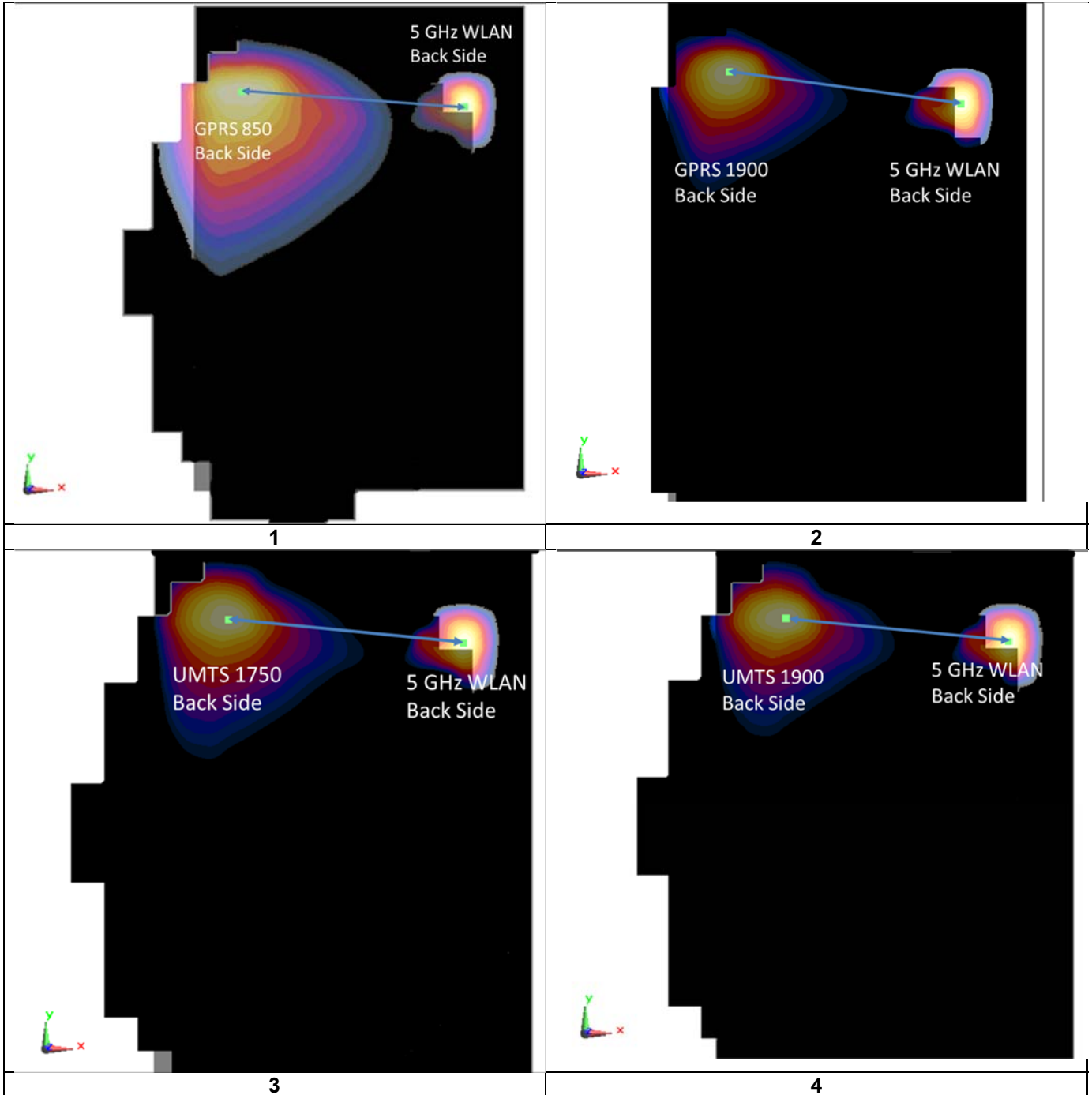
Table 13-7
Peak SAR Locations for Body Back Side

Mode/Band	x (mm)	y (mm)	Reported SAR (W/kg)
5 GHz WLAN	39.00	86.00	0.940
GPRS 850	-56.00	93.00	0.781
GPRS 1900	-55.80	103.20	0.737
UMTS 1750	-60.50	109.50	1.093
UMTS 1900	-53.00	104.50	1.094
LTE Band 66	-53.00	98.50	1.091
LTE Band 2	-54.00	102.00	1.090
LTE Band 7	-24.20	93.60	0.976

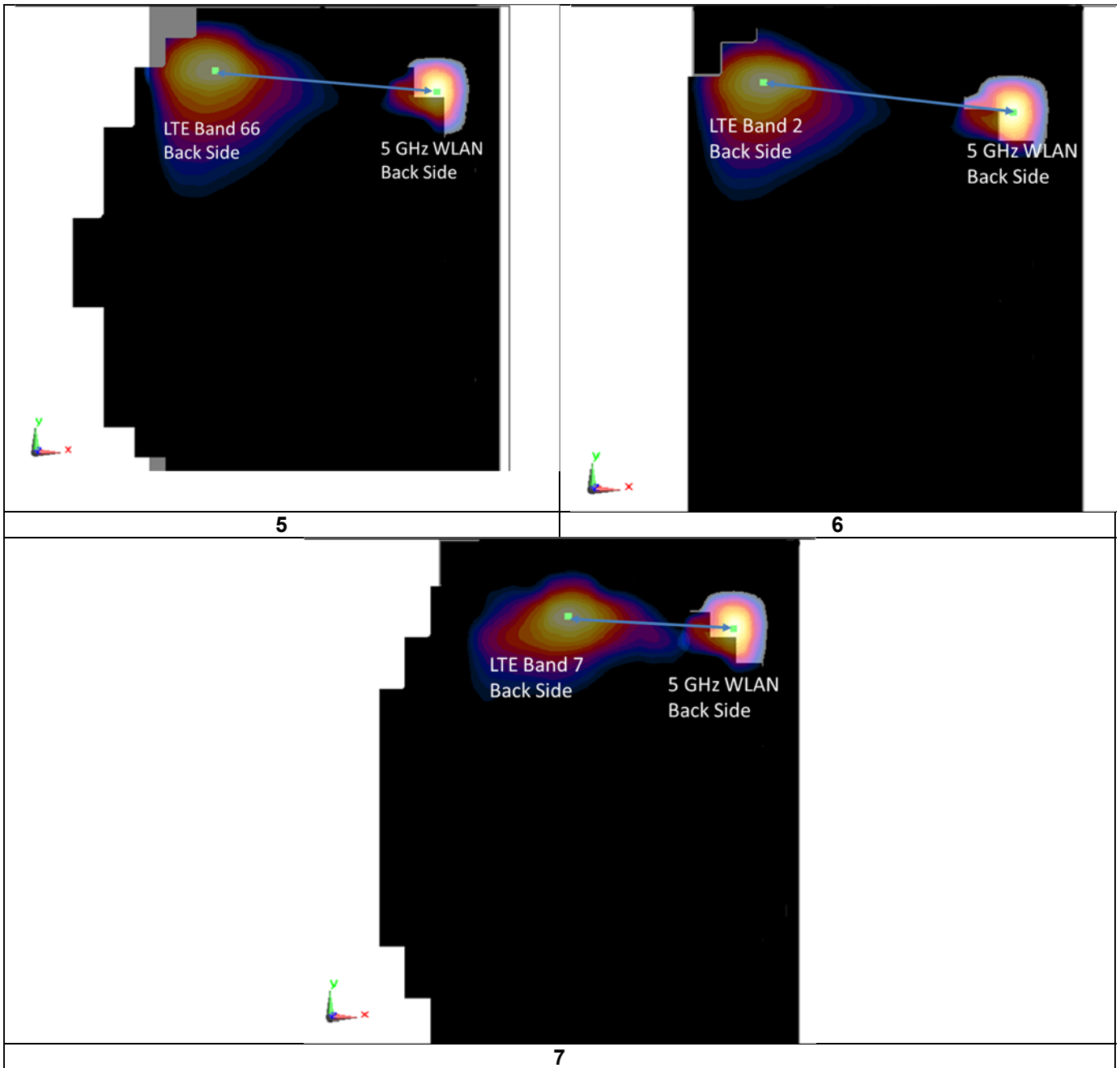
Table 13-8
SAR Sum to Peak Location Separation Ratio Calculations

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio	Plot Number
Ant "a"	Ant "b"	a	b	a+b	D _{a-b}	(a+b) ^{1.5} /D _{a-b}	
5 GHz WLAN	GPRS 850	0.940	0.781	1.721	95.26	0.02	1
5 GHz WLAN	GPRS 1900	0.940	0.737	1.677	96.35	0.02	2
5 GHz WLAN	UMTS 1750	0.940	1.093	2.033	102.24	0.03	3
5 GHz WLAN	UMTS 1900	0.940	1.094	2.034	93.84	0.03	4
5 GHz WLAN	LTE Band 66	0.940	1.091	2.031	92.85	0.03	5
5 GHz WLAN	LTE Band 2	0.940	1.09	2.030	94.37	0.03	6
5 GHz WLAN	LTE Band 7	0.940	0.976	1.916	63.66	0.04	7

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13.6 Simultaneous Transmission Conclusion

The above numerical summed SAR results and SPLSR analysis are 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.

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14 SAR MEASUREMENT VARIABILITY

14.1 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

Table 14-1
Head SAR Measurement Variability Results

HEAD VARIABILITY RESULTS													
Band	FREQUENCY		Mode/Band	Service	Side	Test Position	Data Rate (Mbps)	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)
	MHz	Ch.						(W/kg)	(W/kg)		(W/kg)		(W/kg)
2450	2437.00	6	802.11b, 22 MHz Bandwidth	DSSS	Right	Cheek	1	0.963	0.884	1.09	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Head 1.6 W/kg (mW/g) averaged over 1 gram					

Table 14-2
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS															
Band	FREQUENCY		Mode	Service	# of Time Slots	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.							(W/kg)	(W/kg)		(W/kg)		(W/kg)	
835	824.20	128	GSM 850	GPRS	2	N/A	right	1 mm	0.977	0.865	1.13	N/A	N/A	N/A	N/A
1750	1770.00	132572	LTE Band 66 (AWS), 20 MHz Bandwidth	QPSK, 1 RB, 50 RB Offset	N/A	N/A	back	0 mm	0.887	0.811	1.09	N/A	N/A	N/A	N/A
1900	1860.00	18700	LTE Band 2 (PCS), 20 MHz Bandwidth	QPSK, 1 RB, 50 RB Offset	N/A	N/A	back	0 mm	1.060	1.040	1.02	N/A	N/A	N/A	N/A
5250	5310.00	62	802.11n, 40 MHz Bandwidth	OFDM	N/A	13.5	back	0 mm	0.922	0.918	1.00	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram						

14.2 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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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	8753ES	S-Parameter Vector Network Analyzer	8/19/2016	Annual	8/19/2017	MY40003841
Agilent	8753ES	S-Parameter Network Analyzer	10/26/2016	Annual	10/26/2017	US39170118
Agilent	E4432B	ESG-D Series Signal Generator	3/24/2017	Annual	3/24/2018	US40053896
Agilent	E4438C	ESG Vector Signal Generator	3/24/2017	Biennial	3/24/2019	MY42082385
Agilent	E5515C	8960 Series 10 Wireless Communications Test Set	10/5/2016	Annual	10/5/2017	GB42230325
Agilent	E5515C	Wireless Communications Test Set	5/31/2017	Annual	5/31/2018	GB43304278
Agilent	E5515C	Wireless Communications Test Set	12/12/2016	Annual	12/12/2017	GB44400860
Agilent	E8257D	(250kHz-20GHz) Signal Generator	3/22/2017	Annual	3/22/2018	MY45470194
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB44450273
Agilent	N5182A	MKG Vector Signal Generator	10/27/2016	Annual	10/27/2017	MY47420603
Agilent	N5182A	MKG Vector Signal Generator	2/28/2017	Annual	2/28/2018	MY47420800
Agilent	N9020A	MKA Signal Analyzer	10/28/2016	Annual	10/28/2017	US46470561
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433971
Anritsu	MA24106A	USB Power Sensor	6/7/2017	Annual	6/7/2018	1231535
Anritsu	MA24106A	USB Power Sensor	6/7/2017	Annual	6/7/2018	1231538
Anritsu	MA24106A	USB Power Sensor	6/7/2017	Annual	6/7/2018	1244512
Anritsu	MA24106A	USB Power Sensor	6/7/2017	Annual	6/7/2018	1244515
Anritsu	MA2411B	Pulse Power Sensor	8/18/2016	Annual	8/18/2017	1126066
Anritsu	MA2411B	Pulse Power Sensor	2/10/2017	Annual	2/10/2018	1207364
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	4/20/2017	Annual	4/20/2018	1306009
Anritsu	MT8820C	Radio Communication Analyzer	9/15/2016	Annual	9/15/2017	6200901190
Anritsu	MT8820C	Radio Communication Analyzer	11/4/2016	Annual	11/4/2017	6201144418
COMTECH	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M155A00-009
COMTECH	AR85729-5/5798	Solid State Amplifier	CBT	N/A	CBT	M9W1A00-1002
Control Company	4040	Therm./Clock/Humidity Monitor	3/31/2017	Biennial	3/31/2019	17023294
Control Company	4352	Ultra Long Stem Thermometer	3/8/2016	Biennial	3/8/2018	160261694
Control Company	4352	Ultra Long Stem Thermometer	3/8/2016	Biennial	3/8/2018	160261729
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	6/1/2017	Annual	6/1/2018	MY53401181
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R897950903
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 18GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700MHz	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
Narda	BW-53W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	NC-100	Torque Wrench	3/8/2017	Annual	3/8/2018	N/A
Pasternack	NC-100	Torque Wrench	3/8/2017	Annual	3/8/2018	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	CMU200	Base Station Simulator	12/12/2016	Annual	12/12/2017	838855/0010
Rohde & Schwarz	CMU200	Base Station Simulator	4/11/2017	Annual	4/11/2018	836371/0079
Rohde & Schwarz	CMW500	Radio Communication Tester	10/20/2016	Annual	10/20/2017	100976
Rohde & Schwarz	CMW500	Radio Communication Tester	5/4/2017	Annual	5/4/2018	101699
Seekonk	NC-100	Torque Wrench (8" lb)	9/1/2016	Biennial	9/1/2018	21053
Seekonk	NC-100	Torque Wrench (8" lb)	8/30/2016	Biennial	8/30/2018	N/A
SPEAG	D1750V2	1750 MHz SAR Dipole	5/9/2017	Annual	5/9/2018	1092
SPEAG	D1750V2	1750 MHz SAR Dipole	7/14/2016	Annual	7/14/2017	1150
SPEAG	D1900V2	1900 MHz SAR Dipole	5/10/2017	Annual	5/10/2018	5d026
SPEAG	D1900V2	1900 MHz SAR Dipole	7/8/2016	Annual	7/8/2017	5d080
SPEAG	D1900V2	1900 MHz SAR Dipole	2/9/2017	Annual	2/9/2018	5d148
SPEAG	D2450V2	2450 MHz SAR Dipole	9/13/2016	Annual	9/13/2017	797
SPEAG	D2450V2	2450 MHz SAR Dipole	5/9/2017	Annual	5/9/2018	945
SPEAG	D2600V2	2600 MHz SAR Dipole	4/13/2017	Annual	4/13/2018	1004
SPEAG	D2600V2	2600 MHz SAR Dipole	9/13/2016	Annual	9/13/2017	1071
SPEAG	D5GHzV2	5 GHz SAR Dipole	3/9/2017	Annual	3/9/2018	1123
SPEAG	D5GHzV2	5 GHz SAR Dipole	8/2/2016	Annual	8/2/2017	1237
SPEAG	D750V3	750 MHz SAR Dipole	1/11/2017	Annual	1/11/2018	1003
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	4d047
SPEAG	D835V2	850 MHz SAR Dipole	5/11/2017	Annual	5/11/2018	4d180
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/9/2017	Annual	2/9/2018	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/9/2017	Annual	2/9/2018	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/8/2017	Annual	3/8/2018	1368
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/11/2017	Annual	4/11/2018	1407
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/13/2017	Annual	3/13/2018	1415
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/16/2017	Annual	1/16/2018	1466
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/10/2017	Annual	5/10/2018	1070
SPEAG	DAK-3.5	Dielectric Assessment Kit	9/13/2016	Annual	9/13/2017	1091
SPEAG	ES3DV3	SAR Probe	3/14/2017	Annual	3/14/2018	3209
SPEAG	ES3DV3	SAR Probe	2/10/2017	Annual	2/10/2018	3213
SPEAG	ES3DV3	SAR Probe	2/10/2017	Annual	2/10/2018	3318
SPEAG	ES3DV3	SAR Probe	3/14/2017	Annual	3/14/2018	3319
SPEAG	EX3DV4	SAR Probe	1/13/2017	Annual	1/13/2018	3589
SPEAG	EX3DV4	SAR Probe	2/13/2017	Annual	2/13/2018	3914
SPEAG	EX3DV4	SAR Probe	4/18/2017	Annual	4/18/2018	7406

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. All Equipment was used solely within its calibration period.

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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: A3LSMT385M; Type: Portable Tablet; Serial: 05185

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

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.6$ MHz; $\sigma = 0.899$ S/m; $\epsilon_r = 40.332$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 07-11-2017; Ambient Temp: 21.0°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3209; ConvF(6.36, 6.36, 6.36); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

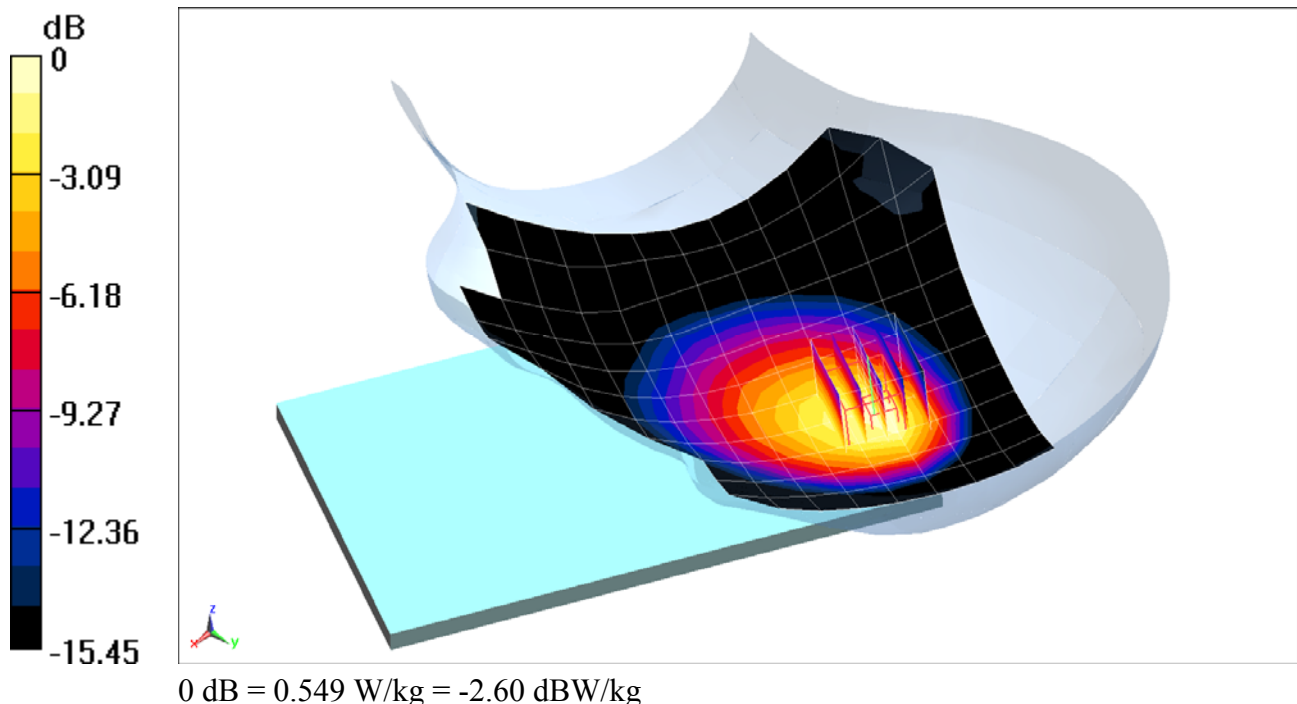
Area Scan (12x18x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 24.02 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.876 W/kg

SAR(1 g) = 0.474 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 04766

Communication System: UID 0, GSM; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium: 1900 Head Medium parameters used:

$f = 1910 \text{ MHz}$; $\sigma = 1.464 \text{ S/m}$; $\epsilon_r = 40.271$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 07-03-2017; Ambient Temp: 21.0°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3209; ConvF(5.31, 5.31, 5.31); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

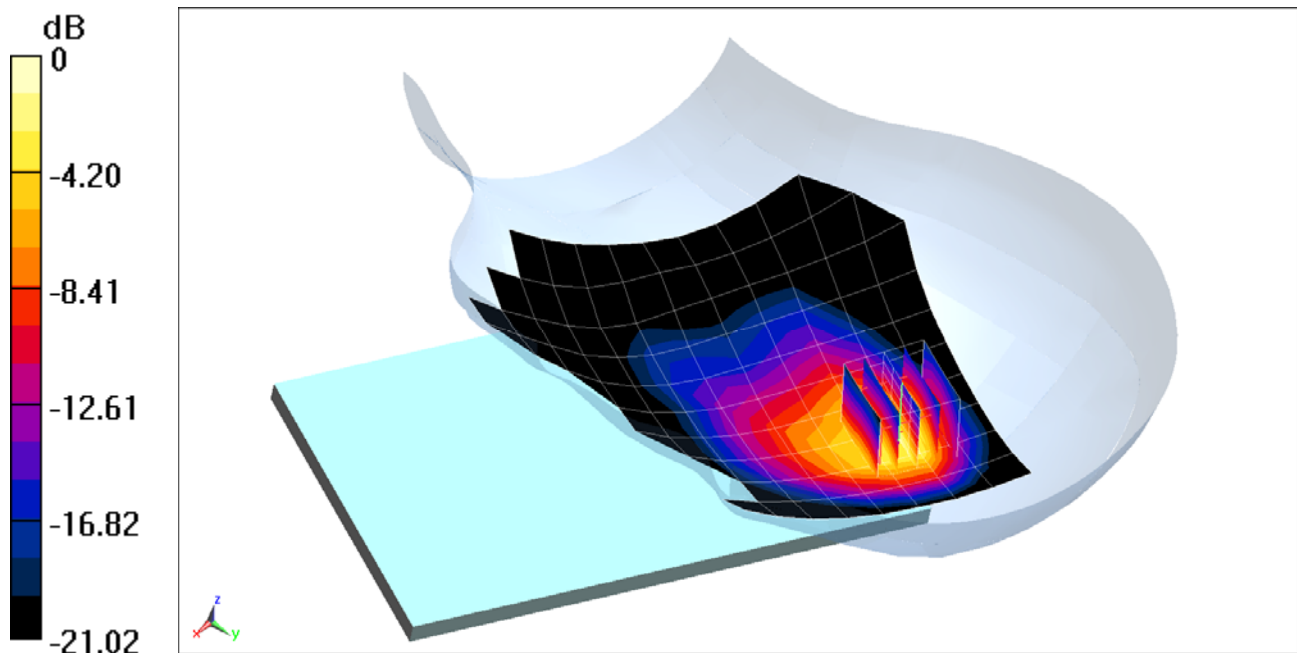
Area Scan (11x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 20.45 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.979 W/kg

SAR(1 g) = 0.509 W/kg



0 dB = 0.669 W/kg = -1.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 05185

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

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.6 \text{ MHz}$; $\sigma = 0.899 \text{ S/m}$; $\epsilon_r = 40.332$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 07-11-2017; Ambient Temp: 21.0°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3209; ConvF(6.36, 6.36, 6.36); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

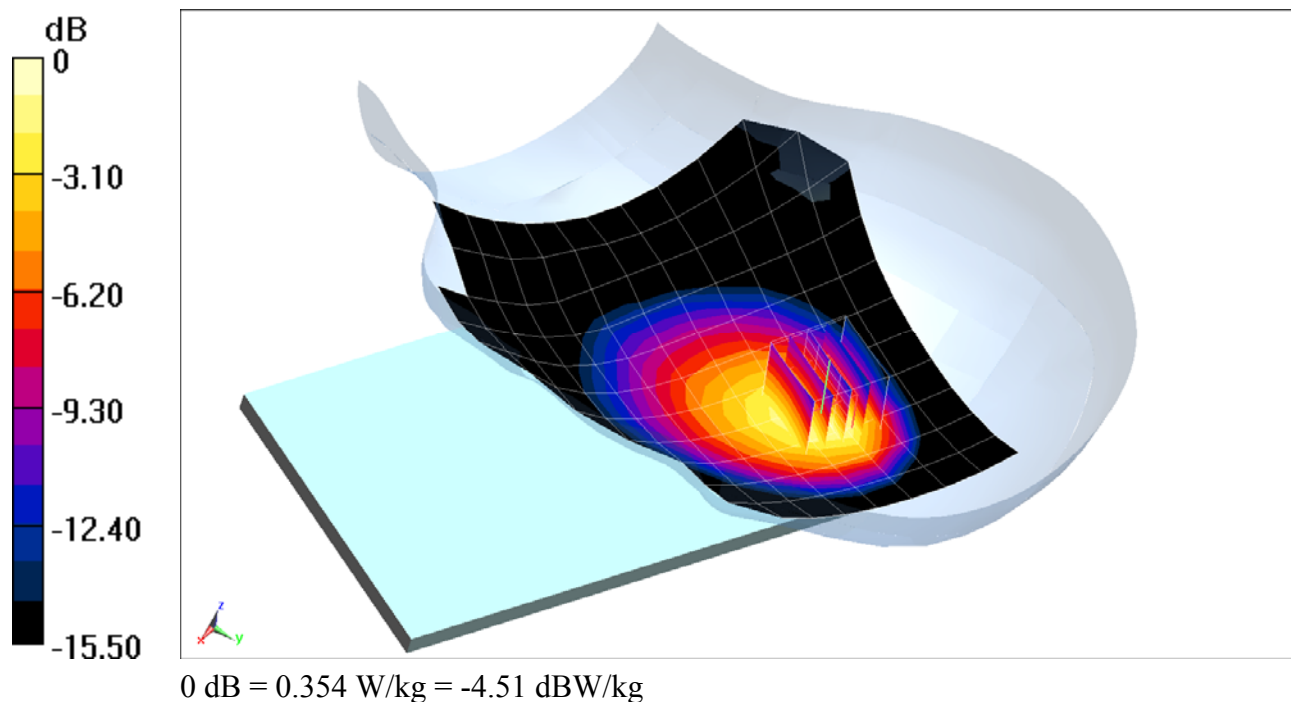
Area Scan (12x18x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 19.27 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.556 W/kg

SAR(1 g) = 0.302 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 03883

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

Medium: 1750 Head Medium parameters used (interpolated):

$f = 1732.4$ MHz; $\sigma = 1.393$ S/m; $\epsilon_r = 38.946$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 07-18-2017; Ambient Temp: 24.2°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3318; ConvF(5.49, 5.49, 5.49); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

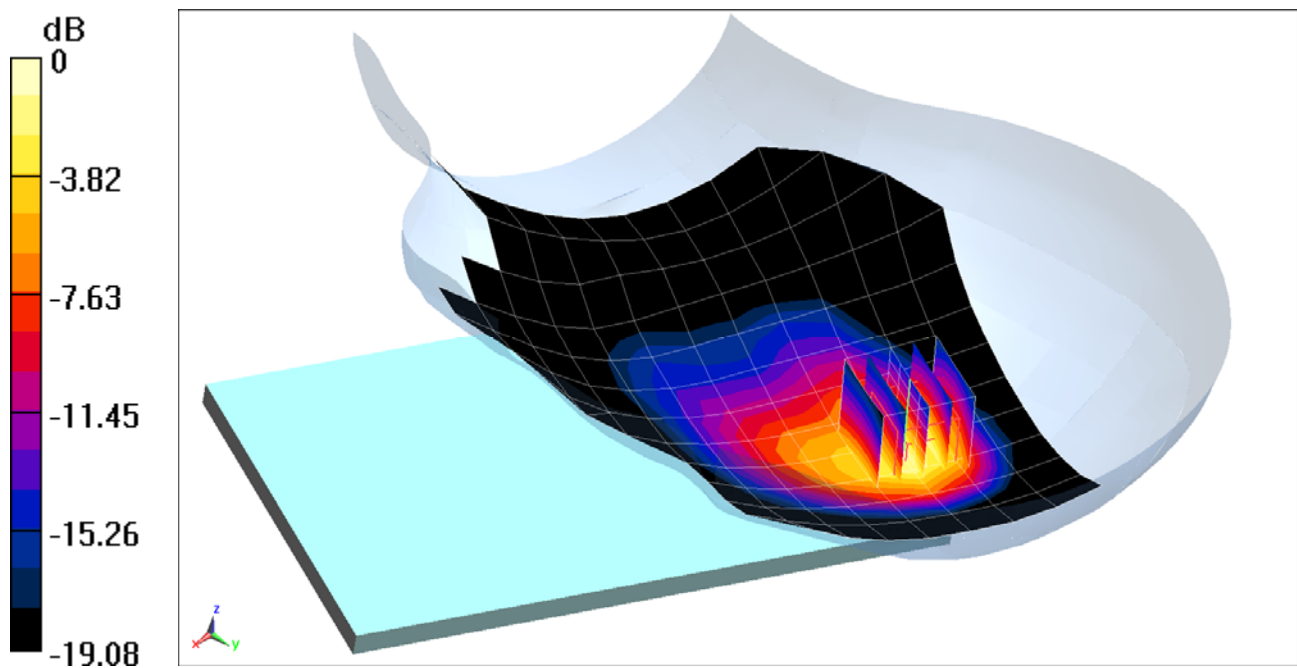
Area Scan (13x18x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 18.44 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.798 W/kg

SAR(1 g) = 0.427 W/kg



0 dB = 0.520 W/kg = -2.84 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 04766

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

Medium: 1900 Head Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.431 \text{ S/m}$; $\epsilon_r = 40.389$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 07-03-2017; Ambient Temp: 21.0°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3209; ConvF(5.31, 5.31, 5.31); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

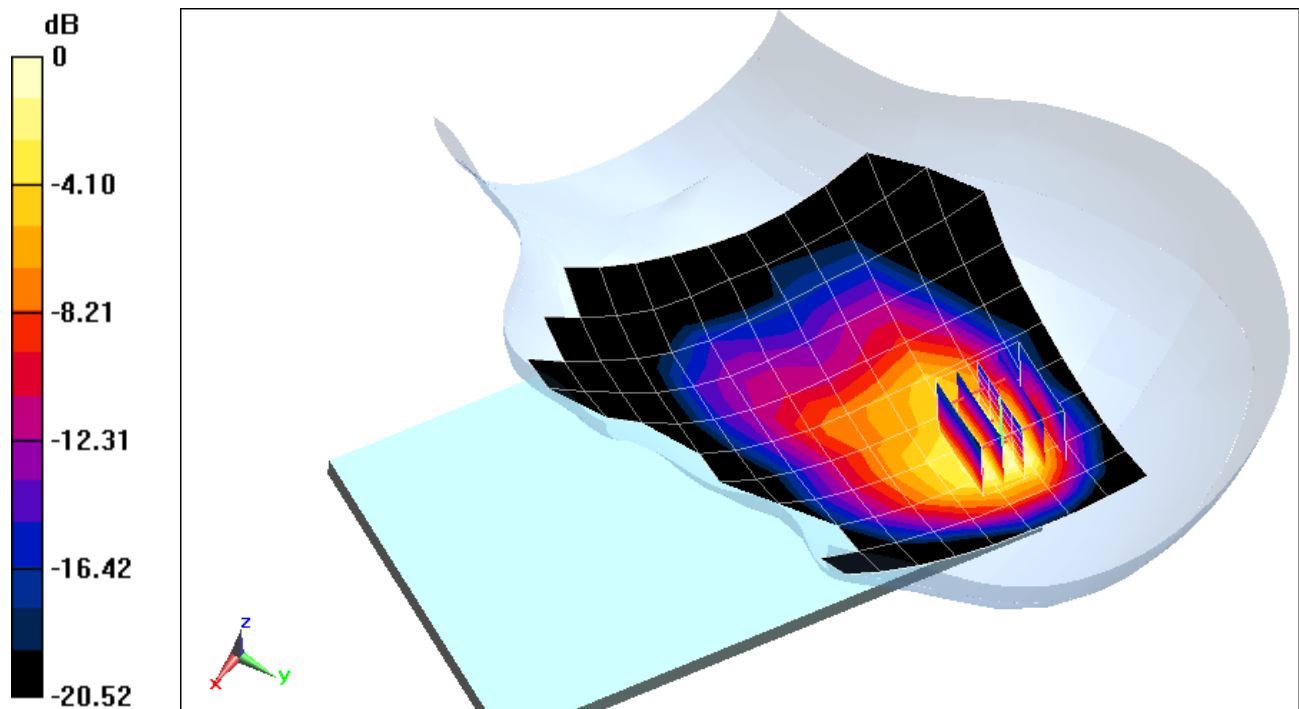
Area Scan (11x17x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 20.50 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.966 W/kg

SAR(1 g) = 0.502 W/kg



0 dB = 0.242 W/kg = -6.16 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 05185

Communication System: UID 0, LTE Band 17; Frequency: 710 MHz; Duty Cycle: 1:1

Medium: 750 Head Medium parameters used:

$f = 710 \text{ MHz}$; $\sigma = 0.867 \text{ S/m}$; $\epsilon_r = 42.438$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 07-05-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3318; ConvF(6.73, 6.73, 6.73); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: LTE Band 17, Left Head, Cheek, Mid.ch,
QPSK, 10 MHz Bandwidth, 25 RB, 25 RB Offset**

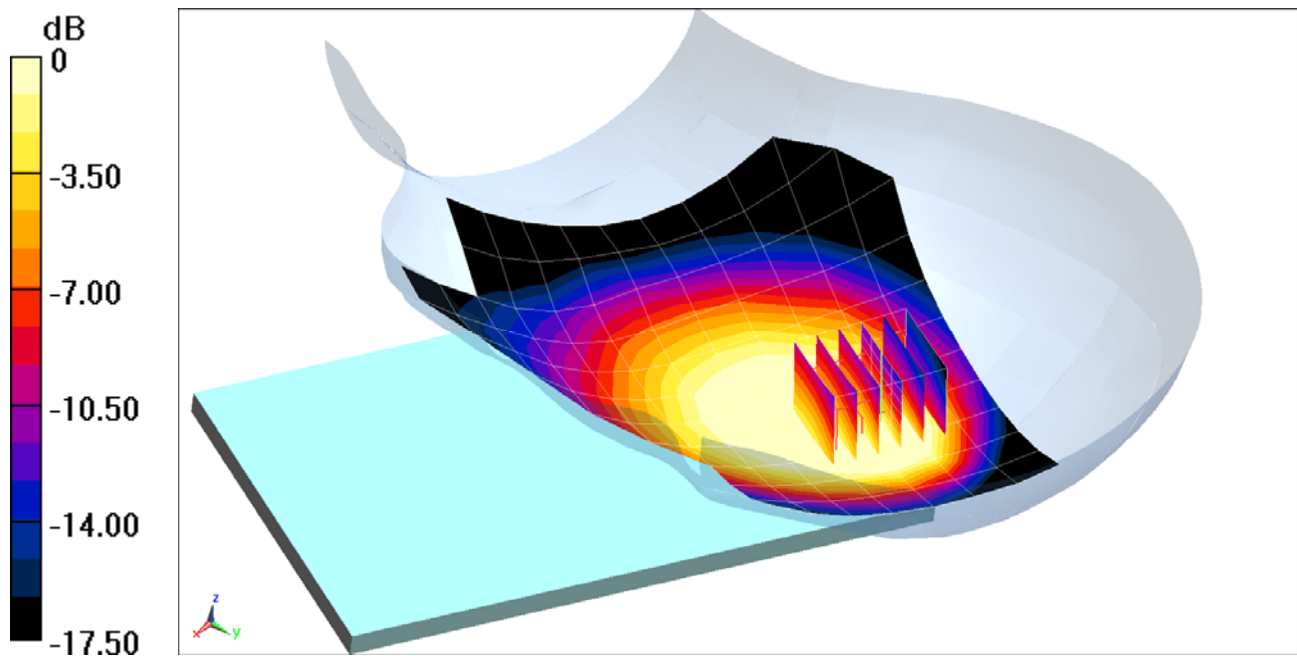
Area Scan (12x18x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 20.85 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.558 W/kg

SAR(1 g) = 0.281 W/kg



0 dB = 0.355 W/kg = -4.50 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 05185

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

Medium: 835 Head Medium parameters used (interpolated):

$f = 836.5$ MHz; $\sigma = 0.899$ S/m; $\epsilon_r = 40.333$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 07-11-2017; Ambient Temp: 21.0°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3209; ConvF(6.36, 6.36, 6.36); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: LTE Band 5 (Cell.), Left Head, Cheek, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 25 RB Offset**

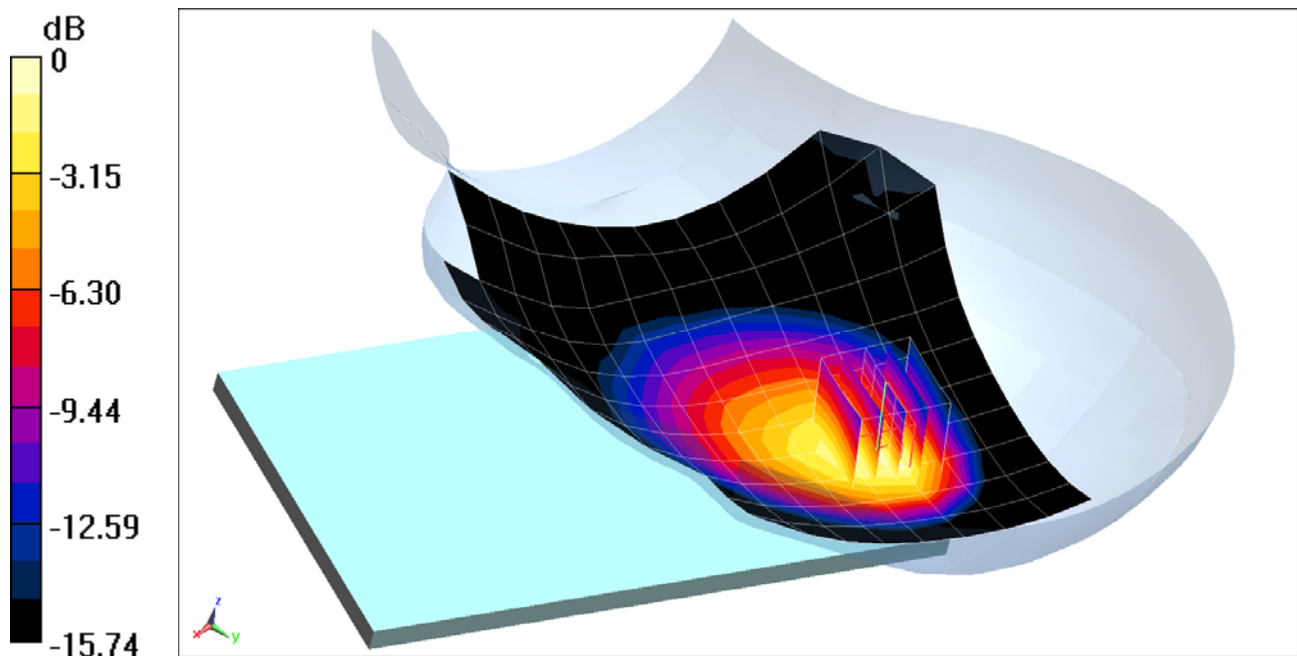
Area Scan (12x18x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 21.00 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 0.549 W/kg

SAR(1 g) = 0.305 W/kg



0 dB = 0.361 W/kg = -4.42 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 05185

Communication System: UID 0, LTE Band 66 (AWS); Frequency: 1745 MHz; Duty Cycle: 1:1

Medium: 1750 Head Medium parameters used (interpolated):

$f = 1745 \text{ MHz}$; $\sigma = 1.399 \text{ S/m}$; $\epsilon_r = 38.806$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 07-07-2017; Ambient Temp: 20.6°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3209; ConvF(5.5, 5.5, 5.5); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: LTE Band 66 (AWS), Left Head, Cheek, Mid.ch,
20 MHz Bandwidth, QPSK, 50 RB, 0 RB Offset**

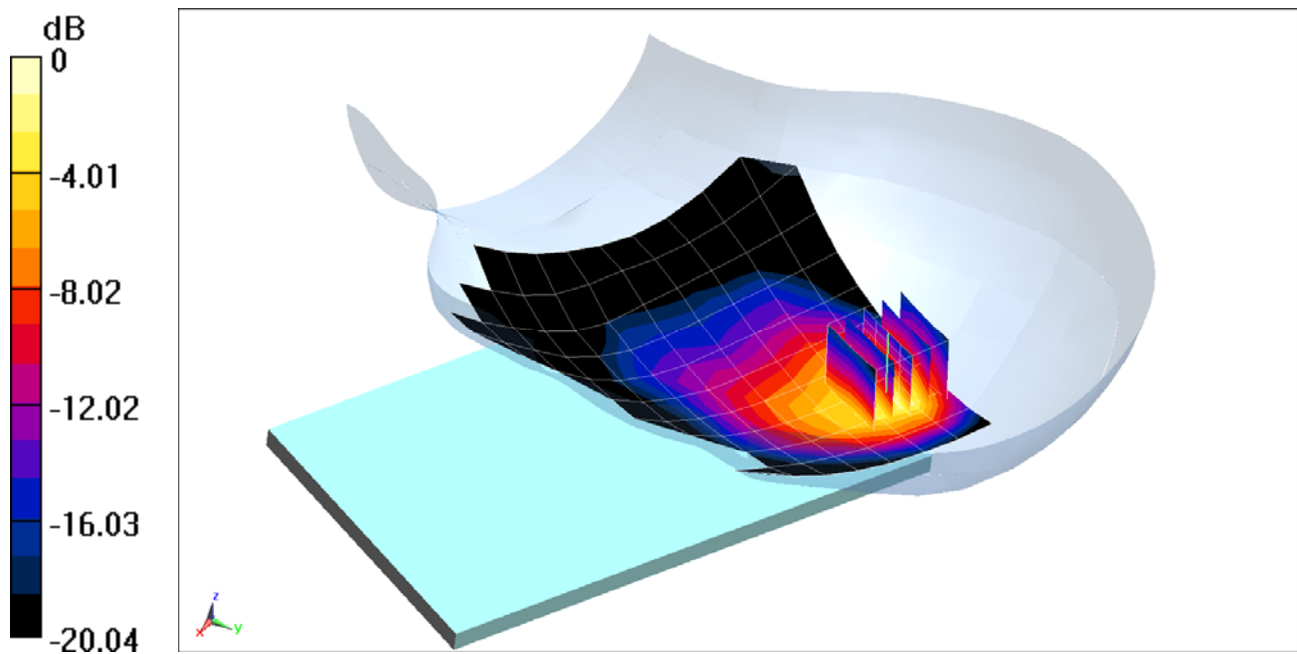
Area Scan (11x17x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 18.53 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.642 W/kg

SAR(1 g) = 0.346 W/kg



0 dB = 0.454 W/kg = -3.43 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 04766

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

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1860 \text{ MHz}$; $\sigma = 1.409 \text{ S/m}$; $\epsilon_r = 40.457$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Test Date: 07-03-2017; Ambient Temp: 21.0°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3209; ConvF(5.31, 5.31, 5.31); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: LTE Band 2 (PCS), Left Head, Cheek, Low.ch,
20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset**

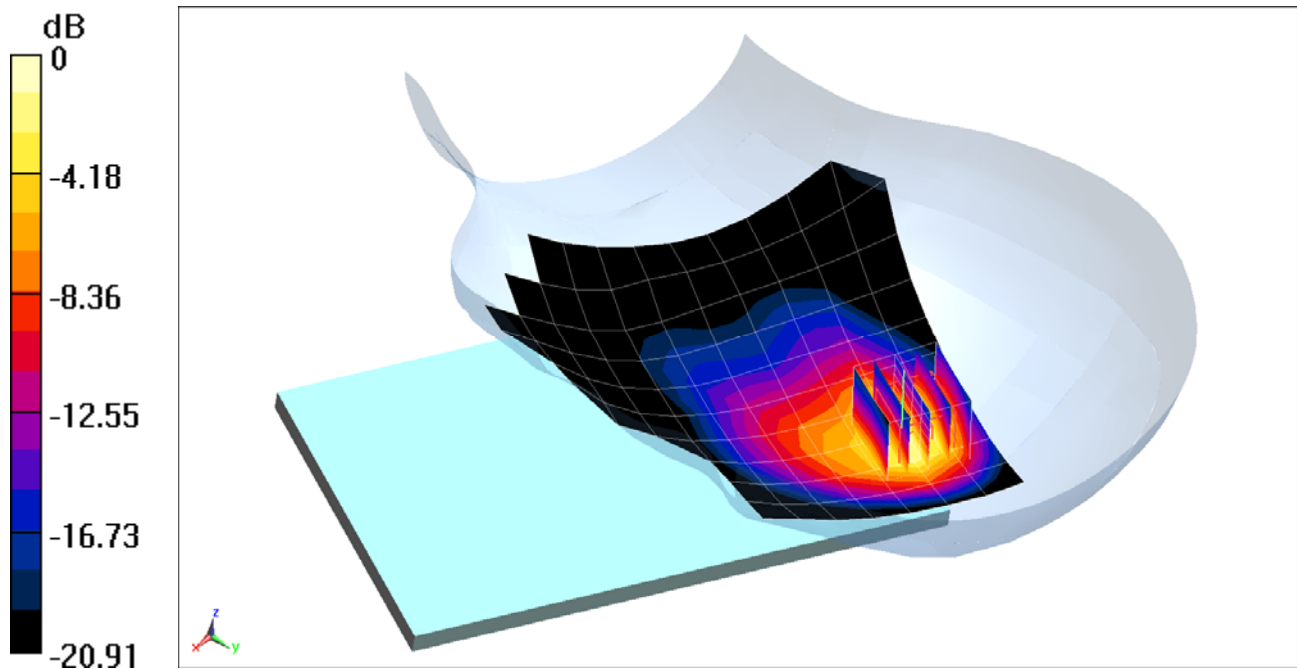
Area Scan (11x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 21.25 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.975 W/kg

SAR(1 g) = 0.504 W/kg



0 dB = 0.619 W/kg = -2.08 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 04766

Communication System: UID 0, _LTE Band 7; Frequency: 2510 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2510$ MHz; $\sigma = 1.942$ S/m; $\epsilon_r = 38.128$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Test Date: 07-10-2017; Ambient Temp: 22.0°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3213; ConvF(4.7, 4.7, 4.7); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

Mode: LTE Band 7, Left Head, Cheek, Low.ch, QPSK
20 MHz Bandwidth, 50 RB, 25 RB Offset

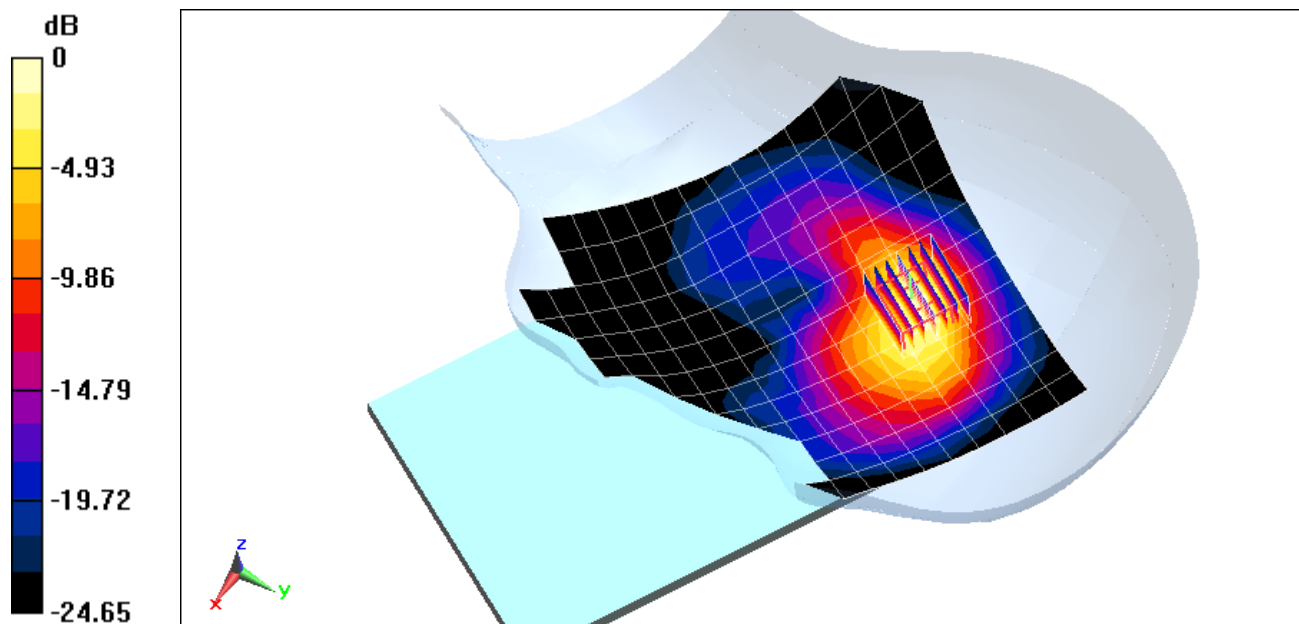
Area Scan (14x18x1): Measurement grid: dx=12mm, dy=12mm

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

Reference Value = 19.09 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.21 W/kg

SAR(1 g) = 0.517 W/kg



0 dB = 0.671 W/kg = -1.73 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 03073

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

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.838 \text{ S/m}$; $\epsilon_r = 38.112$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 07-13-2017; Ambient Temp: 23.0°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3213; ConvF(4.7, 4.7, 4.7); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

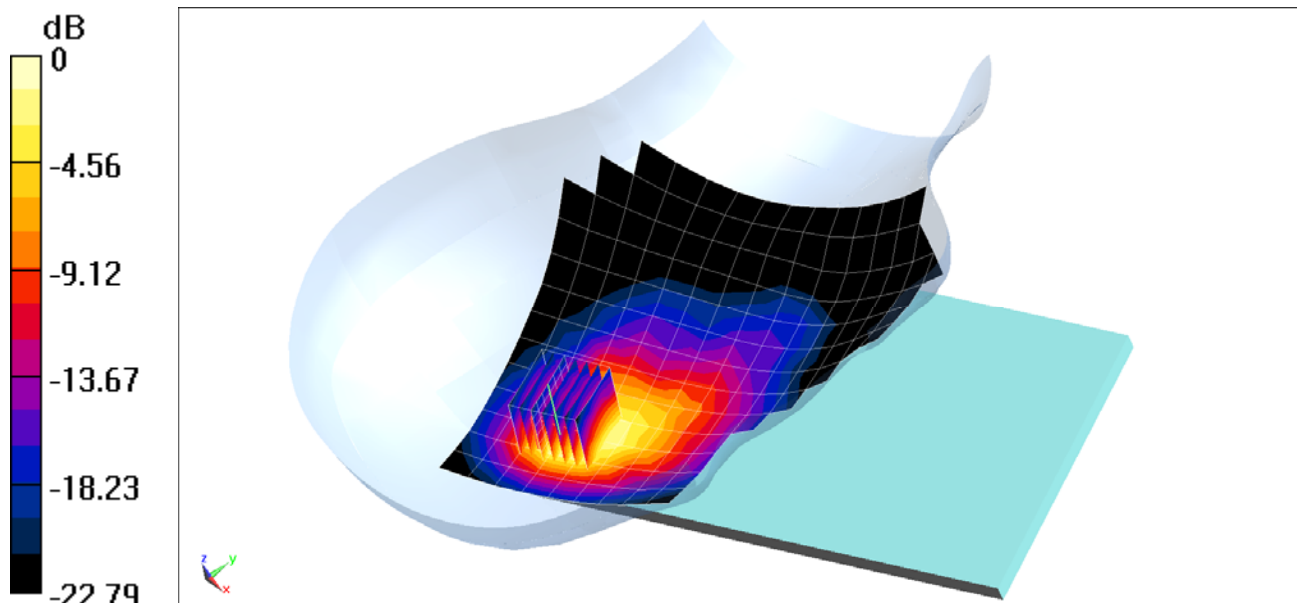
Area Scan (14x18x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 24.94 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 2.33 W/kg

SAR(1 g) = 0.963 W/kg



0 dB = 1.34 W/kg = 1.27 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 01598

Communication System: UID 0, 802.11a 5.2-5.8 GHz Band; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: 5GHz Head Medium parameters used:

$f = 5300 \text{ MHz}$; $\sigma = 4.573 \text{ S/m}$; $\epsilon_r = 35.076$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 07-03-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN3914; ConvF(5.49, 5.49, 5.49); Calibrated: 2/13/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: IEEE 802.11a, U-NII-2A, 20 MHz Bandwidth, Right Head,
Cheek, Ch 60, 6 Mbps**

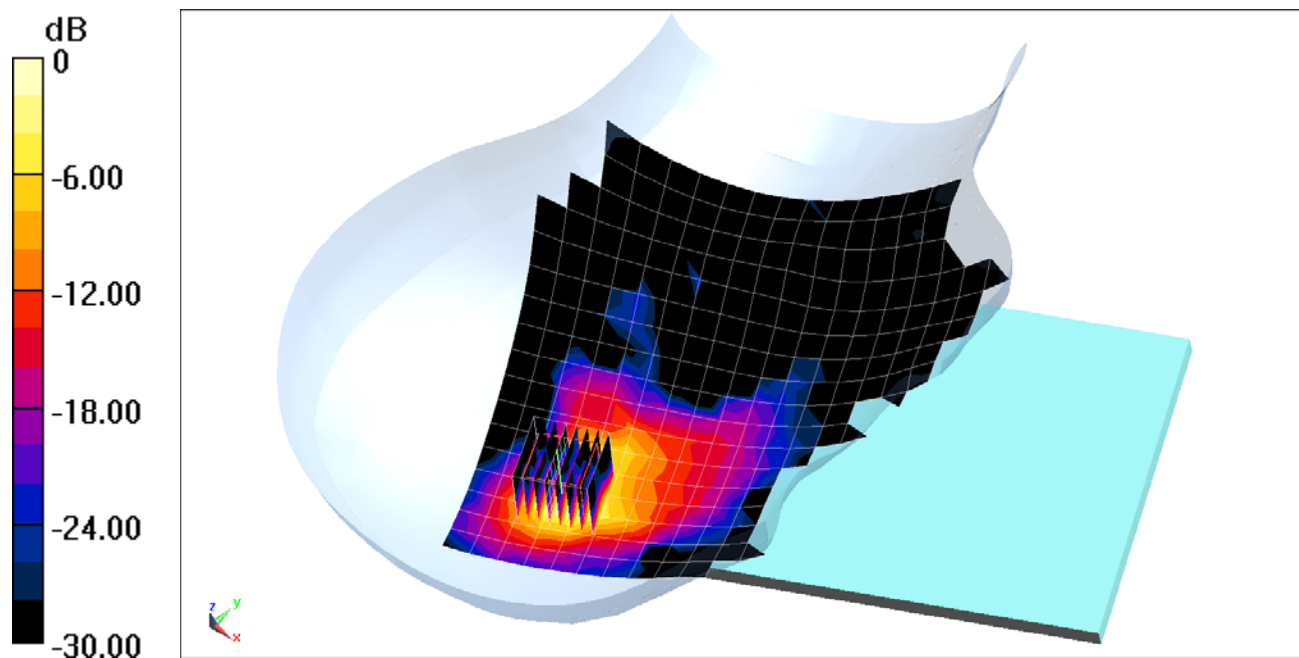
Area Scan (18x27x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Reference Value = 1.629 V/m; Power Drift = 0.20 dB

Peak SAR (extrapolated) = 2.35 W/kg

SAR(1 g) = 0.606 W/kg



0 dB = 1.46 W/kg = 1.64 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 04766

Communication System: UID 0, Bluetooth; Frequency: 2480 MHz; Duty Cycle: 1:1.290

Medium: 2450 Head Medium parameters used (interpolated):

$f = 2480 \text{ MHz}$; $\sigma = 1.909 \text{ S/m}$; $\epsilon_r = 38.25$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 07-10-2017; Ambient Temp: 21.7°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3213; ConvF(4.7, 4.7, 4.7); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

Mode: Bluetooth, Right Head, Cheek, Ch 78, 1 Mbps

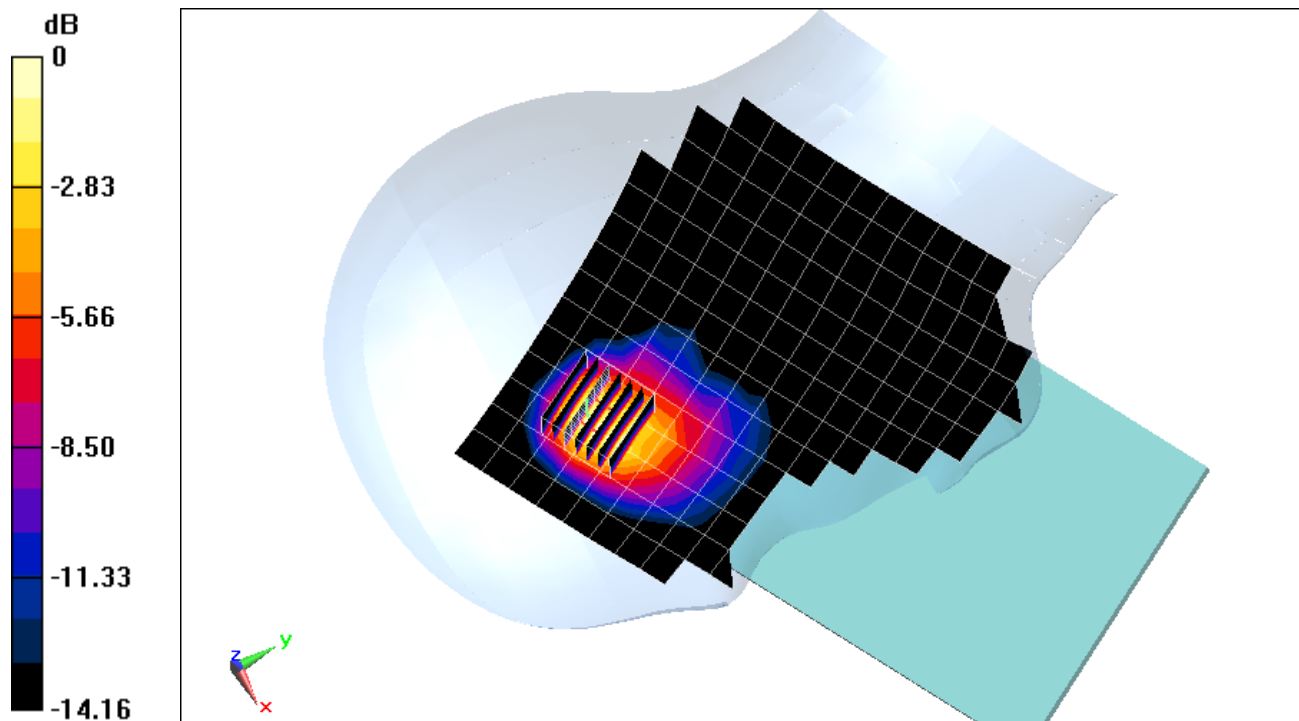
Area Scan (15x20x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 9.068 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.300 W/kg

SAR(1 g) = 0.140 W/kg



0 dB = 0.183 W/kg = -7.38 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 05185

Communication System: UID 0, GSM GPRS; 2 Tx slots;
Frequency: 824.2 MHz; Duty Cycle: 1:4.15
Medium: 835 Body Medium parameters used (interpolated):
 $f = 824.2$ MHz; $\sigma = 0.999$ S/m; $\epsilon_r = 55.053$; $\rho = 1000$ kg/m³
Phantom section: Flat Section; Space: 0.1 cm

Test Date: 07-13-2017; Ambient Temp: 21.1°C; Tissue Temp: 20.0°C

Probe: EX3DV4 - SN7406; ConvF(9.77, 9.77, 9.77); Calibrated: 4/18/2017;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1407; Calibrated: 4/11/2017
Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535
Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

Mode: GPRS 850, Body SAR, Right Edge, Low.ch, 2 Tx Slots

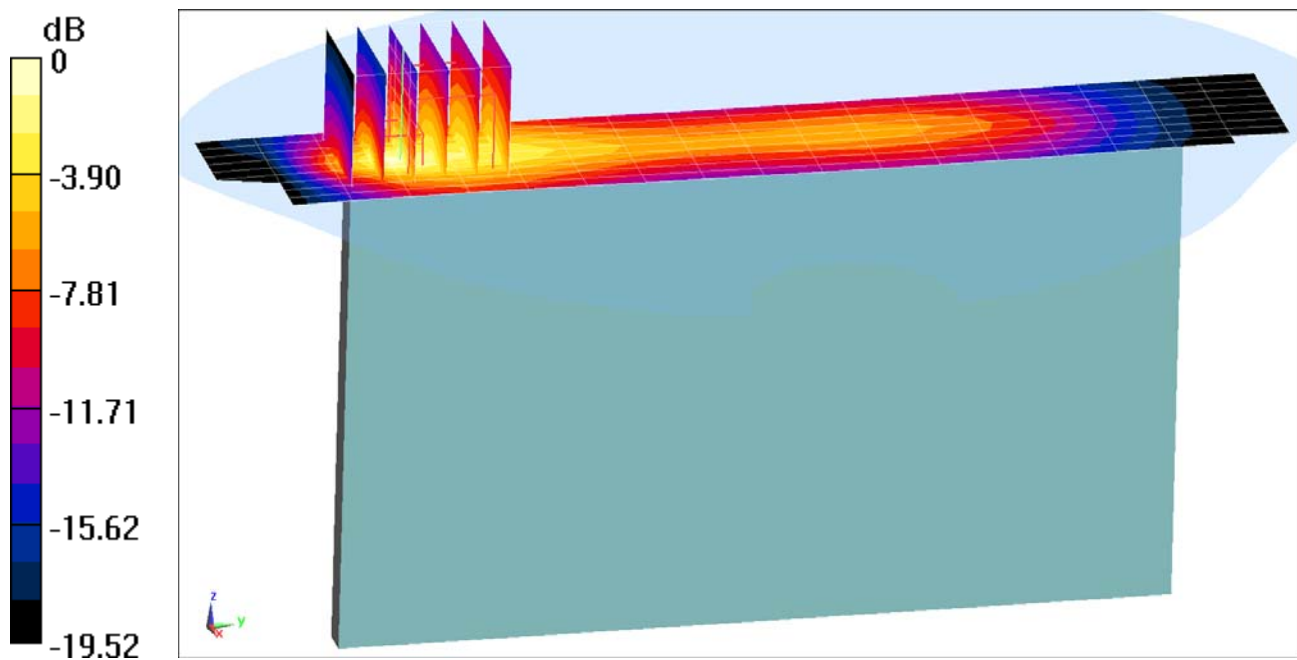
Area Scan (10x19x1): Measurement grid: dx=5mm, dy=15mm

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

Reference Value = 32.11 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 2.71 W/kg

SAR(1 g) = 0.977 W/kg



0 dB = 1.81 W/kg = 2.58 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 01812

Communication System: UID 0, _GSM GPRS; 1 Tx slot; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium: 1900 Body Medium parameters used:

$f = 1910 \text{ MHz}$; $\sigma = 1.593 \text{ S/m}$; $\epsilon_r = 52.032$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-18-2017; Ambient Temp: 22.0°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3213; ConvF(4.94, 4.94, 4.94); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

Mode: GPRS 1900, Body SAR, Back side, High.ch, 1 Tx Slot

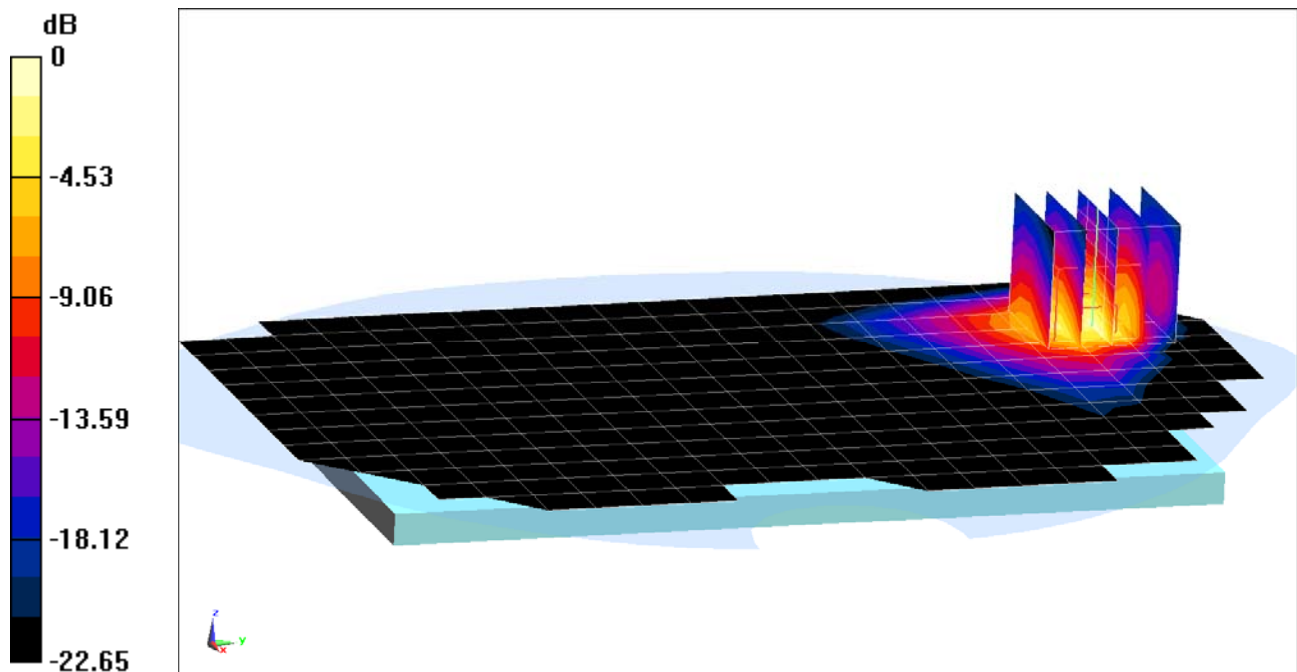
Area Scan (14x22x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 23.94 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 1.61 W/kg

SAR(1 g) = 0.705 W/kg



0 dB = 1.02 W/kg = 0.09 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 04766

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

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.6$ MHz; $\sigma = 1.001$ S/m; $\epsilon_r = 54.919$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 0.1 cm

Test Date: 07-10-2017; Ambient Temp: 20.6°C; Tissue Temp: 18.3°C

Probe: EX3DV4 - SN7406; ConvF(9.77, 9.77, 9.77); Calibrated: 4/18/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/11/2017

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.10;SEMCAD X Version 14.6.10 (7417)

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

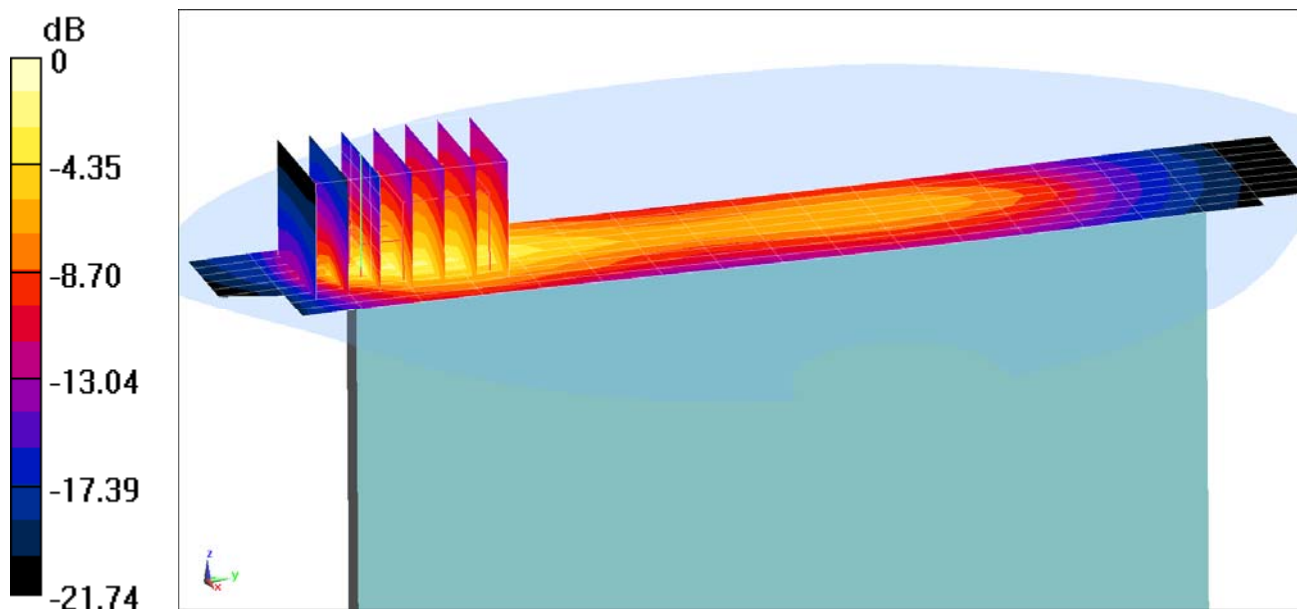
Area Scan (10x19x1): Measurement grid: dx=5mm, dy=15mm

Zoom Scan (5x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 27.61 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 2.46 W/kg

SAR(1 g) = 0.747 W/kg



0 dB = 1.79 W/kg = 2.53 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 03883

Communication System: UID 0, UMTS; Frequency: 1752.6 MHz; Duty Cycle: 1:1

Medium: 1750 Body Medium parameters used (interpolated):

$f = 1752.6 \text{ MHz}$; $\sigma = 1.523 \text{ S/m}$; $\epsilon_r = 51.479$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.4 cm

Test Date: 07-17-2017; Ambient Temp: 22.4°C; Tissue Temp: 20.3°C

Probe: ES3DV3 - SN3318; ConvF(5.12, 5.12, 5.12); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

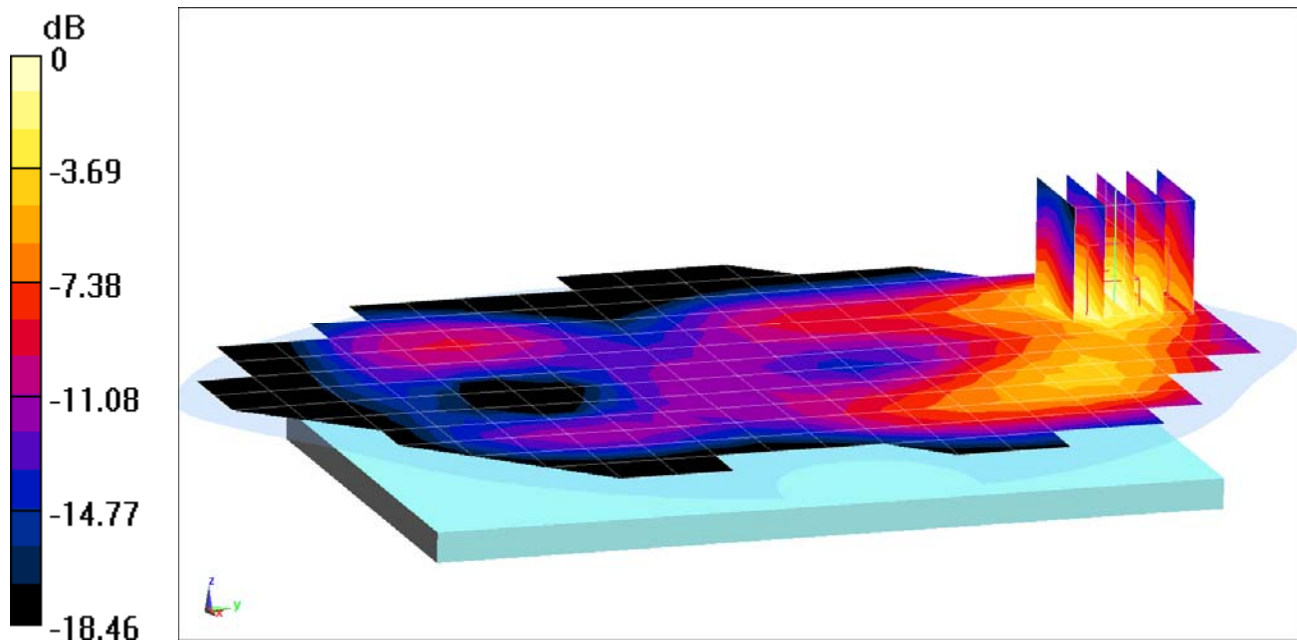
Area Scan (15x19x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 24.87 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 1.32 W/kg

SAR(1 g) = 0.801 W/kg



0 dB = 0.992 W/kg = -0.03 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 02836

Communication System: UID 0, UMTS; Frequency: 1852.4 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1852.4 \text{ MHz}$; $\sigma = 1.523 \text{ S/m}$; $\epsilon_r = 52.241$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-24-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3319; ConvF(4.88, 4.88, 4.88); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/8/2017

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

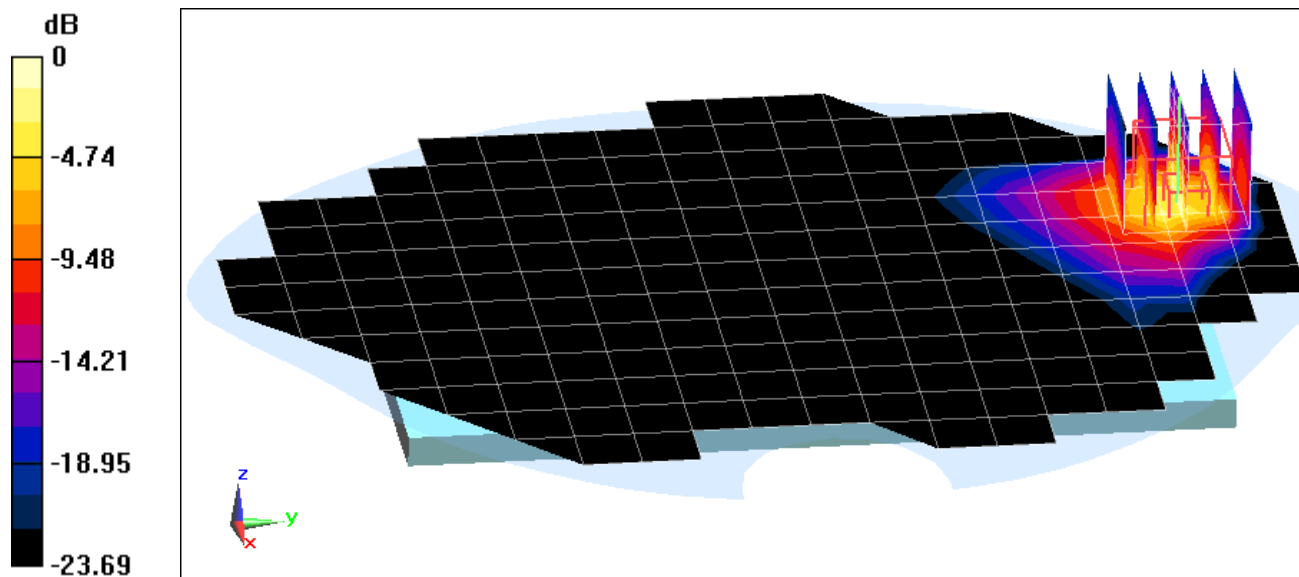
Area Scan (15x19x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 27.71 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 2.17 W/kg

SAR(1 g) = 0.957 W/kg



0 dB = 1.33 W/kg = 1.24 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 04766

Communication System: UID 0, LTE Band 17; Frequency: 710 MHz; Duty Cycle: 1:1

Medium: 750 Body Medium parameters used:

$f = 710 \text{ MHz}$; $\sigma = 0.925 \text{ S/m}$; $\epsilon_r = 55.775$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-04-2017; Ambient Temp: 22.9°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3319; ConvF(6.37, 6.37, 6.37); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/8/2017

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: LTE Band 17, Body SAR, Back side, Mid.ch,
10 MHz Bandwidth, QPSK, 1 RB, 49 RB Offset**

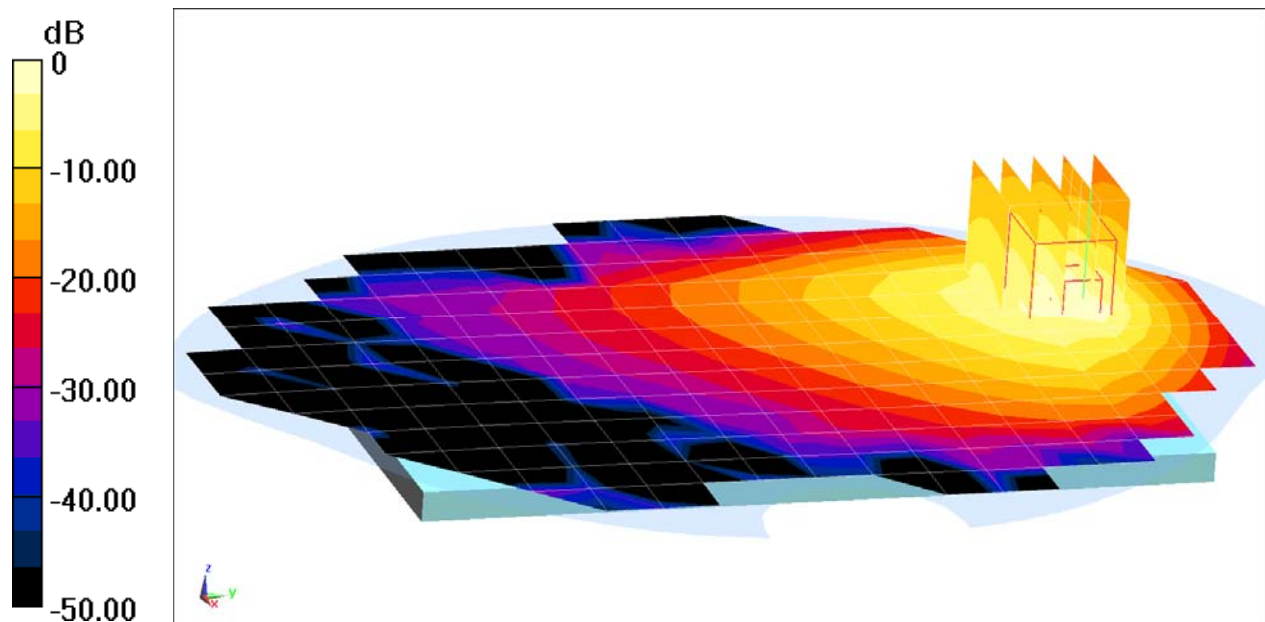
Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 20.73 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.993 W/kg

SAR(1 g) = 0.425 W/kg



0 dB = 0.576 W/kg = -2.40 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 05185

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

Medium: 835 Body Medium parameters used (interpolated):

$f = 836.5 \text{ MHz}$; $\sigma = 1.001 \text{ S/m}$; $\epsilon_r = 54.92$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.1 cm

Test Date: 07-10-2017; Ambient Temp: 20.6°C; Tissue Temp: 18.3°C

Probe: EX3DV4 - SN7406; ConvF(9.77, 9.77, 9.77); Calibrated: 4/18/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/11/2017

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

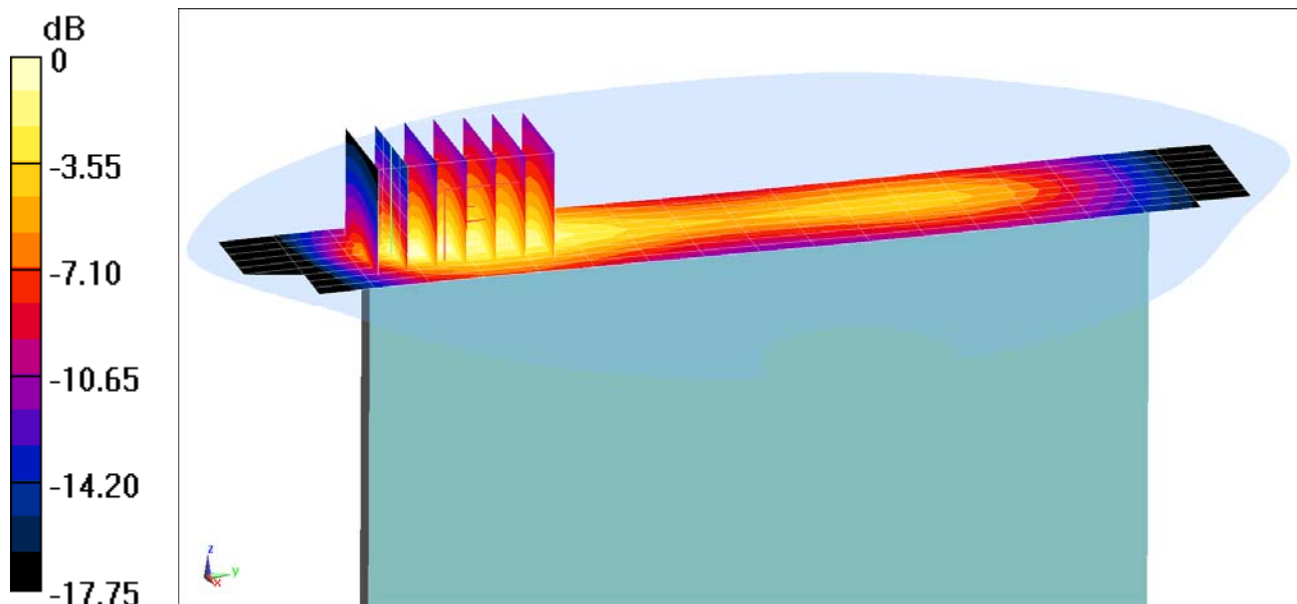
Area Scan (10x19x1): Measurement grid: dx=5mm, dy=15mm

Zoom Scan (5x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 25.56 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 1.56 W/kg

SAR(1 g) = 0.631 W/kg



0 dB = 1.10 W/kg = 0.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 04766

Communication System: UID 0, LTE Band 66 (AWS); Frequency: 1770 MHz; Duty Cycle: 1:1

Medium: 1750 Body Medium parameters used (interpolated):

$f = 1770 \text{ MHz}$; $\sigma = 1.539 \text{ S/m}$; $\epsilon_r = 51.676$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-10-2017; Ambient Temp: 21.0°C; Tissue Temp: 19.2°C

Probe: ES3DV3 - SN3318; ConvF(5.12, 5.12, 5.12); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: LTE Band 66 (AWS), Body SAR, Back side, High.ch,
20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset**

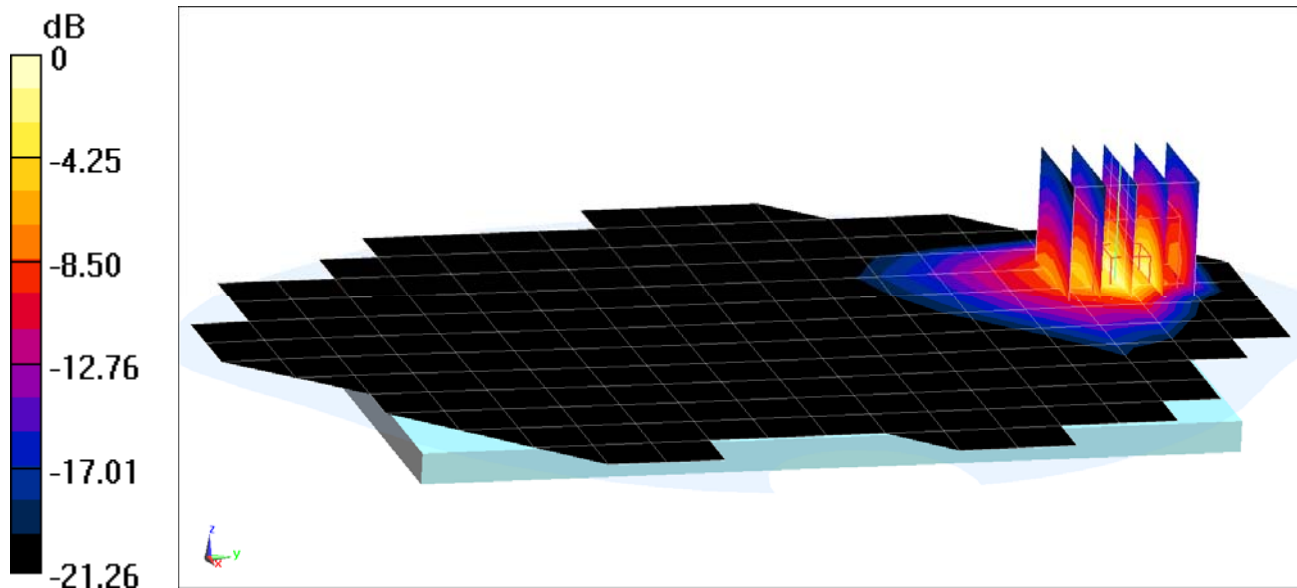
Area Scan (15x19x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 25.65 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.93 W/kg

SAR(1 g) = 0.887 W/kg



0 dB = 1.15 W/kg = 0.61 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 05185

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

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1860 \text{ MHz}$; $\sigma = 1.532 \text{ S/m}$; $\epsilon_r = 52.23$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-24-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3319; ConvF(4.88, 4.88, 4.88); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/8/2017

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

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

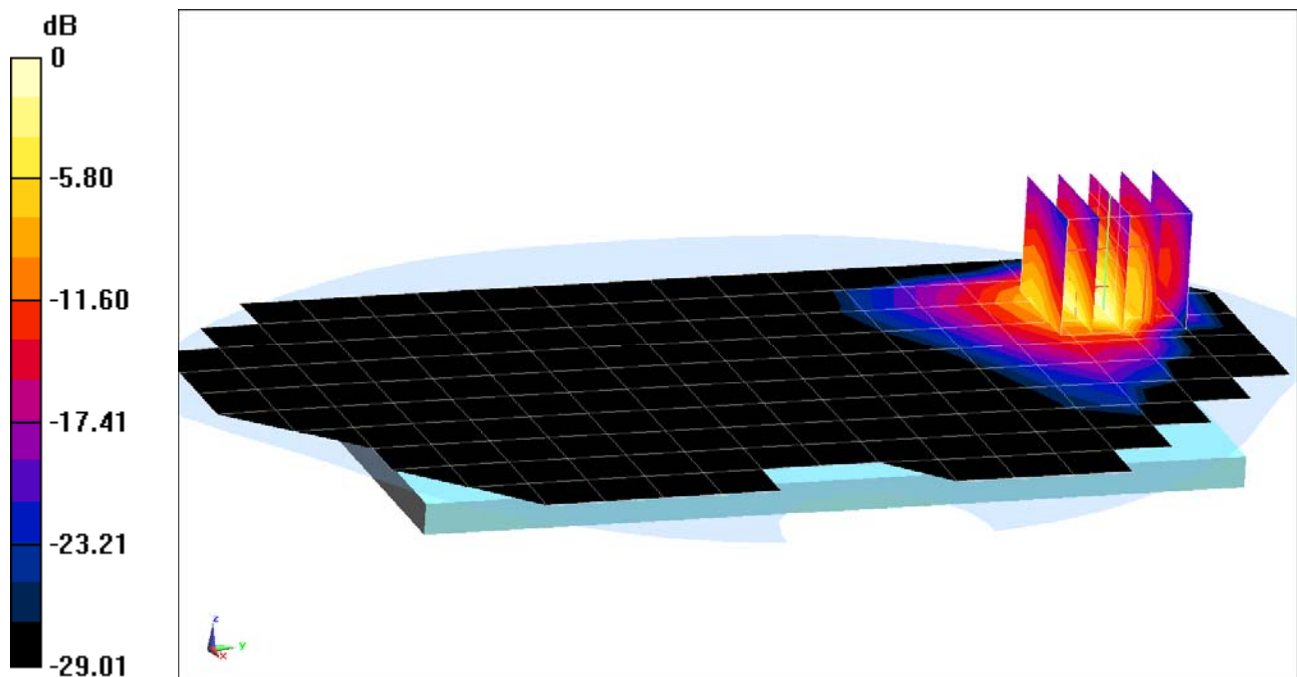
Area Scan (11x19x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 28.54 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.44 W/kg

SAR(1 g) = 1.06 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 01812

Communication System: UID 0, LTE Band 7; Frequency: 2510 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2510 \text{ MHz}$; $\sigma = 2.123 \text{ S/m}$; $\epsilon_r = 51.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-19-2017; Ambient Temp: 22.9°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7406; ConvF(7.6, 7.6, 7.6); Calibrated: 4/18/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/11/2017

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

Mode: LTE Band 7, Body SAR, Back side, Low.ch
20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset

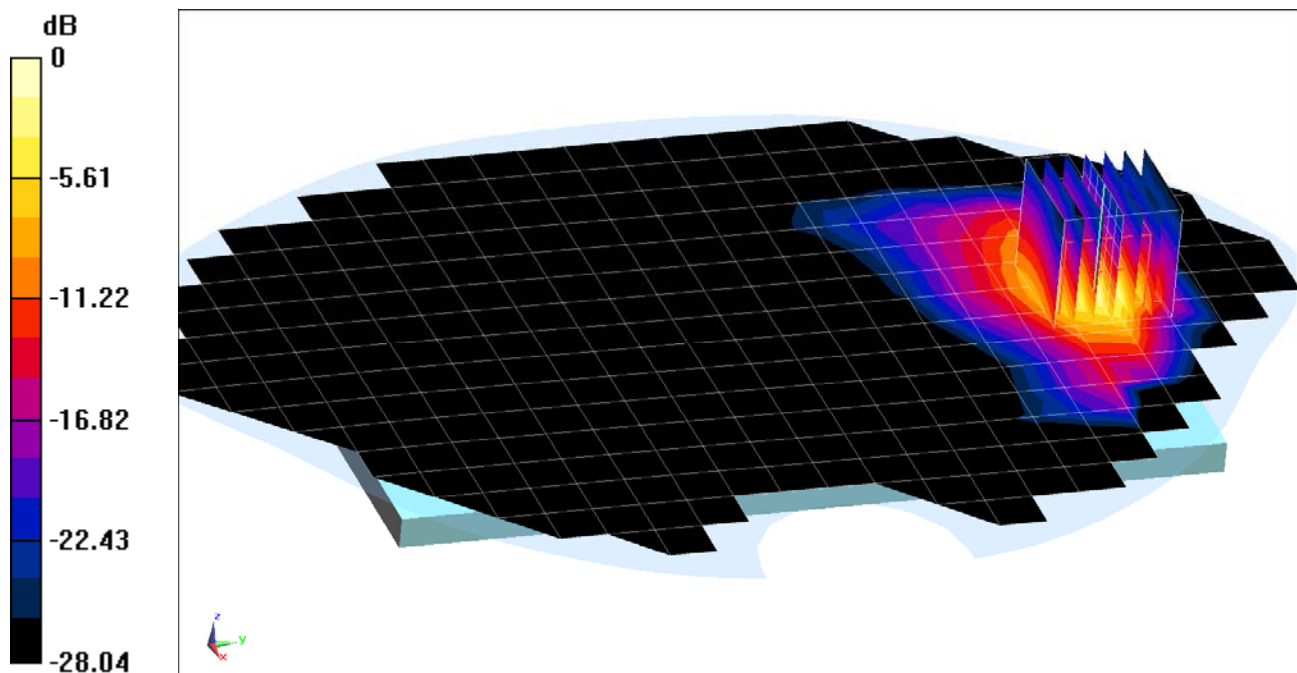
Area Scan (19x25x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 20.06 V/m; Power Drift = -0.18 dB

Peak SAR (extrapolated) = 2.41 W/kg

SAR(1 g) = 0.739 W/kg



0 dB = 1.60 W/kg = 2.04 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 03255

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

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2437 \text{ MHz}$; $\sigma = 1.974 \text{ S/m}$; $\epsilon_r = 51.876$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.3 cm

Test Date: 06-24-2017; Ambient Temp: 23.5°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN7406; ConvF(7.6, 7.6, 7.6); Calibrated: 4/18/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/11/2017

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: IEEE 802.11b, 22 MHz Bandwidth, Body SAR,
Ch 6, 1 Mbps, Left Edge**

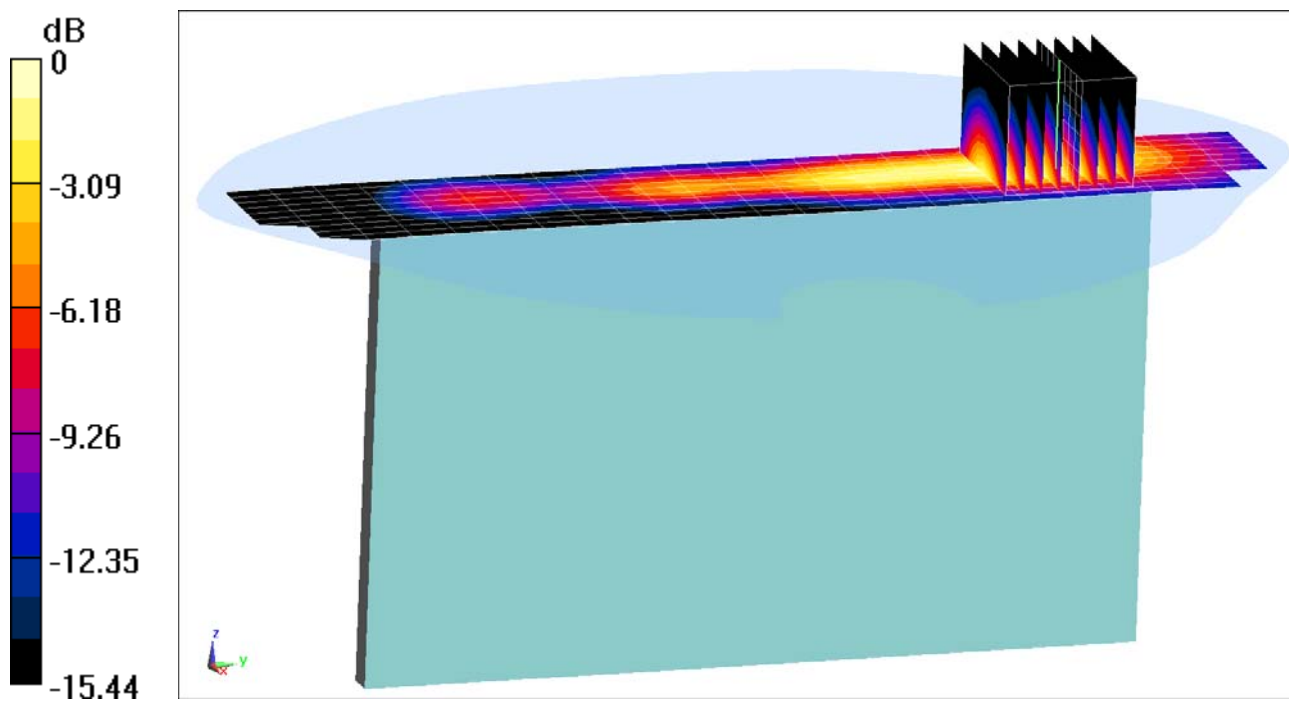
Area Scan (11x24x1): Measurement grid: $dx=5\text{mm}$, $dy=12\text{mm}$

Zoom Scan (9x8x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 11.72 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 0.607 W/kg

SAR(1 g) = 0.282 W/kg



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 03255

Communication System: UID 0, IEEE 802.11n; Frequency: 5310 MHz; Duty Cycle: 1:1

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

$f = 5310 \text{ MHz}$; $\sigma = 5.513 \text{ S/m}$; $\epsilon_r = 47.635$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-10-2017; Ambient Temp: 22.1°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3589; ConvF(4.19, 4.19, 4.19); Calibrated: 1/13/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/16/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

**Mode: IEEE 802.11n, U-NII-2A, 40 MHz Bandwidth, Body SAR,
Ch 62, 13.5 Mbps, Back Side**

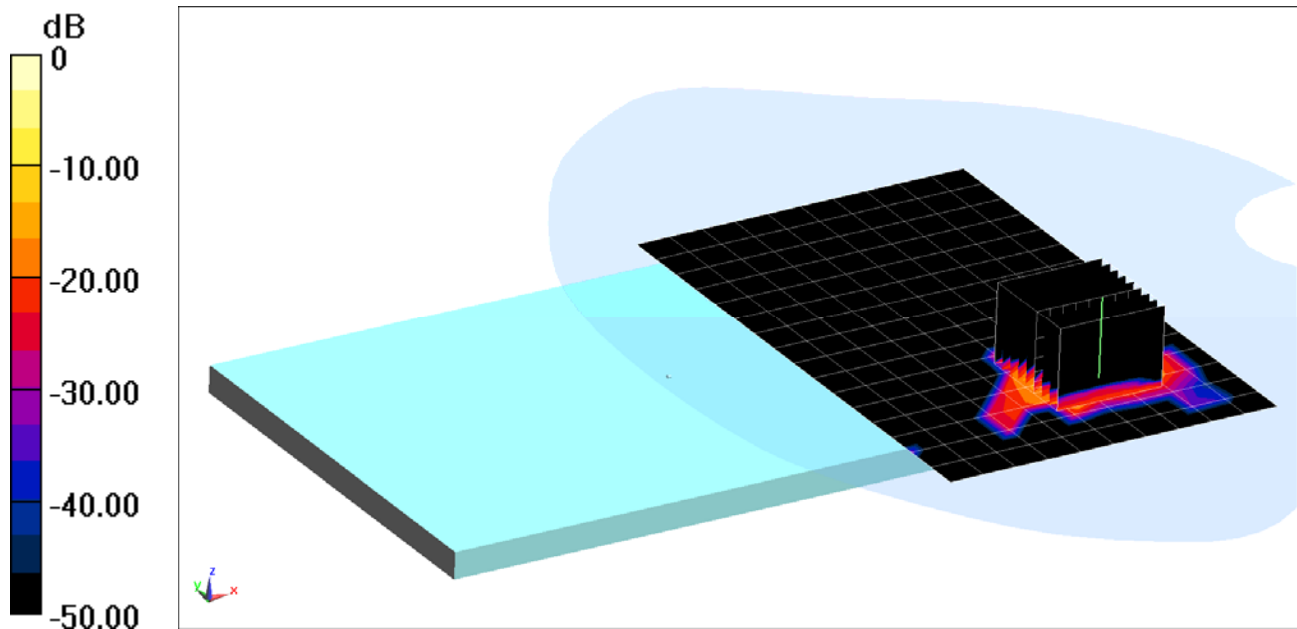
Area Scan (11x17x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Zoom Scan (9x9x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$; Graded Ratio: 1.4

Reference Value = 12.89 V/m; Power Drift = 0.21 dB

Peak SAR (extrapolated) = 5.36 W/kg

SAR(1 g) = 0.922 W/kg



0 dB = 2.93 W/kg = 4.67 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT385M; Type: Portable Tablet; Serial: 03255

Communication System: UID 0, Bluetooth; Frequency: 2480 MHz; Duty Cycle: 1:1.290

Medium: 2450 Body Medium parameters used (interpolated):

$f = 2480 \text{ MHz}$; $\sigma = 2.031 \text{ S/m}$; $\epsilon_r = 51.681$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0.0 cm

Test Date: 06-24-2017; Ambient Temp: 23.5°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN7406; ConvF(7.6, 7.6, 7.6); Calibrated: 4/18/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/11/2017

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

Mode: Bluetooth, Body SAR, Ch 78, 1 Mbps, Back Side

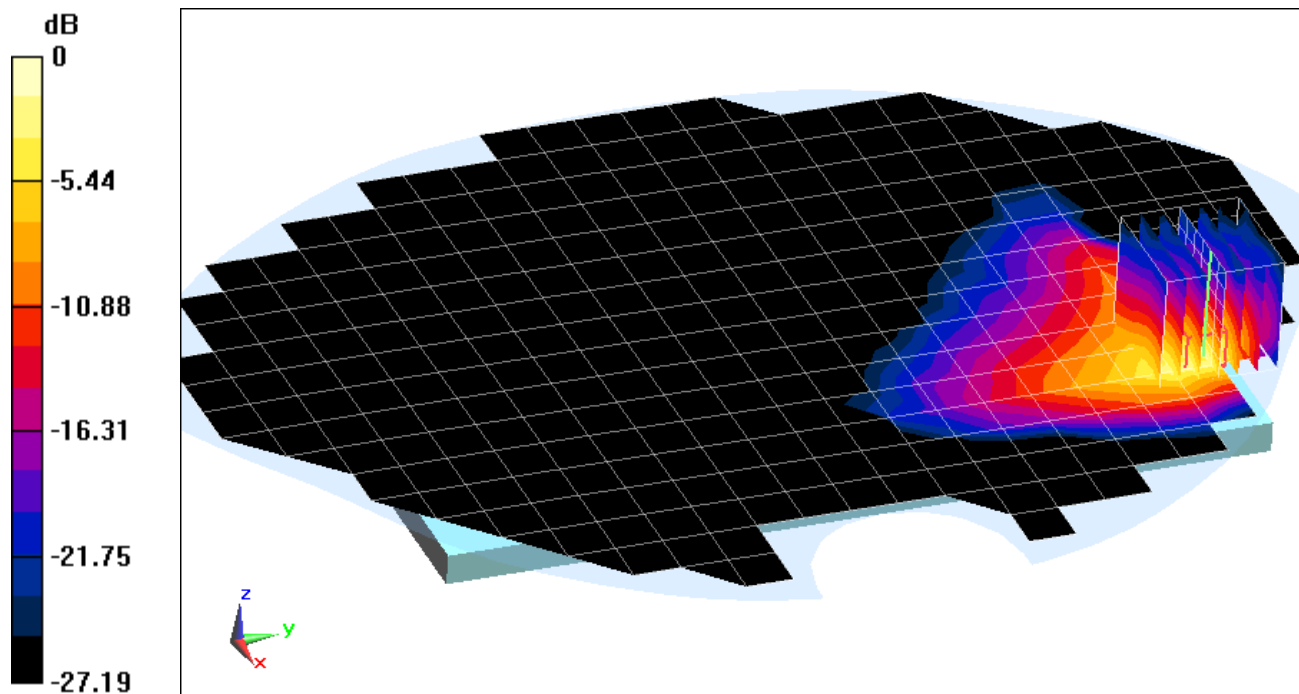
Area Scan (18x24x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Reference Value = 12.29 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.985 W/kg

SAR(1 g) = 0.320 W/kg



0 dB = 0.674 W/kg = -1.71 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 750 MHz; Type: D750V3; Serial: 1003

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

Medium: 750 Head Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.904 \text{ S/m}$; $\epsilon_r = 41.957$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-05-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.5°C

Probe: ES3DV3 - SN3318; ConvF(6.73, 6.73, 6.73); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

750 MHz System Verification at 23.0 dBm (200 mW)

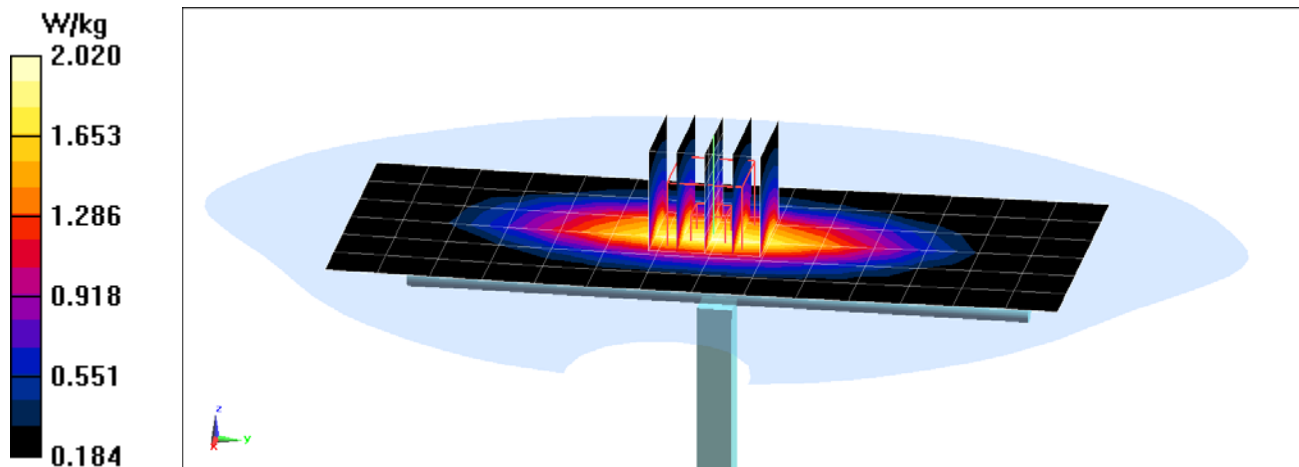
Area Scan (7x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.60 W/kg

SAR(1 g) = 1.73 W/kg

Deviation(1 g) = 3.10%



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 Head Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 0.897 \text{ S/m}$; $\epsilon_r = 40.348$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-11-2017; Ambient Temp: 21.0°C; Tissue Temp: 20.5°C

Probe: ES3DV3 - SN3209; ConvF(6.36, 6.36, 6.36); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

835 MHz System Verification at 23.0 dBm (200 mW)

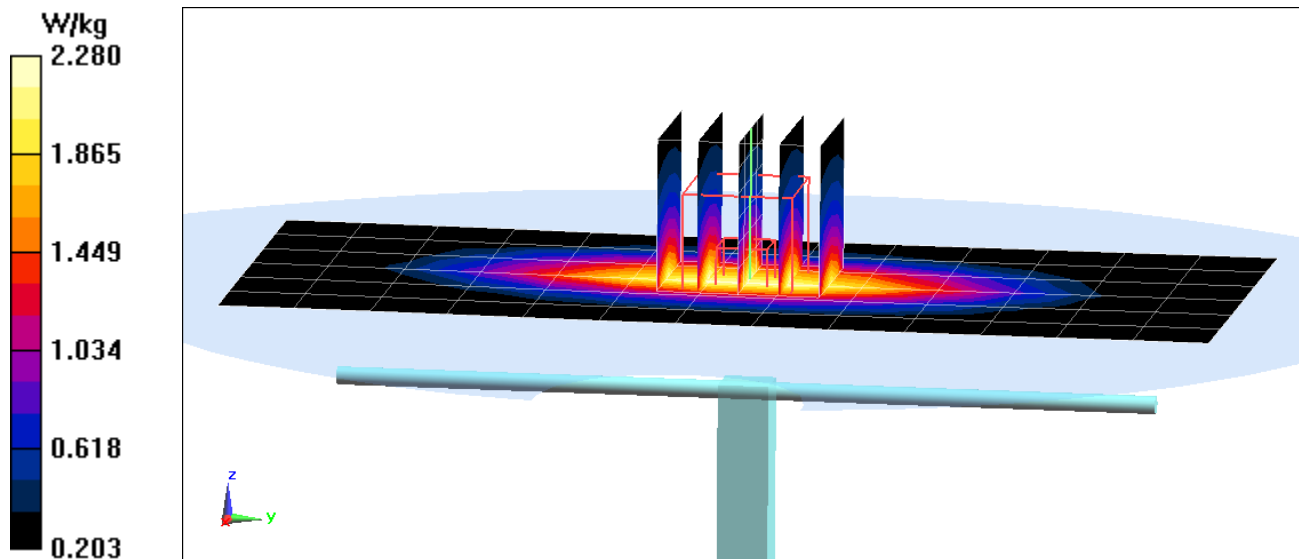
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.86 W/kg

SAR(1 g) = 1.95 W/kg

Deviation(1 g) = 6.79%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: 1150

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

Medium: 1750 Head Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.404 \text{ S/m}$; $\epsilon_r = 38.783$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-07-2017; Ambient Temp: 20.6°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3209; ConvF(5.5, 5.5, 5.5); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

1750 MHz System Verification at 20.0 dBm (100 mW)

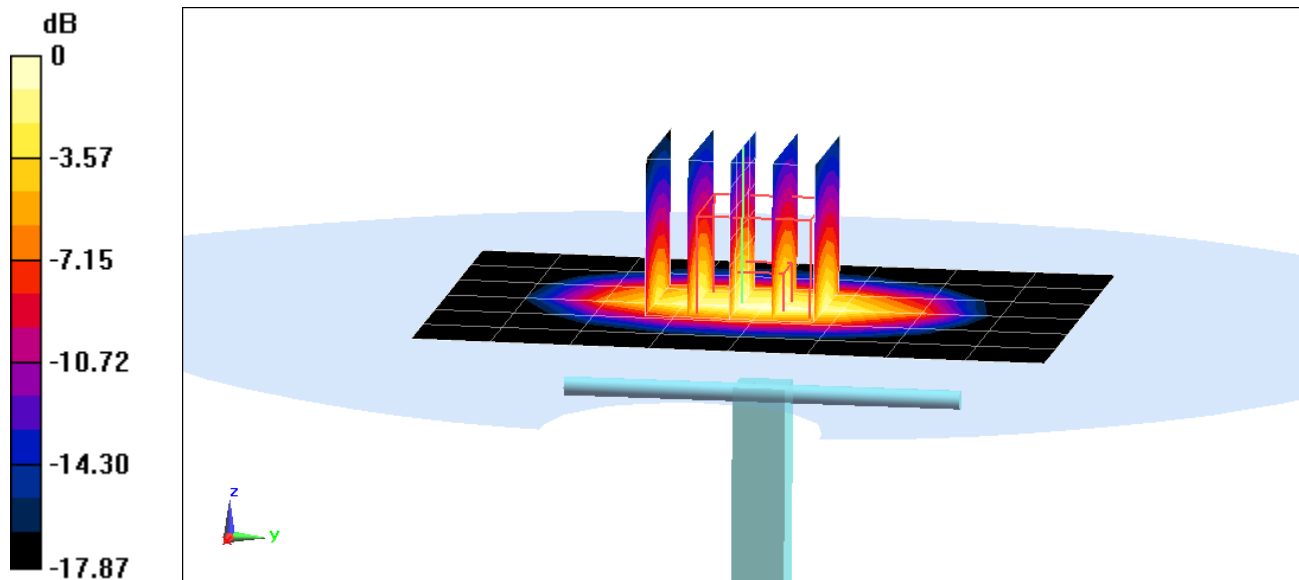
Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.54 W/kg

SAR(1 g) = 3.57 W/kg

Deviation(1 g) = -1.11%



0 dB = 4.46 W/kg = 6.49 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1750 Head Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.412 \text{ S/m}$; $\epsilon_r = 38.858$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-18-2017; Ambient Temp: 24.2°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3318; ConvF(5.49, 5.49, 5.49); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

1750 MHz System Verification at 20.0 dBm (100 mW)

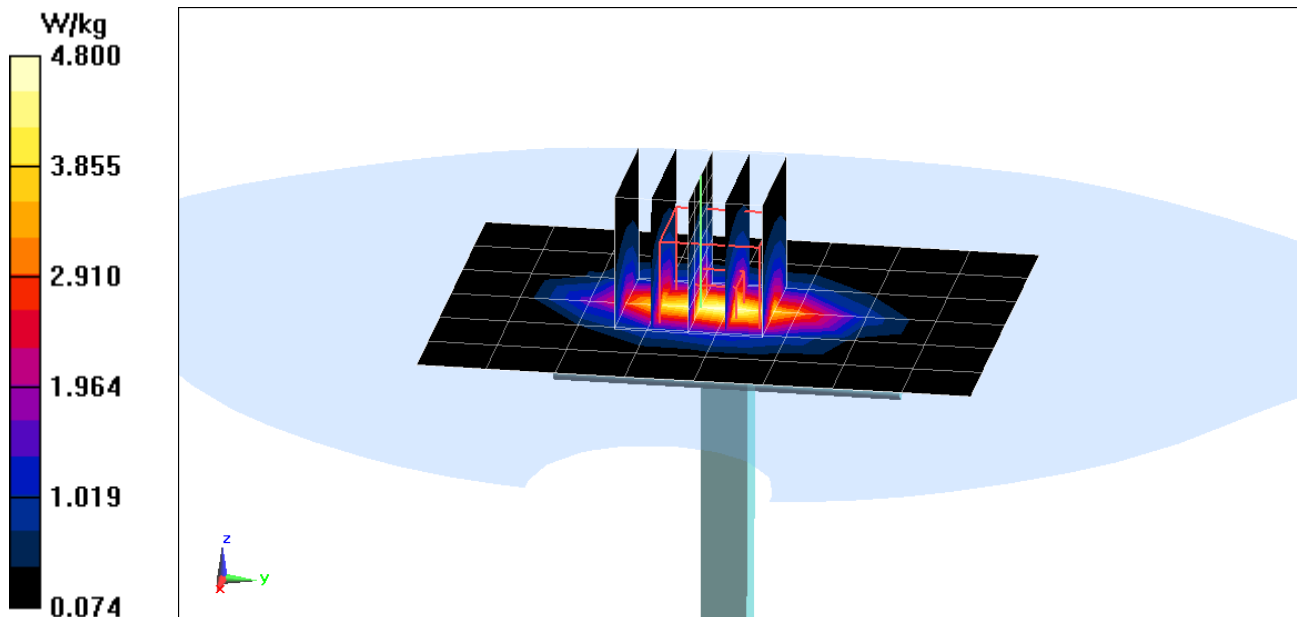
Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm

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

Peak SAR (extrapolated) = 6.98 W/kg

SAR(1 g) = 3.82 W/kg

Deviation(1 g) = 4.95%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.453 \text{ S/m}$; $\epsilon_r = 40.31$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-03-2017; Ambient Temp: 21.0°C; Tissue Temp: 20.8°C

Probe: ES3DV3 - SN3209; ConvF(5.31, 5.31, 5.31); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 3/13/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

1900 MHz System Verification at 20.0 dBm (100 mW)

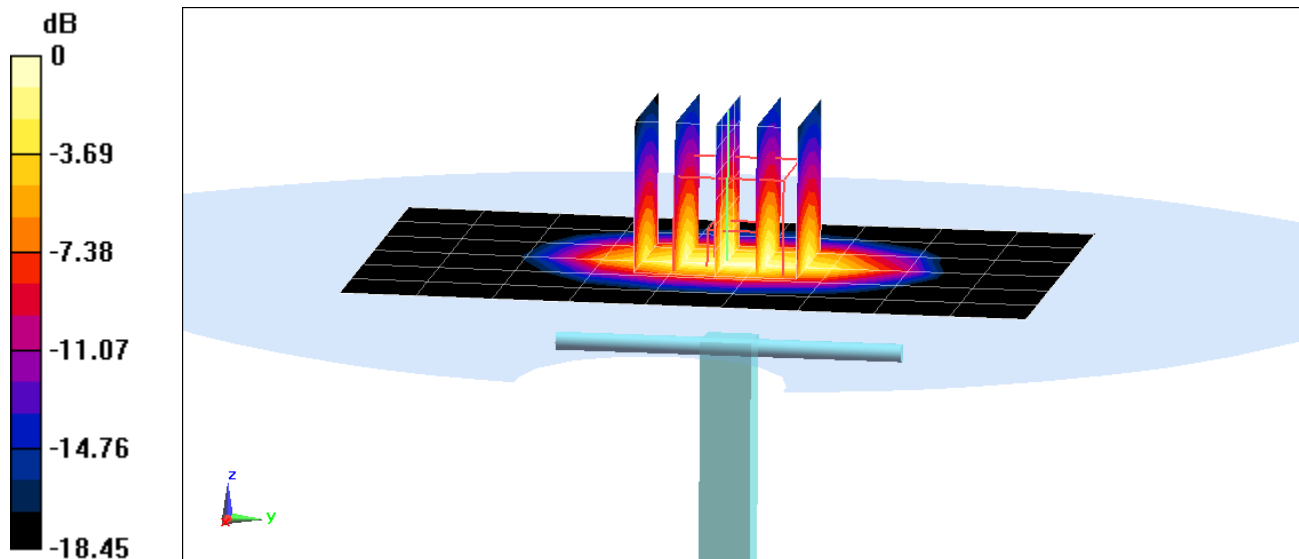
Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 7.18 W/kg

SAR(1 g) = 3.88 W/kg

Deviation(1 g) = -1.27%



0 dB = 4.92 W/kg = 6.92 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 945

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 1.88 \text{ S/m}$; $\epsilon_r = 38.552$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-19-2017; Ambient Temp: 22.6°C; Tissue Temp: 21.4°C

Probe: ES3DV3 - SN3213; ConvF(4.7, 4.7, 4.7); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

2450 MHz System Verification at 20.0 dBm (100 mW)

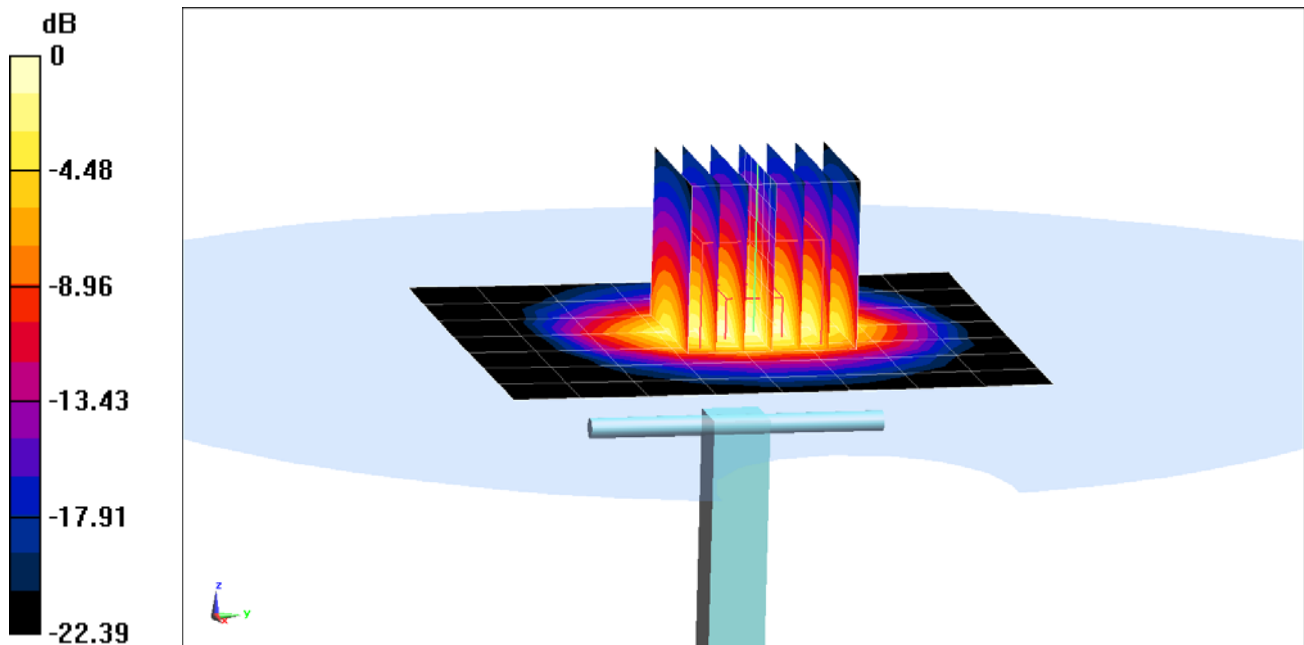
Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Peak SAR (extrapolated) = 11.3 W/kg

SAR(1 g) = 5.42 W/kg

Deviation(1 g) = 5.65%



0 dB = 7.15 W/kg = 8.54 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1004

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium: 2450 Head Medium parameters used:

$f = 2600$ MHz; $\sigma = 2.041$ S/m; $\epsilon_r = 37.802$; $\rho = 1000$ kg/m³

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-10-2017; Ambient Temp: 21.7°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3213; ConvF(4.52, 4.52, 4.52); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

2600 MHz System Verification at 20.0 dBm (100 mW)

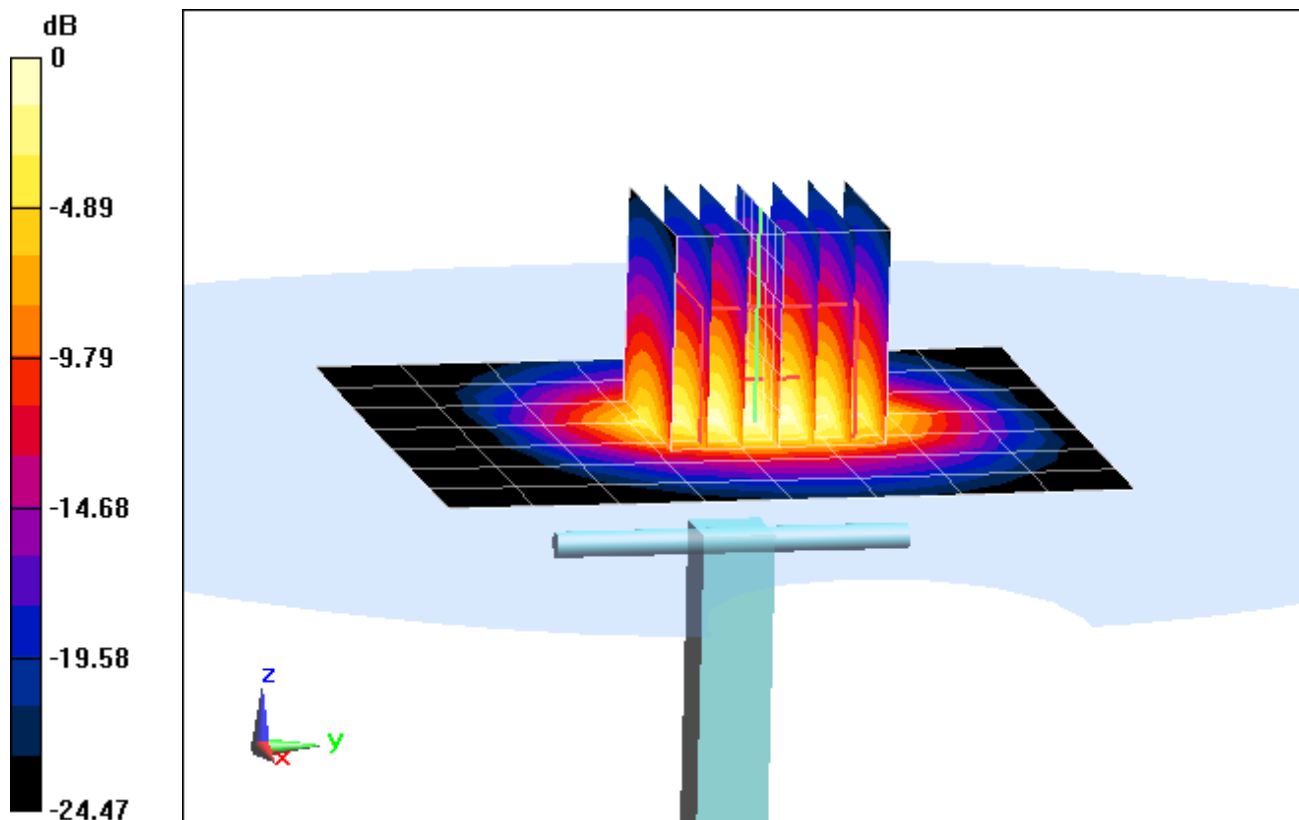
Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 13.8 W/kg

SAR(1 g) = 6.24 W/kg

Deviation(1 g) = 8.33%



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: 5GHz Head Medium parameters used (interpolated):

$f = 5250 \text{ MHz}$; $\sigma = 4.528 \text{ S/m}$; $\epsilon_r = 35.175$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-03-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN3914; ConvF(5.49, 5.49, 5.49); Calibrated: 2/13/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

5250 MHz System Verification at 17.0 dBm (50 mW)

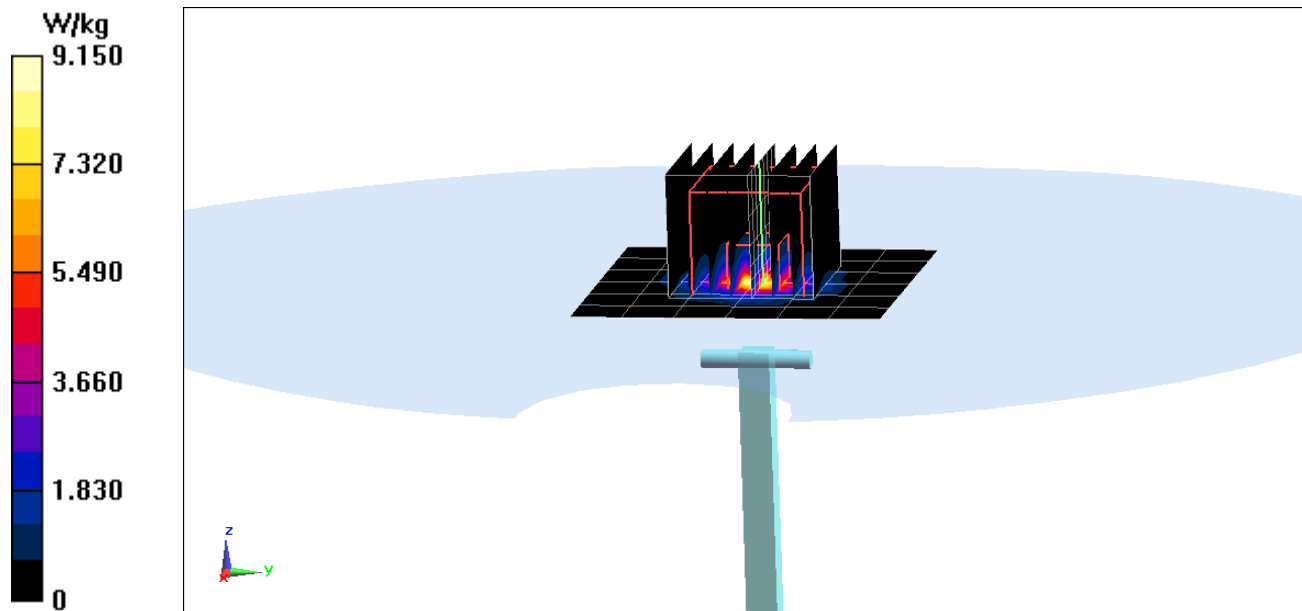
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 15.8 W/kg

SAR(1 g) = 3.70 W/kg

Deviation(1 g) = -6.57%



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: 5GHz Head Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 4.88 \text{ S/m}$; $\epsilon_r = 34.654$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-03-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN3914; ConvF(4.94, 4.94, 4.94); Calibrated: 2/13/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

5600 MHz System Verification at 17.0 dBm (50 mW)

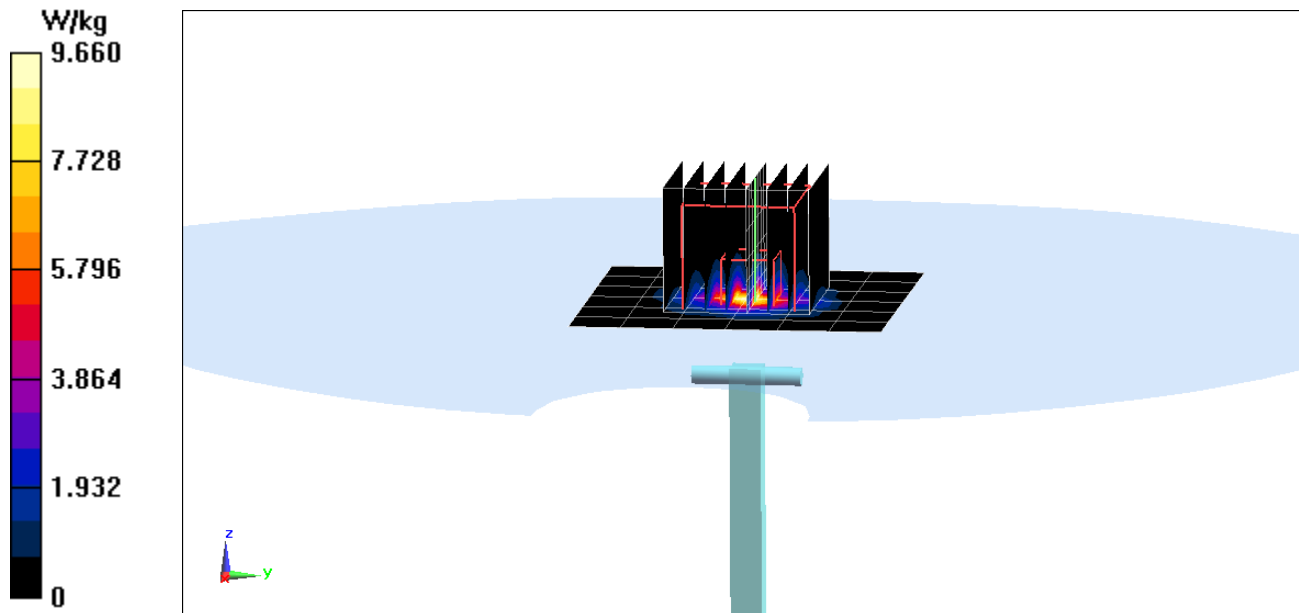
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 17.5 W/kg

SAR(1 g) = 4.02 W/kg

Deviation(1 g) = -3.48%



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: 5GHz Head Medium parameters used (interpolated):

$f = 5750 \text{ MHz}$; $\sigma = 5.026 \text{ S/m}$; $\epsilon_r = 34.479$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-03-2017; Ambient Temp: 21.5°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN3914; ConvF(4.91, 4.91, 4.91); Calibrated: 2/13/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

5750 MHz System Verification at 17.0 dBm (50 mW)

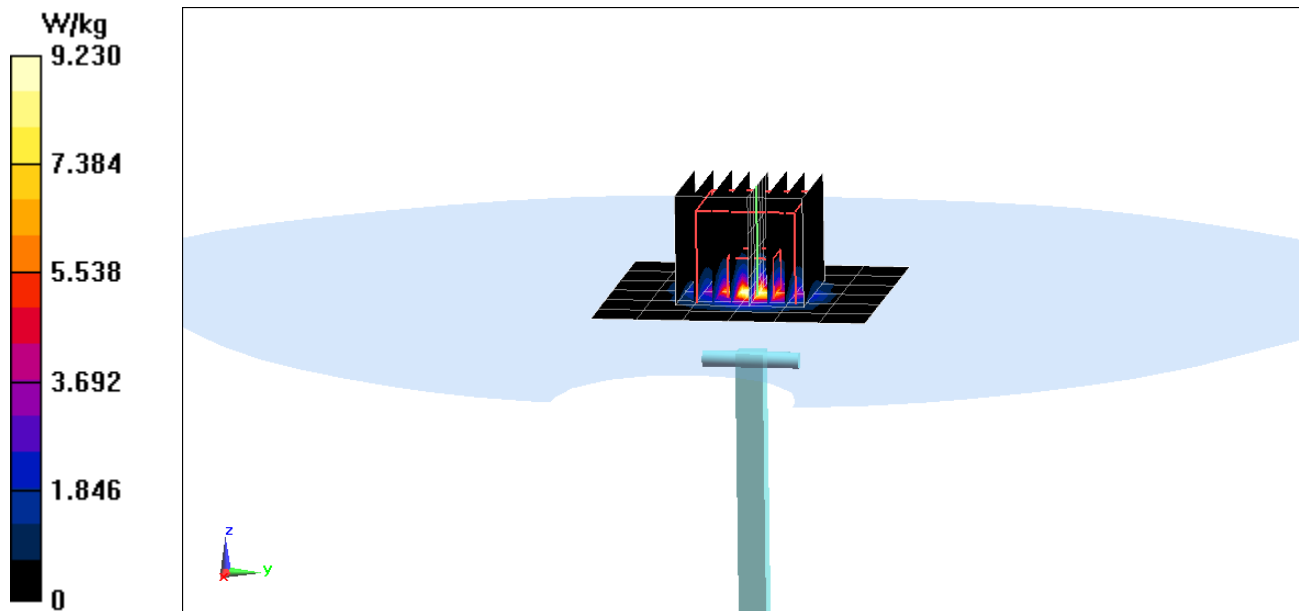
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

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) = 3.77 W/kg

Deviation(1 g) = -7.48%



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 Body Medium parameters used (interpolated):

$f = 750 \text{ MHz}$; $\sigma = 0.965 \text{ S/m}$; $\epsilon_r = 55.501$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-04-2017; Ambient Temp: 22.9°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3319; ConvF(6.37, 6.37, 6.37); Calibrated: 03/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 03/08/2017

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

750 MHz System Verification at 23.0 dBm (200 mW)

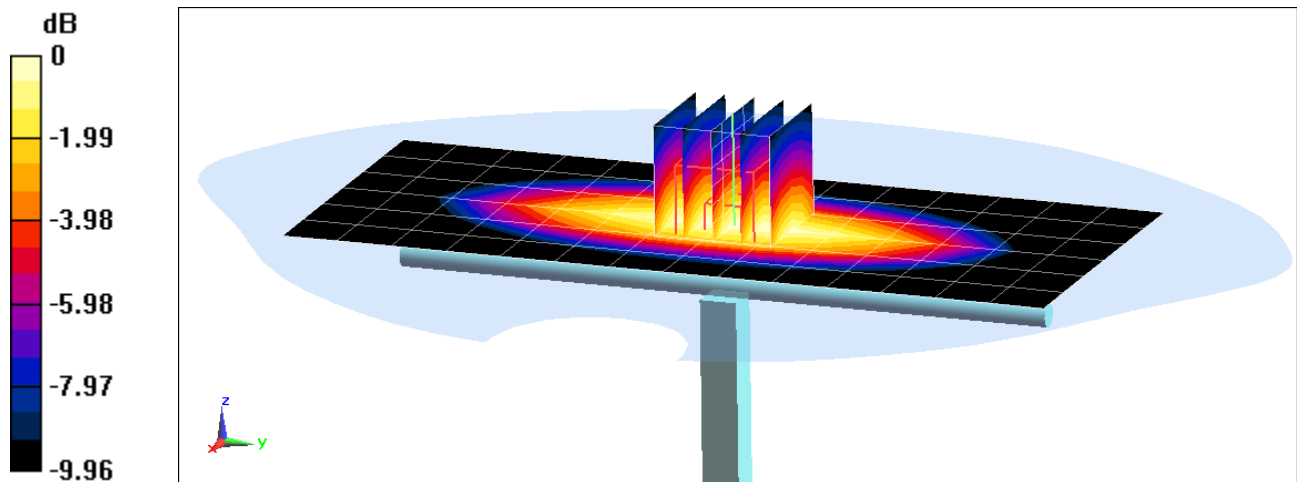
Area Scan (7x15x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 2.54 W/kg

SAR(1 g) = 1.75 W/kg

Deviation(1 g) = 3.80%



0 dB = 2.03 W/kg = 3.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d180

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

Medium: 835 Body Medium parameters used:

$f = 835 \text{ MHz}$; $\sigma = 1.008 \text{ S/m}$; $\epsilon_r = 54.953$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-13-2017; Ambient Temp: 21.1°C; Tissue Temp: 20.0°C

Probe: EX3DV4 - SN7406; ConvF(9.77, 9.77, 9.77); Calibrated: 4/18/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/11/2017

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

835 MHz System Verification at 23.0 dBm (200 mW)

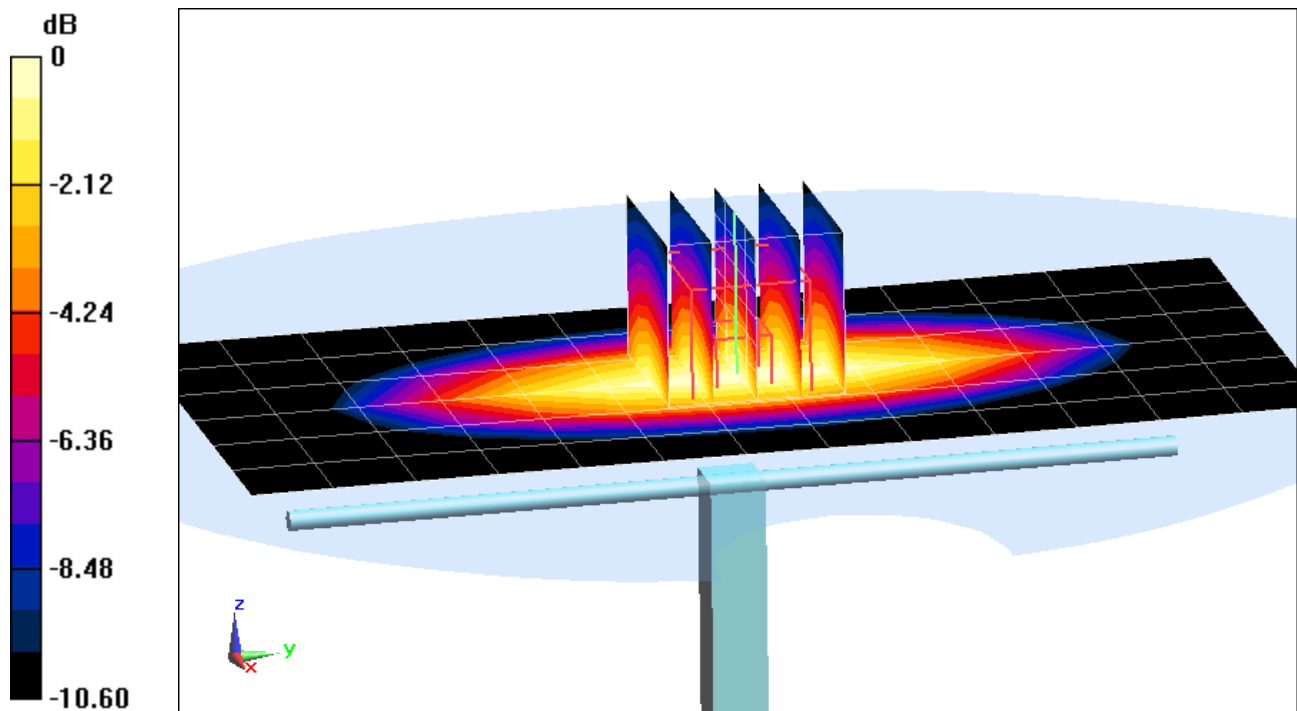
Area Scan (7x14x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 3.16 W/kg

SAR(1 g) = 2.06 W/kg

Deviation (1 g) = 7.18%



PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.52 \text{ S/m}$; $\epsilon_r = 51.488$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-17-2017; Ambient Temp: 22.4°C; Tissue Temp: 20.3°C

Probe: ES3DV3 - SN3318; ConvF(5.12, 5.12, 5.12); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

1750 MHz System Verification at 20.0 dBm (100 mW)

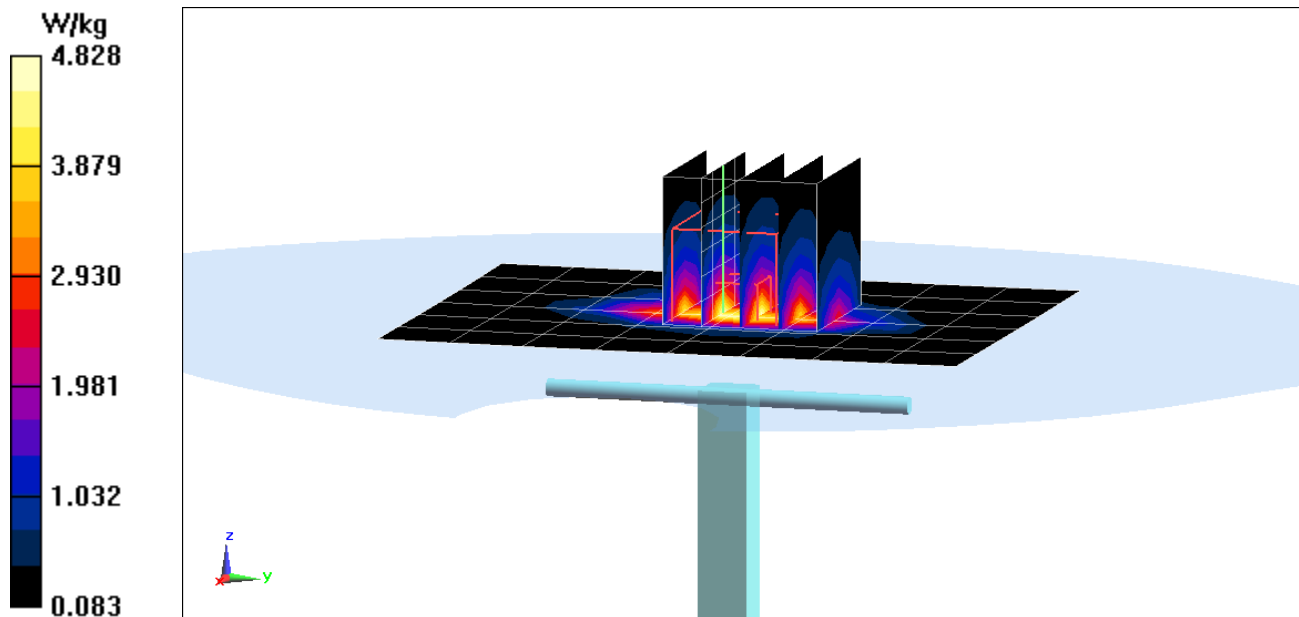
Area Scan (7x9x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 6.89 W/kg

SAR(1 g) = 3.88 W/kg

Deviation(1 g) = 4.86%



PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d148

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

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.544 \text{ S/m}$; $\epsilon_r = 51.971$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-04-2017; Ambient Temp: 21.1°C; Tissue Temp: 21.7°C

Probe: ES3DV3 - SN3209; ConvF(4.93, 4.93, 4.93); Calibrated: 03/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1415; Calibrated: 03/13/2017

Phantom: SAM with CRP v4.0 Left; Type: QD000P40CD; Serial: TP:1692

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

1900 MHz System Verification at 20.0 dBm (100 mW)

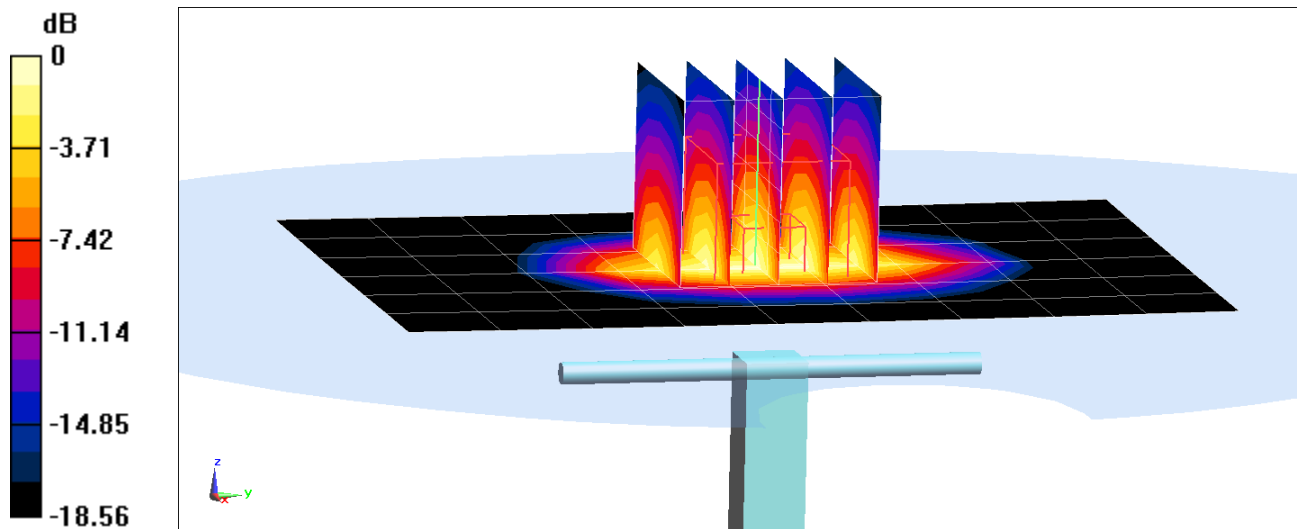
Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 7.10 W/kg

SAR(1 g) = 3.92 W/kg

Deviation(1 g) = -4.16%



0 dB = 5.00 W/kg = 6.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d026

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

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.581 \text{ S/m}$; $\epsilon_r = 52.063$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-18-2017; Ambient Temp: 22.0°C; Tissue Temp: 20.4°C

Probe: ES3DV3 - SN3213; ConvF(4.94, 4.94, 4.94); Calibrated: 2/10/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1272; Calibrated: 2/9/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

1900 MHz System Verification at 20.0 dBm (100 mW)

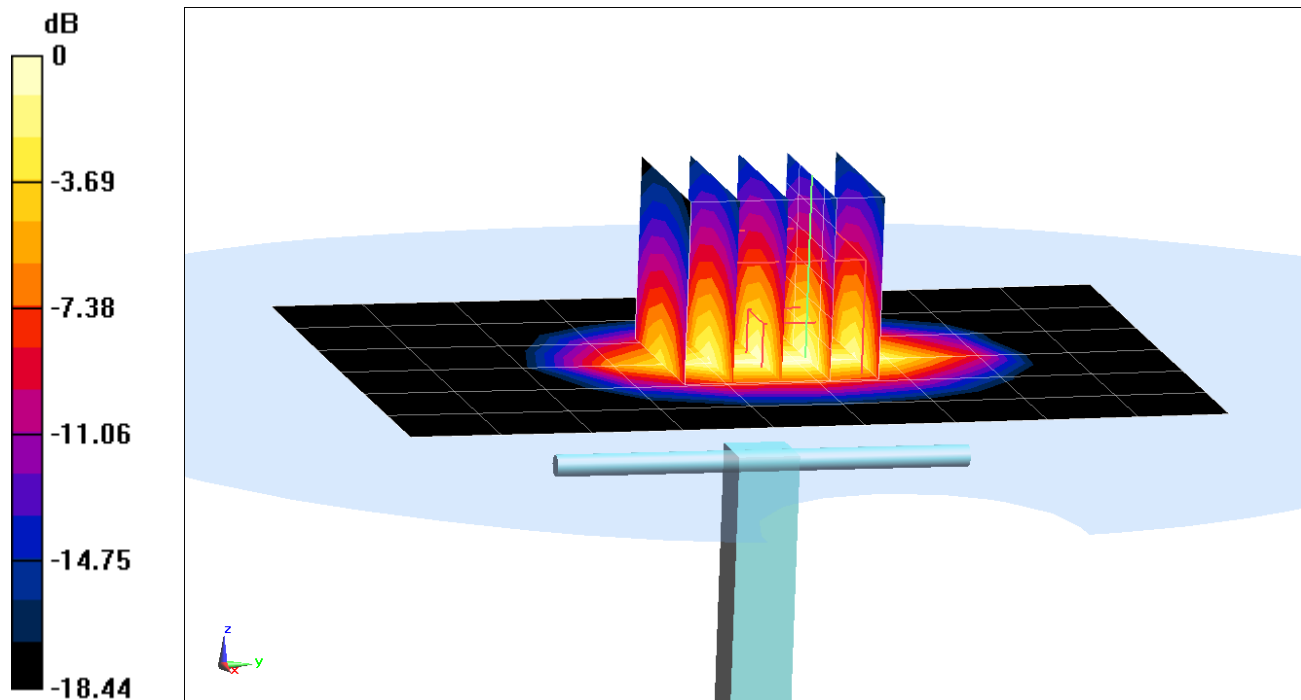
Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 7.34 W/kg

SAR(1 g) = 4.07 W/kg

Deviation(1 g) = 0.99%



0 dB = 5.08 W/kg = 7.06 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d148

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

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.578 \text{ S/m}$; $\epsilon_r = 52.161$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-24-2017; Ambient Temp: 22.7°C; Tissue Temp: 22.5°C

Probe: ES3DV3 - SN3319; ConvF(4.88, 4.88, 4.88); Calibrated: 3/14/2017;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 3/8/2017

Phantom: SAM V5.0 Right; Type: QD000P40CD; Serial: 1647

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

1900 MHz System Verification at 20.0 dBm (100 mW)

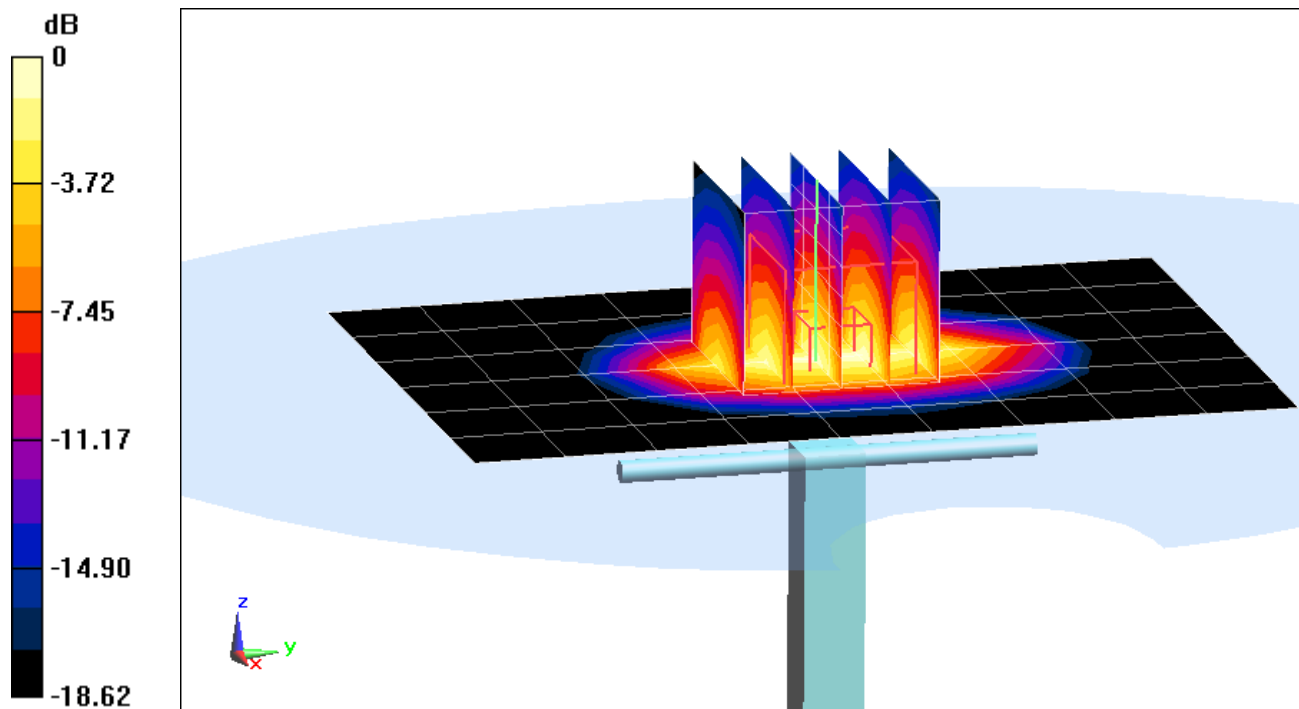
Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Peak SAR (extrapolated) = 7.82 W/kg

SAR(1 g) = 4.27 W/kg

Deviation (1 g) = 4.40%



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

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Body Medium parameters used:

$f = 2450 \text{ MHz}$; $\sigma = 2.033 \text{ S/m}$; $\epsilon_r = 51.829$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-19-2017; Ambient Temp: 22.9°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7406; ConvF(7.6, 7.6, 7.6); Calibrated: 4/18/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/11/2017

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

2450 MHz System Verification at 20.0 dBm (100 mW)

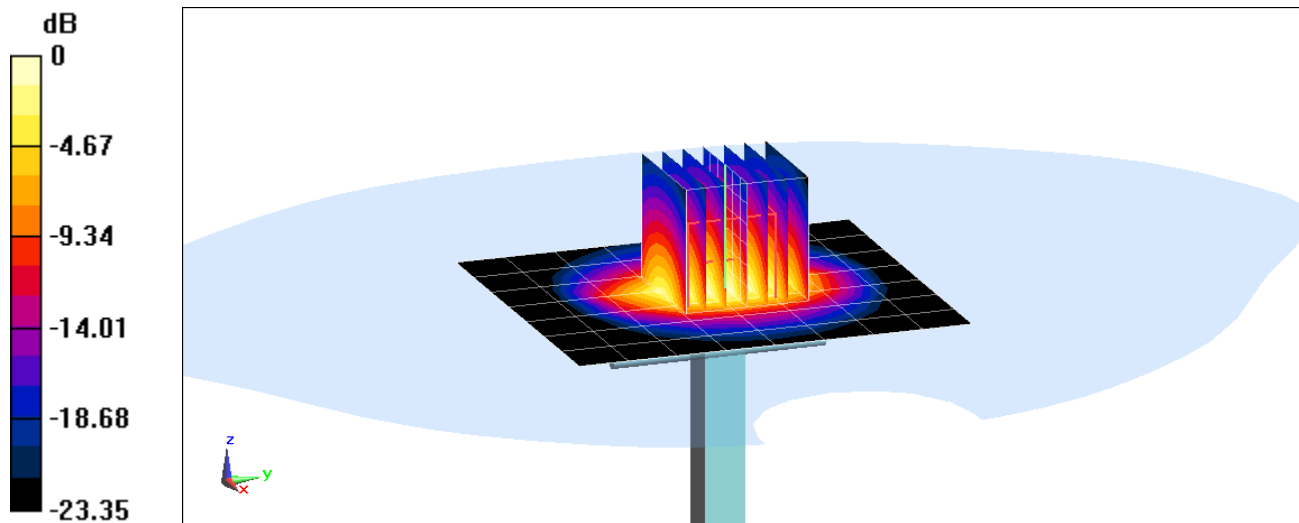
Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

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

Peak SAR (extrapolated) = 11.4 W/kg

SAR(1 g) = 5.22 W/kg

Deviation(1 g) = 2.96%



0 dB = 8.93 W/kg = 9.51 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: 2450 Body Medium parameters used:

$f = 2600 \text{ MHz}$; $\sigma = 2.25 \text{ S/m}$; $\epsilon_r = 51.239$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-19-2017; Ambient Temp: 22.9°C; Tissue Temp: 21.7°C

Probe: EX3DV4 - SN7406; ConvF(7.31, 7.31, 7.31); Calibrated: 4/18/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1407; Calibrated: 4/11/2017

Phantom: SAM Right; Type: QD000P40CD; Serial: TP:7535

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

2600 MHz System Verification at 20.0 dBm (100 mW)

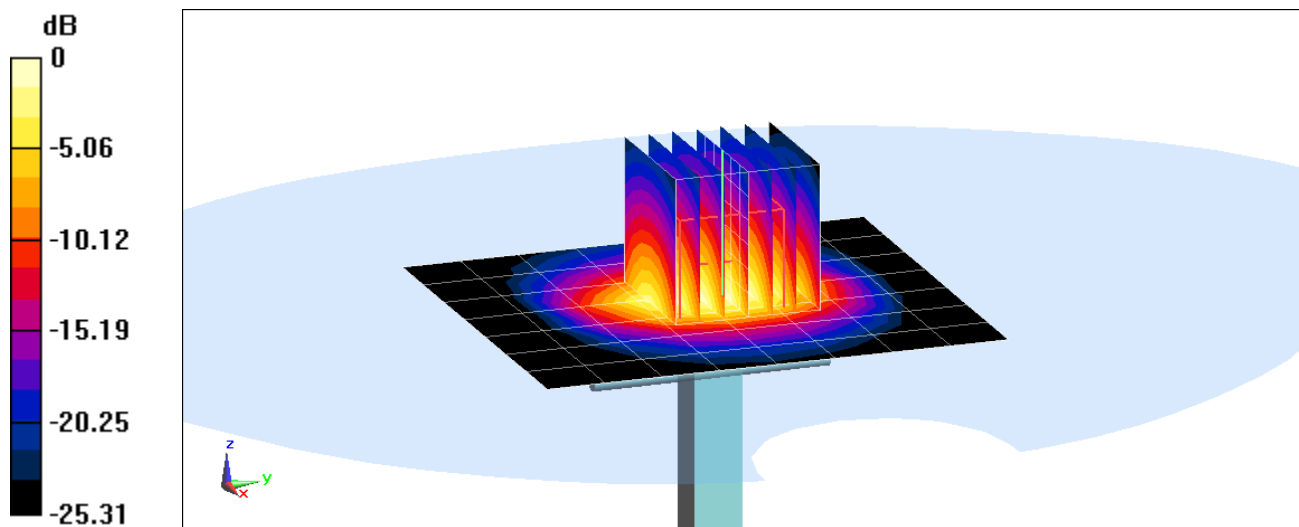
Area Scan (8x9x1): Measurement grid: $dx=12\text{mm}$, $dy=12\text{mm}$

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

Peak SAR (extrapolated) = 12.9 W/kg

SAR(1 g) = 5.64 W/kg

Deviation(1 g) = 4.06%



0 dB = 9.94 W/kg = 9.97 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5250 MHz; Duty Cycle: 1:1

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

$f = 5250 \text{ MHz}$; $\sigma = 5.433 \text{ S/m}$; $\epsilon_r = 47.755$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-10-2017; Ambient Temp: 22.1°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3589; ConvF(4.19, 4.19, 4.19); Calibrated: 1/13/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/16/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

5250 MHz System Verification at 17.0 dBm (50 mW)

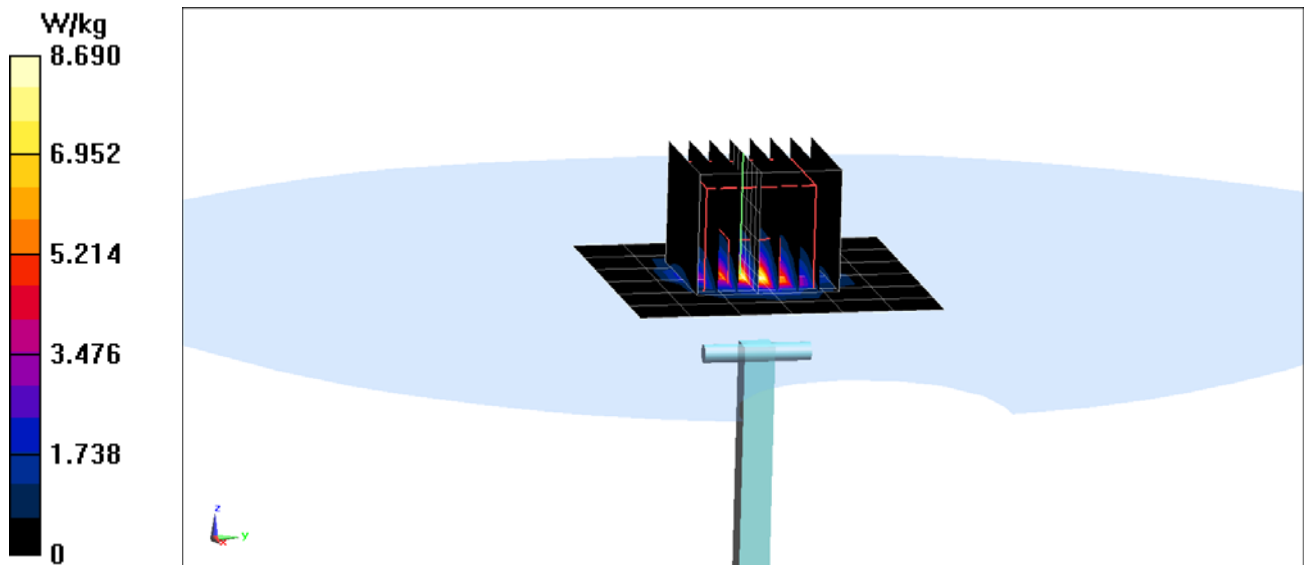
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 15.3 W/kg

SAR(1 g) = 3.61 W/kg

Deviation(1 g) = -4.87%



PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: 5 GHz Body Medium parameters used:

$f = 5600 \text{ MHz}$; $\sigma = 5.912 \text{ S/m}$; $\epsilon_r = 47.149$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-10-2017; Ambient Temp: 22.1°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3589; ConvF(3.82, 3.82, 3.82); Calibrated: 1/13/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/16/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

5600 MHz System Verification at 17.0 dBm (50 mW)

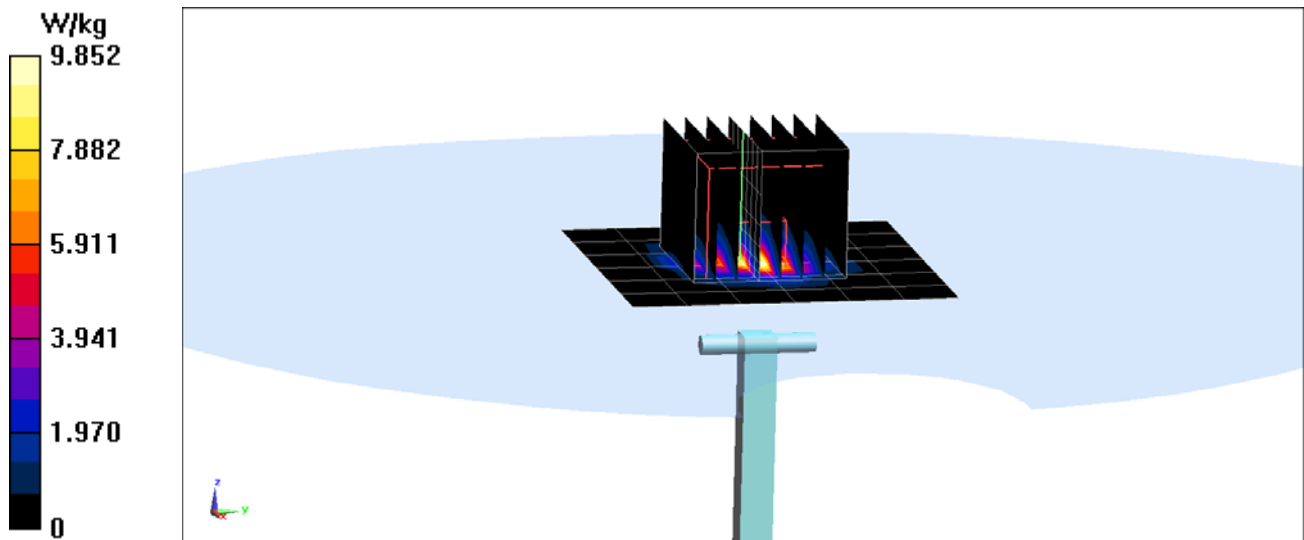
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 18.6 W/kg

SAR(1 g) = 3.97 W/kg

Deviation(1 g) = 0.63%



PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 5750 MHz; Duty Cycle: 1:1

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

$f = 5750 \text{ MHz}$; $\sigma = 6.116 \text{ S/m}$; $\epsilon_r = 46.934$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-10-2017; Ambient Temp: 22.1°C; Tissue Temp: 21.3°C

Probe: EX3DV4 - SN3589; ConvF(3.83, 3.83, 3.83); Calibrated: 1/13/2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1466; Calibrated: 1/16/2017

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

Measurement SW: DASY52, Version 52.10; SEMCAD X Version 14.6.10 (7417)

5750 MHz System Verification at 17.0 dBm (50 mW)

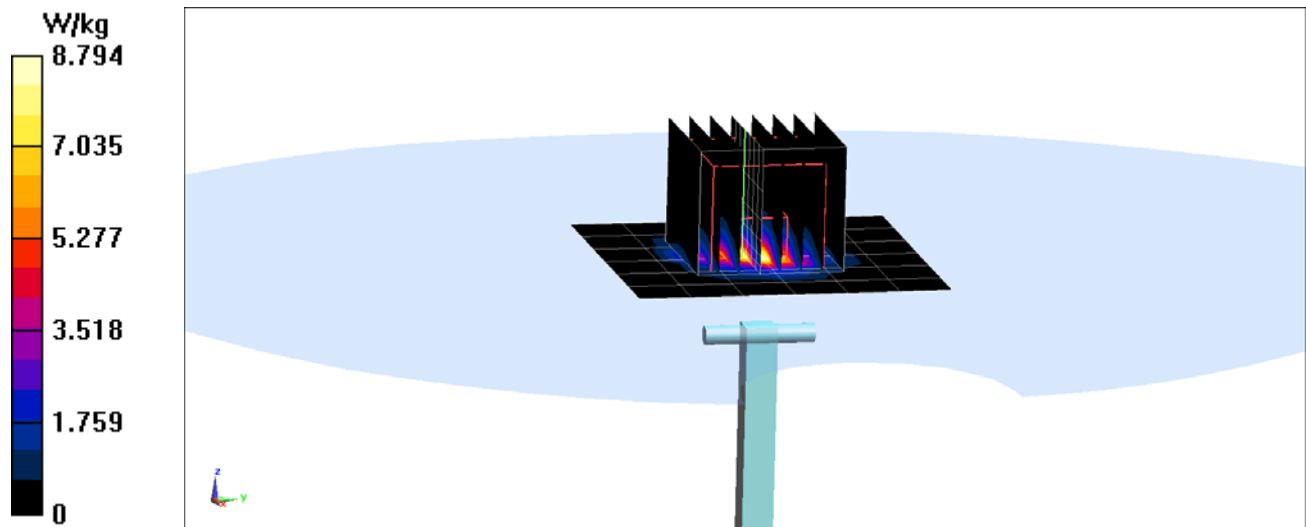
Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio: 1.4

Peak SAR (extrapolated) = 16.1 W/kg

SAR(1 g) = 3.57 W/kg

Deviation(1 g) = -6.42%



APPENDIX C: PROBE CALIBRATION



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Client **PC Test**

Certificate No: **D750V3-1003_Jan17**

CALIBRATION CERTIFICATE

Object **D750V3 - SN:1003**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

BNV
01/26/2017

Calibration date: **January 11, 2017**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ 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	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	04-Jan-17 (No. DAE4-601_Jan17)	Jan-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Jeton Kastrati** Name: **Jeton Kastrati** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Function: **Technical Manager**

Signature

Issued: January 11, 2017

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 62209-1, "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	41.6 $\pm$ 6 %	0.89 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	2.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.39 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	1.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.43 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	54.2 $\pm$ 6 %	0.96 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	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.79 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	1.45 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.78 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	54.3 Ω - 1.4 j Ω
Return Loss	- 27.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.4 Ω - 6.0 j Ω
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.034 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 21, 2009

DASY5 Validation Report for Head TSL

Date: 11.01.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.89 \text{ S/m}$; $\epsilon_r = 41.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(10.17, 10.17, 10.17); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

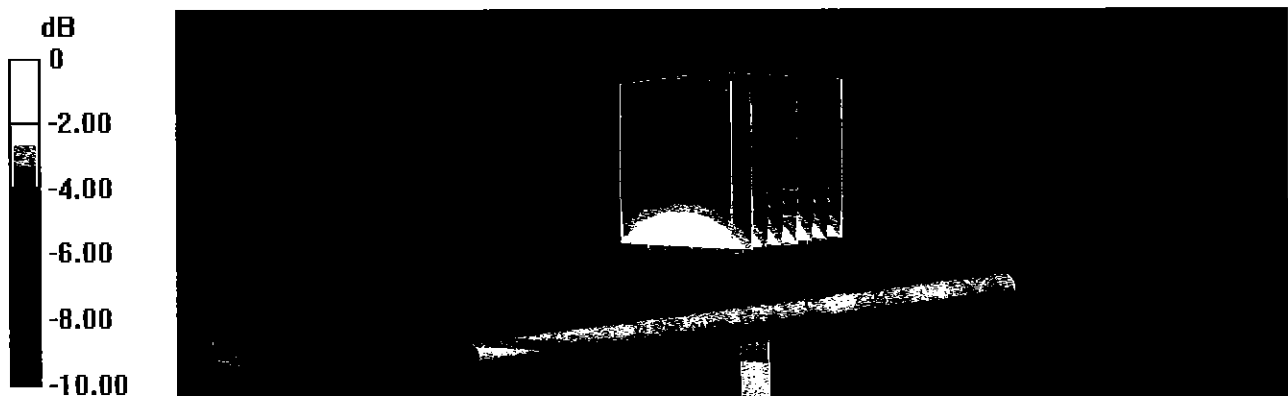
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 59.38 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.20 W/kg

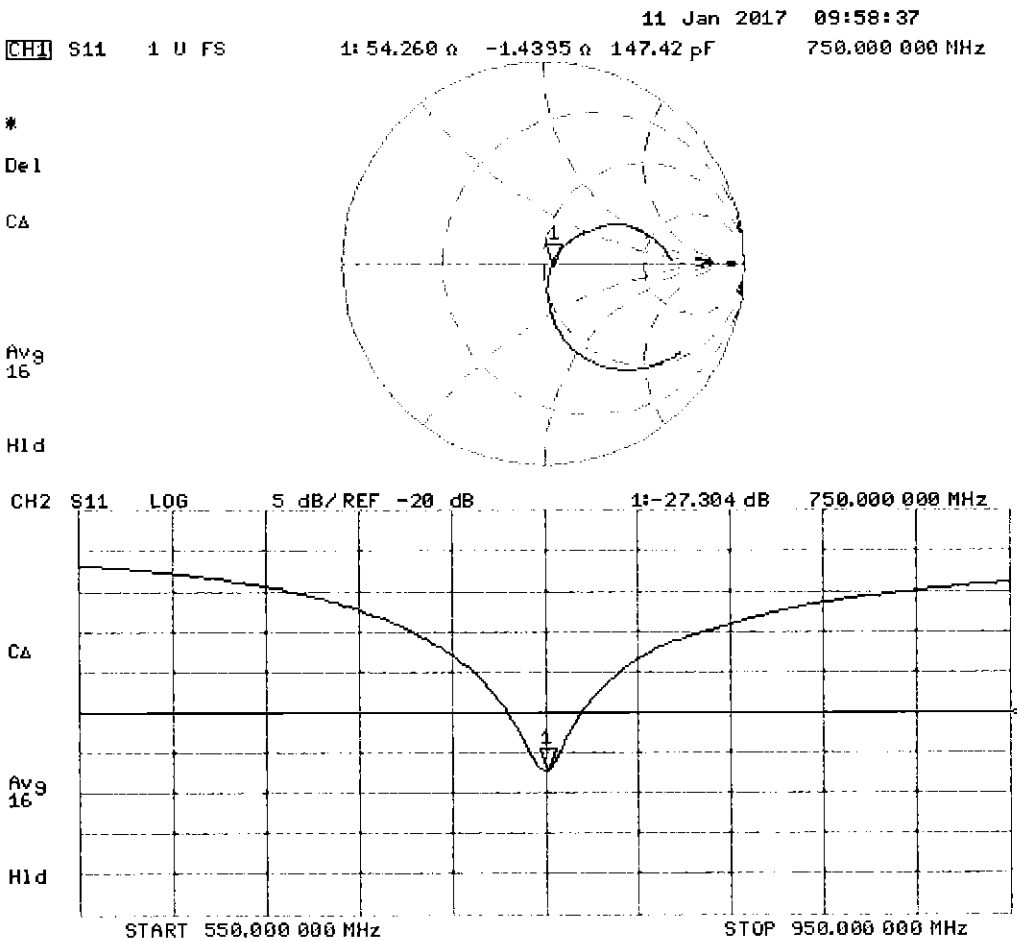
SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.36 W/kg

Maximum value of SAR (measured) = 2.82 W/kg



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

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 10.01.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1003

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.96 \text{ S/m}$; $\epsilon_r = 54.2$; $\rho = 1000 \text{ kg/m}^3$

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: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

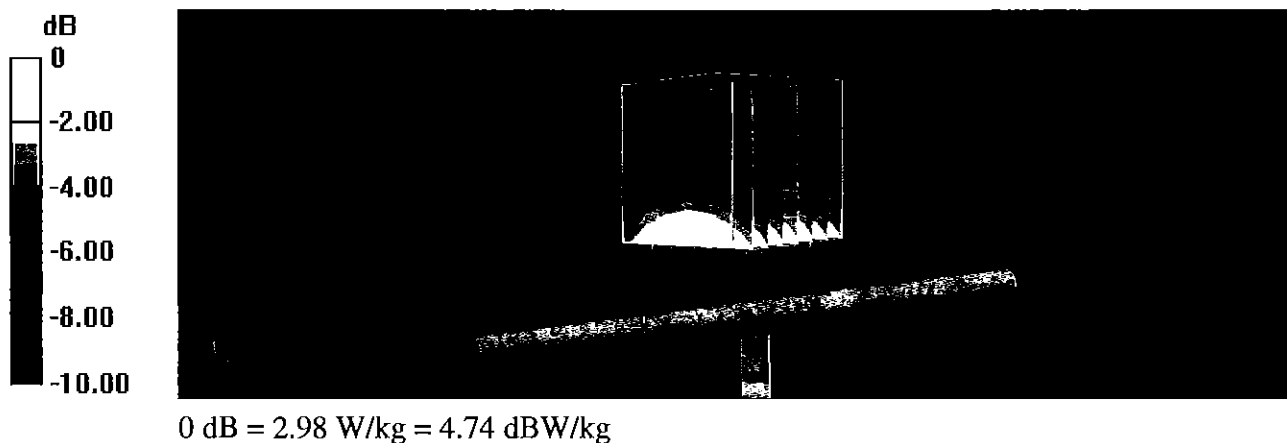
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 58.22 V/m; Power Drift = -0.02 dB

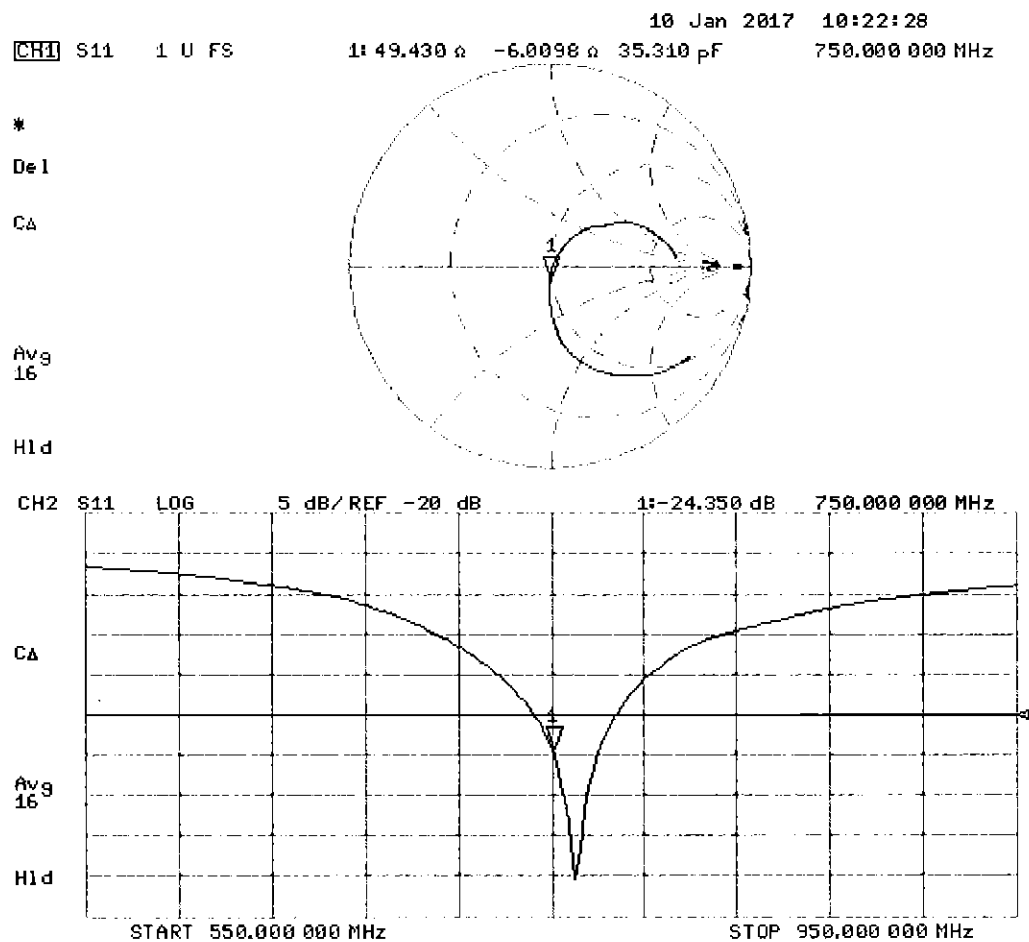
Peak SAR (extrapolated) = 3.40 W/kg

SAR(1 g) = 2.21 W/kg; SAR(10 g) = 1.45 W/kg

Maximum value of SAR (measured) = 2.98 W/kg



Impedance Measurement Plot for Body TSL





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: **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

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
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	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:

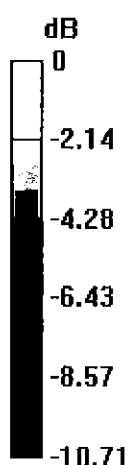
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

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

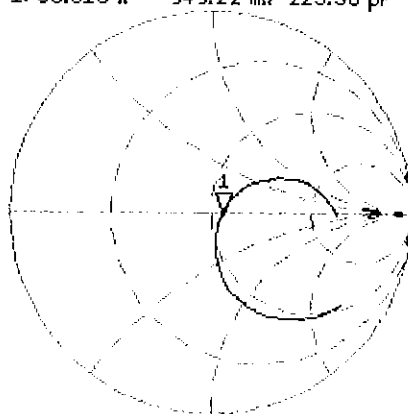


0 dB = 2.80 W/kg = 4.47 dBW/kg

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

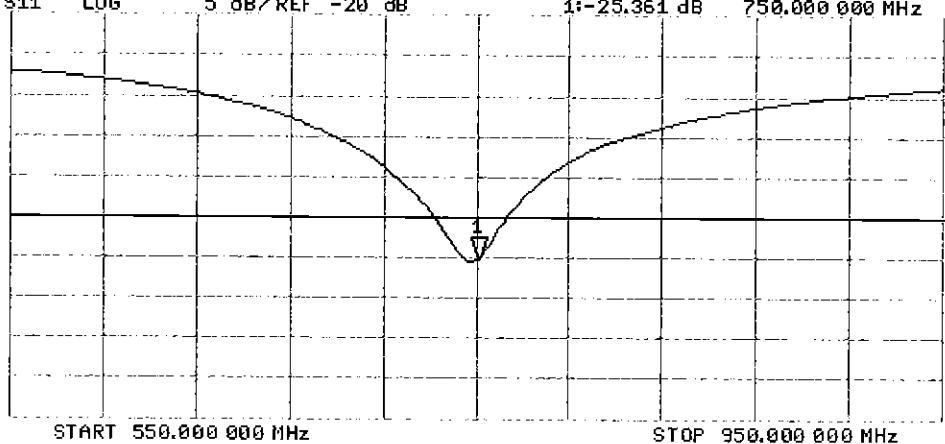
H1d

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: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

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

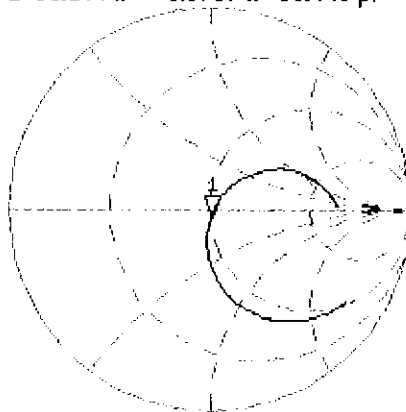


0 dB = 2.87 W/kg = 4.58 dBW/kg

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

*
 Del
 CA

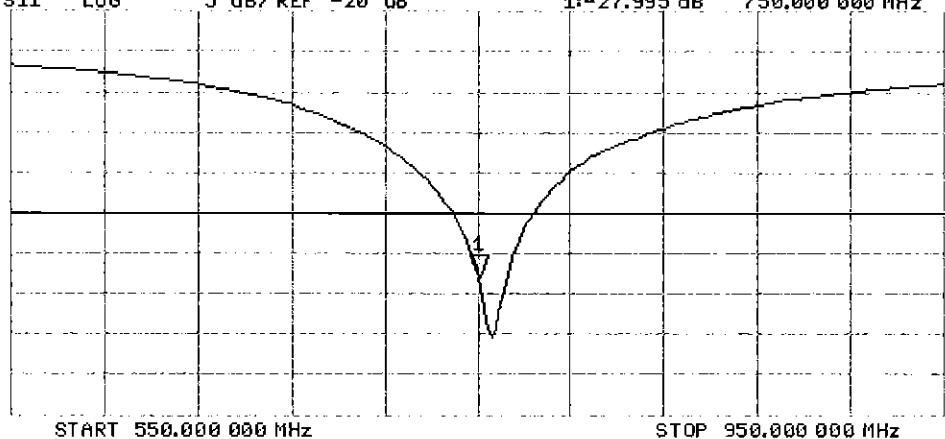


Avg
 16

H1d

CH2 S11 LOG 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
 Function
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**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 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: $f = 835$ MHz; $\sigma = 0.94$ S/m; $\epsilon_r = 40.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

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

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

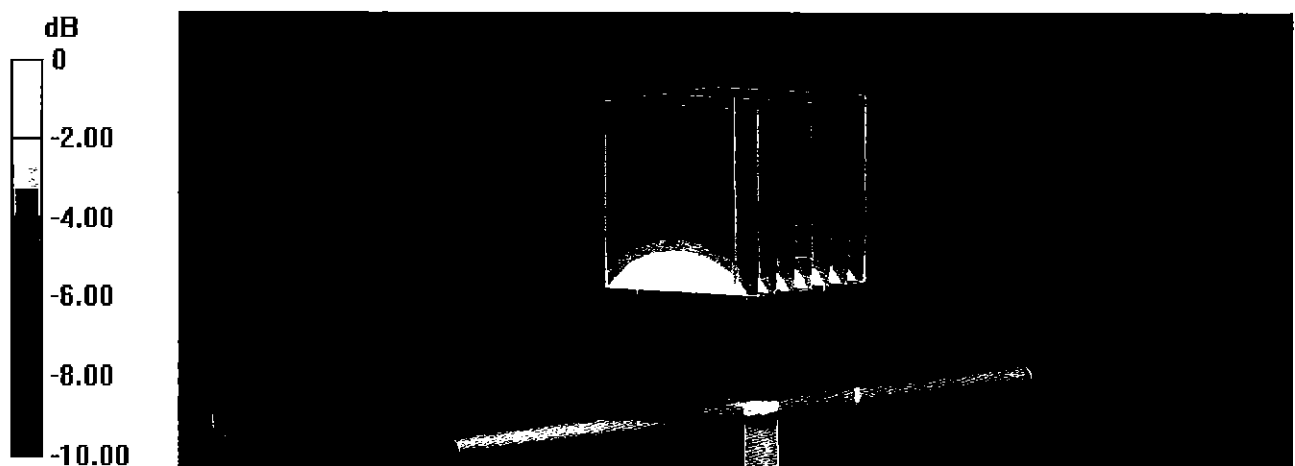
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 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

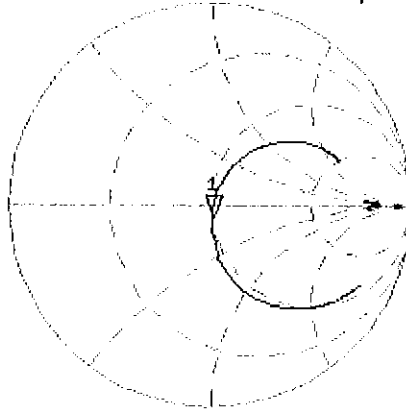


0 dB = 3.17 W/kg = 5.01 dBW/kg

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

*
 Del
 CA



Avg
 16

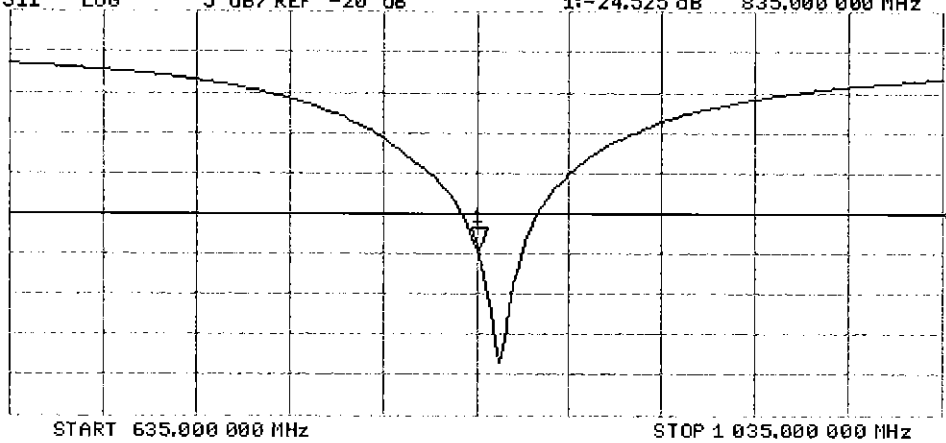
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-24.525 dB 835.000 000 MHz

CA

Avg
 16

H1d



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

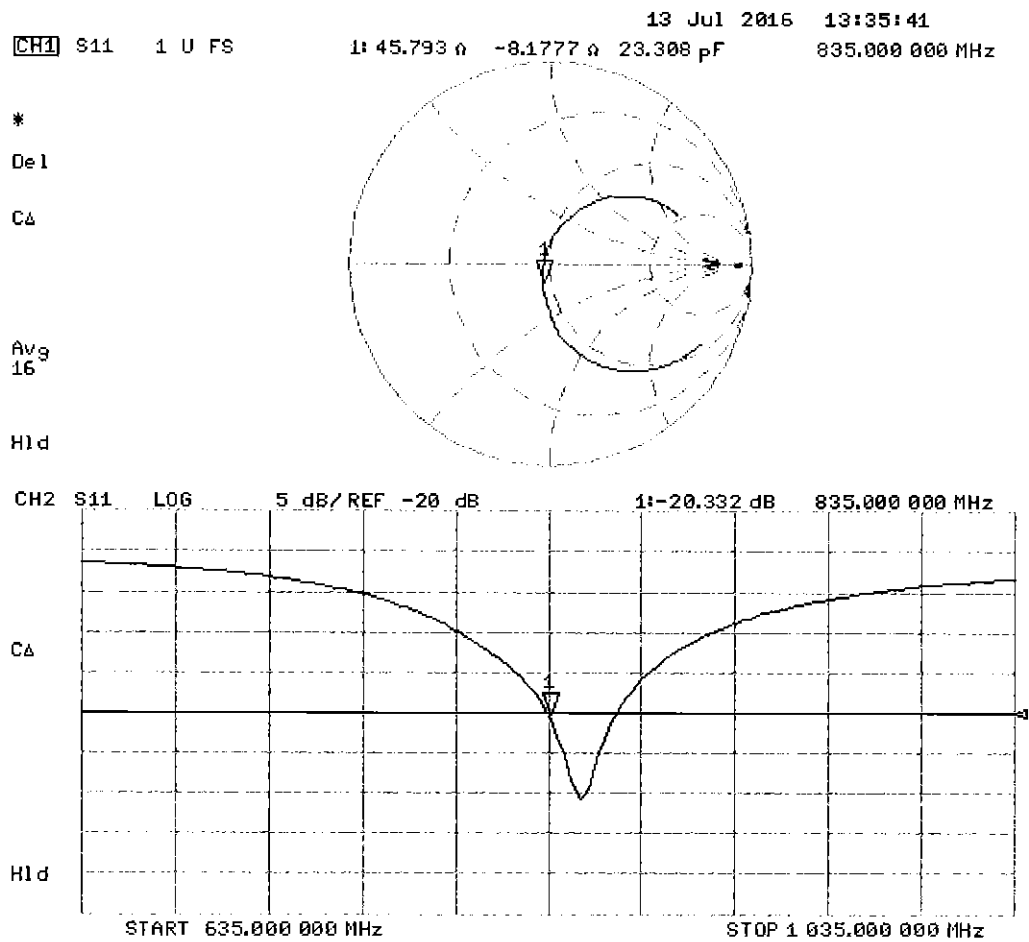
Peak SAR (extrapolated) = 3.67 W/kg

SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.6 W/kg

Maximum value of SAR (measured) = 3.27 W/kg



Impedance Measurement Plot for Body TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D835V2-4d180_May17**

CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d180**

*BN ✓
05-23-2017*

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **May 11, 2017**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Johannes Kurikka** Function: **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** Technical Manager

[Signatures]

Issued: May 11, 2017

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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	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	40.8 $\pm$ 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	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.26 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	1.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.07 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	55.2 $\pm$ 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	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.61 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	6.32 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	51.9 Ω - 5.0 j Ω
Return Loss	- 25.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7 Ω - 8.6 j Ω
Return Loss	- 20.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.393 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 24, 2014

DASY5 Validation Report for Head TSL

Date: 11.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d180

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.94 \text{ S/m}$; $\epsilon_r = 40.8$; $\rho = 1000 \text{ kg/m}^3$

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: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.0(1444); SEMCAD X 14.6.10(7416)

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

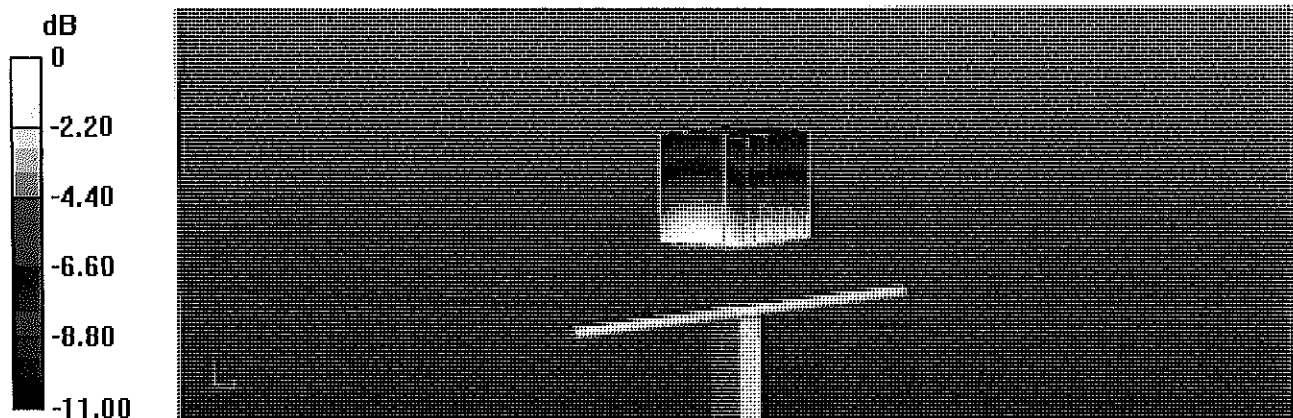
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 62.02 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.58 W/kg

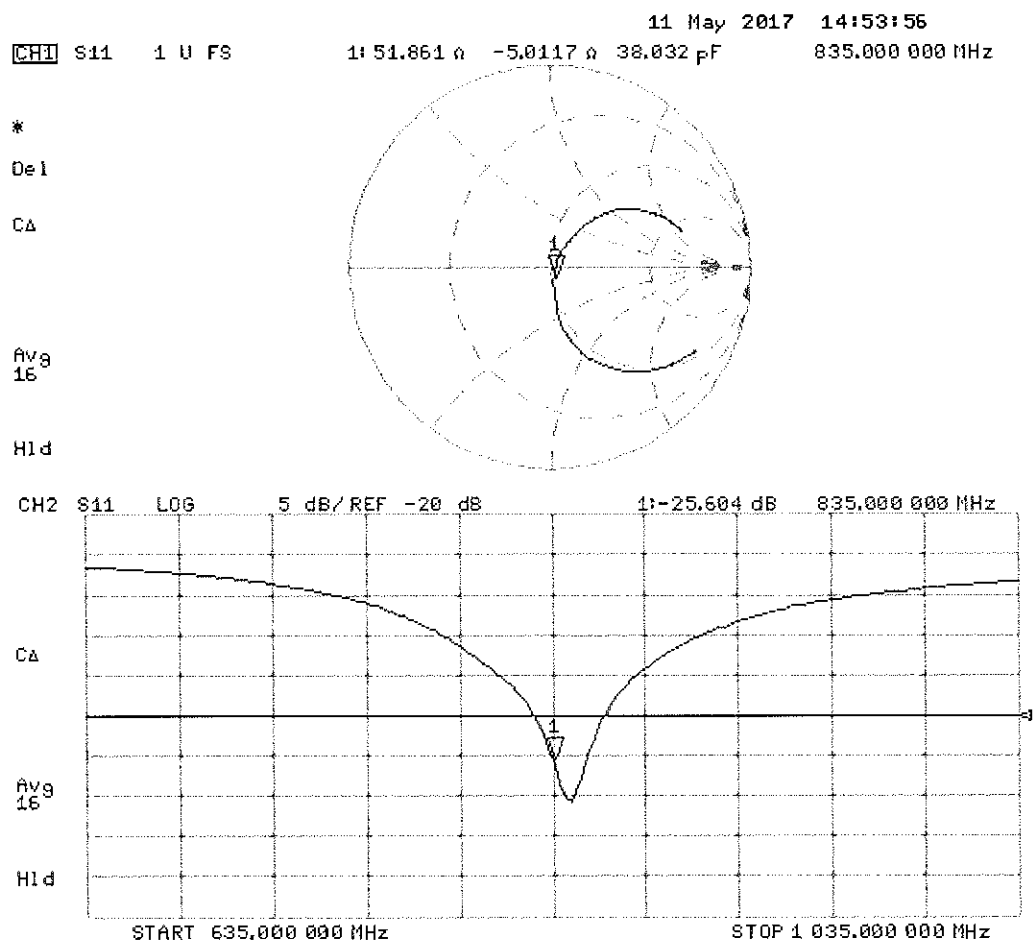
SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 3.21 W/kg



0 dB = 3.21 W/kg = 5.07 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d180

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 0.99$ S/m; $\epsilon_r = 55.2$; $\rho = 1000$ 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: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.0(1444); SEMCAD X 14.6.10(7416)

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

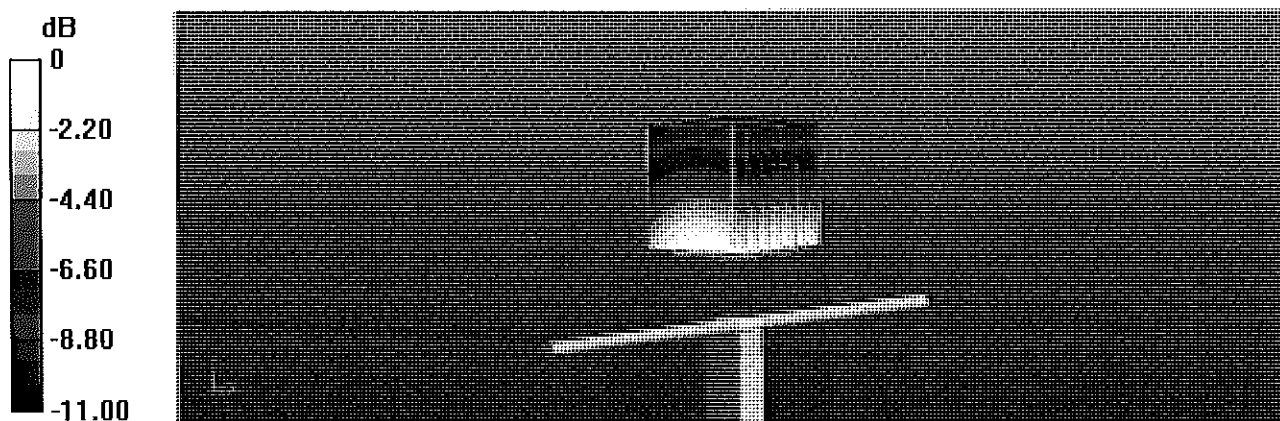
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.10 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.58 W/kg

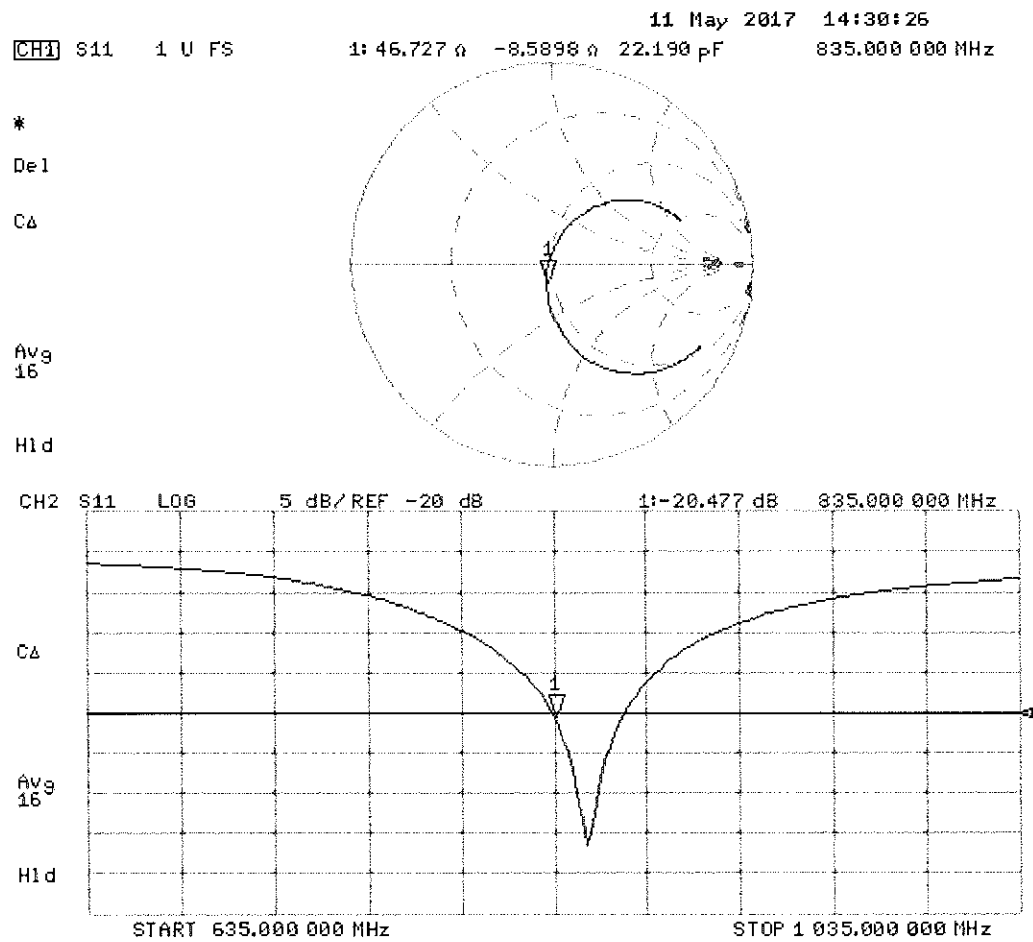
SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.6 W/kg

Maximum value of SAR (measured) = 3.19 W/kg



0 dB = 3.19 W/kg = 5.04 dBW/kg

Impedance Measurement Plot for Body TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1750V2-1150_Jul16**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1150**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

✓ PM
8/9/16

Calibration date: **July 14, 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: July 14, 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	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	38.8 $\pm$ 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	9.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.1 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	4.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.4 $\pm$ 6 %	1.48 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	36.5 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	4.85 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.5 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	$50.9 \Omega + 0.4 j\Omega$
Return Loss	- 40.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$46.4 \Omega - 0.5 j\Omega$
Return Loss	- 28.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.218 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	April 10, 2015

DASY5 Validation Report for Head TSL

Date: 14.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN:1150

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 38.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.46, 8.46, 8.46); 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:

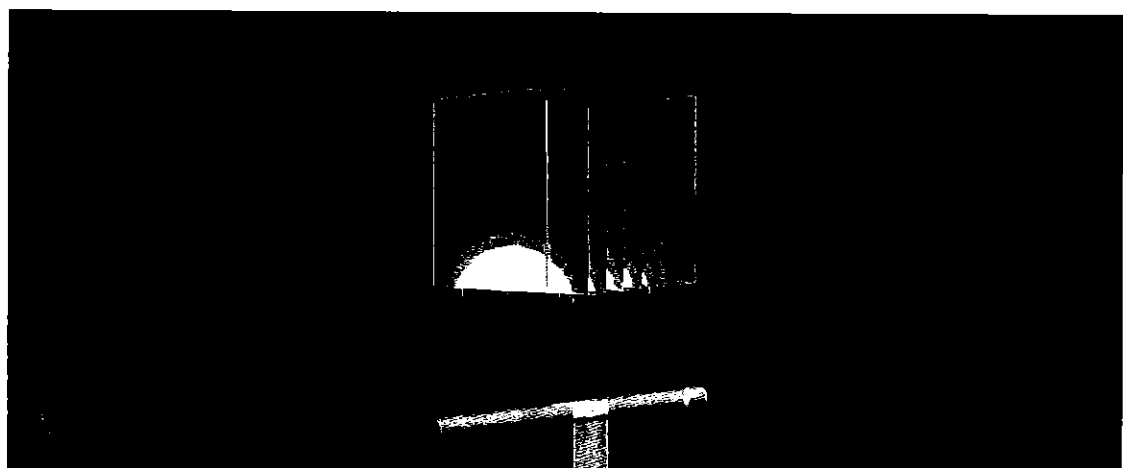
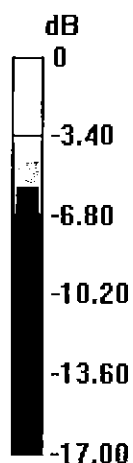
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.4 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 16.6 W/kg

SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.8 W/kg

Maximum value of SAR (measured) = 13.9 W/kg

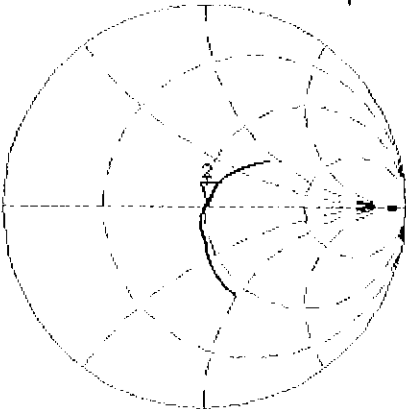


0 dB = 13.9 W/kg = 11.43 dBW/kg

Impedance Measurement Plot for Head TSL

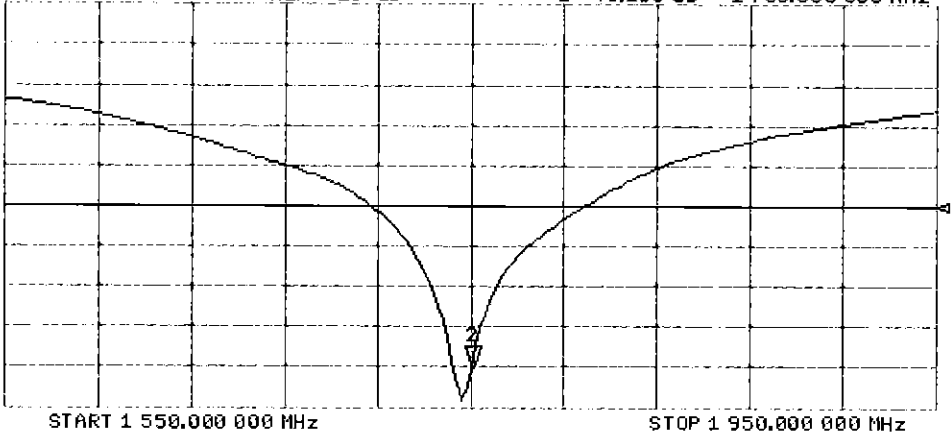
14 Jul 2016 13:09:21
[CH1] S11 1 U FS 2: 50.889 Ω 0.4121 Ω 37.479 pF 1 750.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 2:-40.230 dB 1 750.000 000 MHz

CA
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 14.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN:1150

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.48$ S/m; $\epsilon_r = 53.4$; $\rho = 1000$ 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: 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:

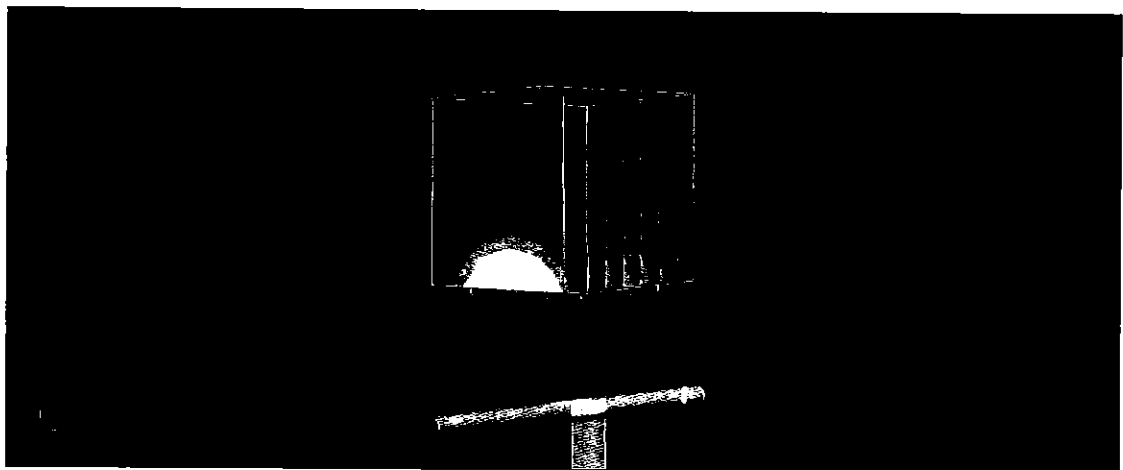
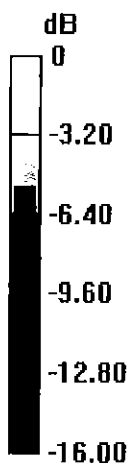
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.4 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 16.0 W/kg

SAR(1 g) = 9.09 W/kg; SAR(10 g) = 4.85 W/kg

Maximum value of SAR (measured) = 13.7 W/kg

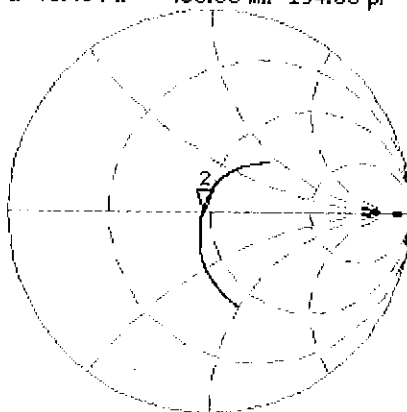


0 dB = 13.7 W/kg = 11.37 dBW/kg

Impedance Measurement Plot for Body TSL

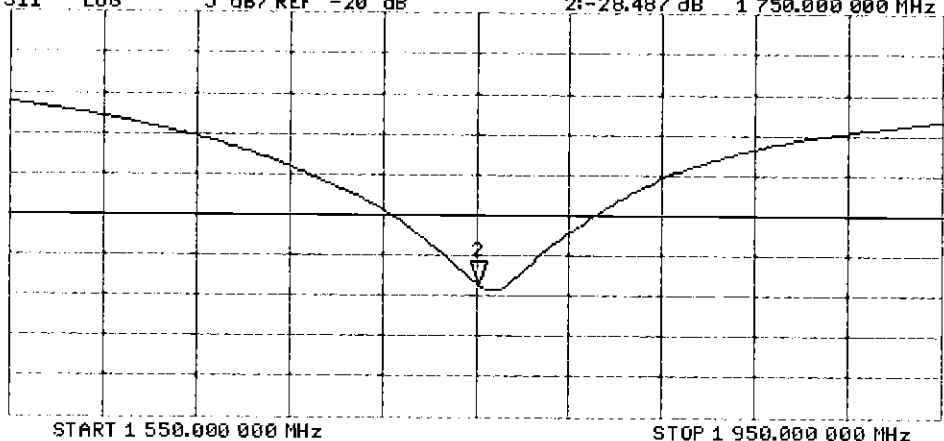
14 Jul 2016 13:08:43
 CH1 S11 1 U FS 2: 46.404 Ω -466.80 m Ω 194.83 pF 1 750.000 000 MHz

*
 Del
 CA
 Avg
 16
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 2:-28.487 dB 1 750.000 000 MHz

CA
 Avg
 16
 H1d





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1750V2-1092_May17**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1092**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **May 09, 2017**

BN ✓
05-23-2017

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ 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	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Claudio Leubler** **Laboratory Technician**

Signature *[Signature]*

Approved by: **Katja Pokovic** **Technical Manager**

[Signature]

Issued: May 11, 2017

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 62209-1, "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	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.0 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.4 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	4.83 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	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.7 $\pm$ 6 %	1.47 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	9.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.0 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	19.8 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	48.9 Ω - 0.5 j Ω
Return Loss	- 38.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.2 Ω - 0.8 j Ω
Return Loss	- 25.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.217 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 07, 2012

DASY5 Validation Report for Head TSL

Date: 09.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.46, 8.46, 8.46); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.0(1442); SEMCAD X 14.6.10(7413)

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

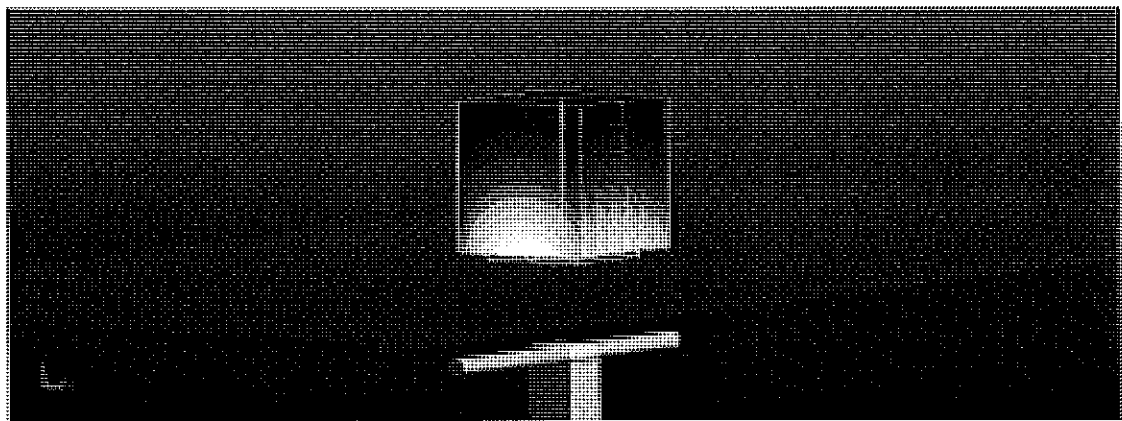
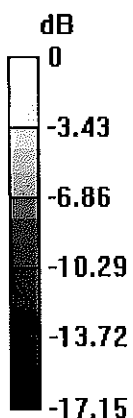
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.6 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 16.5 W/kg

SAR(1 g) = 9.11 W/kg; SAR(10 g) = 4.83 W/kg

Maximum value of SAR (measured) = 13.8 W/kg

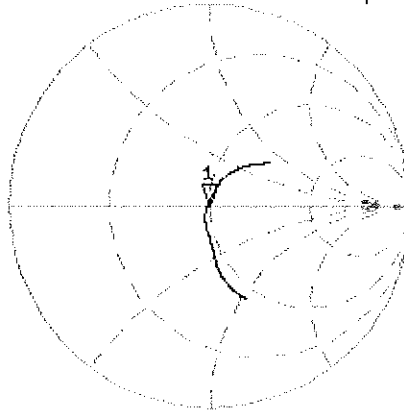


0 dB = 13.8 W/kg = 11.40 dBW/kg

Impedance Measurement Plot for Head TSL

9 May 2017 14:40:22
[CH1] S11 1 U FS 1: 48.926 Ω -480.47 $m\Omega$ 189.29 pF 1 750.000 000 MHz

*
Del
CA



Avg
16

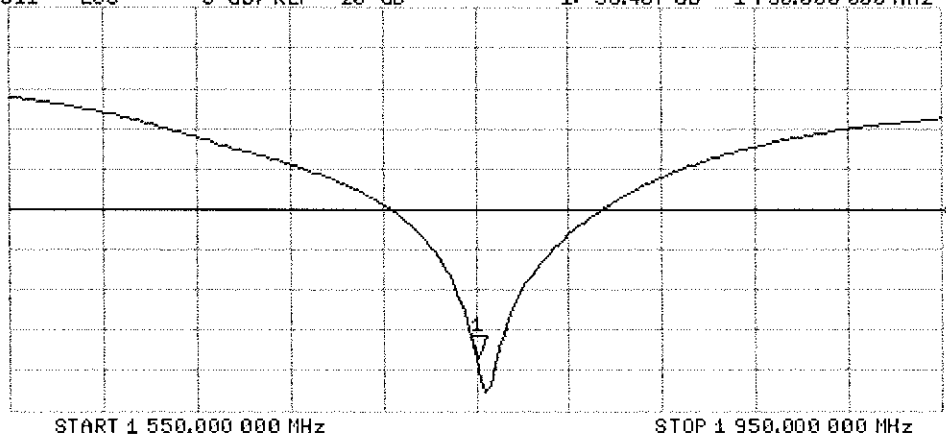
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -38.467 dB 1 750.000 000 MHz

CA

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 09.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.47$ S/m; $\epsilon_r = 53.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.25, 8.25, 8.25); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1442); SEMCAD X 14.6.10(7413)

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

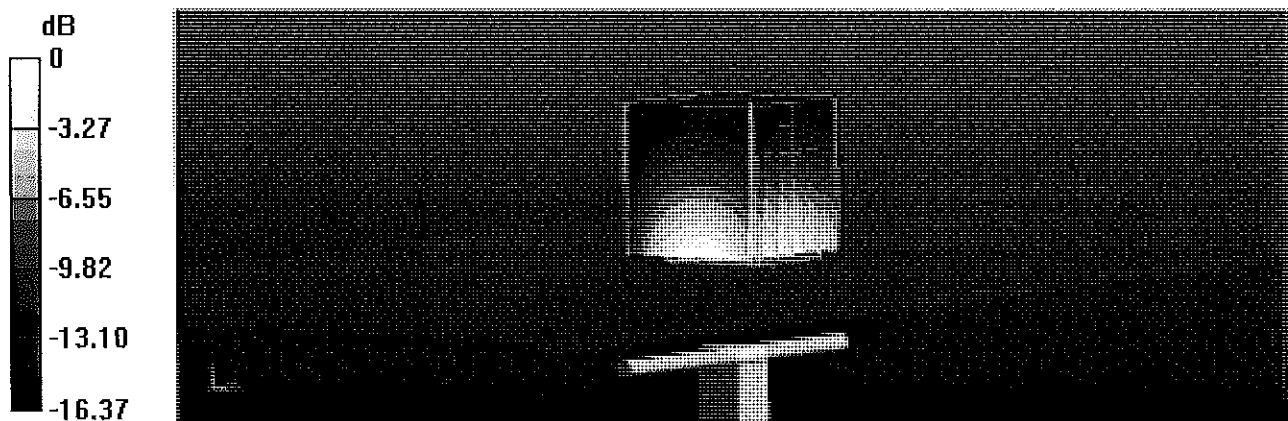
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.81 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 15.8 W/kg

SAR(1 g) = 9.15 W/kg; SAR(10 g) = 4.93 W/kg

Maximum value of SAR (measured) = 13.1 W/kg

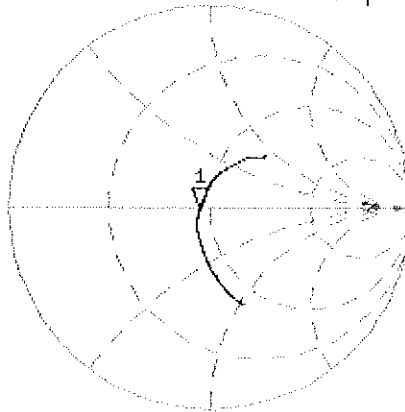


0 dB = 13.1 W/kg = 11.17 dBW/kg

Impedance Measurement Plot for Body TSL

9 May 2017 14:39:51
[CH1] S11 1 U FS 1: 45.234 Ω -765.63 $m\Omega$ 118.79 pF 1 750.000 000 MHz

*
Del
CA



Avg
16

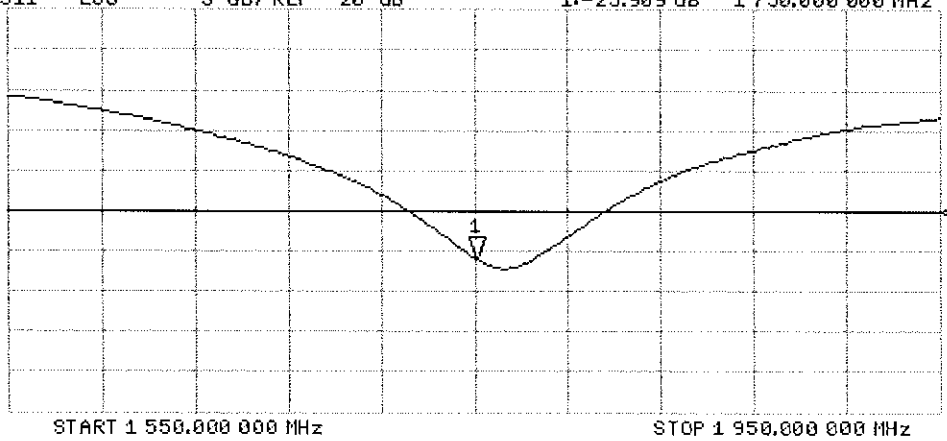
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -25.909 dB 1 750.000 000 MHz

CA

Avg
16

H1d





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1900V2-5d080_Jul16**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d080**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **July 08, 2016**

BN ✓
7/16/2016

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 7349	15-Jun-16 (No. EX3-7349_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

Calibrated by: **Jeton Kastrati** Name **Jeton Kastrati** Function **Laboratory Technician**

Approved by: **Katja Pokovic** Name **Katja Pokovic** Function **Technical Manager**

Signature
[Signature]
[Signature]

Issued: July 13, 2016

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Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- 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	9.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.3 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	5.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.5 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	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	9.75 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.1 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	5.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 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	$52.1 \Omega + 5.3 j\Omega$
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$47.4 \Omega + 6.8 j\Omega$
Return Loss	- 22.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.192 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 28, 2006

DASY5 Validation Report for Head TSL

Date: 08.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ 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:

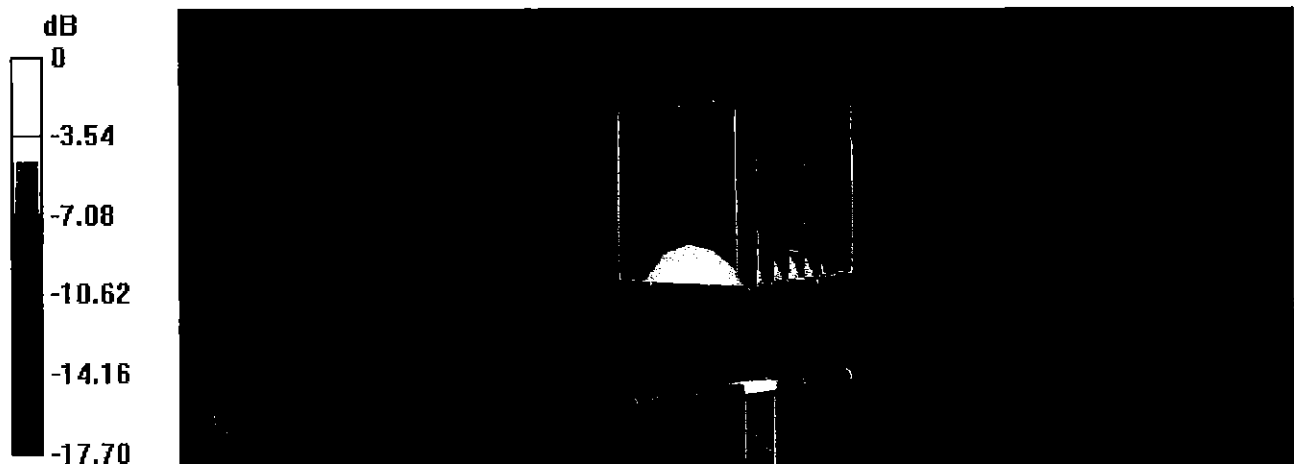
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.6 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 18.4 W/kg

SAR(1 g) = 9.76 W/kg; SAR(10 g) = 5.1 W/kg

Maximum value of SAR (measured) = 15.0 W/kg

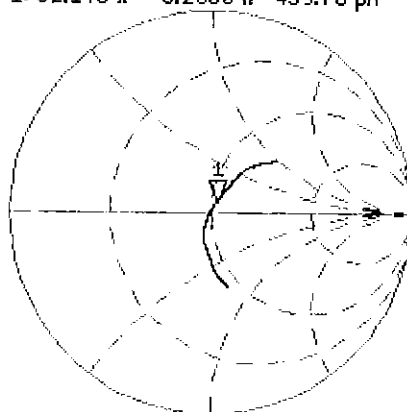


0 dB = 15.0 W/kg = 11.76 dBW/kg

Impedance Measurement Plot for Head TSL

8 Jul 2016 16:18:04
 CH1 S11 1 U FS 1: 52.143 Ω 5.2500 Ω 439.78 μH 1 900.000 000 MHz

*
 Del
 Cor



Avg
 16

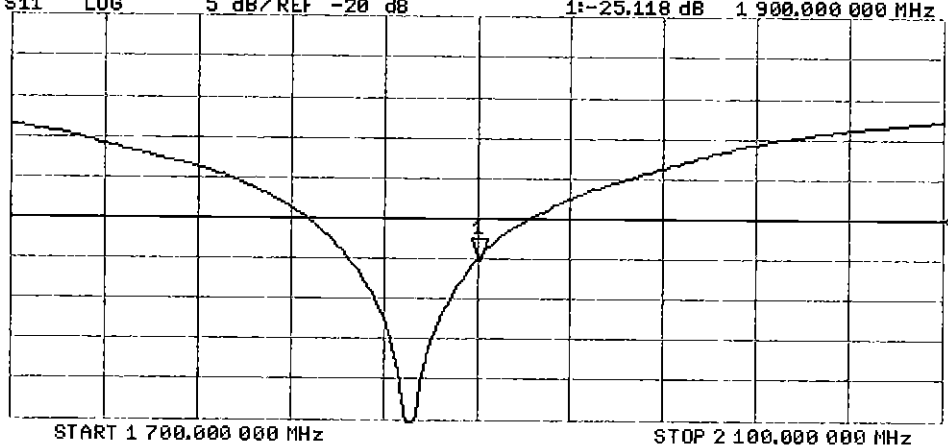
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-25.118 dB 1 900.000 000 MHz

Cor

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 08.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.51$ 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(1258); SEMCAD X 14.6.10(7372)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.1 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 17.1 W/kg

SAR(1 g) = 9.75 W/kg; SAR(10 g) = 5.17 W/kg

Maximum value of SAR (measured) = 14.7 W/kg

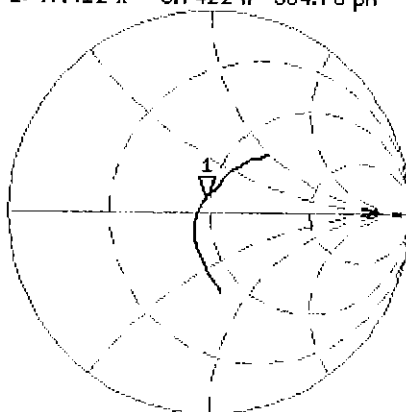


0 dB = 14.7 W/kg = 11.67 dBW/kg

Impedance Measurement Plot for Body TSL

8 Jul 2016 16:16:56
 CH1 S11 1 U FS 1: 47.412 Ω 6.7422 Ω 564.78 μH 1 900.000 000 MHz

*
 Del
 Cor



Avg
 16

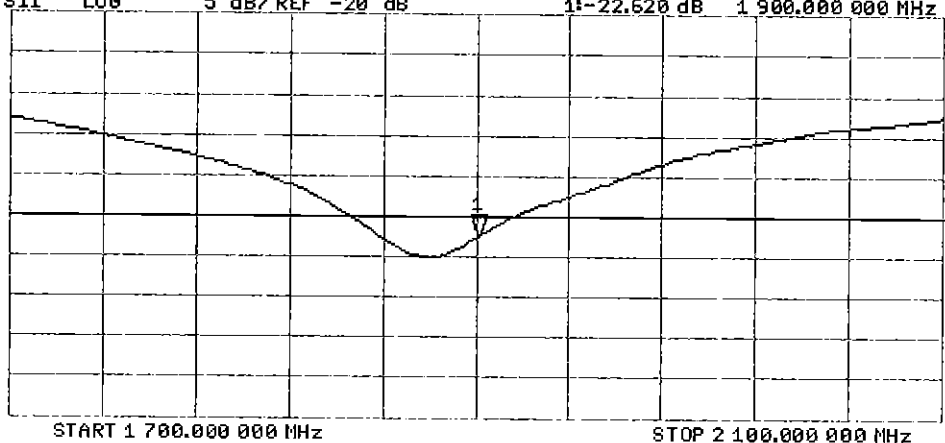
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-22.620 dB 1 900.000 000 MHz

Cor

Avg
 16

H1d





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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1900V2-5d148_Feb17**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d148**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **February 09, 2017**

BNI ✓
03/06/2017

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ 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	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	04-Jan-17 (No. DAE4-601_Jan17)	Jan-18

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

Calibrated by: **Claudio Leubler** **Laboratory Technician**

Approved by: **Katja Pokovic** **Technical Manager**

Signature

Issued: February 10, 2017

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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	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	40.7 $\pm$ 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	9.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.2 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.9 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	54.1 $\pm$ 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	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.9 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	5.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 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	54.1 Ω + 5.8 j Ω
Return Loss	- 23.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω + 7.1 j Ω
Return Loss	- 22.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 09.02.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 40.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.12, 8.12, 8.12); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

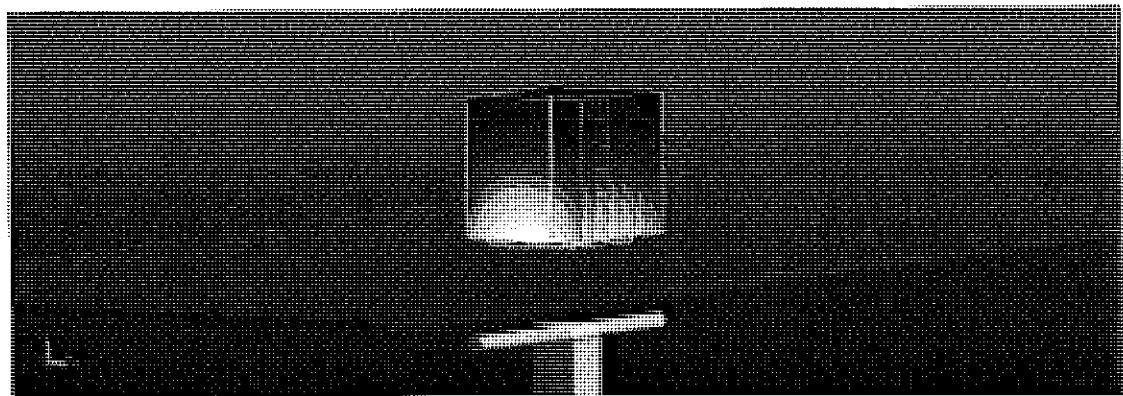
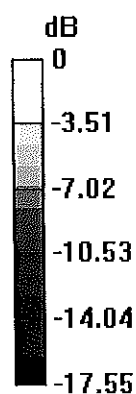
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.8 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 19.2 W/kg

SAR(1 g) = 9.93 W/kg; SAR(10 g) = 5.18 W/kg

Maximum value of SAR (measured) = 15.6 W/kg

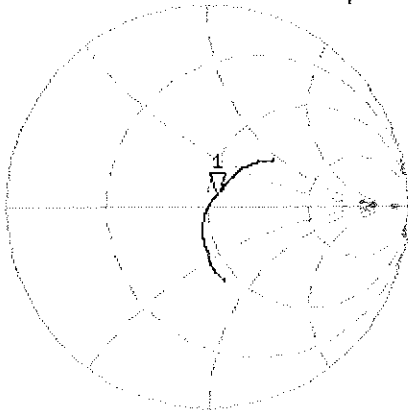


0 dB = 15.6 W/kg = 11.93 dBW/kg

Impedance Measurement Plot for Head TSL

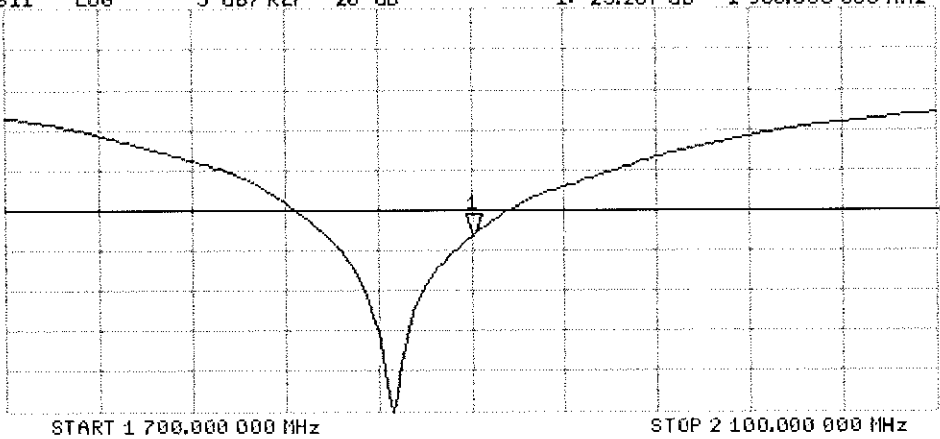
9 Feb 2017 14:46:50
[CH1] S11 1 U FS 1: 54.127 Ω 5.8281 Ω 488.20 μ H 1 900.000 000 MHz

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De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-23.287 dB 1 900.000 000 MHz

CA
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 09.02.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.5$ S/m; $\epsilon_r = 54.1$; $\rho = 1000$ 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: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; 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:

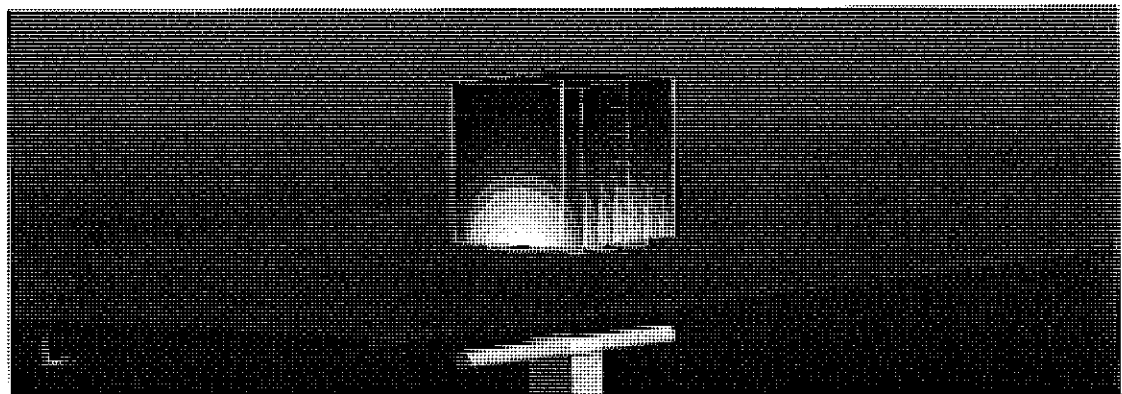
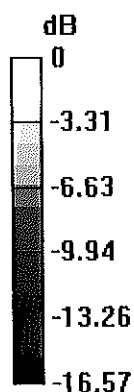
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.3 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 18.1 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.33 W/kg

Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

Impedance Measurement Plot for Body TSL

9 Feb 2017 14:46:18
CH1 S11 1 U FS 1: 48.312 Ω 7.0957 Ω 594.38 μ H 1 900.000 000 MHz

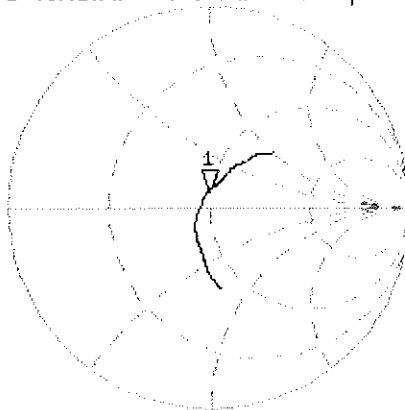
*

De1

CA

Av9
16

H1d

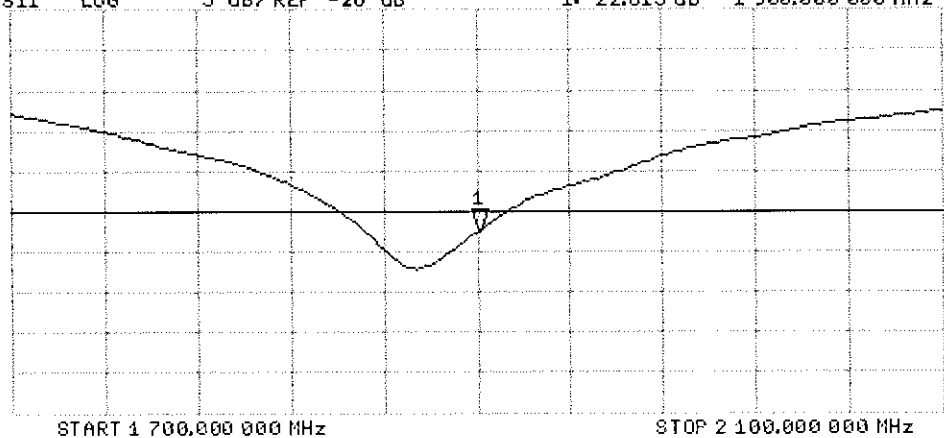


CH2 S11 LOG 5 dB/REF -20 dB 1:-22.615 dB 1 900.000 000 MHz

CA

Av9
16

H1d





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D1900V2-5d026_May17**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d026**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **May 10, 2017**

BNV
05-23-2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Leif Klysner** Function: **Laboratory Technician**

Signature

Leif Klysner

Approved by: **Katja Pokovic** Technical Manager

Katja Pokovic

Issued: May 12, 2017

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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	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 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	41.3 $\pm$ 6 %	1.40 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	9.75 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.3 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	5.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.7 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.2 $\pm$ 6 %	1.51 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.3 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	5.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 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	$52.7 \Omega + 8.4 j\Omega$
Return Loss	- 21.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$47.3 \Omega + 8.8 j\Omega$
Return Loss	- 20.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 17, 2002

DASY5 Validation Report for Head TSL

Date: 10.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d026

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.4$ S/m; $\epsilon_r = 41.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.12, 8.12, 8.12); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.0(1444); SEMCAD X 14.6.10(7416)

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

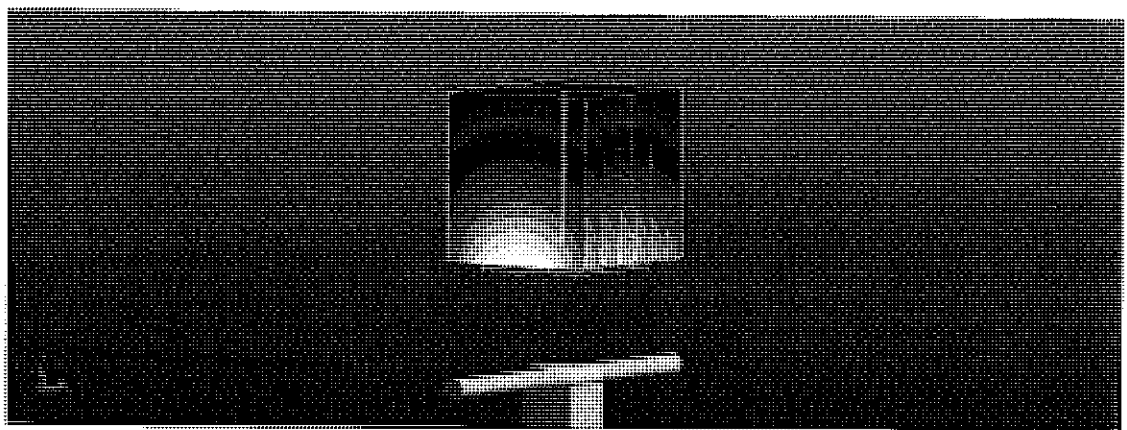
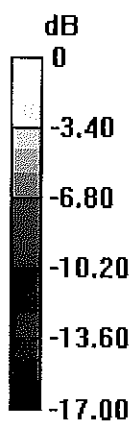
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.4 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 17.9 W/kg

SAR(1 g) = 9.75 W/kg; SAR(10 g) = 5.14 W/kg

Maximum value of SAR (measured) = 14.9 W/kg

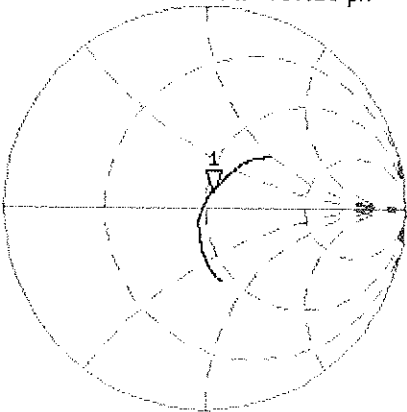


0 dB = 14.9 W/kg = 11.73 dBW/kg

Impedance Measurement Plot for Head TSL

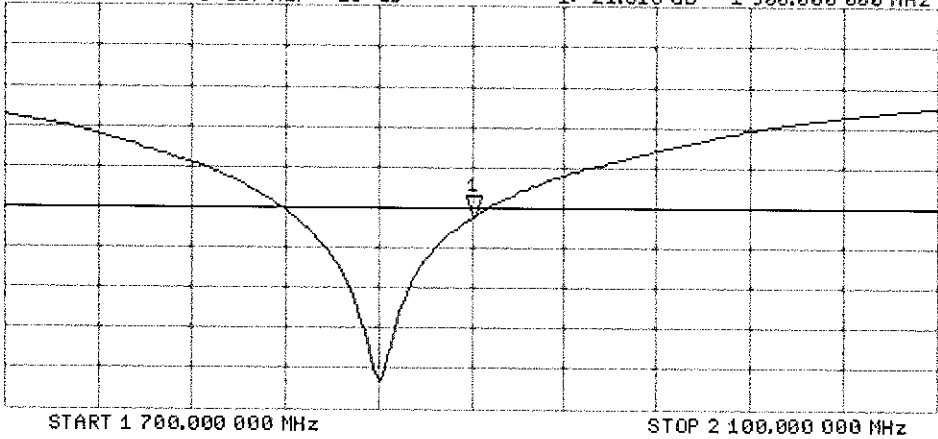
10 May 2017 10:16:29
[CH1] S11 1 U FS 1: 52.662 Ω 8.4414 Ω 707.10 pF 1 900.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-21.315 dB 1 900.000 000 MHz

CA
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 10.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d026

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.51$ S/m; $\epsilon_r = 54.2$; $\rho = 1000$ 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: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1444); SEMCAD X 14.6.10(7416)

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

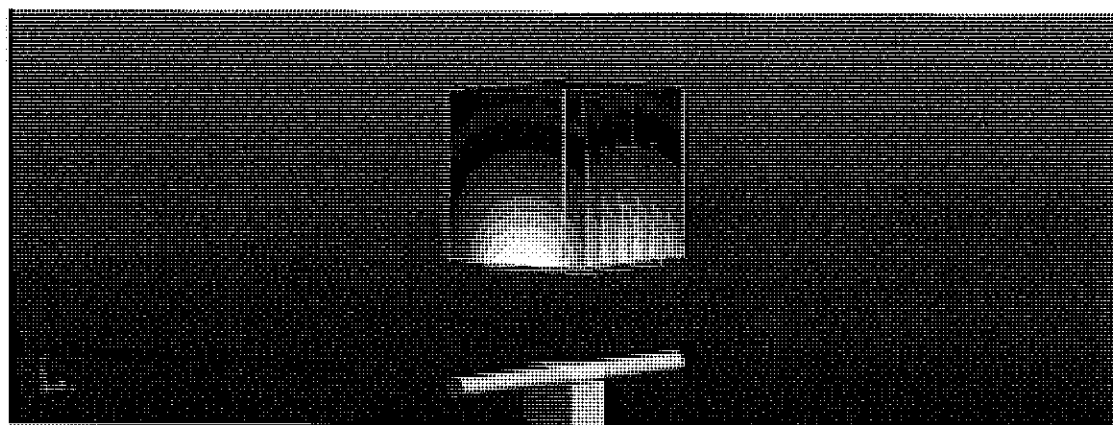
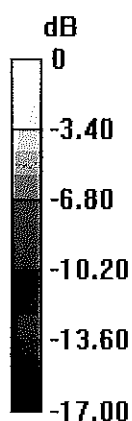
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.9 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 17.7 W/kg

SAR(1 g) = 10 W/kg; SAR(10 g) = 5.34 W/kg

Maximum value of SAR (measured) = 14.5 W/kg

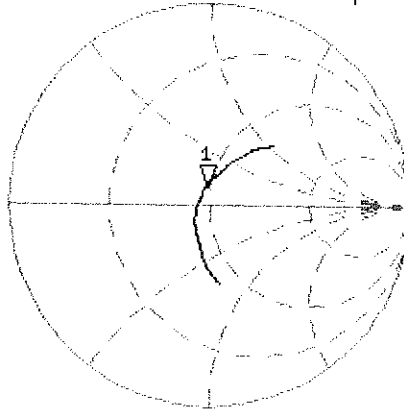


0 dB = 14.5 W/kg = 11.61 dBW/kg

Impedance Measurement Plot for Body TSL

10 May 2017 10:15:44
[CH1] S11 1 U FS 1: 47.309 Ω 3.8281 Ω 739.49 μH 1 900.000 000 MHz

*
Del
CA



Avg
16

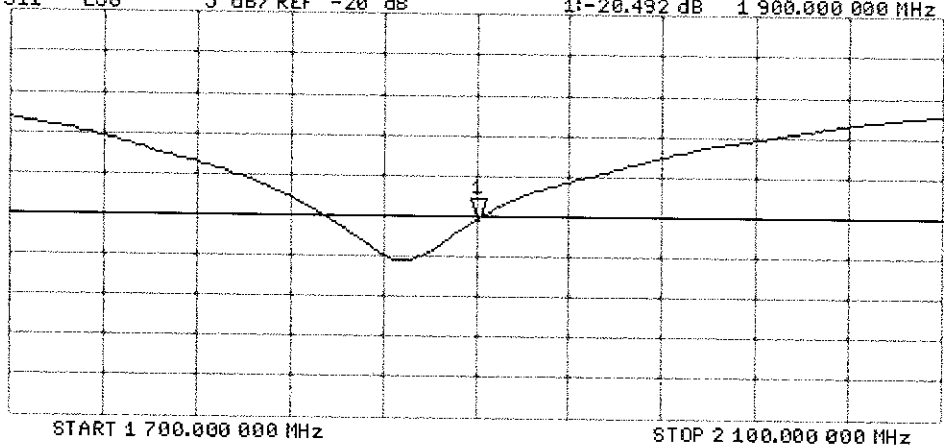
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -20.492 dB 1 900.000 000 MHz

CA

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
[Handwritten signature]
[Handwritten signature]

Issued: September 13, 2016

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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	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: $f = 2450$ MHz; $\sigma = 1.88$ S/m; $\epsilon_r = 37.9$; $\rho = 1000$ 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 = 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

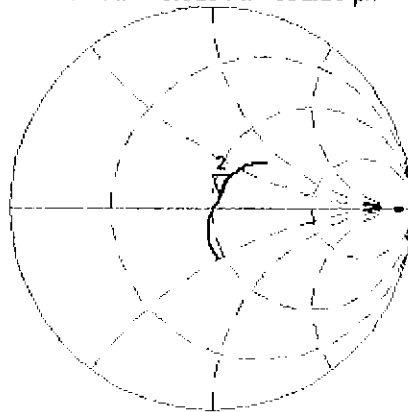


0 dB = 21.9 W/kg = 13.40 dBW/kg

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

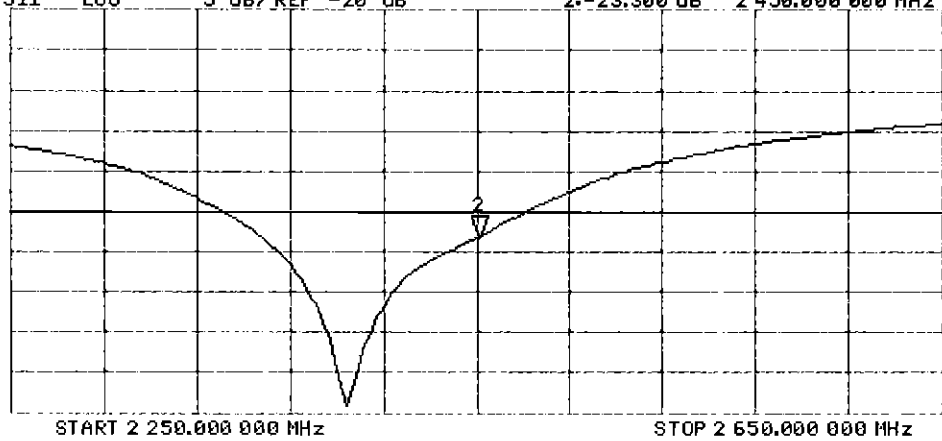
*
 De1
 CA



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:

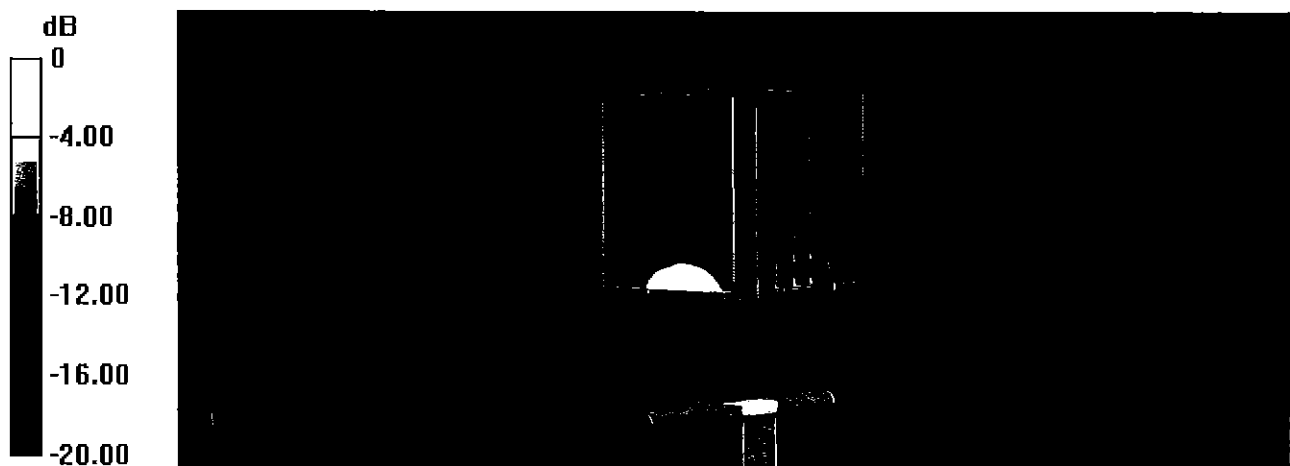
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

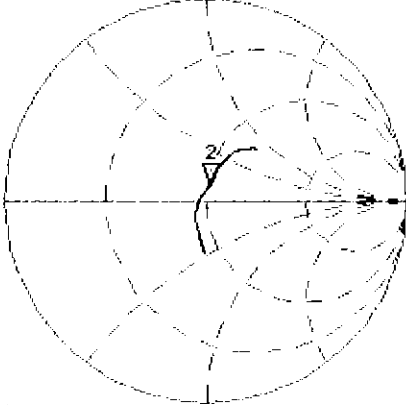


0 dB = 21.2 W/kg = 13.26 dBW/kg

Impedance Measurement Plot for Body TSL

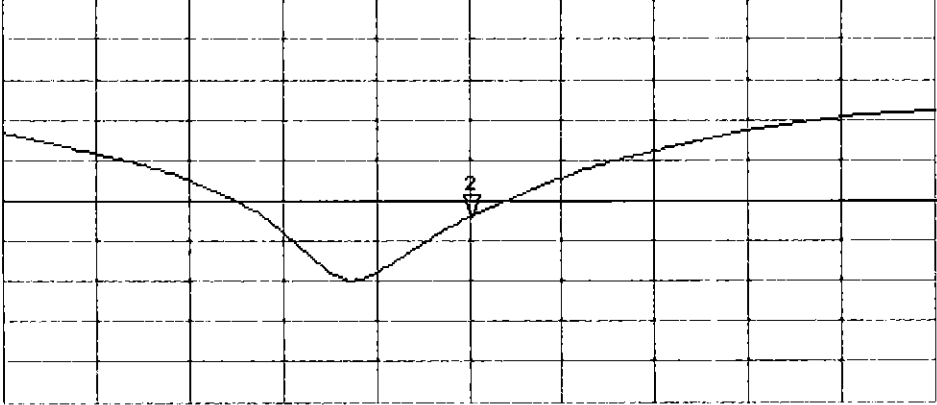
12 Sep 2016 12:40:39
[CH1] S11 1 U FS 2: 50.842 Ω 7.9531 Ω 516.64 μH 2 450.000 000 MHz

*
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: **D2450V2-945_May17**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN:945**

Calibration procedure(s) **QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **May 09, 2017**

*BN ✓
05-23-2017*

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Claudio Leubler** **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** **Technical Manager**

Signature

Issued: May 11, 2017

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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	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.3 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	6.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 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	52.4 $\pm$ 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	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.2 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	5.98 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.7 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	55.3 Ω + 1.8 j Ω
Return Loss	- 25.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.6 Ω + 3.6 j Ω
Return Loss	- 28.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 15, 2014

DASY5 Validation Report for Head TSL

Date: 09.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:945

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.88$ S/m; $\epsilon_r = 37.9$; $\rho = 1000$ 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: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1442); SEMCAD X 14.6.10(7413)

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

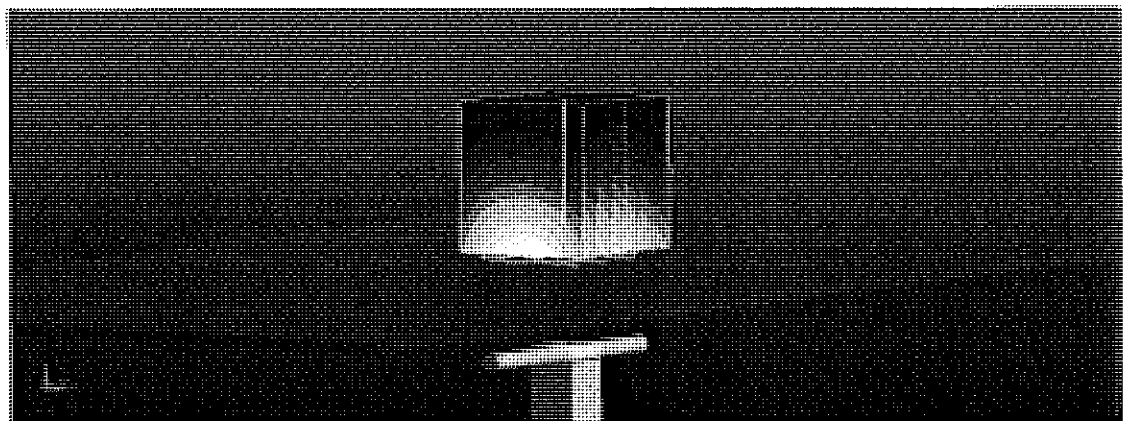
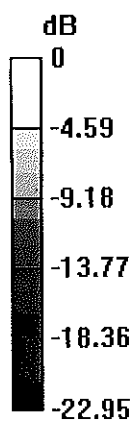
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 114.4 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.08 W/kg

Maximum value of SAR (measured) = 22.0 W/kg



0 dB = 22.0 W/kg = 13.42 dBW/kg

Impedance Measurement Plot for Head TSL

9 May 2017 12:55:53
[CH1] S11 1 U FS 1: 55.334 Ω 1.8242 Ω 118.50 μ H 2 450.000 000 MHz

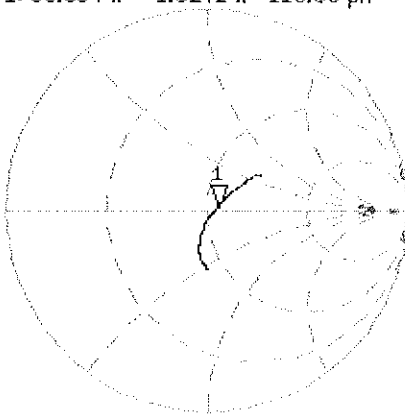
*

De1

CA

Avg
16

H1d

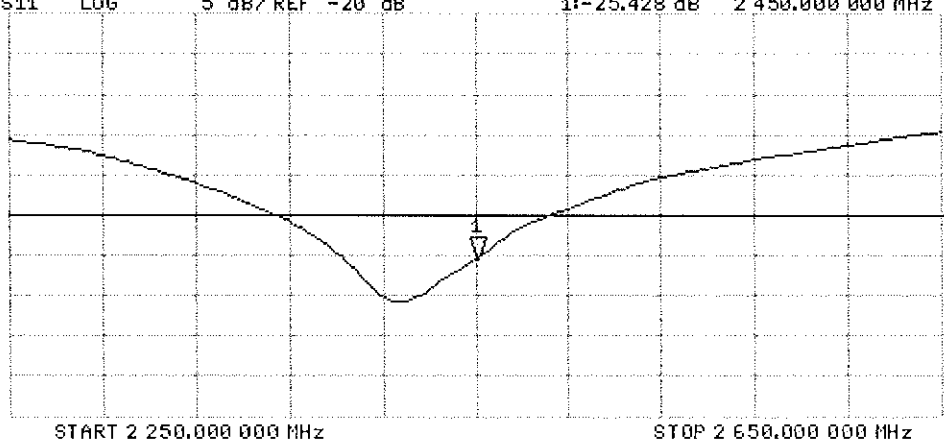


CH2 S11 LOG 5 dB/REF -20 dB 1:-25.428 dB 2 450.000 000 MHz

CA

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 09.05.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:945

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1442); SEMCAD X 14.6.10(7413)

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

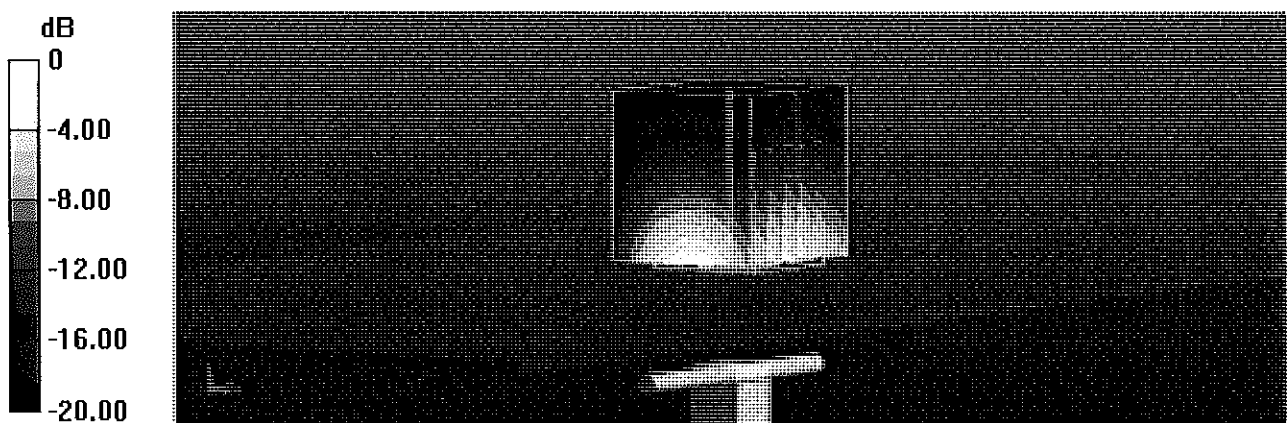
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.8 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 25.3 W/kg

SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.98 W/kg

Maximum value of SAR (measured) = 19.9 W/kg

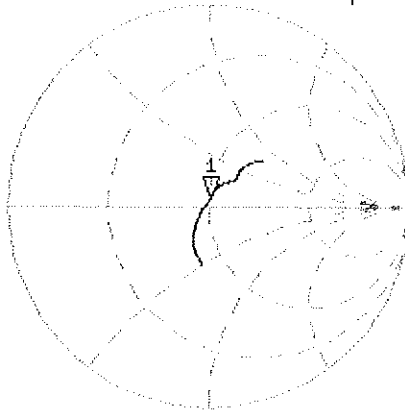


0 dB = 19.9 W/kg = 12.99 dBW/kg

Impedance Measurement Plot for Body TSL

9 May 2017 12:55:22
CH1 S11 1 U FS 1: 50.646 Ω 3.6074 Ω 234.34 pF 2 450.000 000 MHz

*
Del
C Δ



Avg
16

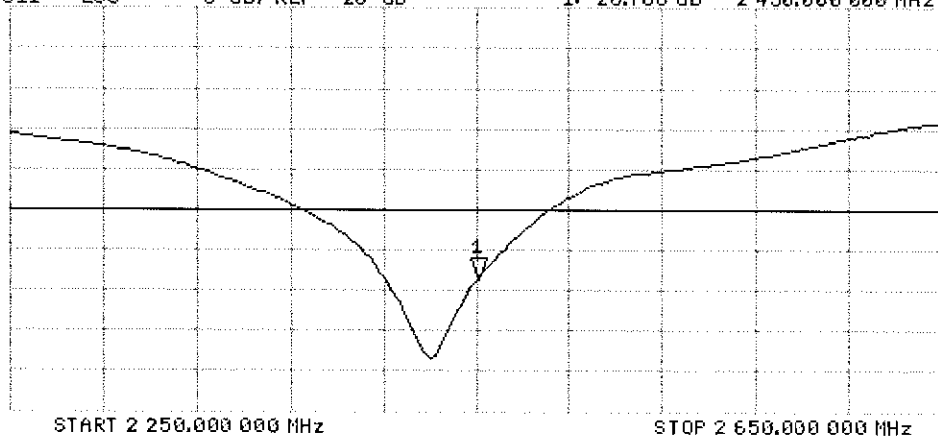
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -28.766 dB 2 450.000 000 MHz

C Δ

Avg
16

H1d





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D2600V2-1004_Apr17**

CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1004**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **April 13, 2017**

*BNV
5-3-2017*

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 7349	31-Dec-16 (No. EX3-7349_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Michael Weber** Name: **Michael Weber** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Function: **Technical Manager**

Signature

[Signature of Michael Weber]

[Signature of Katja Pokovic]

Issued: April 18, 2017

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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	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz $\pm$ 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	37.1 $\pm$ 6 %	2.03 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	14.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	57.6 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	6.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.7 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	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.1 $\pm$ 6 %	2.21 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	14.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	55.3 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	6.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.9 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	48.5 Ω - 5.9 j Ω
Return Loss	- 24.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.7 Ω - 4.9 j Ω
Return Loss	- 22.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 23, 2006

DASY5 Validation Report for Head TSL

Date: 13.04.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1004

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 37.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.56, 7.56, 7.56); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1442); SEMCAD X 14.6.10(7413)

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

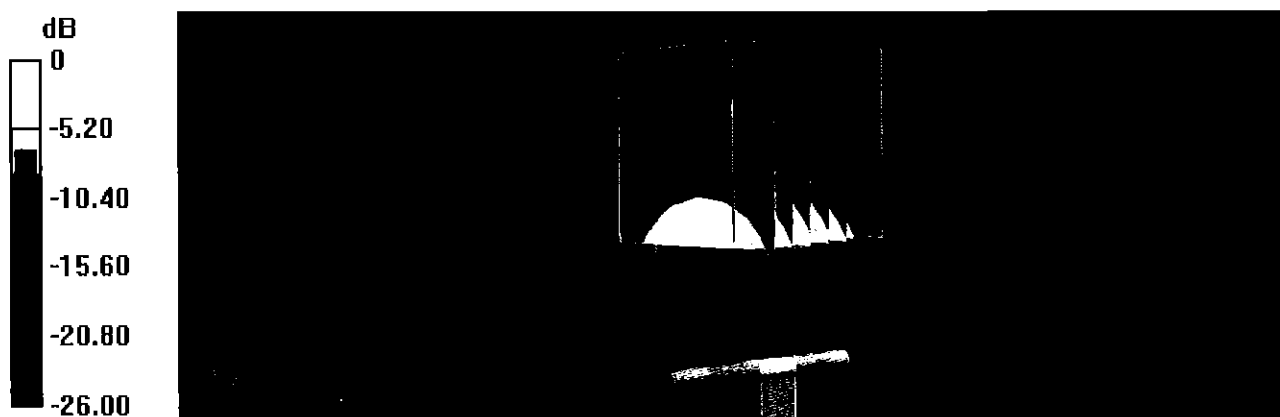
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 115.4 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 31.2 W/kg

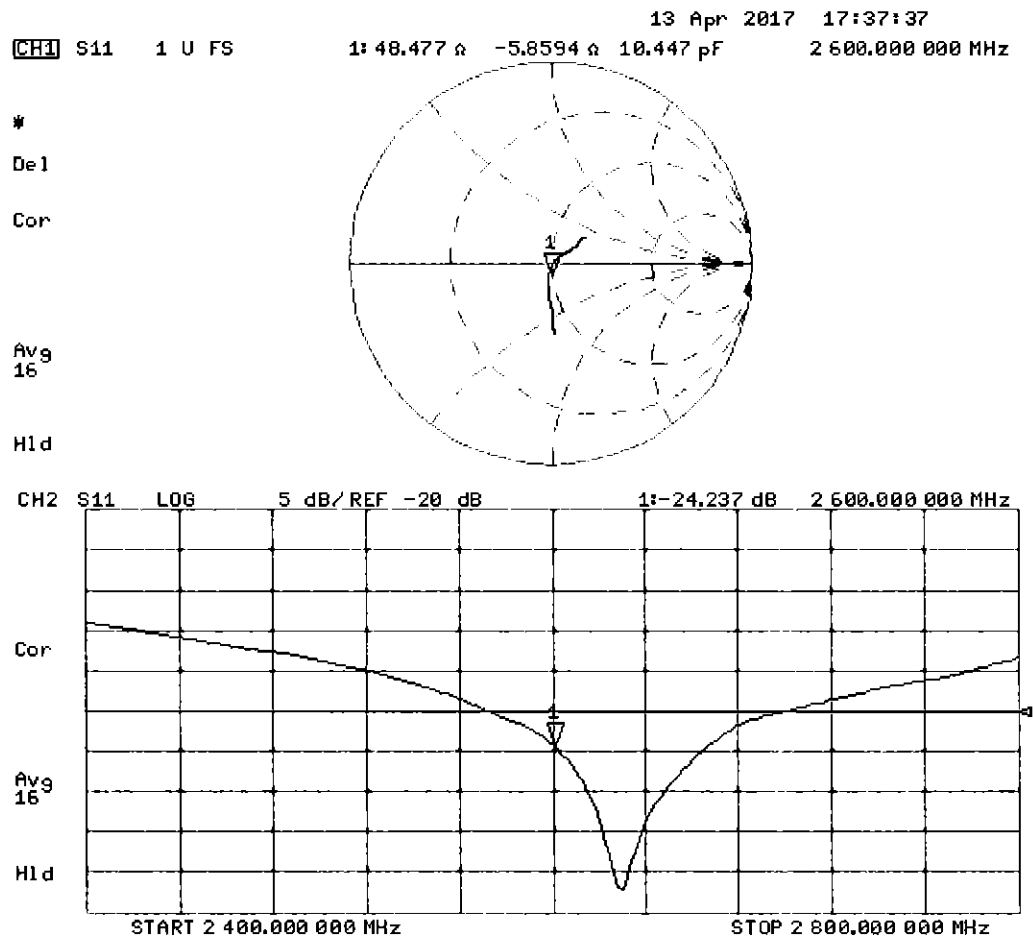
SAR(1 g) = 14.8 W/kg; SAR(10 g) = 6.54 W/kg

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



DASY5 Validation Report for Body TSL

Date: 10.04.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1004

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2.21$ S/m; $\epsilon_r = 52.1$; $\rho = 1000$ 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: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1442); SEMCAD X 14.6.10(7413)

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

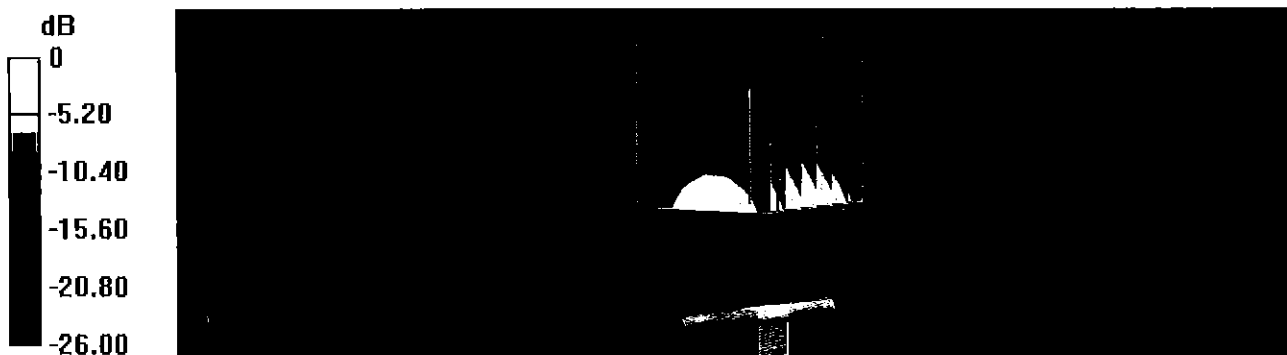
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.3 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 28.2 W/kg

SAR(1 g) = 14 W/kg; SAR(10 g) = 6.26 W/kg

Maximum value of SAR (measured) = 22.0 W/kg

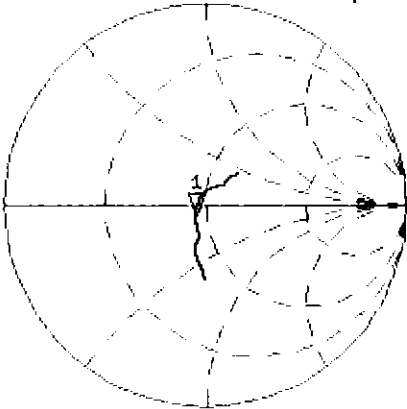


0 dB = 22.0 W/kg = 13.42 dBW/kg

Impedance Measurement Plot for Body TSL

10 Apr 2017 14:58:52
CH1 S11 1 U FS 1: 44.701 Ω -4.8926 Ω 12.511 pF 2 600.000 000 MHz

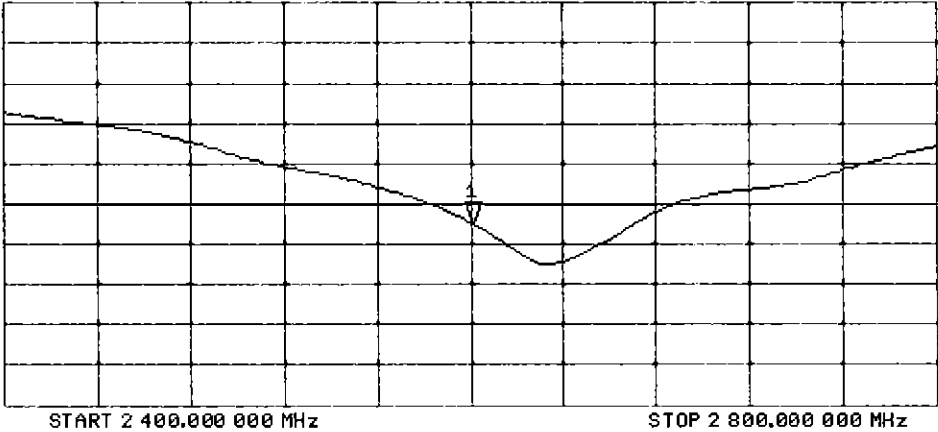
*
De1
CA



Avg
16
H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-22.378 dB 2 600.000 000 MHz

CA
Avg
16
H1d





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 Multilateral Agreement for the recognition of calibration certificates

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

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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	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
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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 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

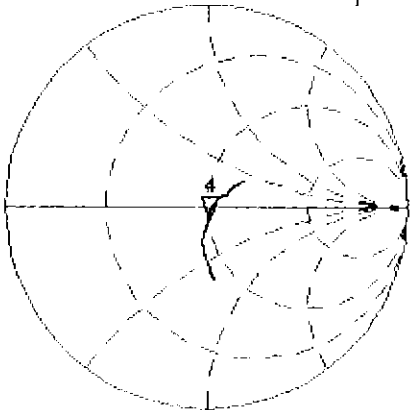


0 dB = 24.6 W/kg = 13.91 dBW/kg

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

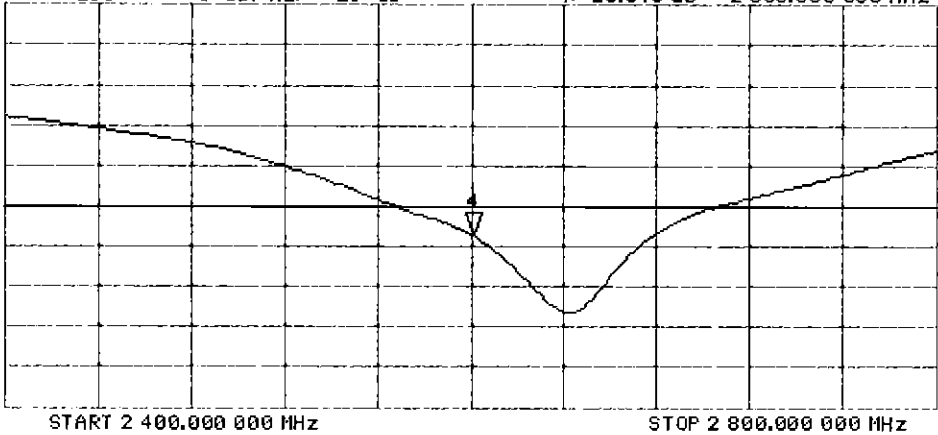
*
De l
CA



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

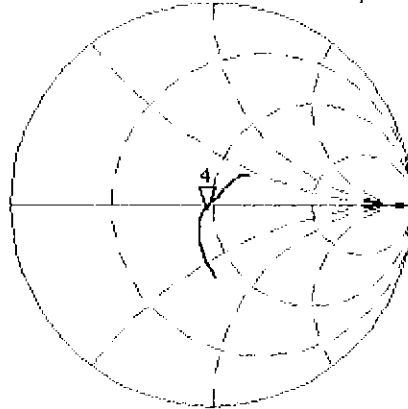


0 dB = 23.3 W/kg = 13.67 dBW/kg

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

*
 De l
 Ca



Avg
 16

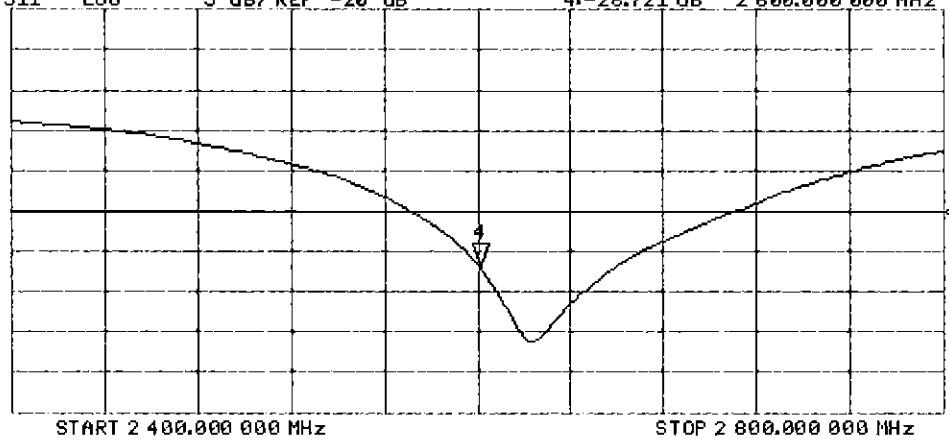
H1 d

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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Accreditation No.: **SCS 0108**

Client **PC Test**

Certificate No: **D5GHzV2-1123_Mar17**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1123**

Calibration procedure(s) **QA CAL-22.v2**
Calibration procedure for dipole validation kits between 3-6 GHz

BNV
03-27-2017

Calibration date: **March 09, 2017**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	31-Dec-16 (No. EX3-3503_Dec16)	Dec-17
DAE4	SN: 601	04-Jan-17 (No. DAE4-601_Jan17)	Jan-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

Calibrated by: **Johannes Kurikka** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

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Issued: March 10, 2017

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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 62209-2, "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	34.9 $\pm$ 6 %	4.57 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	7.98 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.3 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	2.29 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 $\pm$ 0.2) °C	34.4 $\pm$ 6 %	4.92 mho/m $\pm$ 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	8.49 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.2 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	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg $\pm$ 19.5 % (k=2)

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	5.07 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	8.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (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	23.3 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	48.1 ± 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	7.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.9 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	21.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.5 ± 6 %	5.99 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	7.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.2 ± 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	76.3 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	21.3 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	$51.6 \Omega - 5.7 j\Omega$
Return Loss	- 24.7 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	$55.9 \Omega - 0.7 j\Omega$
Return Loss	- 25.1 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	$56.7 \Omega + 1.2 j\Omega$
Return Loss	- 23.9 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	$51.8 \Omega - 3.8 j\Omega$
Return Loss	- 27.7 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	$58.2 \Omega + 1.4 j\Omega$
Return Loss	- 22.3 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	$57.3 \Omega + 3.7 j\Omega$
Return Loss	- 22.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.205 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 08, 2011

DASY5 Validation Report for Head TSL

Date: 08.03.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1123

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: $f = 5250$ MHz; $\sigma = 4.57$ S/m; $\epsilon_r = 34.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.92$ S/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5750$ MHz; $\sigma = 5.07$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.58, 5.58, 5.58); Calibrated: 31.12.2016, ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016, ConvF(5.02, 5.02, 5.02); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.62 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 29.9 W/kg

SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.29 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 = 71.47 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 34.1 W/kg

SAR(1 g) = 8.49 W/kg; SAR(10 g) = 2.42 W/kg

Maximum value of SAR (measured) = 19.8 W/kg

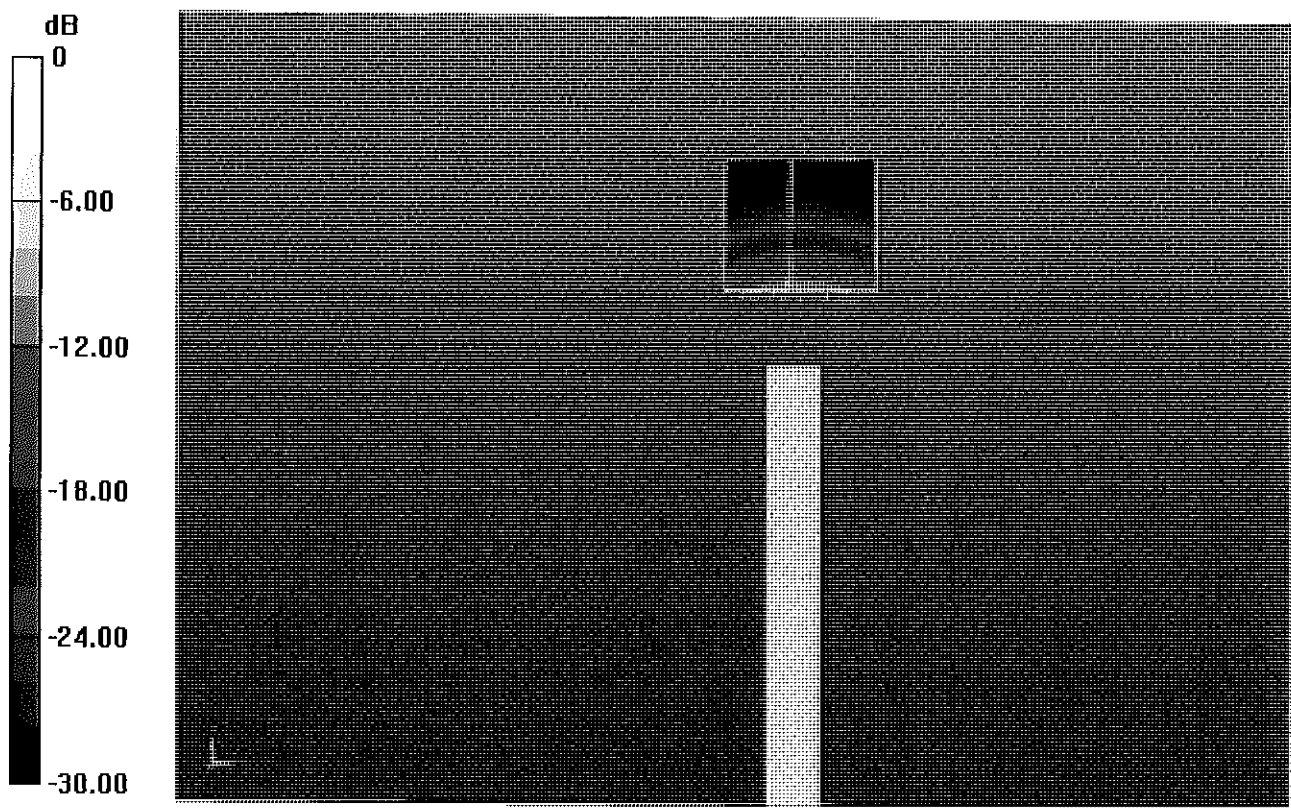
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.34 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 34.6 W/kg

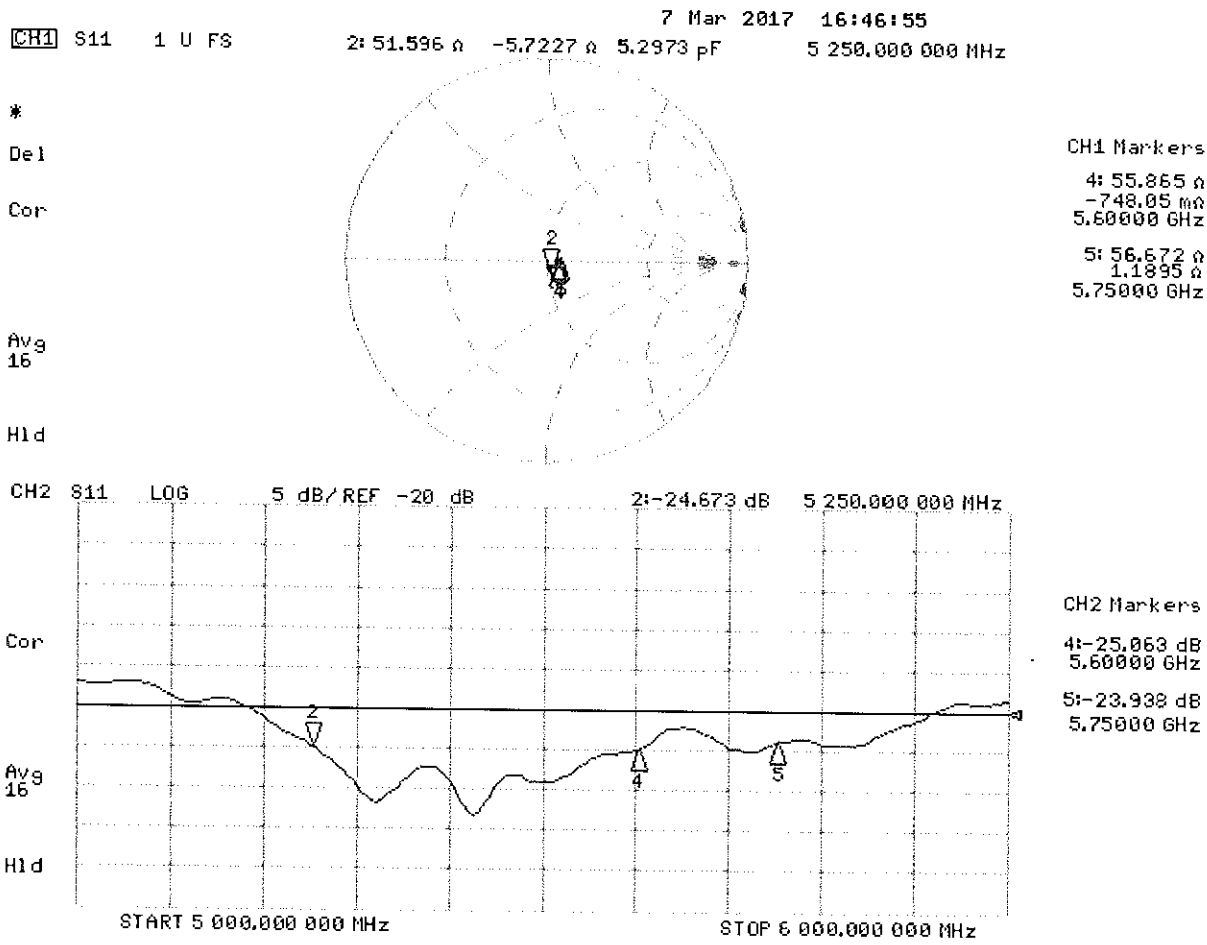
SAR(1 g) = 8.3 W/kg; SAR(10 g) = 2.35 W/kg

Maximum value of SAR (measured) = 19.6 W/kg



0 dB = 18.3 W/kg = 12.62 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 09.03.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1123

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: $f = 5250$ MHz; $\sigma = 5.52$ S/m; $\epsilon_r = 48.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.99$ S/m; $\epsilon_r = 47.5$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5750$ MHz; $\sigma = 6.21$ S/m; $\epsilon_r = 47.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.52, 4.52, 4.52); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.40 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 29.1 W/kg

SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 17.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.91 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 33.2 W/kg

SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.22 W/kg

Maximum value of SAR (measured) = 18.7 W/kg

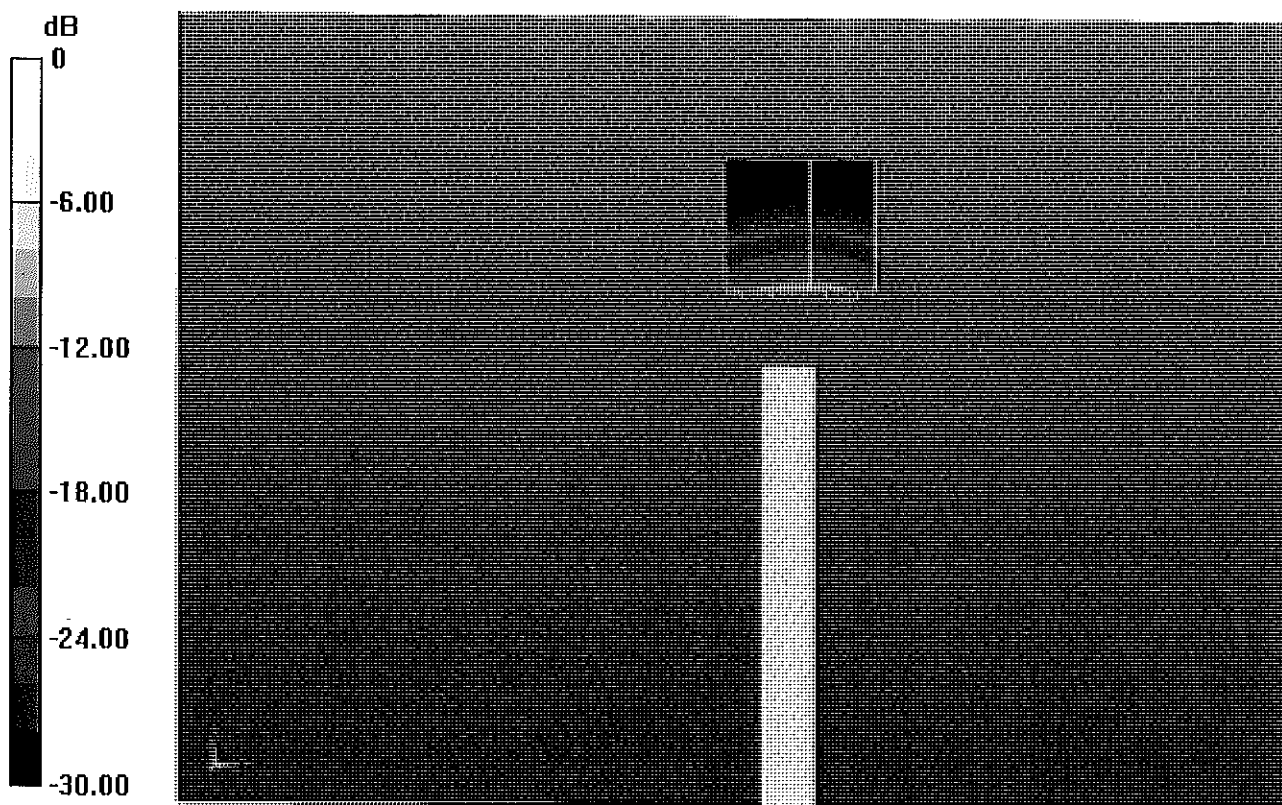
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 63.25 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 33.4 W/kg

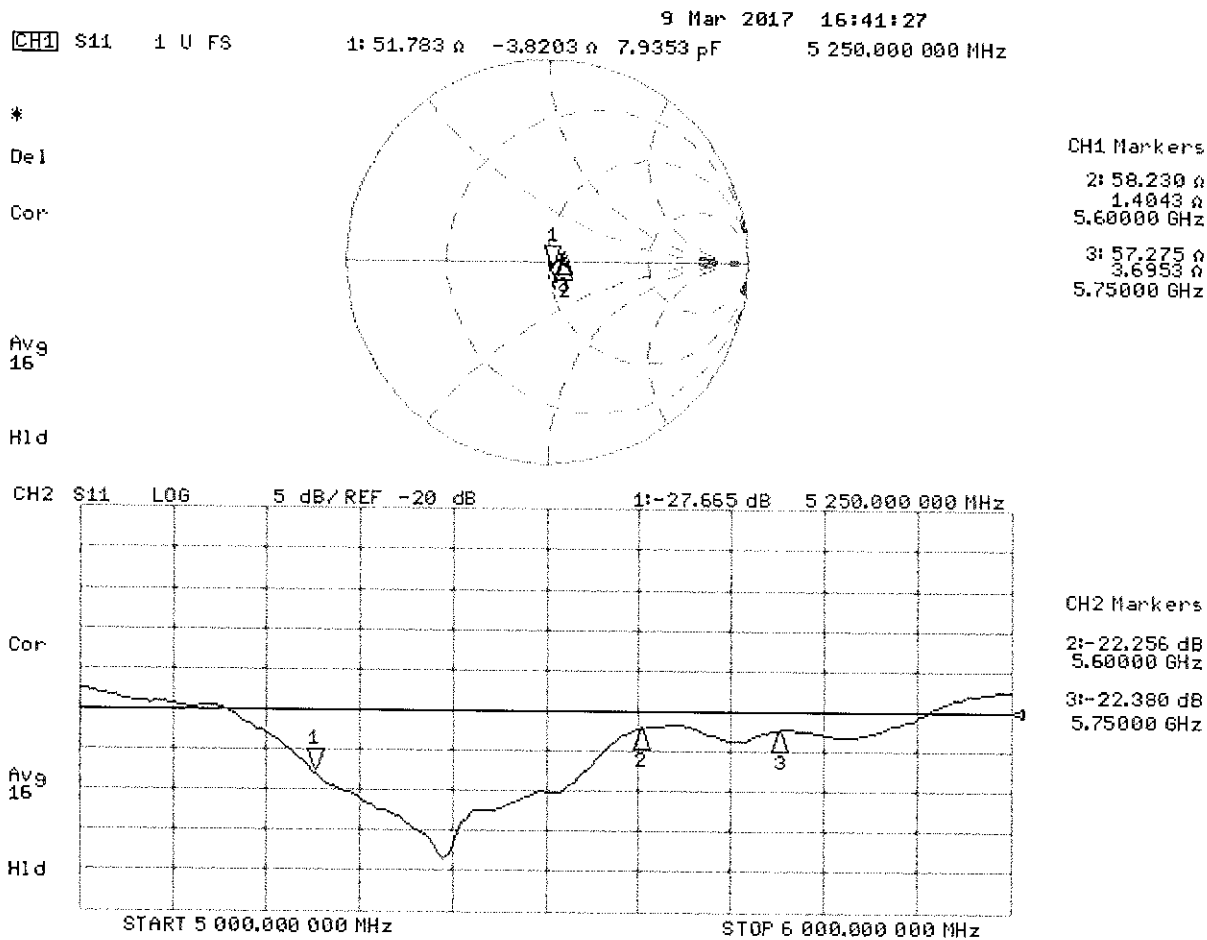
SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 17.5 W/kg = 12.43 dBW/kg

Impedance Measurement Plot for Body TSL





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
----------------------------------	----------

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

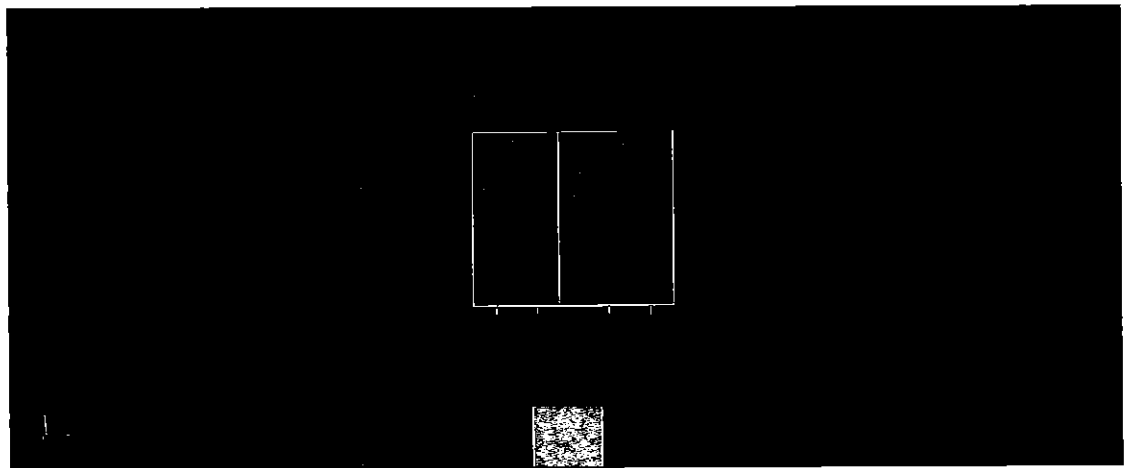
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

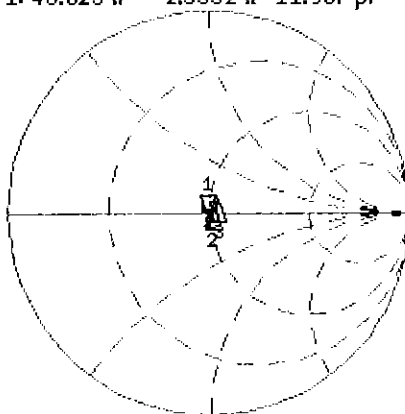


0 dB = 18.3 W/kg = 12.62 dBW/kg

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

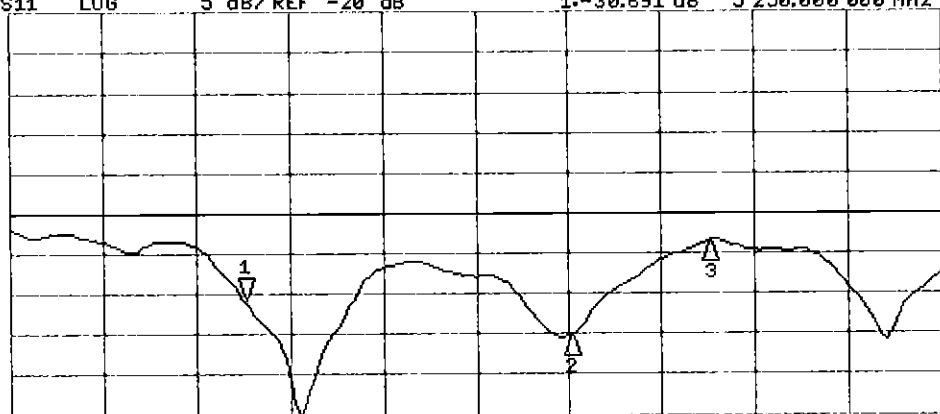
*
 Del
 Cor
 Avg
 16
 H1d



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

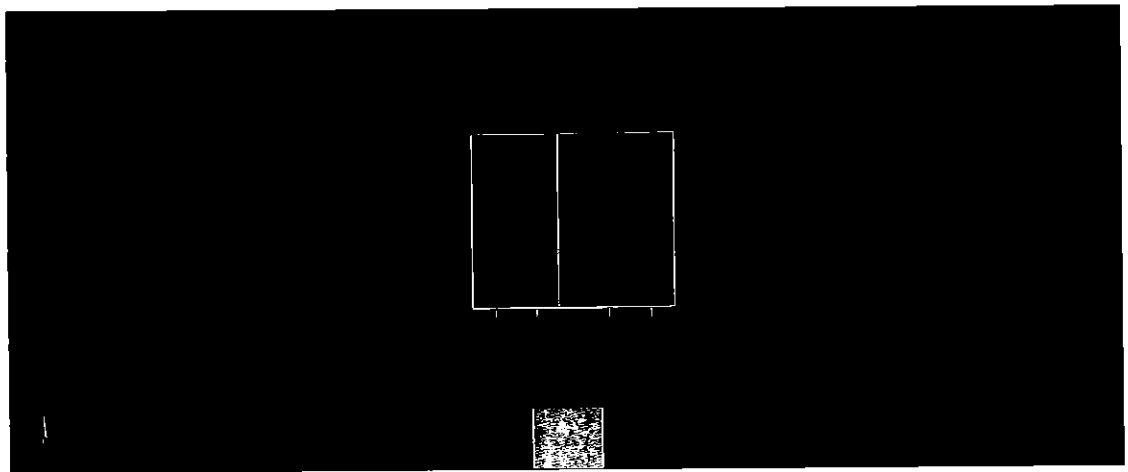
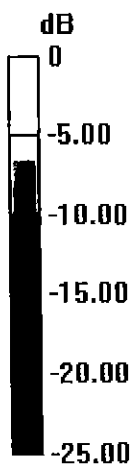
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

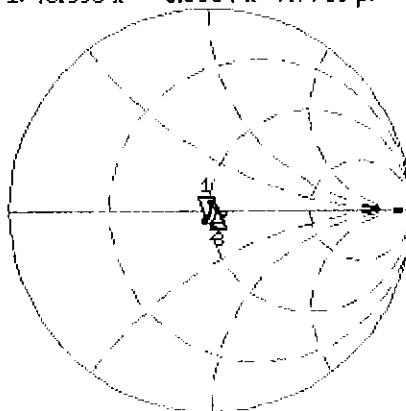


0 dB = 17.3 W/kg = 12.38 dBW/kg

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

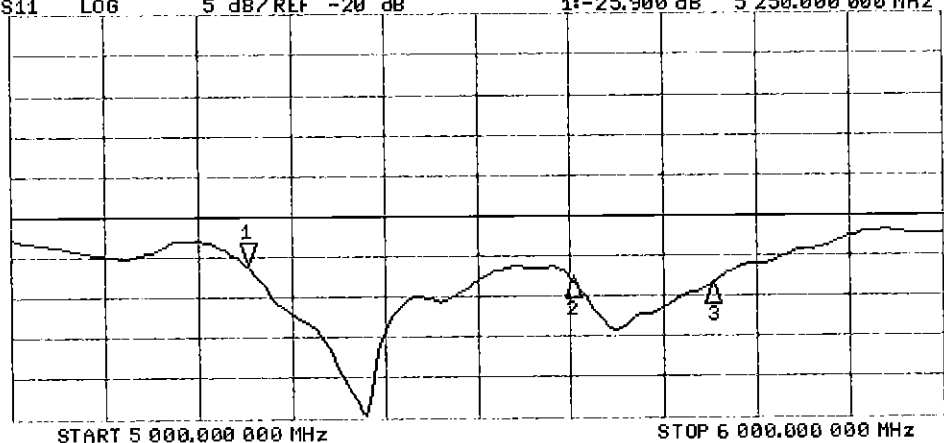
*
 Del
 Cor
 Avg
 16
 H1d



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