HCT CO.,LTD.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea
TEL: +82-31-645-6300 FAX: +82-31-645-6401

SAR TEST REPORT

Applicant Name:	Date of Issue: 02. 23, 2017
SAMSUNG Electronics Co., Ltd. 129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677 Rep. of Korea	**Test Report No.: HCT-A-1702-F004** **Test Site: HCT CO., LTD.**

FCC ID: A3LSMW723

According to the Evaluation report, all of the data contained herein is reused from the reference FCC ID: A3LSMW727V report.

Equipment Type:	**Tablet**
Model Name:	**SM-W723**
Additional Model:	**SM-W720, SM-W720X**
Testing has been carried out in accordance with:	**47CFR §2.1093** **ANSI/ IEEE C95.1 – 1992** **IEEE 1528-2013**
Date of Test:	**01/16/2017 ~ 01/17/2017, 01/31/2017**

This device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in FCC KDB procedures and had been tested in accordance with the measurement procedures specified in FCC KDB procedures.

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.

Tested By	Reviewed By
Tae-Jun Kang **Test Engineer / SAR Team** **Certification Division**	**Yun-Jeang Heo** **Technical Manager / SAR Team** **Certification Division**

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DOCUMENT HISTORY

Version	DATE	DESCRIPTION
HCT-A-1702-F004	02. 23, 2017	First Approval Report

Table of Contents

1. Attestation of Test Result of Device Under Test

Test Laboratory	
Company Name:	HCT Co., LTD
Address	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of Korea
Telephone	+82 31 645 6300
Fax.	+82 31 645 6401

Attestation of SAR test result			
Applicant Name:	SAMSUNG Electronics Co., Ltd.		
FCC ID:	A3LSMW723		
Model:	SM-W723		
Additional Model:	SM-W720, SM-W720X		
EUT Type:	Tablet		
Application Type:	Certification		
The Highest Reported SAR			
Band	**Tx. Frequency (MHz)**	**Equipment Class**	**Reported 1g Body SAR (W/kg)**
802.11b	2 412 - 2 472	DTS	0.51
U-NII-1	5 180 - 5 240	NII	0.35
U-NII-2A	5 260 - 5 320	NII	0.26
U-NII-2C	5 500 - 5 700	NII	0.25
U-NII-3	5 745 - 5 825	NII	0.34
Bluetooth	2 402 - 2 480	DSS/DTS	0.44
Simultaneous SAR per KDB 690783 D01v01r03			0.75
Date(s) of Tests:	01/16/2017 ~ 01/17/2017, 01/31/2017		

2. Device Under Test Description

2.1 DUT specification

<table>
<tr><th colspan="3">Device Wireless specification overview</th></tr>
<tr><th>Band & Mode</th><th>Operating Mode</th><th>Tx Frequency</th></tr>
<tr><td>2.4 GHz WLAN</td><td>Data</td><td>2 412 – 2 472 MHz</td></tr>
<tr><td>U-NII-1</td><td>Data</td><td>5 180 – 5 240 MHz</td></tr>
<tr><td>U-NII-2A</td><td>Data</td><td>5 260 – 5 320 MHz</td></tr>
<tr><td>U-NII-2C</td><td>Data</td><td>5 500 – 5 700 MHz</td></tr>
<tr><td>U-NII-3</td><td>Data</td><td>5 745 – 5 825 MHz</td></tr>
<tr><td>Bluetooth</td><td>Data</td><td>2 402 – 2 480 MHz</td></tr>
</table>

<table>
<tr><th colspan="3">Device Description</th></tr>
<tr><td>Device Dimension:</td><td colspan="2">Overall (Length x Width): 287.5 mm x 196 mm
Overall Diagonal: 348 mm
Display Diagonal: 315 mm</td></tr>
<tr><td rowspan="2">Battery Options</td><td colspan="2">Standard (Li-ion Battery)</td></tr>
<tr><td colspan="2">EB-BW720ABA</td></tr>
<tr><td>Hardware Version:</td><td colspan="2">REV1.0</td></tr>
<tr><td>Software Version :</td><td colspan="2">W723.001</td></tr>
<tr><td rowspan="3">Device Serial Numbers</td><td>Mode</td><td>Serial Number</td></tr>
<tr><td>WiFi 2.4GHz, 5GHz / Bluetooth</td><td>354771080001108
354771080001116</td></tr>
<tr><td colspan="2">Several samples with identical hardware were used to SAR testing.
The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics are within operational tolerances expected for production units.</td></tr>
<tr><td>Cover</td><td colspan="2">Keyboard cover</td></tr>
</table>

2.2 DUT Wireless mode

Wireless Modulation	Band	Operating Mode		Duty Cycle
2.4 GHz WLAN		Data	802.11b, 802.11g, 802.11n (HT20)	99.96 %
5 GHz WLAN		Data	802.11 a, 802.11 n (HT20/HT40) 802.11 ac (VHT20/40/80)	94.62 % (802.11a) 85.23 % (802.11ac)
Bluetooth		Data		76.8 % (DH5)
Bluetooth LE 4.1		Data		N/A

2.3 Power Reduction for SAR

This device uses a power reduction mechanism for SAR compliance. The power reduction mechanism is activated when the device is used in close proximity to the user's body. FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selection SAR test distances for this device. Detailed description of the power reduction mechanism are include in [A3LSMW723] WLAN_Sensor triggering distance Document.

2.4 TEST METHODOLOGY and Procedures

The tests documented in this report were performed in accordance with IEEE Standard 1528-2013 & IEEE 1528-2005 and the following published KDB procedures.

- FCC KDB Publication 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB Publication 447498 D01 General SAR Guidance v06
- FCC KDB Publication 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- FCC KDB Publication 865664 D02 SAR Reporting v01r02
- FCC KDB Publication 616217 D04 SAR Tablet v01r02

2.5 Nominal and Maximum Output Power Specifications

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

2.5.1 Maximum Output Power

Mode/Band			Modulated Average (dBm)				
	Sensor State		a	b	g	n	ac
2.4 GHz WIFI (Ch.1 ~ 11)	Active	Maximum		8.5	8.5	8.5	
		Nominal		8.0	8.0	8.0	
	Inactive	Maximum		14.5	12.5	12.5	
		Nominal		14.0	12.0	12.0	
2.4 GHz WIFI (Ch.12)	Active	Maximum		8.5	8.5	8.5	
		Nominal		8.0	8.0	8.0	
	Inactive	Maximum		8.5	8.5	8.5	
		Nominal		8.0	8.0	8.0	
2.4 GHz WIFI (Ch.13)	Active	Maximum		8.5	3.5	2.5	
		Nominal		8.0	3.0	2.0	
	Inactive	Maximum		8.5	3.5	2.5	
		Nominal		8.0	3.0	2.0	

Mode/Band			Modulated Average (dBm)				
	Sensor State		a	b	g	n	ac
5 GHz WIFI (20MHz BW)							
5200 MHz	Active	Maximum	7.5			7.5	7.5
		Nominal	7.0			7.0	7.0
	Inactive	Maximum	12.5			11.5	11.5
		Nominal	12.0			11.0	11.0
5300 MHz	Active	Maximum	7.5			7.5	7.5
		Nominal	7.0			7.0	7.0
	Inactive	Maximum	12.5			11.5	11.5
		Nominal	12.0			11.0	11.0
5500 MHz	Active	Maximum	7.5			7.5	7.5
		Nominal	7.0			7.0	7.0
	Inactive	Maximum	12.5			11.5	11.5
		Nominal	12.0			11.0	11.0
5800 MHz	Active	Maximum	7.5			7.5	7.5
		Nominal	7.0			7.0	7.0
	Inactive	Maximum	12.5			11.5	11.5
		Nominal	12.0			11.0	11.0
5 GHz WIFI (40MHz BW)							
5200 MHz	Active	Maximum				7.5	7.5
		Nominal				7.0	7.0
	Inactive	Maximum				10.5	10.5
		Nominal				10.0	10.0
5300 MHz	Active	Maximum				7.5	7.5
		Nominal				7.0	7.0
	Inactive	Maximum				10.5	10.5
		Nominal				10.0	10.0
5500 MHz	Active	Maximum				7.5	7.5
		Nominal				7.0	7.0
	Inactive	Maximum				10.5	10.5
		Nominal				10.0	10.0
5800 MHz	Active	Maximum				7.5	7.5
		Nominal				7.0	7.0
	Inactive	Maximum				10.5	10.5
		Nominal				10.0	10.0

Mode/Band			Modulated Average (dBm)				
	Sensor State		a	b	g	n	ac
5 GHz WIFI (80MHz BW)							
5200 MHz	Active	Maximum					7.5
		Nominal					7.0
	Inactive	Maximum					10.5
		Nominal					10.0
5300 MHz	Active	Maximum					7.5
		Nominal					7.0
	Inactive	Maximum					10.5
		Nominal					10.0
5500 MHz	Active	Maximum					7.5
		Nominal					7.0
	Inactive	Maximum					10.5
		Nominal					10.0
5800 MHz	Active	Maximum					7.5
		Nominal					7.0
	Inactive	Maximum					10.5
		Nominal					10.0

Mode / Band		Modulated Average (dBm)
Bluetooth (DH5)	Maximum	10.0
	Nominal	9.5
Bluetooth LE	Maximum	4.5
	Nominal	4.0

2.6 Power Reduction by Proximity Sensing

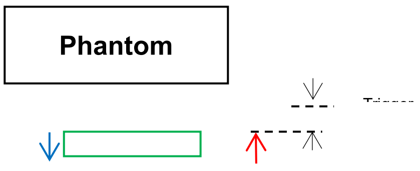
2.6.1 Proximity Sensor Triggering Distance

Rear of the DUT was placed directly below the flat phantom. The DUT was moved toward the phantom in accordance with the steps outlined in KDB 616217 §6.2 to determine the trigger distance for enabling power reduction. The DUT was moved away from the phantom to determine the trigger distance for resuming full power.

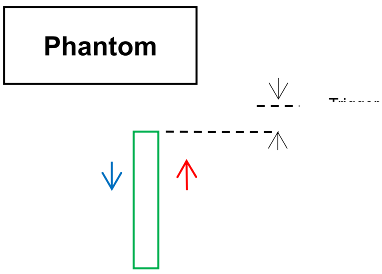
The measurement was repeated for the surface of Rear and Top side.

The DUT featured a visual indicator on is display that showed the status of the proximity sensor (Triggered or not triggered). This was used to determine the status of the sensor during the proximity sensor assessment as monitoring the output power directly was not practical without affecting the measurement.

It was confirmed separately that the output power was altered according to the proximity sensor status indication. This was achieved by observing the proximity sensor status at the same time as monitoring the conducted power. Section 9 contains both the full and reduced conducted power measurements.



Proximity Sensor Trigger Distance Assessment
KDB 616217 §6.2, Rear side



Proximity Sensor Trigger Distance Assessment
KDB 616217 §6.2, Top side

LEGEND

→ Direction of DUT travel for determination of power reduction triggering point

→ Direction of DUT travel for determination of full power resumption triggering point

Tissue simulating liquid	Trigger distance - Rear		Trigger distance - Top	
	Moving toward phantom	Moving from phantom	Moving from phantom	Moving from phantom
2450 muscle	7	7	7	7
5000 muscle	7	7	7	7

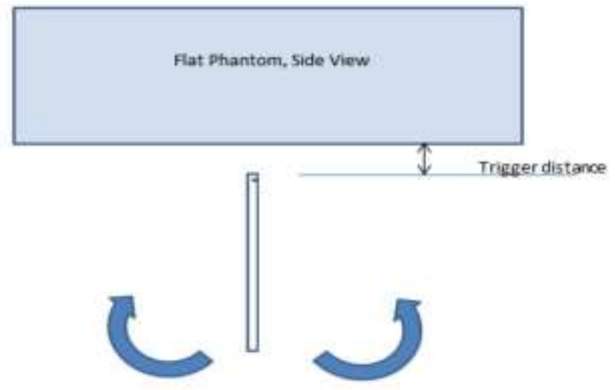
Summary of Trigger Distances

2.6.2 Proximity Sensor Coverage for SAR measurements

As there is no spatial offset between the antenna and the proximity sensor element, proximity sensor coverage did not need to be assessed.

2.6.3 Proximity Sensor Tilt Angle Assessment (KDB 616217 §6.4)

The DUT was positioned directly below the flat phantom at the minimum measured trigger distance with Top side parallel to the base of the flat phantom for each band.
The EUT was rotated about Top side for angles up to ±45°. If the output power increased during the rotation the DUT was moved 1mm toward the phantom and the rotation repeated. This procedure was repeated until the power remained reduced for all angles up ±45°.



Proximity sensor tilt angle assessment (Top side) KDB 616217 §6.4

Summary of Tablet Tilt Angle influence to Proximity Sensor Triggering

Band (MHz)	Minimum trigger distance measured according to KDB 616217 §6.2	Minimum distance at which power reduction was maintained over-45°	Power reduction status										
			-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
2450	7 mm	7 mm	On	On	On	On	On	On	On	On	On	On	On
5000	7 mm	7 mm	On	On	On	On	On	On	On	On	On	On	On

2.6.4 Proximity sensor triggering distance measurement results Wi-Fi

Rear side – EUT Moving toward (trigger) to the Phantom

Distance (mm)	12	11	10	9	8	7	6	5	4	3
2.4GHz 802.11b	13.81	13.79	13.79	13.80	13.82	8.41	8.39	8.45	8.39	8.38
2.4GHz 802.11g	11.26	11.26	11.25	11.25	11.23	7.24	7.21	7.24	7.29	7.29
2.4GHz 802.11n	11.06	11.03	11.11	11.06	11.07	7.30	7.34	7.33	7.30	7.29
5 GHz 802.11a [BW 20]	11.22	11.23	11.26	11.25	11.19	6.14	6.13	6.11	6.17	6.19
5 GHz 802.11n [BW 20]	9.96	9.97	9.93	9.95	10.00	5.59	5.57	5.60	5.63	5.60
5 GHz 802.11n [BW 40]	8.93	8.97	8.96	8.94	8.96	5.40	5.43	5.37	5.36	5.36
5 GHz 802.11ac [BW 20]	9.87	9.88	9.89	9.92	9.90	5.48	5.50	5.43	5.52	5.46
5 GHz 802.11ac [BW 40]	8.81	8.76	8.80	8.78	8.84	5.32	5.31	5.33	5.34	5.31
5 GHz 802.11ac [BW80]	8.04	8.03	8.00	7.99	8.02	5.37	5.36	5.35	5.36	5.35

Rear side – EUT Moving away (Release) from the Phantom

Distance (mm)	3	4	5	6	7	8	9	10	11	12
2.4GHz 802.11b	8.41	8.44	8.43	8.46	8.44	13.73	13.69	13.69	13.76	13.70
2.4GHz 802.11g	7.28	7.24	7.33	7.32	7.27	11.30	11.26	11.28	11.27	11.35
2.4GHz 802.11n	7.40	7.42	7.38	7.38	7.43	11.01	11.03	11.03	11.00	11.00
5 GHz 802.11a [BW 20]	6.21	6.23	6.25	6.26	6.26	11.18	11.15	11.14	11.23	11.14
5 GHz 802.11n [BW 20]	5.60	5.56	5.61	5.62	5.59	9.98	9.95	10.02	10.01	9.94
5 GHz 802.11n [BW 40]	5.43	5.46	5.43	5.39	5.46	9.00	9.05	9.03	9.05	9.03
5 GHz 802.11ac [BW 20]	5.56	5.51	5.59	5.56	5.53	9.83	9.78	9.84	9.83	9.81
5 GHz 802.11ac [BW 40]	5.47	5.51	5.44	5.50	5.47	8.74	8.73	8.73	8.75	8.76
5 GHz 802.11ac [BW80]	5.34	5.34	5.35	5.36	5.35	8.12	8.08	8.14	8.11	8.12

Top side – EUT Moving toward (trigger) to the Phantom

Distance (mm)	12	11	10	9	8	7	6	5	4	3
2.4GHz 802.11b	13.88	13.85	13.92	13.90	13.89	8.47	8.44	8.46	8.52	8.43
2.4GHz 802.11g	11.23	11.21	11.22	11.25	11.24	7.24	7.24	7.23	7.25	7.21
2.4GHz 802.11n	11.00	10.95	10.96	11.04	10.97	7.43	7.48	7.41	7.42	7.40
5 GHz 802.11a [BW 20]	11.18	11.23	11.14	11.18	11.16	6.16	6.12	6.21	6.16	6.13
5 GHz 802.11n [BW 20]	9.92	9.97	9.92	9.96	9.91	5.54	5.59	5.50	5.55	5.54
5 GHz 802.11n [BW 40]	9.00	9.05	8.97	8.99	9.00	5.41	5.39	5.45	5.43	5.39
5 GHz 802.11ac [BW 20]	9.81	9.83	9.83	9.83	9.79	5.61	5.60	5.63	5.62	5.62
5 GHz 802.11ac [BW 40]	8.74	8.69	8.77	8.72	8.77	5.43	5.42	5.40	5.48	5.46
5 GHz 802.11ac [BW80]	8.10	8.08	8.11	8.09	8.06	5.37	5.38	5.38	5.35	5.36

Top side – EUT Moving away (Release) from the Phantom

Distance (mm)	3	4	5	6	7	8	9	10	11	12
2.4GHz 802.11b	8.38	8.35	8.40	8.35	8.41	13.76	13.73	13.71	13.80	13.79
2.4GHz 802.11g	7.20	7.16	7.22	7.24	7.17	11.28	11.30	11.25	11.29	11.31
2.4GHz 802.11n	7.26	7.29	7.29	7.31	7.21	11.03	11.07	11.06	10.99	11.08
5 GHz 802.11a [BW 20]	6.21	6.17	6.21	6.17	6.20	11.11	11.16	11.14	11.08	11.11
5 GHz 802.11n [BW 20]	5.62	5.60	5.61	5.57	5.58	9.98	10.01	10.02	9.96	9.95
5 GHz 802.11n [BW 40]	5.44	5.44	5.47	5.41	5.43	9.04	9.00	8.99	9.05	9.05
5 GHz 802.11ac [BW 20]	5.50	5.49	5.47	5.53	5.51	9.87	9.85	9.87	9.85	9.82
5 GHz 802.11ac [BW 40]	5.37	5.37	5.40	5.42	5.36	8.81	8.79	8.81	8.83	8.86
5 GHz 802.11ac [BW80]	5.35	5.36	5.35	5.36	5.35	8.15	8.15	8.17	8.10	8.20

2.6.5 Resulting test positions for SAR measurements

Wireless technologies	Position	§6.2 Triggering Distance	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for SAR
WLAN	Rear	7	N/A	N/A	6
	Top	7	N/A	7	6

2.6.6 SAR Test Configurations

Full Power Condition : Sensor Inactive														
Antenna	Band	Frequency (MHz)	Maximum Power		Separation Distances (mm)					Device Configurations for SAR Testing				
			dBm	mW	Rear	Top	Left side	Right side	Bottom	Rear	Top	Left side	Right side	Bottom
WLAN Ant1	2.4Ghz	2462	14.5	28	3.1	3.4	196.2	81	188.5	YES	YES	NO	NO	NO
WLAN Ant1	BT	2480	10	10	3.1	3.4	196.2	81	188.5	YES	YES	NO	NO	NO
WLAN Ant1	5GHz	5 825	12.5	18	3.1	3.4	196.2	81	188.5	YES	YES	NO	NO	NO
WLAN Ant2	2.4Ghz	2462	14.5	28	3.1	3.4	177	95.5	188.5	YES	YES	NO	NO	NO
WLAN Ant2	5GHz	5 825	12.5	18	3.1	3.4	177	95.5	188.5	YES	YES	NO	NO	NO

Reduced Power : Sensor Active														
Antenna	Band	Frequency (MHz)	Maximum Power		Separation Distances (mm)					Device Configurations for SAR Testing				
			dBm	mW	Rear	Top	Left side	Right side	Bottom	Rear	Top	Left side	Right side	Bottom
WLAN Ant1	2.4Ghz	2462	8.5	7	3.1	3.4	196.2	81	188.5	YES	YES	NO	NO	NO
WLAN Ant1	5GHz	5 825	7.5	6	3.1	3.4	196.2	81	188.5	YES	YES	NO	NO	NO
WLAN Ant2	2.4Ghz	2462	8.5	7	3.1	3.4	196.2	81	188.5	YES	YES	NO	NO	NO
WLAN Ant2	5GHz	5 825	7.5	6	3.1	3.4	177	95.5	188.5	YES	YES	NO	NO	NO

Antennas <50mm to adjacent edges : Accroding to KDB 447498 D01v06., if the caluated threshold value >3 then SAR test is requird

Antennas > 50mm to adjacent edges : Accroding to KDB 447498 D01v06., if the caluated Power threshold is less than the output power then SAR test is requird

Note; All test configurations are based on front view.

Per FCC KDB Publication 616217 D04v01r02, the rear surface and edges of 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 closet 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.

2.7 SAR Summation Scenario

According to FCC KDB 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 EUT are shown below paths and are mode in same rectangle to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

Simultaneous transmission paths

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

Simultaneous Transmission Scenarios	
Applicable Combination	Body
2.4 GHz WiFi Ant.1 + 2.4 GHz WiFi Ant.2	Yes
5 GHz WiFi Ant.1 + 5 GHz WiFi Ant.2	Yes
2.4 GHz Bluetooth Ant.1 + 2.4 GHz WiFi Ant.2	Yes

1. This device support 2X2 MIMO Tx for WLAN 802.11a/g/n/ac .each antenna can transmit independently or together when operating with MIMO.

3. INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

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 C95.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., Ne York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring 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 National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. 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.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative of the incremental electromagnetic energy (d*W*) absorbed by (dissipated in) an incremental mass (d*m*) contained in a volume element (d*V*) of a given density (*r*). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body.

$$SAR = \frac{d}{\;}\left(\frac{d\;U}{\;}\right)$$

Figure 1. SAR Mathematical Equation

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

$$SAR = \sigma E^2 / \rho$$

Where:

σ = conductivity of the tissue-simulant material (S/m)

ρ = mass density of the tissue-simulant material (kg/㎥)

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 relations 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.

4. DESCRIPTION OF TEST EQUIPMENT

4.1 SAR MEASUREMENT SETUP

These measurements are performed using the DASY4 automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure.2).

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The PC with Windows XP or Windows 7 is working with SAR Measurement system DASY4 & DASY5, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

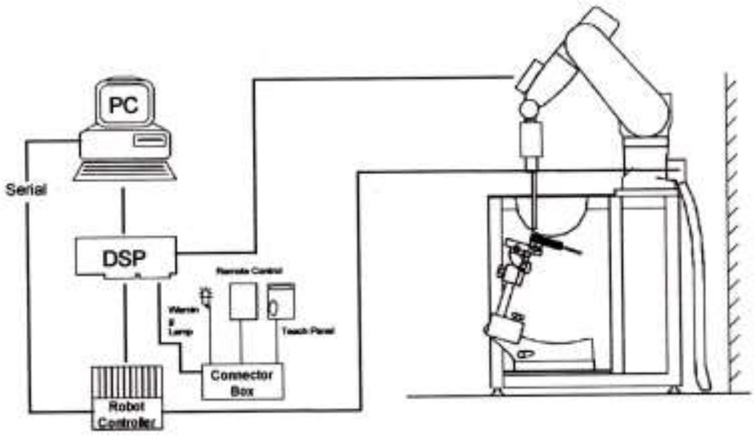


Figure 2. HCT SAR Lab. Test Measurement Set-up

The DAE consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

5. SAR MEASUREMENT PROCEDURE

The evaluation was performed with the following procedure:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no more than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the DUT's head and body area and the horizontal grid resolution was depending on the FCC KDB 865664 D01v01r04 table 4-1 & IEEE 1528-2013.

2. Based on step, the area of the maximum absorption was determined by sophisticated interpolations routines implemented in DASY software. When an Area Scan has measured all reachable point. DASY system computes the field maximal found in the scanned are, within a range of the maximum. SAR at this fixed point was measured and used as a reference value.

3. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB 865664 D01v01r04 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 (reference from the DASY manual.)

   a. The data at the surface were extrapolated, since the center of the dipoles is no more than 2.7 mm away from the tip of the probe (it is different from the probe type) and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

   b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed using the 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 integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

   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. If the value changed by more than 5 %, the SAR evaluation and drift measurements were repeated.

Area scan and zoom scan resolution setting follow KDB 865664 D01v01r04 quoted below.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5±1 mm</td><td>$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30°±1°</td><td>20°±1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan Spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤15 mm
2-3 GHz: ≤12 mm</td><td>3-4 GHz: ≤12 mm
4-6 GHz: ≤10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan Spatial resolution: Δx_{zoom}, Δy_{zoom}</td><td>≤ 2 GHz: ≤8mm
2-3 GHz: ≤5mm*</td><td>3-4 GHz: ≤5 mm*
4-6 GHz: ≤4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan Spatial resolution normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{zoom}(n)$</td><td>≤ 5 mm</td><td>3-4 GHz: ≤4 mm
4-5 GHz: ≤3 mm
5-6 GHz: ≤2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{zoom}(1)$: between 1st two Points closest to phantom surface</td><td>≤ 4 mm</td><td>3-4 GHz: ≤3 mm
4-5 GHz: ≤2.5 mm
5-6 GHz: ≤2 mm</td></tr>
<tr><td>$\Delta z_{zoom}(n>1)$: between subsequent Points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3-4 GHz: ≥28 mm
4-5 GHz: ≥25 mm
5-6 GHz: ≥22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

6. DESCRIPTION OF TEST POSITION

6.1 Device Holder

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

6.2 SAR Testing for Tablet Per KDB Publication 616217 D04v01r02

Per FCC KDB Publication 616217 D04v01r02, 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 configuration. 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.

6.3 Proximity Sensor Considerations.

This device uses a sensor to reduce output powers in certain use conditions when the device is used close the user's body.

When the sensor detects a user is touching the device on or near to the antenna the device reduces the maximum allowed output power However, the proximity sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, an additional exposure condition 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 616217 D04 Section 8 was used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. The smallest separation distance determined by the sensor triggering and sensor coverage for each applicable edge, minus 1 mm. was used as the test separation distance for SAR testing. Sensor triggering distance summary data is included in below table.

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

7. ANSI/ IEEE C95.1 - 1992 RF EXPOSURE LIMITS

HUMAN EXPOSURE	UNCONTROLLED ENVIRONMENT General Population	CONTROLLED ENVIRONMENT Occupational
	(W/kg) or (mW/g)	(W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.00

Table 8.1 Safety Limits for Partial Body Exposure

NOTES:

* The Spatial Peak value of the SAR averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole-body.

******* The Spatial Peak value of the SAR averaged over any 10 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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 mad 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.

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.

8. FCC SAR GENERAL MEASUREMENT PROCEDURES

8.1 Measured and Reported SAR

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

8.2 SAR Testing with 802.11 Transmitters

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

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

8.2.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII2A 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 for 1g SAR or > 3.0 W/kg for 10g SAR. 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 for 1g SAR or > 3.0 W/kg for 10g SAR.

8.2.3 U-NII-C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380MHz (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.

8.2.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating nest 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 for 1g SAR and ≤ 1.0 W/kg for 10g SAR, no additional testing for the remaining test position is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg for 1g SAR and ≤ 2.0 W/kg for 10g SAR or all test positions are measured.

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

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

8.2.6 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate and lowest order 802.11 a/g/n/ac mode. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11 ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.2., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

8.2.7 Initial Test Configuration Procedure

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

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

8.2.8 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 on 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 for 1g SAR and ≤ 3.0 W/kg for 10g SAR, no additional SAR tests for the subsequent test configurations are required.

8.2.9 MIMO SAR Considerations

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

9. Output Power Specifications

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

9.1 WiFi

9.1.1 Maximum Power : Sensor Active Conditions:

IEEE 802.11 Average RF Conducted Power – Antenna 1

Mode	Freq. [MHz]	Channel	IEEE 802.11 (2.4 GHz) Conducted Power [dBm]
802.11b	2 412	1	13.98
	2 437	6	13.89
	2 462	11	**14.17**
	2 467	12	7.86
	2 472	13	7.61
802.11g	2 412	1	11.59
	2 437	6	11.56
	2 462	11	11.75
	2 467	12	7.31
	2 472	13	2.36
802.11n	2 412	1	11.42
	2 437	6	11.40
	2 462	11	11.52
	2 467	12	7.11
	2 472	13	1.17

IEEE 802.11a Average RF Conducted Power – 20 MHz Bandwidth – Antenna 1

Mode	Freq. [MHz]	Channel	IEEE 802.11 (5 GHz) Conducted Power [dBm]
802.11a	5 180	36	11.61
	5 200	40	11.14
	5 240	48	**11.68**
	5 260	52	11.27
	5 300	60	11.29
	5 320	64	11.35
	5 500	100	11.32
	5 580	116	11.37
	5 700	140	11.41
	5 745	149	11.63
	5 785	157	11.17
	5 825	165	11.47

IEEE 802.11 Average RF Conducted Power – Antenna 2

Mode	Freq. [MHz]	Channel	IEEE 802.11 (2.4 GHz) Conducted Power [dBm]
802.11b	2 412	1	14.21
	2 437	6	14.09
	2 462	11	**14.31**
	2 467	12	8.39
	2 472	13	7.61
802.11g	2 412	1	11.71
	2 437	6	11.59
	2 462	11	11.85
	2 467	12	8.10
	2 472	13	2.20
802.11n	2 412	1	11.41
	2 437	6	11.44
	2 462	11	11.68
	2 467	12	8.17
	2 472	13	1.13

IEEE 802.11a Average RF Conducted Power – 20 MHz Bandwidth – Antenna 2

Mode	Freq. [MHz]	Channel	IEEE 802.11 (5 GHz) Conducted Power [dBm]
802.11a	5 180	36	11.37
	5 200	40	11.31
	5 240	48	11.57
	5 260	52	11.55
	5 300	60	11.45
	5 320	64	11.50
	5 500	100	11.47
	5 580	116	11.41
	5 700	140	11.20
	5 745	149	11.35
	5 785	157	11.52
	5 825	165	11.72

9.1.2 Reduced Power Condition: Sensor Active Conditions:

IEEE 802.11 Reduced Average RF Conducted Power – Antenna 1

Mode	Freq. [MHz]	Channel	IEEE 802.11 (2.4 GHz) Conducted Power [dBm]
802.11b	2 412	1	8.34
	2 437	6	7.09
	2 462	11	7.19
	2 467	12	7.86
	2 472	13	7.61
802.11g	2 412	1	7.30
	2 437	6	6.92
	2 462	11	6.95
	2 467	12	7.31
	2 472	13	2.36
802.11n	2 412	1	7.39
	2 437	6	7.19
	2 462	11	7.23
	2 467	12	7.17
	2 472	13	1.05

IEEE 802.11ac Average RF Conducted Power – 80 MHz Bandwidth – Antenna 1

Mode	Freq. [MHz]	Channel	IEEE 802.11 (5 GHz) Conducted Power [dBm]
802.11ac	5 210	42	5.75
	5 290	58	6.00
	5 530	106	6.07
	5 775	155	6.11

IEEE 802.11 Reduced Average RF Conducted Power – Antenna 2

Mode	Freq. [MHz]	Channel	IEEE 802.11 (2.4 GHz) Conducted Power [dBm]
802.11b	2 412	1	**8.48**
	2 437	6	8.19
	2 462	11	7.98
	2 467	12	8.39
	2 472	13	7.61
802.11g	2 412	1	8.25
	2 437	6	7.82
	2 462	11	8.13
	2 467	12	8.10
	2 472	13	2.20
802.11n	2 412	1	8.09
	2 437	6	7.56
	2 462	11	7.92
	2 467	12	8.17
	2 472	13	1.13

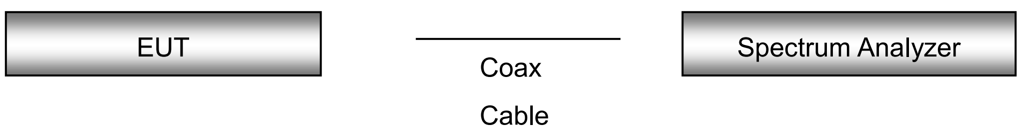
IEEE 802.11ac Average RF Conducted Power – 80 MHz Bandwidth – Antenna 2

Mode	Freq. [MHz]	Channel	IEEE 802.11 (5 GHz) Conducted Power [dBm]
802.11ac	5 210	42	6.61
	5 290	58	6.35
	5 530	106	6.93
	5 775	155	6.50

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 mode 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.
- Output power and SAR measurement is not required for 802.11n channels when the specified tune-up tolerances for 802.11n are lower than 802.11a by more than 1/2dB and the measured SAR is $\leq$ 1.2 W/kg

Test Configuration



9.2 BT

Averaged-conducted Power

Mode	Channel	BT Power [dBm]
DH5	0	8.52
	39	9.36
	78	7.60
2-DH5	0	4.99
	39	5.90
	78	4.03
3-DH5	0	4.99
	39	5.90
	78	4.04

Per October 2016 TCB Workshop Notes:
When call box and Bluetooth protocol are used for BT SAR measurement, time-domain plot is required to identify duty factor for supporting the test setup and result.
Bluetooth duty cycle was measured using Bluetooth tester equipment (CBT / R&S) with Bluetooth protocol. DH5 mode is the highest duty cycle and conducted power. SAR test were performed at DH5 mode

Duty Cycle

= (BT-On time /BT-Full time) =(2.880/3.750)*100 = 0.768(DH5)

Duty factor= 1/Duty cycle : 1.3

10. SYSTEM VERIFICATION

10.1 Tissue Verification

The Head /body simulating material is calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity.

Table for Body Tissue Verification									
Date of Tests	Tissue Temp	Tissue Type	Freq. (MHz)	Measured Conductivity σ (S/m)	Measured Dielectric Constant, ε	Target Conductivity σ (S/m)	Target Dielectric Constant, ε	% dev σ	% dev ε
01/16/2017	19.6	2450B	2 400	1.888	52.442	1.902	52.770	-0.74%	-0.62%
			2 450	1.954	52.231	1.950	52.700	0.21%	-0.89%
			2 500	2.015	52.065	2.021	52.640	-0.30%	-1.09%
01/31/2017	21.3	5200B-5300B	5 180	5.138	48.514	5.283	49.038	-2.74%	-1.07%
			5 250	5.253	48.303	5.358	48.950	-1.96%	-1.32%
01/17/2017	19.6	5200B-5800B	5 250	5.206	48.190	5.377	48.936	-3.18%	-1.52%
			5 280	5.253	48.119	5.400	48.908	-2.72%	-1.61%
			5 320	5.315	48.013	5.447	48.852	-2.42%	-1.72%
			5 500	5.614	47.491	5.650	48.610	-0.64%	-2.30%
			5 600	5.770	47.254	5.766	48.470	0.07%	-2.51%
			5 720	5.973	46.933	5.915	48.312	0.98%	-2.85%
			5 750	6.026	46.868	5.944	48.277	1.38%	-2.92%
			5 800	6.098	46.753	6.000	48.200	1.63%	-3.00%
			5 825	6.134	46.672	6.037	48.165	1.61%	-3.10%

10.2 System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at 2 450 MHz / 5 250 MHz / 5 600 MHz / 5 750 MHz by using the system Verification kit. (Graphic Plots Attached)

System Verification Results

Freq. [MHz]	Date	Probe (S/N)	Dipole (S/N)	Liquid	Amb. Temp. [°C]	Liquid Temp. [°C]	1 W Target SAR_{1g} (SPEAG) [W/kg]	Measured SAR_{1g} [W/kg]	1 W Normalized SAR_{1g} [W/kg]	Deviation [%]	Limit [%]
2 450	01/16/2017	3968	965	Body	19.8	19.6	49.2	4.78	47.8	- 2.85	± 10
5 250	01/31/2017	3968	1253	Body	21.5	21.3	76.4	7.11	71.1	- 6.94	± 10
5 250	01/17/2017	3968	1253	Body	19.8	19.6	76.4	7.47	74.7	- 2.23	± 10
5 600	01/17/2017	3968	1253	Body	19.8	19.6	80.0	8.04	80.4	+ 0.50	± 10
5 750	01/17/2017	3968	1253	Body	19.8	19.6	77.1	7.76	77.6	+ 0.65	± 10

10.3 System Verification Procedure

SAR measurement was prior to assessment, the system is verified to the ± 10 % of the specifications at each frequency band by using the system Verification kit. (Graphic Plots Attached)
- Cabling the system, using the Verification kit equipments.
- Generate about 100 mW Input Level from the Signal generator to the Dipole Antenna.
- Dipole Antenna was placed below the Flat phantom.
- The measured one-gram SAR at the surface of the phantom above the dipole feed-point should be within 10 % of the target reference value.
- The results are normalized to 1 W input power.

NOTE;
SAR Verification was performed according to the FCC KDB 865664 D01v01r04.

11. SAR TEST DATA SUMMARY

11.1 SAR Measurement Results

Wi-Fi (DTS) Body SAR - Antenna 1																
Frequency		Mode	Band width	Data Rate	Tune-Up Limit	Meas. Power	Power Drift	Test Position	Sensor	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(Mbps)	(dBm)	(dBm)	(dB)				(mm)	(W/kg)		(Duty)	(W/kg)	
2 462	11	802.11b	22	1	14.5	14.17	0.14	Rear	Inactive	99.96	6	0.352	1.079	1.000	0.380	-
2 462	11	802.11b	22	1	14.5	14.17	0.11	Top	Inactive	99.96	6	0.224	1.079	1.000	0.242	-
2 412	1	802.11b	22	1	8.5	8.34	-0.18	Rear	Active	99.96	0	**0.489**	1.038	1.000	**0.508**	1
2 412	1	802.11b	22	1	8.5	8.34	0.11	Top	Active	99.96	0	0.073	1.038	1.000	0.076	-
2 412	1	802.11b	22	1	8.5	8.34	-0.13	Rear With cover	Active	99.96	0	0.246	1.038	1.000	0.255	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg Averaged over 1 gram								

Wi-Fi (DTS) Body SAR - Antenna 2																
Frequency		Mode	Band width	Data Rate	Tune-Up Limit	Meas. Power	Power Drift	Test Position	Sensor	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(Mbps)	(dBm)	(dBm)	(dB)				(mm)	(W/kg)		(Duty)	(W/kg)	
2 462	11	802.11b	22	1	14.5	14.31	0.19	Rear	Inactive	99.96	6	0.230	1.045	1.000	0.240	-
2 462	11	802.11b	22	1	14.5	14.31	0.02	Top	Inactive	99.96	6	0.171	1.045	1.000	0.179	-
2 412	1	802.11b	22	1	8.5	8.48	0.03	Rear	Active	99.96	0	**0.241**	1.005	1.000	**0.242**	2
2 412	1	802.11b	22	1	8.5	8.48	0.02	Top	Active	99.96	0	0.168	1.005	1.000	0.169	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg Averaged over 1 gram								

Bluetooth Body SAR											
Frequency		Mode	Tune-Up Limit	Meas. Power	Power Drift	Test Position	Distance	Meas. SAR	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(dBm)	(dBm)	(dB)		(mm)	(W/kg)		(W/kg)	
2 441	39	Bluetooth DH5	10.0	9.36	0.00	Rear	0	**0.381**	1.159	**0.441**	3
2 441	39	Bluetooth DH5	10.0	9.36	0.18	Top	0	0.131	1.159	0.152	-
2 441	39	Bluetooth DH5	10.0	9.36	0.12	Rear With cover	0	0.294	1.159	0.341	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population						Body 1.6 W/kg Averaged over 1 gram					

Wi-Fi (NII) Body SAR - Antenna 1																
Frequency		Mode	Band width	Data Rate	Tune-Up Limit	Meas. Power	Power Drift	Test Position	Sensor	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(Mbps)	(dBm)	(dBm)	(dB)				(mm)	(W/kg)		(Duty)	(W/kg)	
5240	48	802.11a	20	6Mbps	12.5	11.68	-0.10	Rear	Inactive	94.62	6	0.043	1.208	1.057	0.055	-
5240	48	802.11a	20	6Mbps	12.5	11.68	-0.10	Top	Inactive	94.62	6	0.05	1.208	1.057	0.064	-
5210	42	802.11ac	80	MCS0	7.5	5.75	0.00	Rear	Active	85.23	0	0.107	1.496	1.173	0.188	-
5210	42	802.11ac	80	MCS0	7.5	5.75	-0.10	Top	Active	85.23	0	0.168	1.496	1.173	0.295	-
5 320	64	802.11a	20	6Mbps	12.5	11.35	-0.13	Rear	Inactive	94.62	6	0.116	1.303	1.057	0.160	-
5 320	64	802.11a	20	6Mbps	12.5	11.35	0.10	Top	Inactive	94.62	6	0.140	1.303	1.057	0.193	-
5 290	58	802.11ac	80	MCS0	7.5	6.00	0.00	Rear	Active	85.23	0	0.084	1.413	1.173	0.139	-
5 290	58	802.11ac	80	MCS0	7.5	6.00	0.00	Top	Active	85.23	0	0.156	1.413	1.173	0.259	-
5 700	140	802.11a	20	6Mbps	12.5	11.41	-0.10	Rear	Inactive	94.62	6	0.150	1.285	1.057	0.204	-
5 700	140	802.11a	20	6Mbps	12.5	11.41	-0.18	Top	Inactive	94.62	6	0.157	1.285	1.057	0.213	-
5 530	106	802.11ac	80	MCS0	7.5	6.07	-0.10	Rear	Active	85.23	0	0.151	1.390	1.173	0.246	-
5 530	106	802.11ac	80	MCS0	7.5	6.07	0.00	Top	Active	85.23	0	0.053	1.390	1.173	0.086	-
5 745	149	802.11a	20	6Mbps	12.5	11.63	0.00	Rear	Inactive	94.62	6	0.139	1.222	1.057	0.180	-
5 745	149	802.11a	20	6Mbps	12.5	11.63	-0.10	Top	Inactive	94.62	6	0.164	1.222	1.057	0.212	-
5 775	155	802.11ac	80	MCS0	7.5	6.11	0.00	Rear	Active	85.23	0	0.213	1.377	1.173	**0.344**	4
5 775	155	802.11ac	80	MCS0	7.5	6.11	0.00	Top	Active	85.23	0	0.060	1.377	1.173	0.097	-
5 775	155	802.11ac	80	MCS0	7.5	6.11	0.00	Rear With cover	Active	80.91	0	0.058	1.377	1.236	0.099	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg Averaged over 1 gram								

Wi-Fi (NII) Body SAR - Antenna 2																
Frequency		Mode	Band width	Data Rate	Tune-Up Limit	Meas. Power	Power Drift	Test Position	Sensor	Duty Cycle	Distance	Meas. SAR	Scaling Factor	Scaling Factor	Scaled SAR	Plot No.
MHz	Ch.		(MHz)	(Mbps)	(dBm)	(dBm)	(dB)				(mm)	(W/kg)		(Duty)	(W/kg)	
5 240	48	802.11a	20	6Mbps	12.5	11.57	-0.10	Rear	Inactive	94.62	6	0.115	1.239	1.057	0.151	-
5 240	48	802.11a	20	6Mbps	12.5	11.57	-0.10	Top	Inactive	94.62	6	0.036	1.239	1.057	0.047	-
5 210	42	802.11ac	80	MCS0	7.5	6.61	0.00	Rear	Active	85.23	0	0.244	1.227	1.173	**0.351**	5
5 210	42	802.11ac	80	MCS0	7.5	6.61	0.00	Top	Active	85.23	0	0.062	1.227	1.173	0.089	-
5 260	52	802.11a	20	6Mbps	12.5	11.55	-0.17	Rear	Inactive	94.62	6	0.114	1.245	1.057	0.150	-
5 260	52	802.11a	20	6Mbps	12.5	11.55	0.19	Top	Inactive	94.62	6	0.057	1.245	1.057	0.075	-
5 290	58	802.11ac	80	MCS0	7.5	6.35	0.00	Rear	Active	85.23	0	0.102	1.303	1.173	0.156	-
5 290	58	802.11ac	80	MCS0	7.5	6.35	0.00	Top	Active	85.23	0	0.051	1.303	1.173	0.078	-
5 500	100	802.11a	20	6Mbps	12.5	11.47	-0.10	Rear	Inactive	94.62	6	0.071	1.268	1.057	0.095	-
5 500	100	802.11a	20	6Mbps	12.5	11.47	-0.10	Top	Inactive	94.62	6	0.053	1.268	1.057	0.071	-
5 530	106	802.11ac	80	MCS0	7.5	6.93	0.00	Rear	Active	85.23	0	0.103	1.140	1.173	0.138	-
5 530	106	802.11ac	80	MCS0	7.5	6.93	0.00	Top	Active	85.23	0	0.038	1.140	1.173	0.051	-
5 825	165	802.11a	20	6Mbps	12.5	11.72	-0.10	Rear	Inactive	94.62	6	0.146	1.197	1.057	0.185	-
5 825	165	802.11a	20	6Mbps	12.5	11.72	-0.13	Top	Inactive	94.62	6	0.069	1.197	1.057	0.087	-
5 775	155	802.11ac	80	MCS0	7.5	6.50	0.00	Rear	Active	85.23	0	0.164	1.259	1.173	0.242	-
5 775	155	802.11ac	80	MCS0	7.5	6.50	0.00	Top	Active	85.23	0	0.061	1.259	1.173	0.090	-
5 210	42	802.11ac	80	MCS0	7.5	6.61	0	Rear Keyboard Cover	Active	85.23	0	0.062	1.227	1.173	0.089	-
ANSI/ IEEE C95.1 - 1992– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg Averaged over 1 gram								

11.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04v01r02 and KDB Publication 447498 D01v06
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB 447498 D01v06.
6. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for frequency band were grater than or equal to 0.8 W/kg. Repeated SAR measurements are performed.. Please see Section 13 for variability analysis information.
7. This device utilizes power reduction for wireless mode and technologies, as outlined in sec. 2.5 and sec.9. The maximum output power allowed for each transmitter and exposure condition was evaluated for SAR compliance based on expected use conditions and simultaneous scenarios.
8. FCC KDB Publication 616217 D04v01r02 Section 4.3, SAR tests are required for the back surface and Top side 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.
9. Per FCC KDB 865664 D01v01r04, variability SAR tests were not performed since the measured SAR results for all frequency bands were less than 0.8 W/kg. Please see Section 13 for variability analysis information.

WLAN Notes:

1. Per KDB 2482227 D01v02r02 justification for test configurations of 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 802.11 g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
2. Per KDB 2482227 D01v02r02 justification for test configurations of 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 mode were not investigated since the highest reported SAR for initial test configuration adjusted by the ration of maximum output powers is less than 1.2 W/kg for 1g SAR and less than 3.0 W/kg for 10 g SAR.
3. Per KDB 2482227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR Provisions from KDB 447498D01v06.
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 rated, 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 WLAN test reports.

Bluetooth Notes:

1. Bluetooth SAR was measured with the device connected to a call box with hopping disabled with DH5 operation and Tx Tests mode type. Per October 2016 TCBC Workshop Notes, the reported SAR was scaled to 100% transmission duty factor to determine compliance. Please see sec.9.5 for the time-domain plot and calculation for duty factor of the device.

12. Simultaneous Transmission SAR Analysis

12.1 Simultaneous Transmission Summation for Body

Simultaneous Tx	configurations	2.4 GHz Antenna 1 (W/kg)	2.4 GHz Antenna 2 (W/kg)	∑ 1-g SAR (W/kg)
Body SAR	Rear	0.508	0.242	**0.750**
	Top	0.242	0.179	0.421

Simultaneous Tx	configurations	5GHz Antenna 1 (W/kg)	5GHz Antenna 2 (W/kg)	∑ 1-g SAR (W/kg)
Body SAR	Rear	0.344	0.351	0.695
	Top	0.295	0.090	0.385

Simultaneous Tx	configurations	BT (W/kg)	2.4 Antenna 2 (W/kg)	∑ 1-g SAR (W/kg)
Body SAR	Rear	0.441	0.242	0.683
	Top	0.152	0.179	0.331

12.2 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit. And therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528-2013.

13. SAR Measurement Variability and Uncertainty

In accordance with KDB procedure 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz, SAR additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is 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) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg for 1g SAR or < 2.0 W/kg for 10g SAR; steps 2) through 4) do not apply.

2) When the original highest measured 1g SAR is ≥ 0.80 W/kg or 10g SAR ≥ 2.0W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg for 1g SAR or ≥ 3.625 W/kg for 10g SAR (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg for 1g SAR or ≥3.75 W/kg for 10g SAR and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

14. MEASUREMENT UNCERTAINTY

Error Description	Tol (± %)	Prob. dist.	Div.	c_i	Standard Uncertainty (± %)	v_{eff}
1. Measurement System						
Probe Calibration	6.55	N	1	1	6.55	∞
Axial Isotropy	4.70	R	1.73	0.70	1.90	∞
Hemispherical Isotropy	9.60	R	1.73	0.70	3.88	∞
Boundary Effects	2.00	R	1.73	1	1.15	∞
Linearity	4.70	R	1.73	1	2.71	∞
System Detection Limits	0.25	R	1.73	1	0.14	∞
Readout Electronics	0.30	N	1.00	1	0.30	∞
Response Time	0.80	R	1.73	1	0.46	∞
Integration Time	2.60	R	1.73	1	1.50	∞
RF Ambient Noise	3.00	R	1.73	1	1.73	∞
RF Ambient Reflections	3.00	R	1.73	1	1.73	∞
Probe Positioner	0.80	R	1.73	1	0.46	∞
Probe Positioning	6.70	R	1.73	1	3.87	∞
Max SAR Eval	4.00	R	1.73	1	2.31	∞
2.Test Sample Related						
Device Positioning	2.11	N	1.00	1	2.11	9
Device Holder	3.60	N	1.00	1	3.60	5
Power Drift	5.00	R	1.73	1	2.89	∞
Power Scaling	0.00	R	1.73	1	0.00	∞
3.Phantom and Setup						
Phantom Uncertainty	7.90	R	1.73	1	3.82	∞
Liquid Conductivity(target)	5.00	R	1.73	0.64	1.85	∞
Liquid Permitivity(target)	5.00	R	1.73	0.60	1.73	∞
Liquid Conductivity(meas.)	3.80	N	1	0.78	2.96	5
Liquid Permitivity(meas.)	2.60	N	1	0.23	0.60	5
Liquid Conductivity(temp.)	1.70	R	1.73	0.78	0.77	∞
Liquid Permitivity(temp.)	2.70	R	1.73	0.23	0.36	∞
Combind Standard Uncertainty					12.49	
Coverage Factor for 95 %					k=2	
Expanded STD Uncertainty					24.98	

15. SAR TEST EQUIPMENT

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	ELI Phantom	-	N/A	N/A	N/A
HP	SAR System Control PC	-	N/A	N/A	N/A
Staubli	Robot RX90B L	F01/5K09A1/A/01	N/A	N/A	N/A
Staubli	TX90 Xlspeag	F10/5D1CA1/A/01	N/A	N/A	N/A
Staubli	Robot ControllerCS7MB	F01/5K09A1/C/01	N/A	N/A	N/A
Staubli	CS8Cspeag-TX90	F10/5D1CA1/C/01	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D221340.01	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D21142106	N/A	N/A	N/A
SPEAG	DAE3	504	07/26/2016	Annual	07/26/2017
SPEAG	E-Field Probe EX3DV4	3968	05/31/2016	Annual	05/31/2017
SPEAG	Dipole D2450V2	965	04/19/2016	Annual	04/19/2017
SPEAG	Dipole D5GHzV2	1253	01/09/2017	Annual	01/09/2018
Agilent	Power Meter N1911A	MY45101406	09/28/2016	Annual	09/28/2017
HP	Power Sensor 8481A	2702A72055	05/27/2016	Annual	05/27/2017
SPEAG	DAKS 3.5	1038	05/31/2016	Annual	05/31/2017
HP	Directional Bridge	86205A	05/18/2016	Annual	05/18/2017
Agilent	Base Station E5515C	GB44400269	02/05/2016	Annual	02/05/2017
HP	Signal Generator N5182A	MY47070230	05/13/2016	Annual	05/13/2017
Hewlett Packard	11636B/Power Divider	58698	02/27/2016	Annual	02/27/2017
TESTO	175-H1/Thermometer	40331939309	02/12/2016	Annual	02/12/2017
EMPOWER	RF Power amplifier	1011	10/17/2016	Annual	10/17/2017
Agilent	Attenuator(3dB)	52744	10/16/2016	Annual	10/16/2017
Agilent	Attenuator(20dB)	52664	10/16/2016	Annual	10/16/2017
HP	Dielectric Probe Kit 85070C	00721521	N/A	N/A	N/A
HP	Dual Directional Coupler	16072	10/16/2016	Annual	10/16/2017
Rohde & Schwarz	CBT / Bluetooth Tester	100272	02/28/2016	Annual	02/28/2017

NOTE:

1. The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Verification measurement is performed by HCT Lab. before each test. The brain/body simulating material is calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity (dielectric constant) of the brain/body-equivalent material.

16. CONCLUSION

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the ANSI/ IEEE C95.1- 1992

These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests.

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC and Industry Canada. 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.

17. REFERENCES

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[29] FCC General RF Exposure Guidance and SAR procedures for Dongles, KDB 447498 D01,D02.

Attachment 1. – SAR Test Plots

Test Laboratory:	HCT CO., LTD
EUT Type:	Tablet
Liquid Temperature:	19.6 ℃
Ambient Temperature:	19.8 ℃
Test Date:	01/16/2017
Plot No.:	1

DUT: SM-W723; Type: Tablet

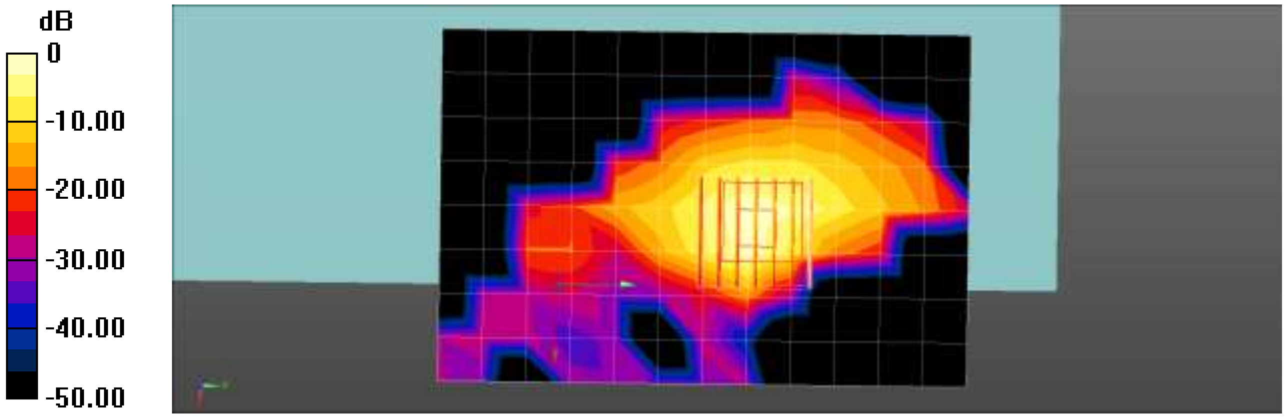
Communication System: UID 0, 2450MHz FCC; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.901 S/m; ε_r = 52.395; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(7.31, 7.31, 7.31); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (1);

SM-W723/Ant 1 802.11b Pwr back-off Body Rear 1Mbps 1ch/Area Scan (9x13x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.729 W/kg

SM-W723/Ant 1 802.11b Pwr back-off Body Rear 1Mbps 1ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.678 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 1.35 W/kg
SAR(1 g) = 0.489 W/kg; SAR(10 g) = 0.177 W/kg
Maximum value of SAR (measured) = 0.870 W/kg



0 dB = 0.729 W/kg = −1.37 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Tablet
Liquid Temperature: 19.6 ℃
Ambient Temperature: 19.8 ℃
Test Date: 01/16/2017
Plot No.: 2

DUT: SM-W723; Type: Tablet

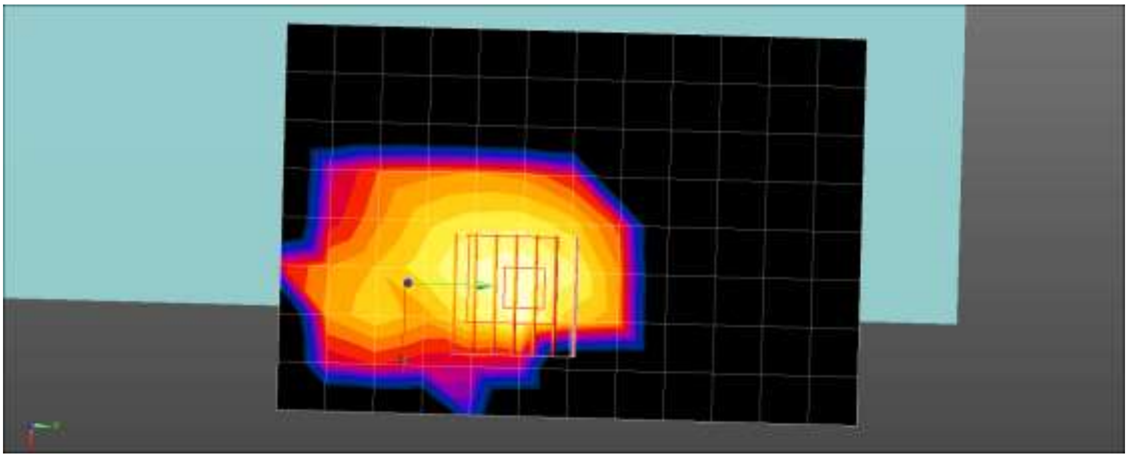
Communication System: UID 0, 2450MHz FCC; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.901 S/m; ε_r = 52.395; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(7.31, 7.31, 7.31); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (1);

SM-W723/Ant 2 802.11b PWR back-off Body Rear 1Mbps 1ch/Area Scan (9x13x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.406 W/kg

SM-W723/Ant 2 802.11b PWR back-off Body Rear 1Mbps 1ch/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.503 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.679 W/kg
SAR(1 g) = 0.241 W/kg; SAR(10 g) = 0.089 W/kg
Maximum value of SAR (measured) = 0.405 W/kg



0 dB = 0.406 W/kg = -3.92 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Tablet
Liquid Temperature: 19.6 ℃
Ambient Temperature: 19.8 ℃
Test Date: 01/16/2017
Plot No.: 3

DUT: SM-W723; Type: Tablet

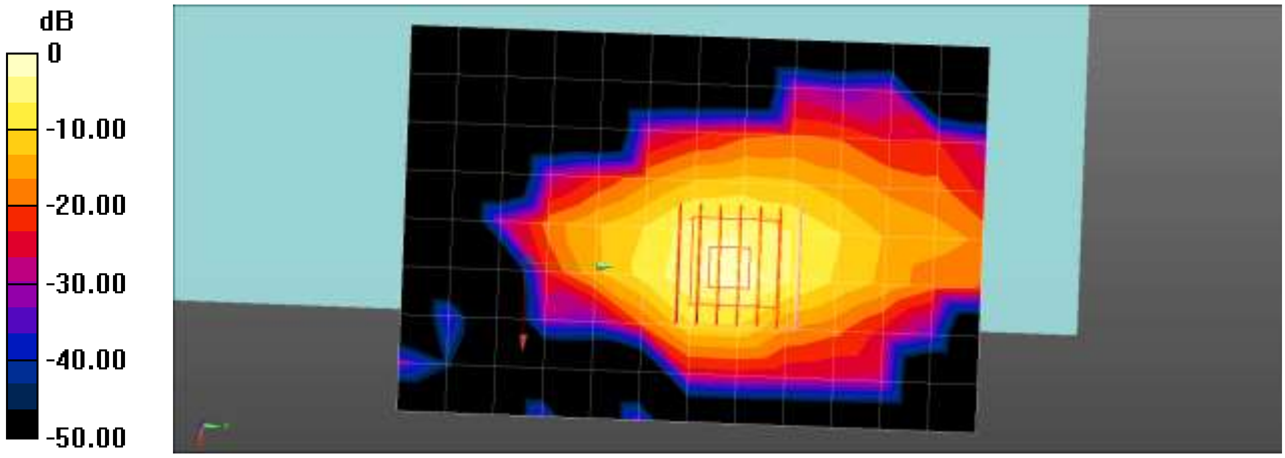
Communication System: UID 0, Bluetooth; Frequency: 2441 MHz;Duty Cycle: 1:1.3
Medium parameters used (interpolated): f = 2441 MHz; σ = 1.942 S/m; ε_r = 52.267; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(7.31, 7.31, 7.31); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (1);

SM-W723/BT Body Rear DH5 39ch 2/Area Scan (9x13x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.645 W/kg

SM-W723/BT Body Rear DH5 39ch 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.03 W/kg
SAR(1 g) = 0.381 W/kg; SAR(10 g) = 0.137 W/kg
Maximum value of SAR (measured) = 0.646 W/kg



0 dB = 0.645 W/kg = -1.91 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Tablet
Liquid Temperature: 19.6 ℃
Ambient Temperature: 19.8 ℃
Test Date: 01/17/2017
Plot No.: 4

DUT: SM-W723; Type: Tablet

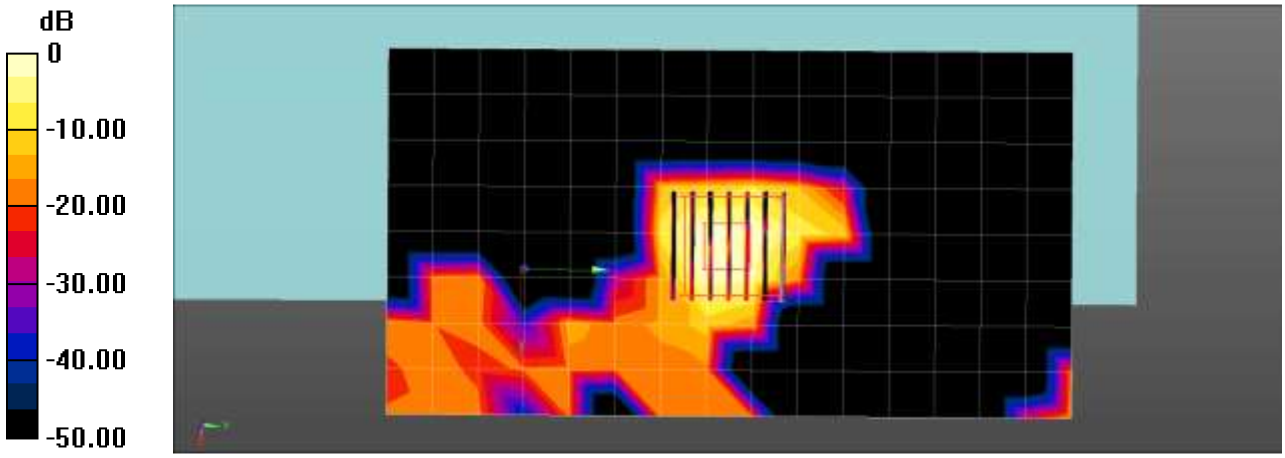
Communication System: UID 0, WiFI5GHz ac80; Frequency: 5775 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5775 MHz; σ = 6.062 S/m; ε_r = 46.811; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(3.92, 3.92, 3.92); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (1);

SM-W723/Ant 1 802.11ac80 UNII_3 Pwr back-off 0mm Body Rear VHT0 155ch/Area Scan (9x16x1):
Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.338 W/kg

SM-W723/Ant 1 802.11ac80 UNII_3 Pwr back-off 0mm Body Rear VHT0 155ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio:1.4
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.13 W/kg
SAR(1 g) = 0.213 W/kg; SAR(10 g) = 0.044 W/kg
Maximum value of SAR (measured) = 0.732 W/kg



0 dB = 0.338 W/kg = -4.71 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: Tablet
Liquid Temperature: 19.6 ℃
Ambient Temperature: 19.8 ℃
Test Date: 01/17/2017
Plot No.: 5

DUT: SM-W723; Type: Tablet

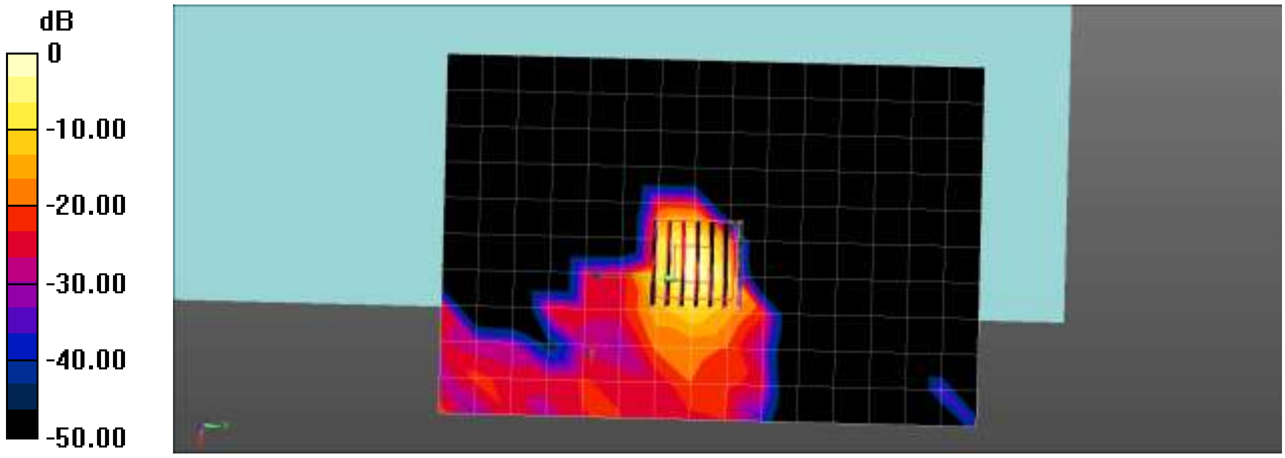
Communication System: UID 0, WiFI5GHz ac80; Frequency: 5210 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5210 MHz; σ = 5.185 S/m; ε_r = 48.424; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(4.37, 4.37, 4.37); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (1);

SM-W723/Ant 2 802.11ac80 UNII-1 Back-off Pwr 0mm Body Rear VHT0 42ch/Area Scan (11x16x1):
Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.598 W/kg

SM-W723/Ant 2 802.11ac80 UNII-1 Back-off Pwr 0mm Body Rear VHT0 42ch/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio:1.4
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.03 W/kg
SAR(1 g) = 0.244 W/kg; SAR(10 g) = 0.047 W/kg
Maximum value of SAR (measured) = 0.712 W/kg



0 dB = 0.598 W/kg = −2.23 dBW/kg

Attachment 2. – Dipole Verification Plots

Verification Data (2 450 MHz Body)

Test Laboratory: HCT CO., LTD
Input Power 100 mW (20 dBm)
Liquid Temp: 19.6 ℃
Test Date: 01/16/2017

DUT: Dipole 2450 MHz; Type: D2450V2

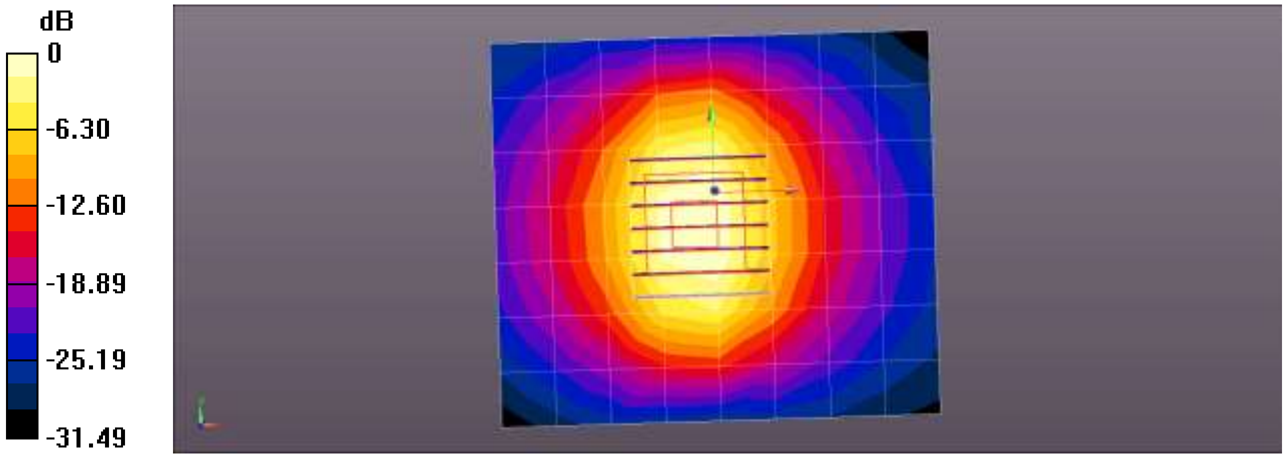
Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.954 S/m; ε_r = 52.231; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(7.31, 7.31, 7.31); Calibrated: 2016-05-31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: Flat Phantom
- Measurement SW: DASY52, Version 52.8 (1);

2.45GHz Verification body/Area Scan (9x8x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 5.90 W/kg

2.45GHz Verification body/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.51 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 9.92 W/kg
SAR(1 g) = 4.78 W/kg; SAR(10 g) = 2.21 W/kg
Maximum value of SAR (measured) = 7.32 W/kg



0 dB = 5.90 W/kg = 7.71 dBW/kg

Verification Data (5.25 GHz Body)

Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	21.3 ℃
Test Date:	01/31/2017

DUT: Dipole D5GHzV2; Type: D5GHzV2

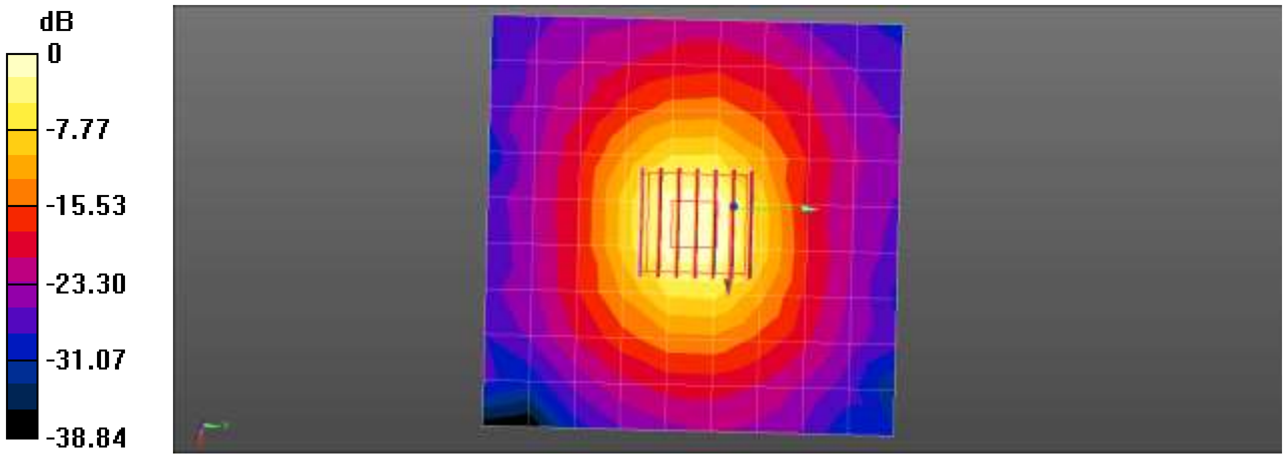
Communication System: UID 0, CW (0); Frequency: 5250 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5250 MHz; σ = 5.253 S/m; ε_r = 48.303; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(4.37, 4.37, 4.37); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (1);

5250MHz Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 10.5 W/kg

5250MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio:1.4
Reference Value = 41.33 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 29.3 W/kg
SAR(1 g) = 7.11 W/kg; SAR(10 g) = 1.99 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 10.5 W/kg = 10.22 dBW/kg

■ Verification Data (5.25 GHz Body)

Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	19.6 ℃
Test Date:	01/17/2017

DUT: Dipole D5GHzV2; Type: D5GHzV2

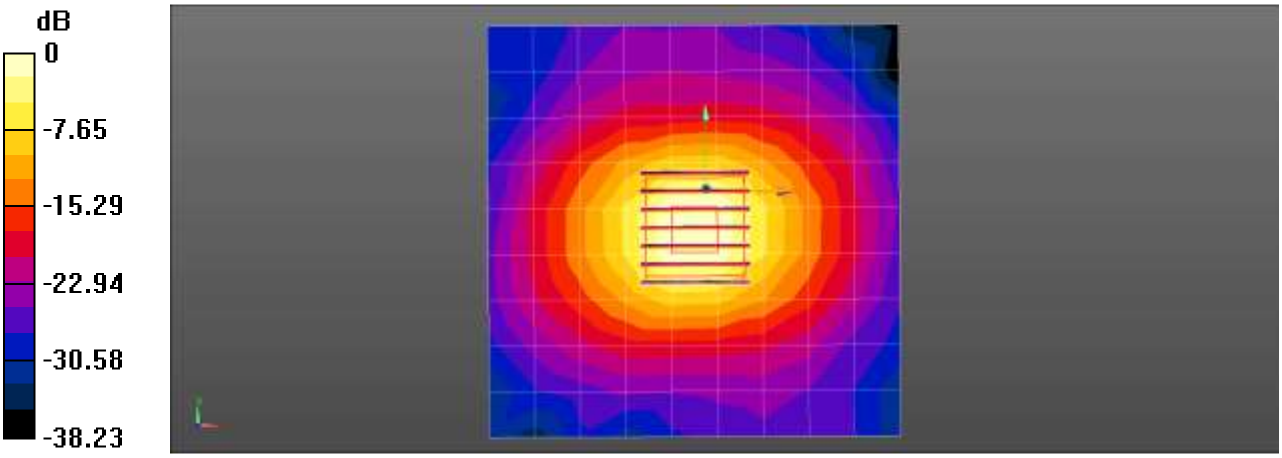
Communication System: UID 0, CW (0); Frequency: 5250 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5250 MHz; σ = 5.206 S/m; ε_r = 48.19; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(4.37, 4.37, 4.37); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (8);

5250MHz Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 10.9 W/kg

5250MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio:1.4
Reference Value = 41.85 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 30.5 W/kg
SAR(1 g) = 7.47 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 10.9 W/kg = 10.37 dBW/kg

■ Verification Data (5.6 GHz Body)

Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	19.6 ℃
Test Date:	01/17/2017

DUT: Dipole D5GHzV2; Type: D5GHzV2

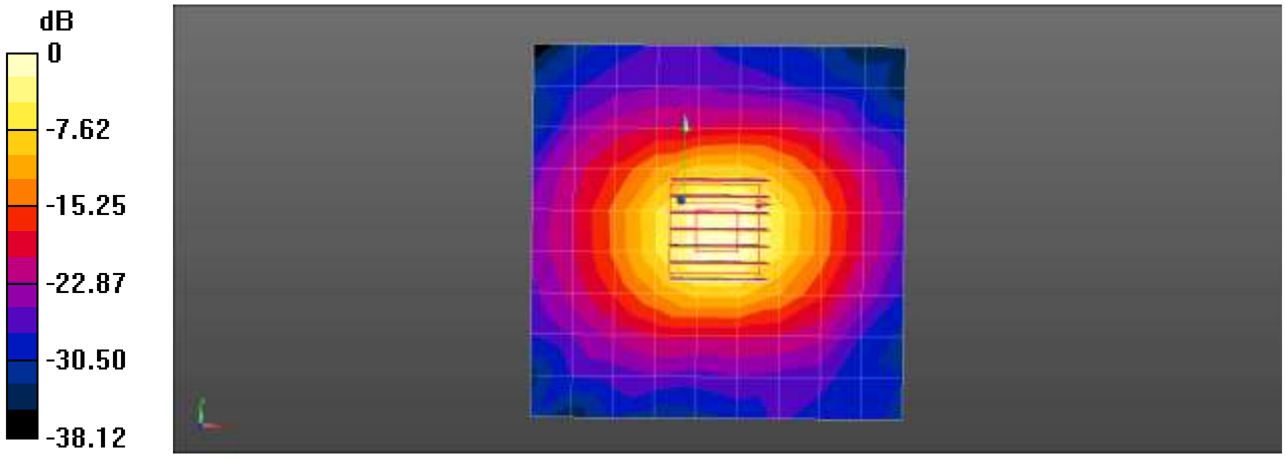
Communication System: UID 0, CW (0); Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.77 S/m; ε_r = 47.254; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(3.78, 3.78, 3.78); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (8);

5600MHz Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 12.3 W/kg

5600MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm;
Graded Ratio:1.4
Reference Value = 41.06 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 34.9 W/kg
SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 21.3 W/kg



0 dB = 12.3 W/kg = 10.90 dBW/kg

Verification Data (5.75 GHz Body)

Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	19.6 ℃
Test Date:	01/17/2017

DUT: Dipole D5GHzV2; Type: D5GHzV2

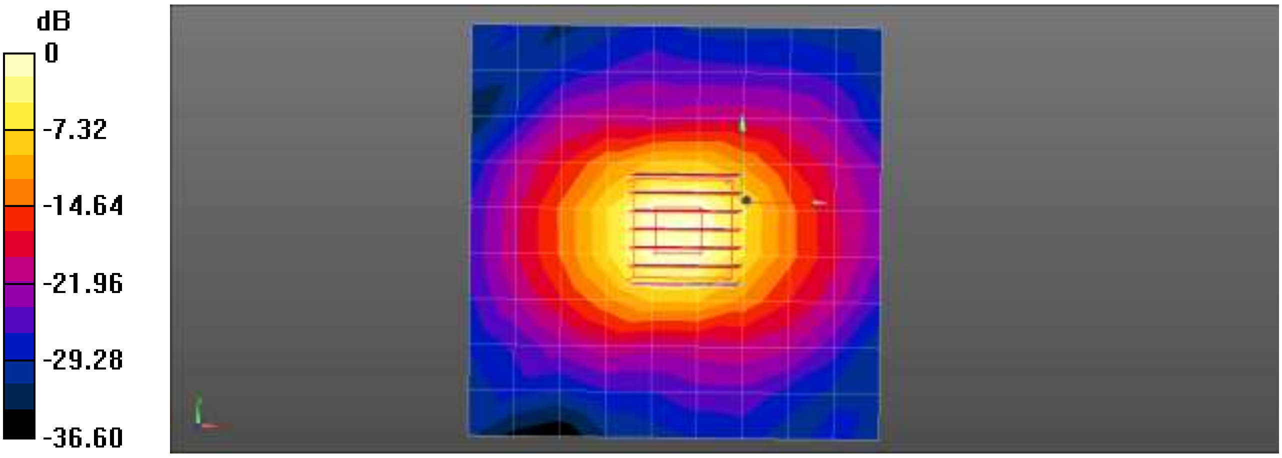
Communication System: UID 0, CW (0); Frequency: 5750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5750 MHz; σ = 6.026 S/m; ε_r = 46.868; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(3.92, 3.92, 3.92); Calibrated: 2016-05-31;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI
- Measurement SW: DASY52, Version 52.8 (8);

5750MHz Verification/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 12.1 W/kg

5750MHz Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio:1.4
Reference Value = 38.78 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 34.9 W/kg
SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.12 W/kg
Maximum value of SAR (measured) = 20.6 W/kg



0 dB = 12.1 W/kg = 10.83 dBW/kg

Attachment 3. – Probe Calibration Data

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

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

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

Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)** Certificate No: **EX3-3968_May16**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3968

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: May 31, 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: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-16
Power sensor E4412A	SN: MY41498087	06-Apr-16 (No. 217-02285)	In house check: Jun-16
Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284)	In house check: Jun-16
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Jun-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: June 1, 2016

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

Certificate No: EX3-3968_May16 Page 1 of 11

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "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"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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Probe EX3DV4

SN:3968

Manufactured: September 30, 2013
Calibrated: May 31, 2016

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3968

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.36	0.35	0.42	± 10.1 %
DCP (mV)[B]	101.7	102.0	97.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.4	±2.5 %
		Y	0.0	0.0	1.0		131.5	
		Z	0.0	0.0	1.0		146.5	

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

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3968

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	13.17	13.17	13.17	0.00	1.00	± 13.3 %
300	45.3	0.87	12.10	12.10	12.10	0.09	1.10	± 13.3 %
450	43.5	0.87	10.73	10.73	10.73	0.16	1.20	± 13.3 %
750	41.9	0.89	10.27	10.27	10.27	0.51	0.80	± 12.0 %
835	41.5	0.90	9.97	9.97	9.97	0.42	0.87	± 12.0 %
900	41.5	0.97	9.62	9.62	9.62	0.25	1.20	± 12.0 %
1450	40.5	1.20	8.55	8.55	8.55	0.34	0.80	± 12.0 %
1750	40.1	1.37	8.45	8.45	8.45	0.33	0.80	± 12.0 %
1900	40.0	1.40	8.14	8.14	8.14	0.31	0.80	± 12.0 %
1950	40.0	1.40	7.89	7.89	7.89	0.37	0.80	± 12.0 %
2300	39.5	1.67	7.72	7.72	7.72	0.30	0.89	± 12.0 %
2450	39.2	1.80	7.30	7.30	7.30	0.35	0.80	± 12.0 %
2600	39.0	1.96	7.24	7.24	7.24	0.37	0.80	± 12.0 %
5250	35.9	4.71	5.35	5.35	5.35	0.30	1.80	± 13.1 %
5600	35.5	5.07	4.66	4.66	4.66	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.78	4.78	4.78	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3968

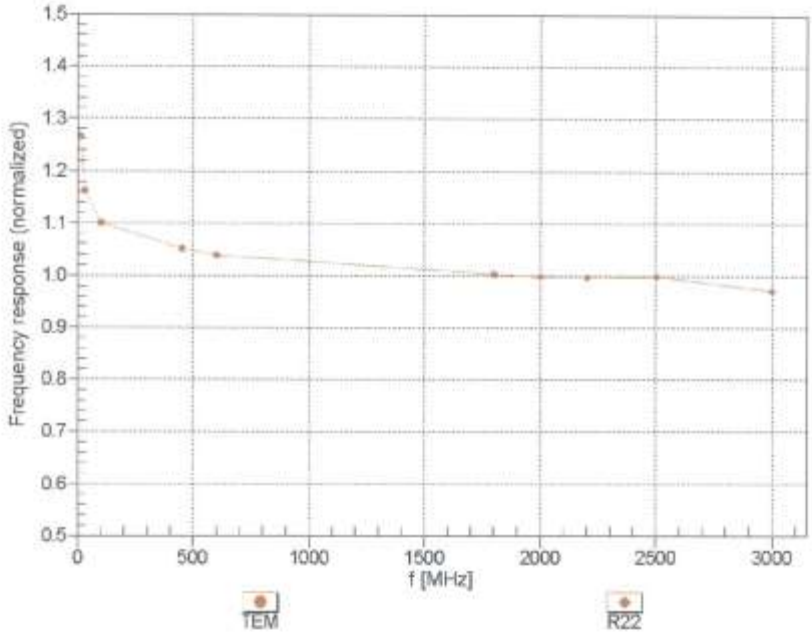
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	12.46	12.46	12.46	0.00	1.00	± 13.3 %
300	58.2	0.92	11.57	11.57	11.57	0.08	1.11	± 13.3 %
450	56.7	0.94	11.24	11.24	11.24	0.10	1.20	± 13.3 %
750	55.5	0.96	9.65	9.65	9.65	0.40	0.92	± 12.0 %
835	55.2	0.97	9.66	9.66	9.66	0.49	0.80	± 12.0 %
1750	53.4	1.49	8.16	8.16	8.16	0.34	0.80	± 12.0 %
1900	53.3	1.52	7.89	7.89	7.89	0.40	0.80	± 12.0 %
2450	52.7	1.95	7.31	7.31	7.31	0.41	0.80	± 12.0 %
2600	52.5	2.16	7.11	7.11	7.11	0.34	0.80	± 12.0 %
5250	48.9	5.36	4.37	4.37	4.37	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.78	3.78	3.78	0.55	1.90	± 13.1 %
5750	48.3	5.94	3.92	3.92	3.92	0.60	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4– SN:3968 May 31, 2016

Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

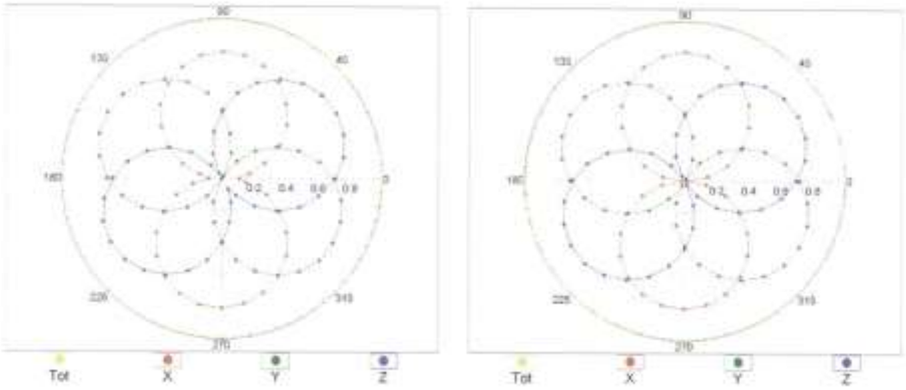


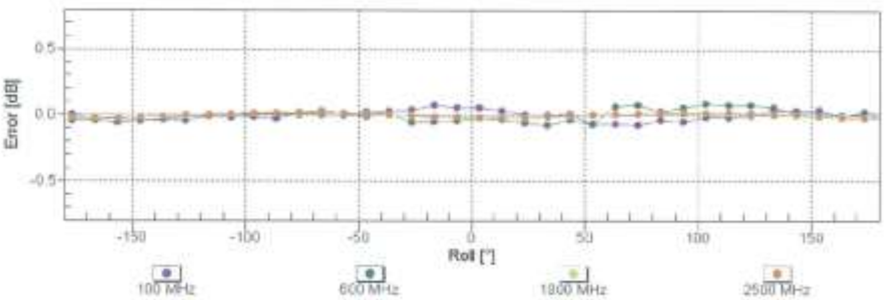
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

EX3DV4– SN:3968 May 31, 2016

Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM f=1800 MHz,R22



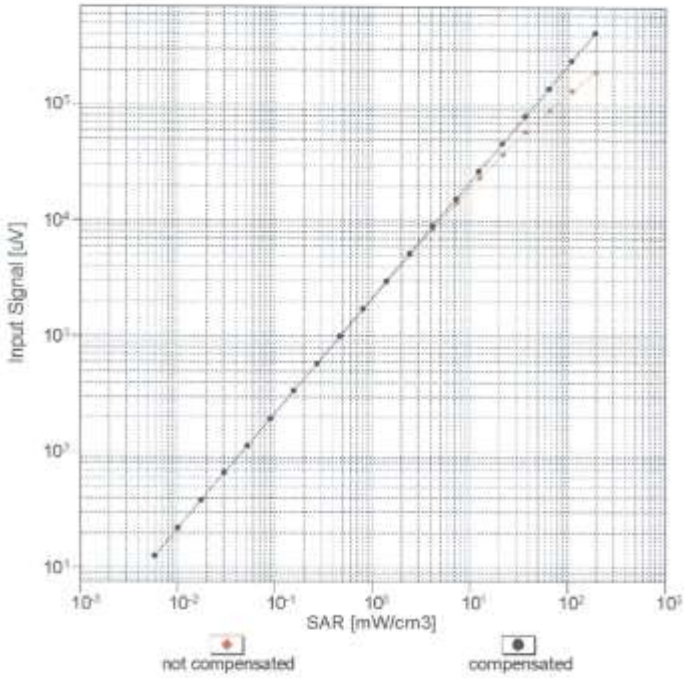


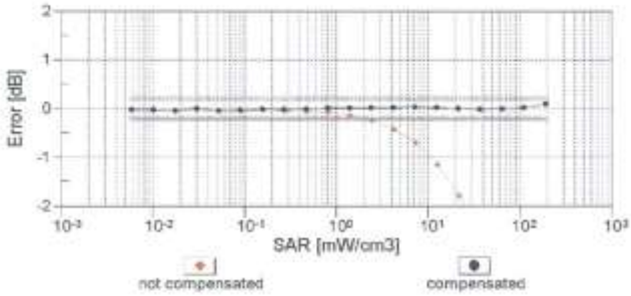
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: EX3-3968_May16 Page 8 of 11

EX3DV4– SN:3968 May 31, 2016

Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)



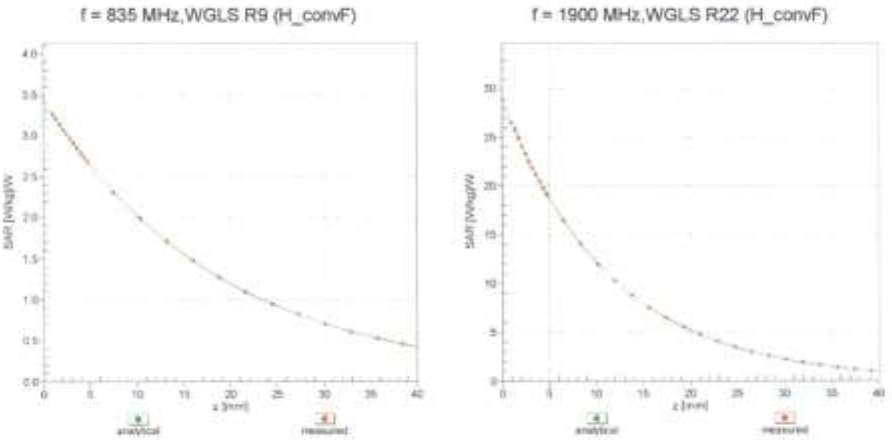


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: EX3-3968_May16 Page 9 of 11

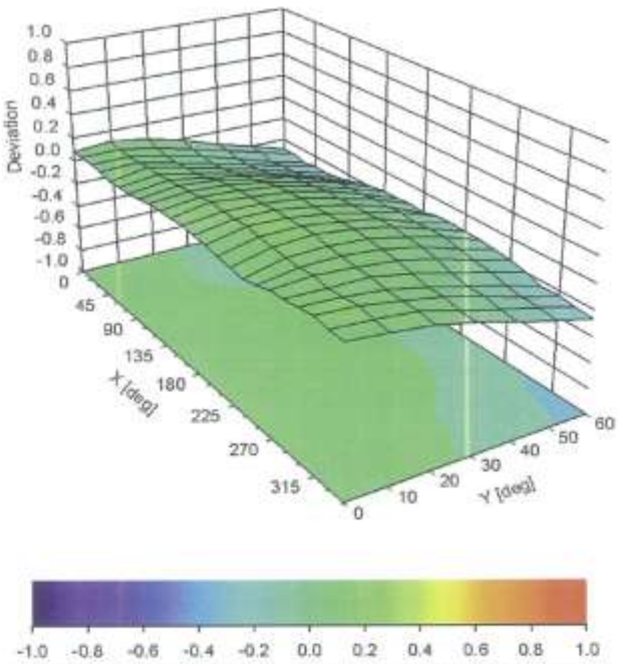
EX3DV4– SN:3968 May 31, 2016

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Certificate No: EX3-3968_May16 Page 10 of 11

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3968

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	63.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Attachment 4. – Dipole Calibration Data

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **D2450V2-965_Apr16**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 965
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	April 19, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: April 20, 2016

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

Certificate No: D2450V2-965_Apr16 Page 1 of 8

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.0 ± 6 %	1.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**50.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.5 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.7 ± 6 %	1.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.4 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.78 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.6 Ω + 3.8 jΩ
Return Loss	- 24.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.0 Ω + 5.9 jΩ
Return Loss	- 24.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.162 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 19, 2014

DASY5 Validation Report for Head TSL

Date: 19.04.2016

Test Laboratory: SPEAG, Zurich, Switzerland

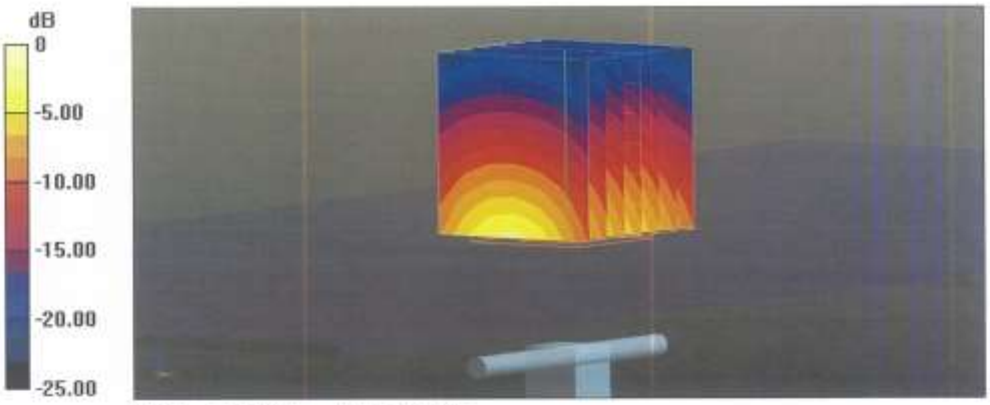
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 965

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.83 S/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

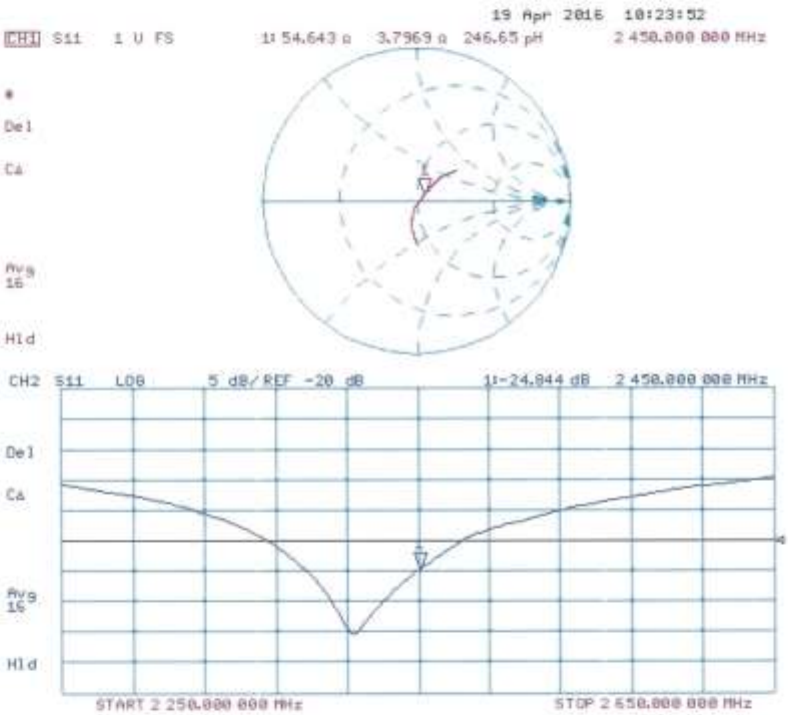
- Probe: EX3DV4 - SN7349; ConvF(7.76, 7.76, 7.76); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 112.4 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 25.6 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.89 W/kg
Maximum value of SAR (measured) = 20.7 W/kg



0 dB = 20.7 W/kg = 13.16 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-965_Apr16 Page 6 of 8

DASY5 Validation Report for Body TSL

Date: 19.04.2016

Test Laboratory: SPEAG, Zurich, Switzerland

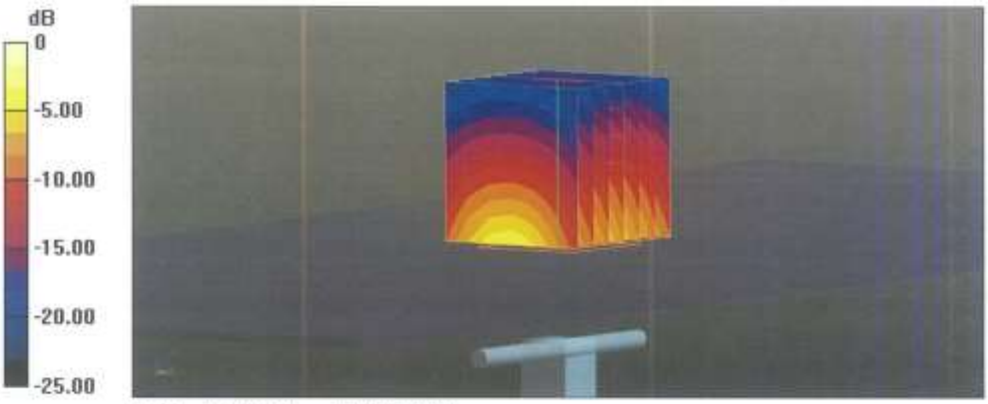
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 965

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.98 S/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

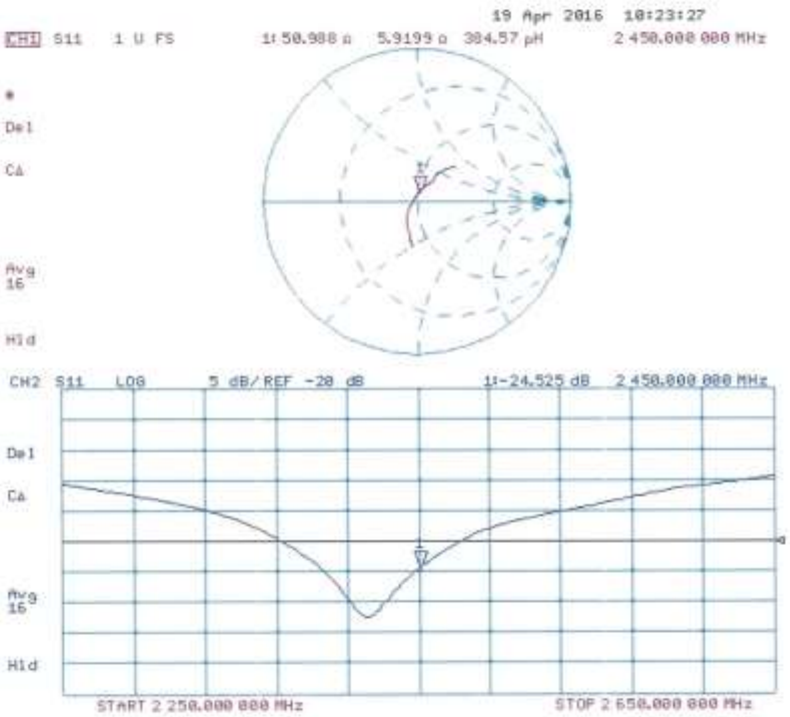
- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 104.7 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 24.7 W/kg
SAR(1 g) = 12.4 W/kg; SAR(10 g) = 5.78 W/kg
Maximum value of SAR (measured) = 20.0 W/kg



0 dB = 20.0 W/kg = 13.01 dBW/kg

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-965_Apr16 Page 8 of 8

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)** Certificate No: **D5GHzV2-1253_Jan17**

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN:1253
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	January 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

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

Issued: January 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:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.6 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.4 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.9 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)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

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

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.5 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	47.0 ± 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 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.70 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**76.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 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	46.4 ± 6 %	6.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**80.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.5 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	46.1 ± 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	7.77 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.4 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.1 Ω - 4.3 jΩ
Return Loss	- 27.3 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	51.3 Ω + 1.3 jΩ
Return Loss	- 34.8 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	54.3 Ω + 3.4 jΩ
Return Loss	- 25.6 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	49.3 Ω - 2.8 jΩ
Return Loss	- 30.6 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	52.8 Ω + 2.2 jΩ
Return Loss	- 29.3 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	55.1 Ω + 3.9 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 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 22, 2016

DASY5 Validation Report for Head TSL

Date: 09.01.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1253

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

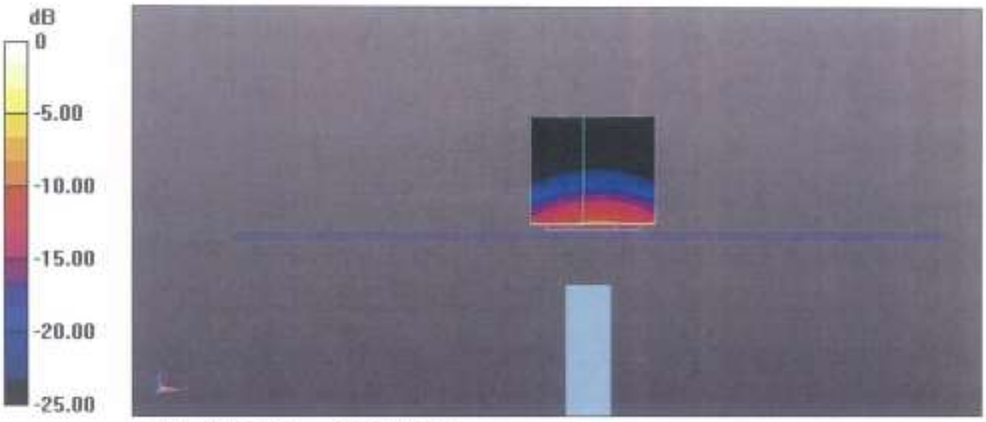
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.58, 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: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7331)

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 = 71.85 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 29.9 W/kg
SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

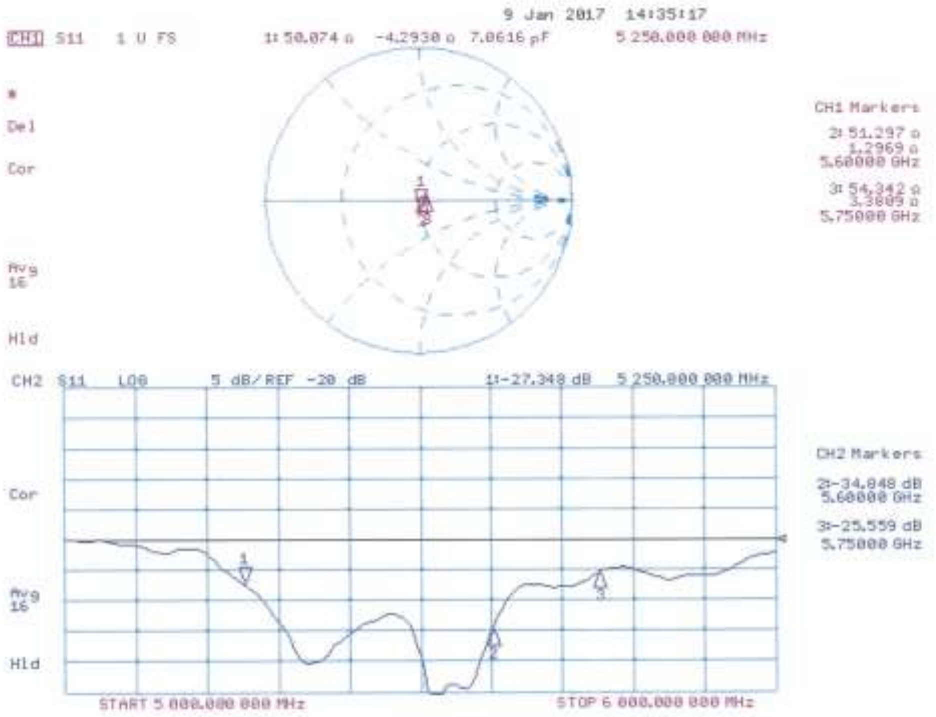
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 72.17 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 33.6 W/kg
SAR(1 g) = 8.24 W/kg; SAR(10 g) = 2.35 W/kg
Maximum value of SAR (measured) = 19.9 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 = 70.45 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 33.7 W/kg
SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.27 W/kg
Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 18.5 W/kg = 12.67 dBW/kg

Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 06.01.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1253

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 5.52 S/m; ε_r = 47; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 6 S/m; ε_r = 46.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5750 MHz; σ = 6.21 S/m; ε_r = 46.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

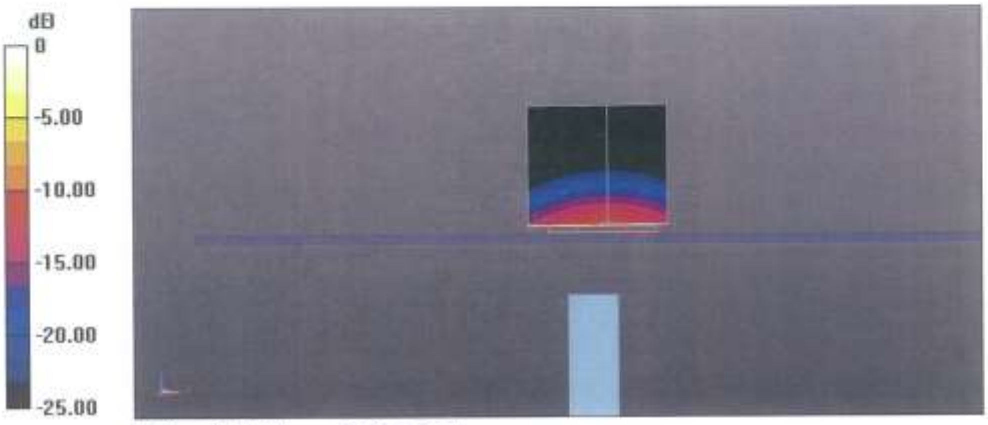
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.52, 4.52, 4.52); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.01.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.21 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 30.2 W/kg
SAR(1 g) = 7.7 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 18.2 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 = 66.67 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 34.1 W/kg
SAR(1 g) = 8.06 W/kg; SAR(10 g) = 2.27 W/kg
Maximum value of SAR (measured) = 19.7 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 = 64.63 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 34.5 W/kg
SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 18.2 W/kg = 12.60 dBW/kg

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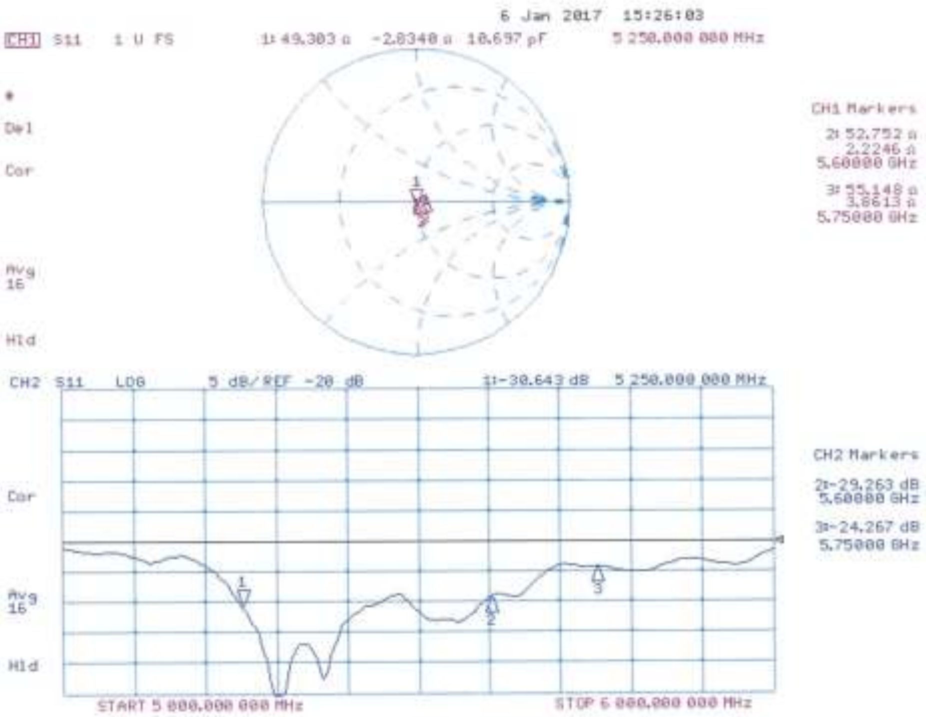
Impedance Measurement Plot for Body TSL



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Attachment 5. – SAR Tissue Characterization

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bacteriacide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrove.

Ingredients (% by weight)	Frequency (MHz)			
	2 450 – 2 700		5 200 - 5 800	
Tissue Type	Head	Body	Head	Body
Water	71.88	73.2	65.52	78.66
Salt (NaCl)	0.16	0.1	0.0	0.0
Sugar	0.0	0.0	0.0	0.0
HEC	0.0	0.0	0.0	0.0
Bactericide	0.0	0.0	0.0	0.0
Triton X-100	19.97	0.0	17.24	10.67
DGBE	7.99	26.7	0.0	0.0
Diethylene glycol hexyl ether	-	-	-	-

Salt: 99 % Pure Sodium Chloride Sugar: 98 % Pure Sucrose

Water: De-ionized, 16M resistivity HEC: Hydroxyethyl Cellulose

DGBE: 99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether

Composition of the Tissue Equivalent Matter

Attachment 6. – SAR SYSTEM VALIDATION

Per FCC KCB 865664 D02v01r02, SAR system validation status should be document to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2013 and FCC KDB 865664 D01v01r04. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

SAR System No.	Probe	Probe Type	Probe Calibration Point		Dipole	Date	Dielectric Parameters		CW Validation			Modulation Validation		
							Measured Permittivity	Measured Conductivity	Sensitivity	Probe Linearity	Probe Isotropy	MOD. Type	Duty Factor	PAR
9	3968	EX3DV4	Body	2450	965	2016.06.14	52.4	1.96	PASS	PASS	PASS	OFDM	N/A	PASS
9	3968	EX3DV4	Body	5250	1253	2017.01.31	48.8	5.35	PASS	PASS	PASS	OFDM	N/A	PASS
9	3968	EX3DV4	Body	5600	1253	2017.01.31	48.3	5.79	PASS	PASS	PASS	OFDM	N/A	PASS
9	3968	EX3DV4	Body	5750	1253	2017.01.31	48.4	5.96	PASS	PASS	PASS	OFDM	N/A	PASS

SAR System Validation Summary 1g

Note;

All measurement were performed using probes calibrated for CW signal only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04. SAR system were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664 D01v01r04.