SAR TEST REPORT

No. I18Z60700-SEM02

For

WORKERBASE GmbH

WIFI/BT Watch

Model Name: WB-3301

With

Hardware Version: PIO01

Software Version: W0P

FCC ID: 2APQFWB3301

Issued Date: 2018-9-25

TESTING
NVLAP LAB CODE 600118-0

Note:

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REPORT HISTORY

Report Number	Revision	Issue Date	Description
I18Z60700-SEM02	Rev.0	2018-9-25	Initial creation of test report

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1 Test Laboratory

1.1 Testing Location

Company Name:	CTTL(Shouxiang)
Address:	No. 51 Shouxiang Science Building, Xueyuan Road, Haidian District, Beijing, P. R. China100191

1.2 Testing Environment

Temperature:	18°C~25°C,
Relative humidity:	30%~ 70%
Ground system resistance:	< 0.5 Ω
Ambient noise & Reflection:	< 0.012 W/kg

1.3 Project Data

Project Leader:	Qi Dianyuan
Test Engineer:	Lin Xiaojun
Testing Start Date:	August 15, 2018
Testing End Date:	August 16, 2018

1.4 Signature

Lin Xiaojun

(Prepared this test report)

Qi Dianyuan

(Reviewed this test report)

Lu Bingsong

Deputy Director of the laboratory

(Approved this test report)

2 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for WORKERBASE GmbH WIFI/BT Watch WB-3301 are as follows:

Table 2.1: Highest Reported SAR (10g)

Exposure Configuration	Technology Band	Highest Reported SAR 10g (W/kg)	Equipment Class	Limited (W/kg)
Wrist exposure (Separation Distance 0mm)	WLAN 2.4G	0.68	DTS	4.0
	WLAN 5G	0.20	UNII	

Table 2.2: Highest Reported SAR (1g)

Exposure Configuration	Technology Band	Highest Reported SAR 1g (W/kg)	Equipment Class	Limited (W/kg)
Next to the mouth (Separation Distance 10mm)	WLAN 2.4G	0.57	DTS	2.0
	WLAN 5G	0.27	UNII	

The SAR values found for the DUT are below the maximum recommended levels of 4.0 W/kg (10g) for limb and 2.0 W/kg (1g) for head according to the ANSI C95.1-1992.

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

The measurement together with the test system set-up is described in annex C of this test report. A detailed description of the equipment under test can be found in chapter 4 of this test report.

The highest reported SAR value is obtained at the case of Table 2.1&2.2**,** and the values are**: 0.68** W/kg (10g) for limb and **0.57** W/kg (1g) for head.

3 Client Information

3.1 Applicant Information

Company Name:	WORKERBASE GmbH
Address /Post:	Aventinstr. 7, Munich, Germany
Contact:	Norman Hartmann
Email:	info@workerbase.com
Telephone:	+49 89 21540295
Fax:	/

3.2 Manufacturer Information

Company Name:	WORKERBASE GmbH
Address /Post:	Aventinstr. 7, Munich, Germany
Contact:	Norman Hartmann
Email:	info@workerbase.com
Telephone:	+49 89 21540295
Fax:	/

4 Equipment Under Test (EUT) and Ancillary Equipment (AE)

4.1 About EUT

Description:	WIFI/BT Watch
Model Name:	WB-3301
Operation Model(s):	BT, WiFi
Tx Frequency:	2412 – 2462 MHz (Wi-Fi 2.4G)
	5150-5250 MHz (U-NII-1)
	5250-5350 MHz (U-NII-2A)
	5470-5720 MHz (U-NII-2C)

4.2 Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version
EUT1	5C7776CE66BD250	PIO01	W0P
EUT2	5C7776F9797B360	PIO01	W0P

*EUT ID: is used to identify the test sample in the lab internally.

Note: It is performed to test SAR with the EUT1 and conducted power with the EUT2.

4.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	CAB22B0000C1	/	BYD CO LTD

*AE ID: is used to identify the test sample in the lab internally.

5 TEST METHODOLOGY

5.1 Applicable Limit Regulations

ANSI C95.1–1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

5.2 Applicable Measurement Standards

IEEE 1528–2013: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

KDB447498 D01: General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

KDB865664 D01SAR measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz.

KDB865664 D02 RF Exposure Reporting v01r02: RF Exposure Compliance Reporting and Documentation Considerations

6 Specific Absorption Rate (SAR)

6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

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

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = c\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

Where: σ is the conductivity of the tissue, ρ is the mass density of tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

7 Tissue Simulating Liquids

7.1 Targets for tissue simulating liquid

Table 7.1: Targets for tissue simulating liquid

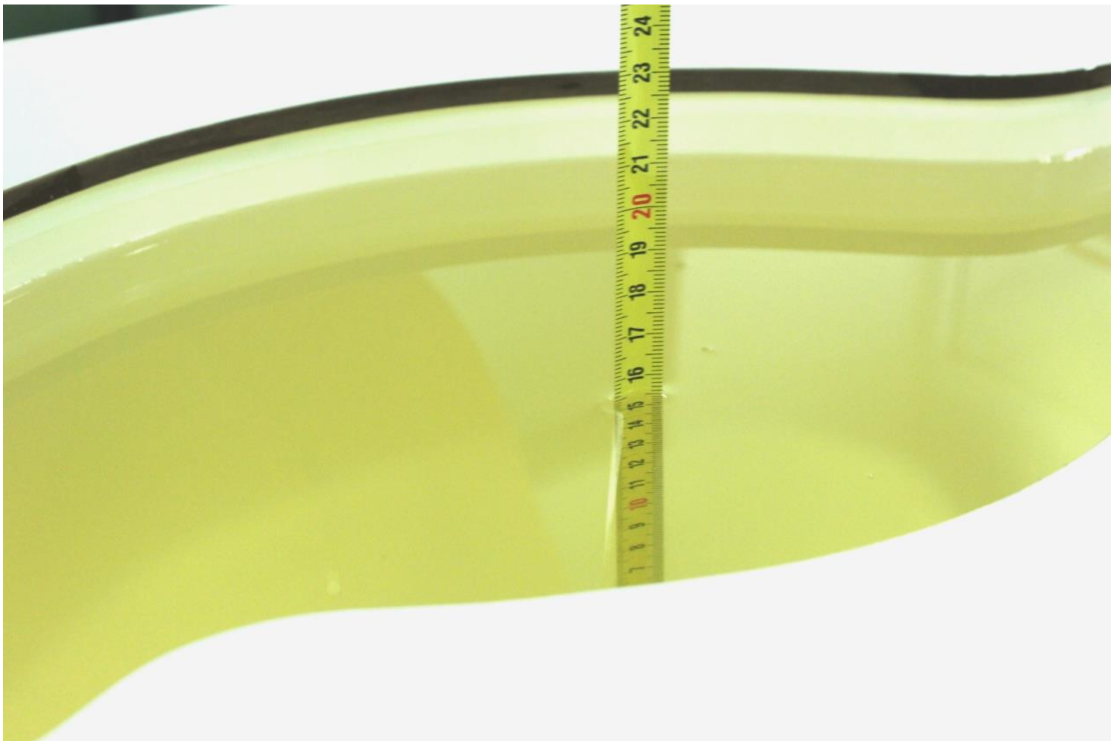
Frequency (MHz)	Liquid Type	Conductivity (σ)	± 5% Range	Permittivity (ε)	± 5% Range
2450	Body	1.95	1.85～2.05	52.7	50.1～55.3
5300	Body	5.42	5.15～5.69	48.9	46.46～51.34
5600	Body	5.77	5.48～6.06	48.5	46.08～50.92
2450	Head	1.80	1.71～1.89	39.2	37.2～41.2
5300	Head	4.76	4.52～5.00	35.87	34.08～37.66
5600	Head	5.07	4.82～5.32	35.53	33.75～37.31

7.2 Dielectric Performance

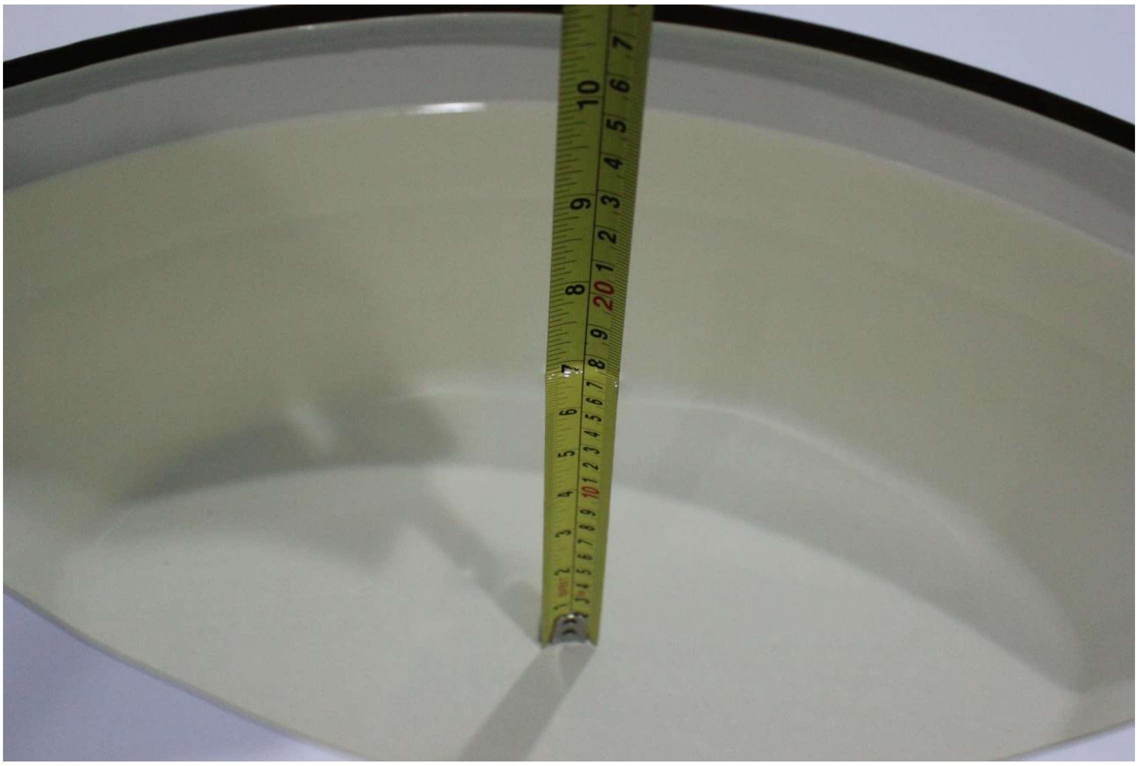
Table 7.2: Dielectric Performance of Tissue Simulating Liquid

Measurement Date (yyyy-mm-dd)	**Type**	**Frequency**	**Permittivity ε**	**Drift (%)**	**Conductivity σ (S/m)**	**Drift (%)**
2018-8-16	Body	2450 MHz	51.98	-1.37	1.974	1.23
2018-8-16	Body	5300 MHz	47.79	-2.27	5.326	-1.73
2018-8-16	Body	5600 MHz	47.49	-2.08	5.719	-0.88
2018-8-15	Head	2450 MHz	39.85	1.66	1.824	1.33
2018-8-15	Head	5300 MHz	36.79	2.56	4.727	-0.69
2018-8-15	Head	5600 MHz	35.19	-0.96	5.182	2.21

Note: The liquid temperature is 22.0℃



Picture 7-1: Liquid depth in the Flat Phantom (2450MHz)

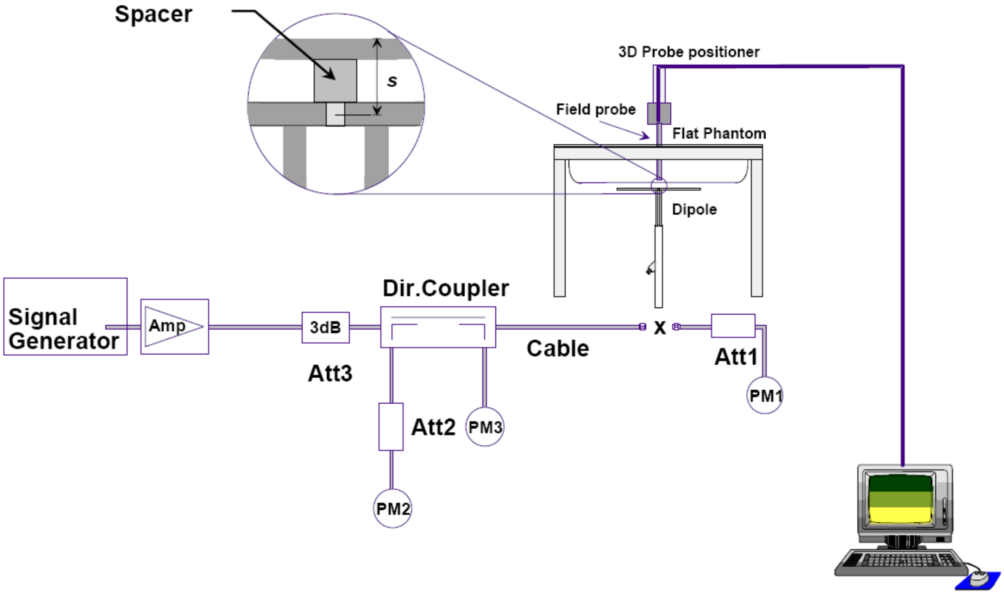


Picture 7-2 Liquid depth in the Flat Phantom (5GHz)

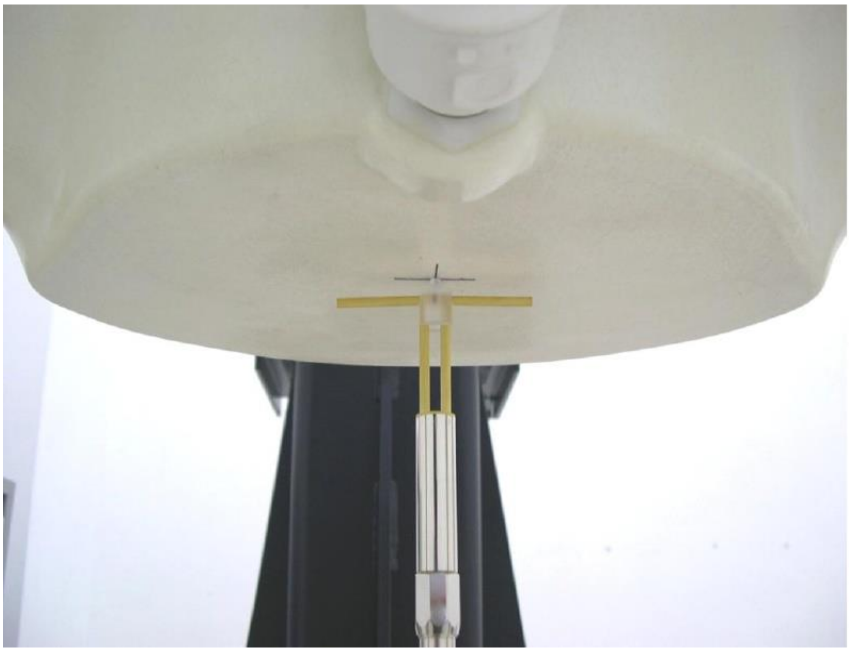
8 System verification

8.1 System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:



Picture 8.1 System Setup for System Evaluation



Picture 8.2 Photo of Dipole Setup

8.2 System Verification

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device.

The system verification results are required that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR. The details are presented in annex B.

Table 8.1: System Verification of Body

Measurement Date (yyyy-mm-dd)	Frequency	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2018-8-16	2450 MHz	23.8	50.4	24.28	51.60	2.02%	2.38%
2018-8-16	5300 MHz	21.6	77.0	21.40	75.70	-0.93%	-1.69%
2018-8-16	5600 MHz	22.6	80.5	22.20	79.10	-1.77%	-1.74%

Table 8.2: System Verification of Head

Measurement Date (yyyy-mm-dd)	Frequency	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2018-8-15	2450 MHz	24.7	52.2	24.5	52.0	-0.73%	-0.38%
2018-8-15	5300 MHz	24.0	83.8	23.4	82.2	-2.50%	-1.91%
2018-8-15	5600 MHz	24.1	84.5	23.8	83.2	-1.24%	-1.54%

9 Measurement Procedures

9.1 Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in picture 9.1.

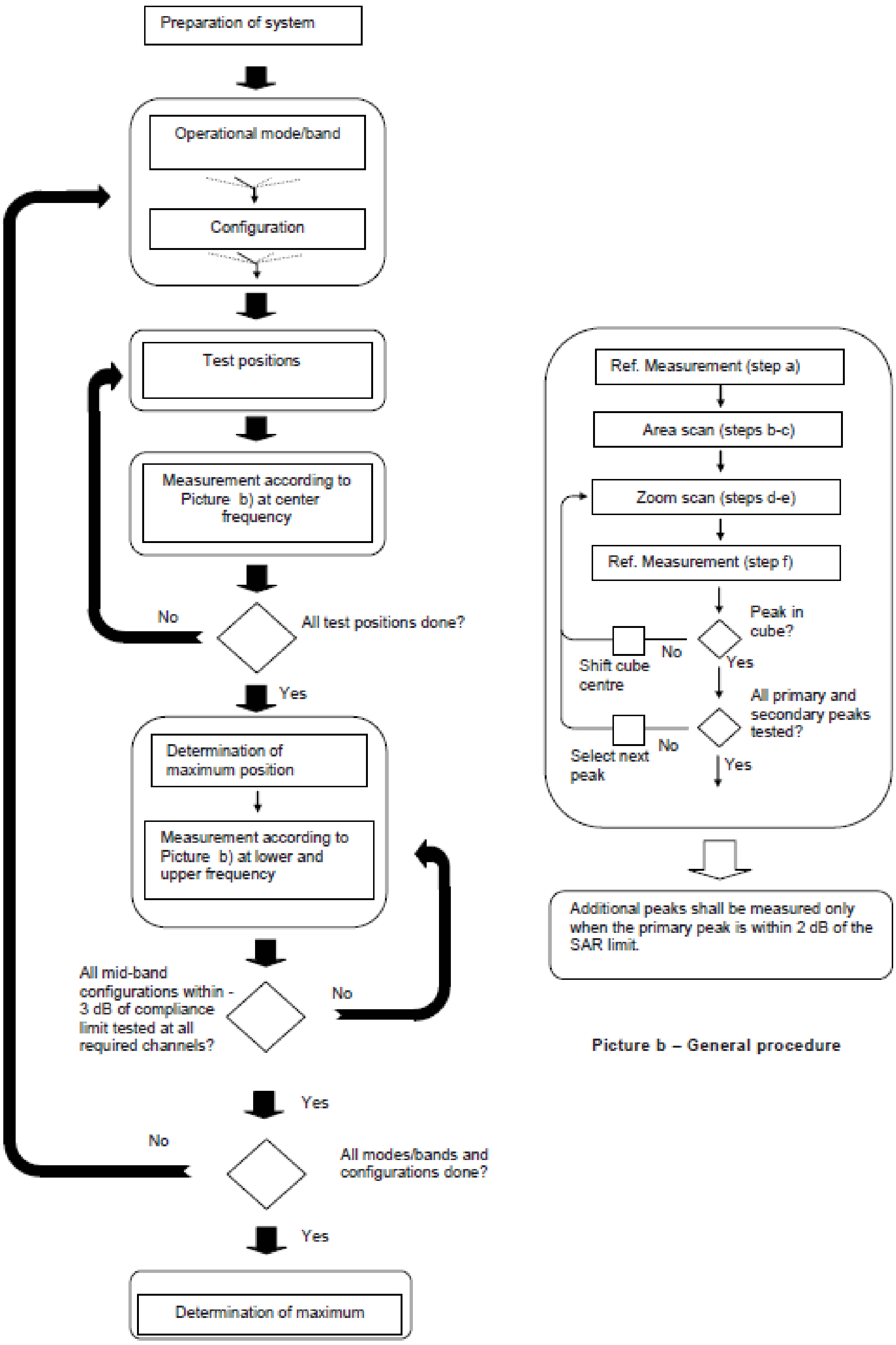
Step 1: The tests described in 9.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom, as described in annex D),
b) all configurations for each device position in a), e.g., antenna extended and retracted, and
c) all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., $N_c > 3$), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

Step 2: For the condition providing highest peak spatial-average SAR determined in Step 1,perform all tests described in 9.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

Step 3: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.



Picture a – Tests to be performed

Picture 9.1Block diagram of the tests to be performed

9.2 General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2003. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

<table>
<tr><td colspan="3"></td><td>$\leq$ 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>½·δ·ln(2) ± 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>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 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 $\leq$ 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>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 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>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 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>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 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>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 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 <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 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>

9.3 Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. 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 that the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a 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. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

9.4 Power Drift

To control the output power stability during the SAR test, DASY4 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in section 12 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

10 Conducted Output Power

The maximum average conducted power for BT is 8.63dBm.
The tune up of BT is 9dBm (7.94mW), less than the limit power of 9.6mW. So the SAR of BT should not be performed.

The average conducted power for Wi-Fi is as following:

802.11b (dBm)

Channel\data rate	1Mbps	2Mbps	5.5Mbps	11Mbps
11	17.27	/	/	/
6	17.80	17.60	17.47	17.09
1	17.68	/	/	/
Tune up	**19**	**19**	**19**	**19**

802.11g (dBm)

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
11	13.55	/	/	/	/	/	/	/
6	13.91	13.45	13.23	12.85	12.46	11.87	11.37	11.19
1	13.81	/	/	/	/	/	/	/
Tune up	**15**	**15**	**14**	**14**	**13**	**13**	**12**	**12**

802.11n (dBm) - HT20 (2.4G)

Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
11	12.46	/	/	/	/	/	/	/
6	12.79	12.34	11.96	11.58	11.03	10.56	10.38	10.17
1	12.71	/	/	/	/	/	/	/
Tune up	**14**	**14**	**13**	**13**	**12**	**12**	**11**	**11**

802.11n (dBm) – HT40 (2.4G)

Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
9	12.52	/	/	/	/	/	/	/
6	12.81	12.33	11.94	11.56	10.99	10.52	10.34	10.15
3	12.37	/	/	/	/	/	/	/
Tune up	**14**	**14**	**13**	**13**	**12**	**12**	**11**	**11**

802.11a (dBm)

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
36	14.23	/	/	/	/	/	/	/
40	14.55	/	/	/	/	/	/	/
44	14.86	/	/	/	/	/	/	/
48	**15.43**	15.14	14.97	14.46	13.99	13.17	12.65	12.37
52	14.97	/	/	/	/	/	/	/
56	15.07	/	/	/	/	/	/	/
60	**15.55**	15.18	14.81	14.44	13.86	13.30	12.61	12.46
64	15.29	/	/	/	/	/	/	/
100	14.38	/	/	/	/	/	/	/
104	14.93	/	/	/	/	/	/	/
108	15.09	/	/	/	/	/	/	/
112	15.55	/	/	/	/	/	/	/
116	15.79	/	/	/	/	/	/	/
120	15.83	/	/	/	/	/	/	/
124	**15.93**	15.35	14.92	14.53	13.95	13.45	12.81	12.61
128	15.85	/	/	/	/	/	/	/
132	15.59	/	/	/	/	/	/	/
136	15.52	/	/	/	/	/	/	/
140	15.49	/	/	/	/	/	/	/
144	15.75	/	/	/	/	/	/	/
Tune up	**16**	**16**	**15**	**15**	**14**	**14**	**14**	**14**

802.11n-20M (dBm)

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
36	14.46	/	/	/	/	/	/	/
40	14.88	/	/	/	/	/	/	/
44	15.13	/	/	/	/	/	/	/
48	**15.37**	14.87	14.35	13.87	13.16	12.61	12.39	12.16
52	15.24	/	/	/	/	/	/	/
56	15.52	/	/	/	/	/	/	/
60	**15.48**	14.84	14.33	13.94	13.23	12.81	12.54	12.23
64	15.55	/	/	/	/	/	/	/
100	14.43	/	/	/	/	/	/	/
104	14.71	/	/	/	/	/	/	/
108	15.18	/	/	/	/	/	/	/
112	15.74	/	/	/	/	/	/	/
116	15.84	/	/	/	/	/	/	/
120	15.81	/	/	/	/	/	/	/
124	15.76	/	/	/	/	/	/	/
128	15.78	/	/	/	/	/	/	/
132	**15.86**	15.08	14.52	14.21	13.52	12.88	12.68	12.50

136	15.69	/	/	/	/	/	/	/
140	15.59	/	/	/	/	/	/	/
144	15.49	/	/	/	/	/	/	/
Tune up	**16**	**16**	**15**	**15**	**14**	**14**	**14**	**14**

802.11n-40M (dBm)

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
38	13.52	/	/	/	/	/	/	/
46	**14.23**	13.40	12.87	12.45	11.85	11.25	11.14	10.85
54	14.20	/	/	/	/	/	/	/
62	**14.43**	13.86	13.29	12.83	12.12	11.51	11.34	11.18
102	13.67	/	/	/	/	/	/	/
110	14.24	/	/	/	/	/	/	/
118	14.73	/	/	/	/	/	/	/
126	**14.93**	14.09	13.61	13.16	12.47	11.92	11.70	11.47
134	14.62	/	/	/	/	/	/	/
142	14.33	/	/	/	/	/	/	/
Tune up	**15**	**15**	**14**	**14**	**13**	**13**	**12**	**12**

11 SAR Test Result

This product has a curve back and cannot achieve the normal SAR test positions, so we make a KDB inquiry and the tracking number is 841886. Please see the file of "The Photos of SAR test" for detail of antenna location and tested position.

The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} \times 10^{(P_{Target} - P_{Measured})/10}$$

Where P_{Target} is the power of manufacturing upper limit;

$P_{Measured}$ is the measured power in chapter 10.

Table 11.1: SAR Values (WLAN - Limb)– 802.11b 1Mbps

Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C										
Frequency		Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
2462	11	Position1	Fig.1	17.27	19	0.446	**0.66**	1.07	**1.59**	0.09
2437	6	Position1	/	17.80	19	0.423	**0.56**	0.976	**1.29**	-0.12
2412	1	Position1	/	17.68	19	0.437	**0.59**	1.02	**1.38**	-0.09
2462	11	Position2	/	17.27	19	0.305	**0.45**	0.673	**1.00**	0.08
2437	6	Position2	/	17.80	19	0.231	**0.30**	0.513	**0.68**	-0.12
2412	1	Position2	/	17.68	19	0.306	**0.41**	0.671	**0.91**	0.12

Note: **Position1**: Place the watch under the neck of SAM phantom so that the WiFi antenna part in direct contact with the phantom.

Position2: the back of watch in contact with the flat phantom.

Table 11.2: SAR Values (WLAN – Next to the mouth)– 802.11b 1Mbps

Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C										
Frequency		Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
2462	11	Position3	Fig.2	17.27	19	0.183	**0.27**	0.373	**0.56**	0.04
2437	6	Position3	/	17.80	19	0.093	**0.12**	0.195	**0.26**	0.09
2412	1	Position3	/	17.68	19	0.105	**0.14**	0.220	**0.30**	-0.18

Note: **Position3**: Next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom.

Table 11.3: SAR Values (WLAN - Limb)– 802.11a 6Mbps

Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C										
Frequency		Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
5300	60	Position1	Fig.3	15.55	16	0.153	0.17	0.417	**0.46**	0.04
5300	60	Position2	/	15.55	16	0.062	**0.07**	0.193	**0.21**	-0.05
5620	124	Position1	/	15.93	16	0.149	**0.15**	0.391	**0.40**	0.09
5620	124	Position2	/	15.93	16	0.063	**0.06**	0.172	**0.17**	0.00

Note: **Position1**: Place the watch under the neck of SAM phantom so that the WiFi antenna part in direct contact with the phantom.
Position2: the back of watch in contact with the flat phantom.

Table 11.4: SAR Values (WLAN – Next to the mouth)– 802.11a 6Mbps

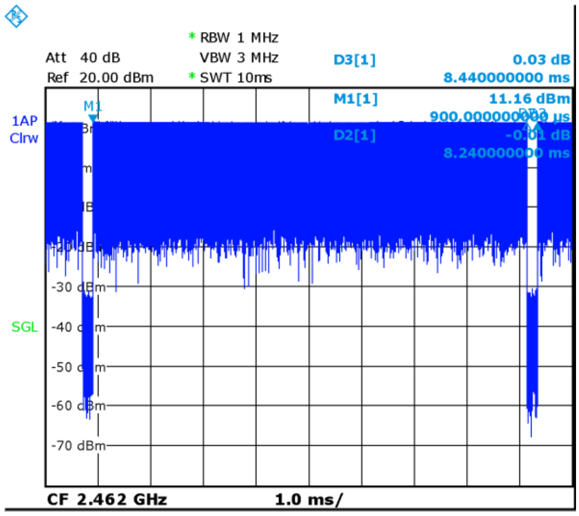
Ambient Temperature: 22.9 °C Liquid Temperature: 22.5°C										
Frequency		Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
5300	60	Position3	Fig.4	15.55	16	0.043	**0.05**	0.112	**0.12**	-0.11
5620	124	Position3	/	15.93	16	0.072	**0.07**	0.231	0.23	-0.09

Note: **Position3**: Next to the mouth use is evaluated with the front of the device positioned at 10 mm from a flat phantom.

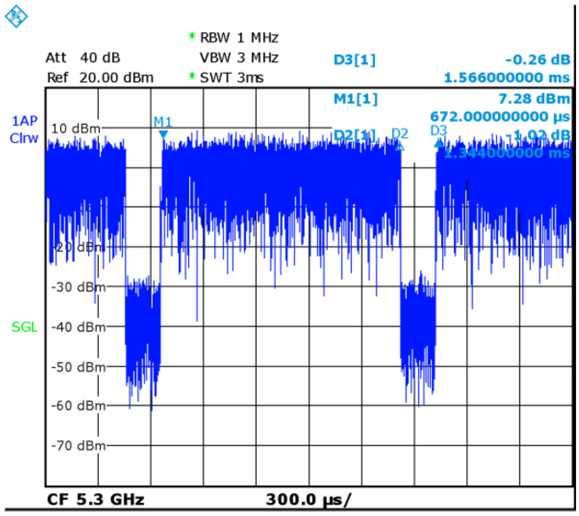
According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below.

Table 11.5: SAR Values (Scaled Reported SAR)

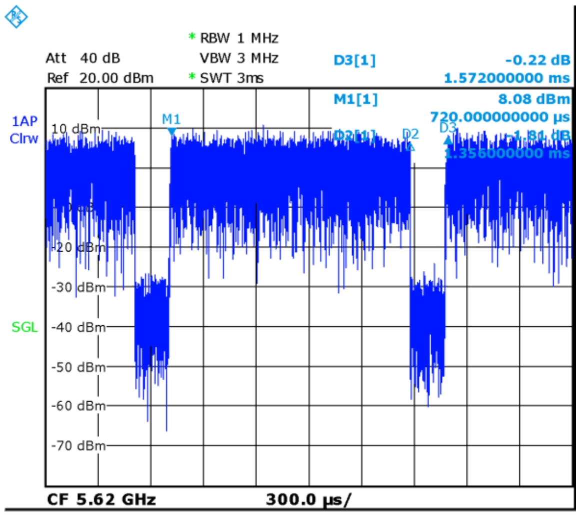
Frequency		Mode	Test Position	Actual duty factor	maximum duty factor	Reported SAR (10g) (W/kg)	Scaled reported SAR (10g) (W/kg)
MHz	Ch.						
2462	11	802.11b-1Mbps	Positon1	97.63%	100%	**0.66**	0.68
2462	11	802.11b-1Mbps	Positon3	97.63%	100%	**0.56**	0.57
5300	60	802.11a-6Mbps	Positon1	85.82%	100%	**0.17**	0.20
5620	124	802.11a-6Mbps	Positon3	86.26%	100%	**0.23**	0.27



Picture 11.1 The plot of duty factor for CH11 of 11b



Picture 11.2 The plot of duty factor for CH60 of 11a



Picture 11.3 The plot of duty factor for CH124 of 11a

12 SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required.
1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 W/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 ≥ 1.45W/kg (~ 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 and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Table 12.1: SAR Measurement Variability for WLAN-2.4G (1g)

Frequency		Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
Ch.	MHz					
11	2462	Position1	1.07	1.05	1.02	/

13 Measurement Uncertainty

13.1 Measurement Uncertainty for SAR Tests (300MHz~3GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	6.0	N	1	1	1	6.0	6.0	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	N	1	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521

Combined standard uncertainty	$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$					9.55	9.43	257
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$					19.1	18.9	

13.2 Measurement Uncertainty for SAR Tests (3~6GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	6.55	N	1	1	1	6.55	6.55	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	6.7	R	$\sqrt{3}$	1	1	3.9	3.9	∞
13	Post-processing	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43

20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c^{'}=\sqrt{\sum_{i=1}^{21}c_i^2u_i^2}$						10.7	10.6	257
Expanded uncertainty (confidence interval of 95 %)		$u_e=2u_c$						21.4	21.1	

14 MAIN TEST INSTRUMENTS

Table 14.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	E5071C	MY46110673	January 24, 2018	One year
02	Power meter	NRVD	102083	November 01, 2017	One year
03	Power sensor	NRV-Z5	100542		
04	Signal Generator	E4438C	MY49071430	January 2,2018	One Year
05	Amplifier	60S1G4	0331848	No Calibration Requested	
06	E-field Probe	SPEAG EX3DV4	7464	September 12,2017	One year
07	DAE	SPEAG DAE4	1525	October 2, 2017	One year
08	Dipole Validation Kit	SPEAG D2450V2	853	July 21, 2017	Three year
09	Dipole Validation Kit	SPEAG D5GHzV2	1060	July 25, 2017	Three year

END OF REPORT BODY

ANNEX A Graph Results

Wifi 802.11b Position 1 Channel 11

Date: 2018-8-16
Electronics: DAE4 Sn1525
Medium: Body 2450 MHz
Medium parameters used (interpolated): f = 2462 MHz; σ = 1.981 mho/m; ε_r = 52.01; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: WLan 2450 Frequency: 2462 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(8.09, 8.09, 8.09)

Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.43 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.6310 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 2.43 W/kg
SAR(1 g) = 1.07 W/kg; SAR(10 g) = 0.446 W/kg
Maximum value of SAR (measured) = 1.46 W/kg

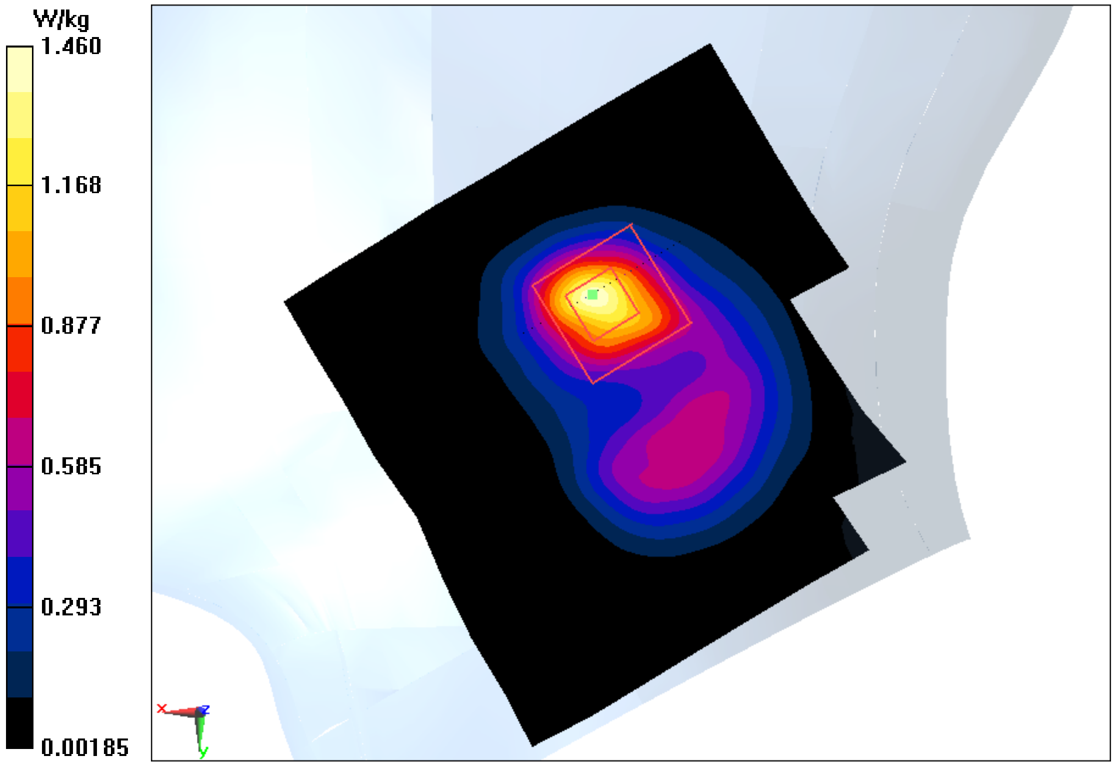


Fig.1 2450 MHz

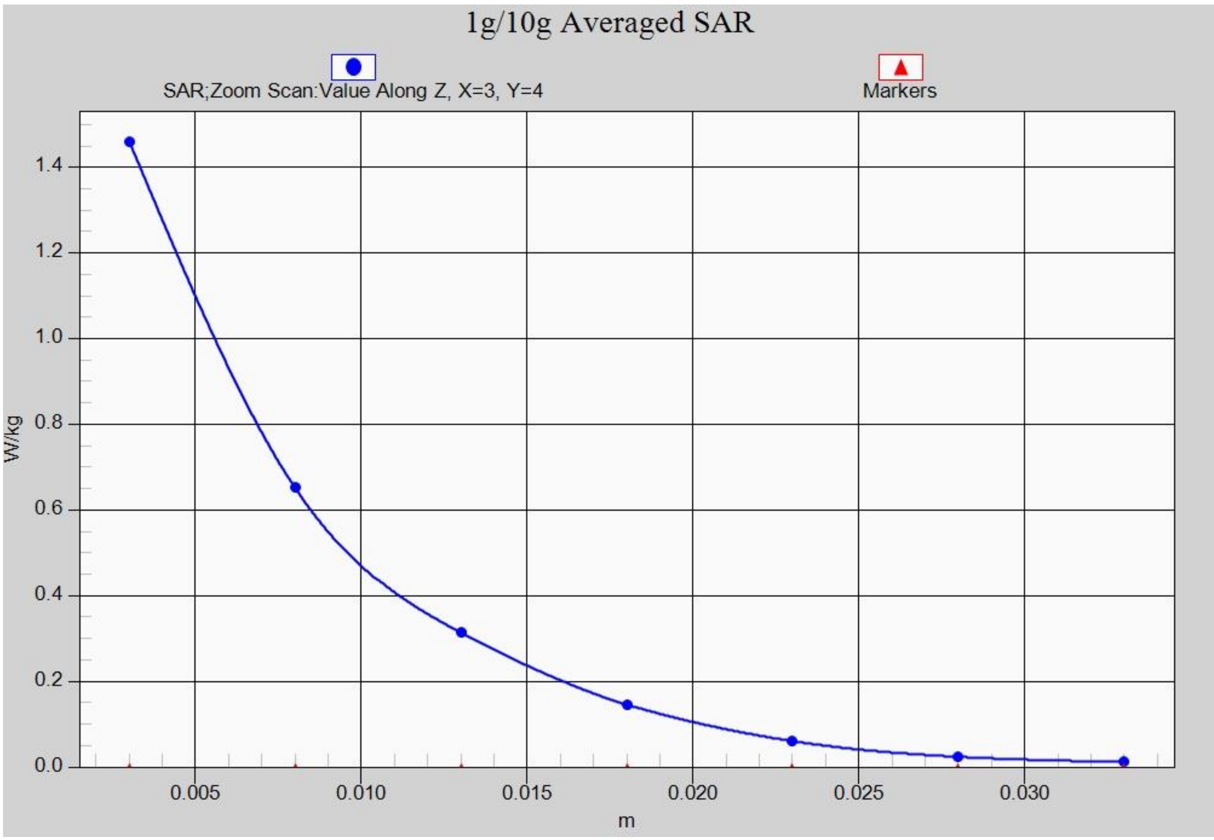


Fig. 1-1 Z-Scan at power reference point (2450 MHz)

Wifi 802.11b Position 3 Channel 11
Date: 2018-8-15
Electronics: DAE4 Sn1525
Medium: Head 2450 MHz
Medium parameters used (interpolated): f = 2462 MHz; σ = 1.837 mho/m; ε_r = 39.802; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: WLan 2450 Frequency: 2462 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(7.89, 7.89, 7.89)

Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.506 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.598 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.807 W/kg
SAR(1 g) = 0.373 W/kg; SAR(10 g) = 0.183 W/kg
Maximum value of SAR (measured) = 0.487 W/kg

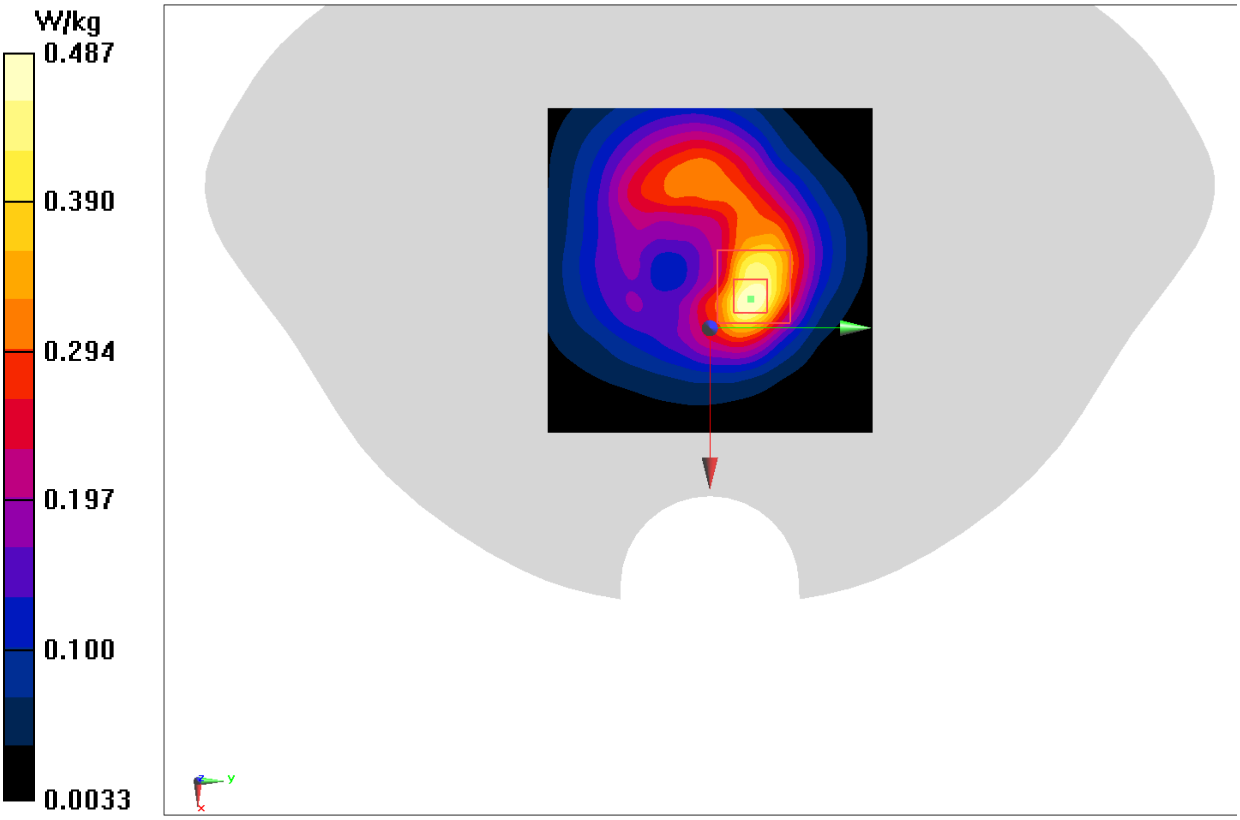


Fig.2 2450 MHz

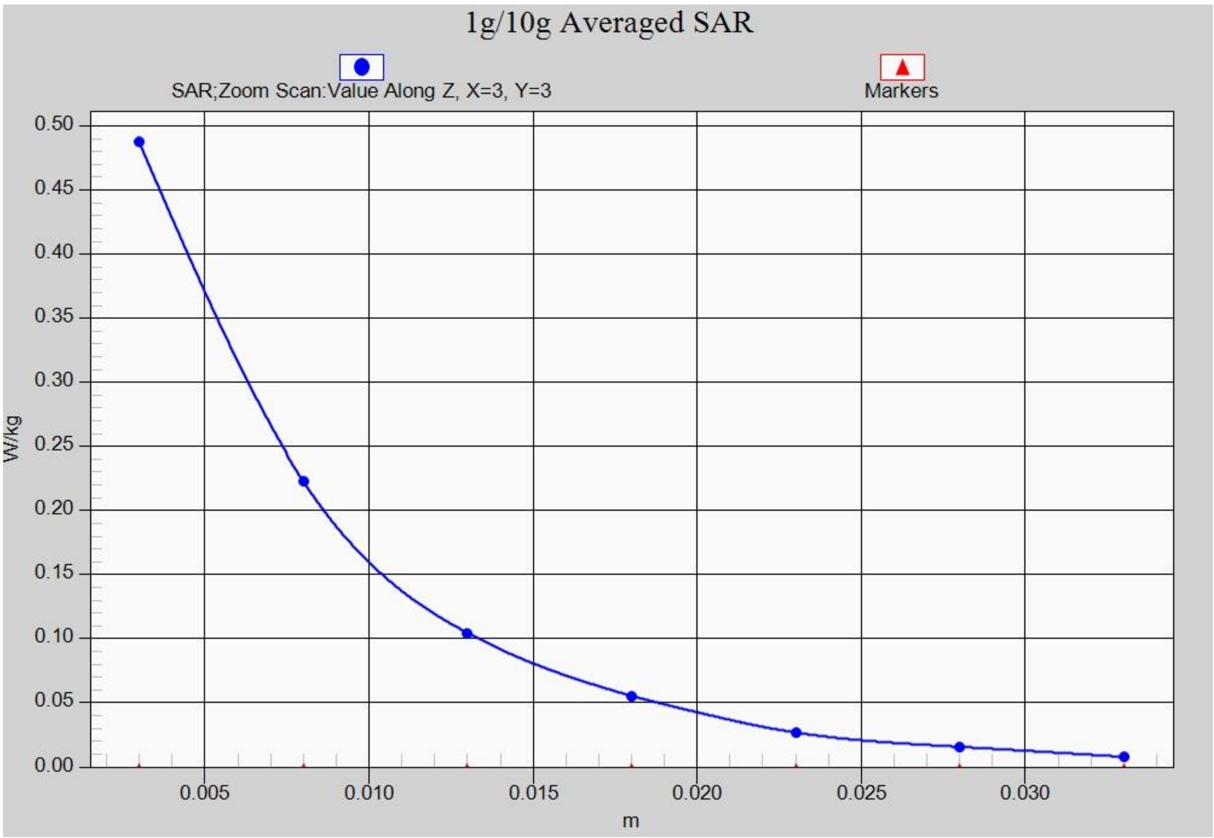


Fig. 2-1 Z-Scan at power reference point (2450 MHz)

Wifi 802.11a Position 1 Channel 60
Date: 2018-8-16
Electronics: DAE4 Sn1525
Medium: Body 5 GHz
Medium parameters used: f = 5300 MHz; σ = 5.326 mho/m; ε_r = 47.79; ρ = 1000 kg/m^3
Ambient Temperature: 22.9ºC Liquid Temperature: 22.5ºC
Communication System: WLan 5G Frequency: 5300 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(5.11, 5.11, 5.11)

Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.585 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.508 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.96 W/kg
SAR(1 g) = 0.417 W/kg; SAR(10 g) = 0.153 W/kg
Maximum value of SAR (measured) = 1.02 W/kg

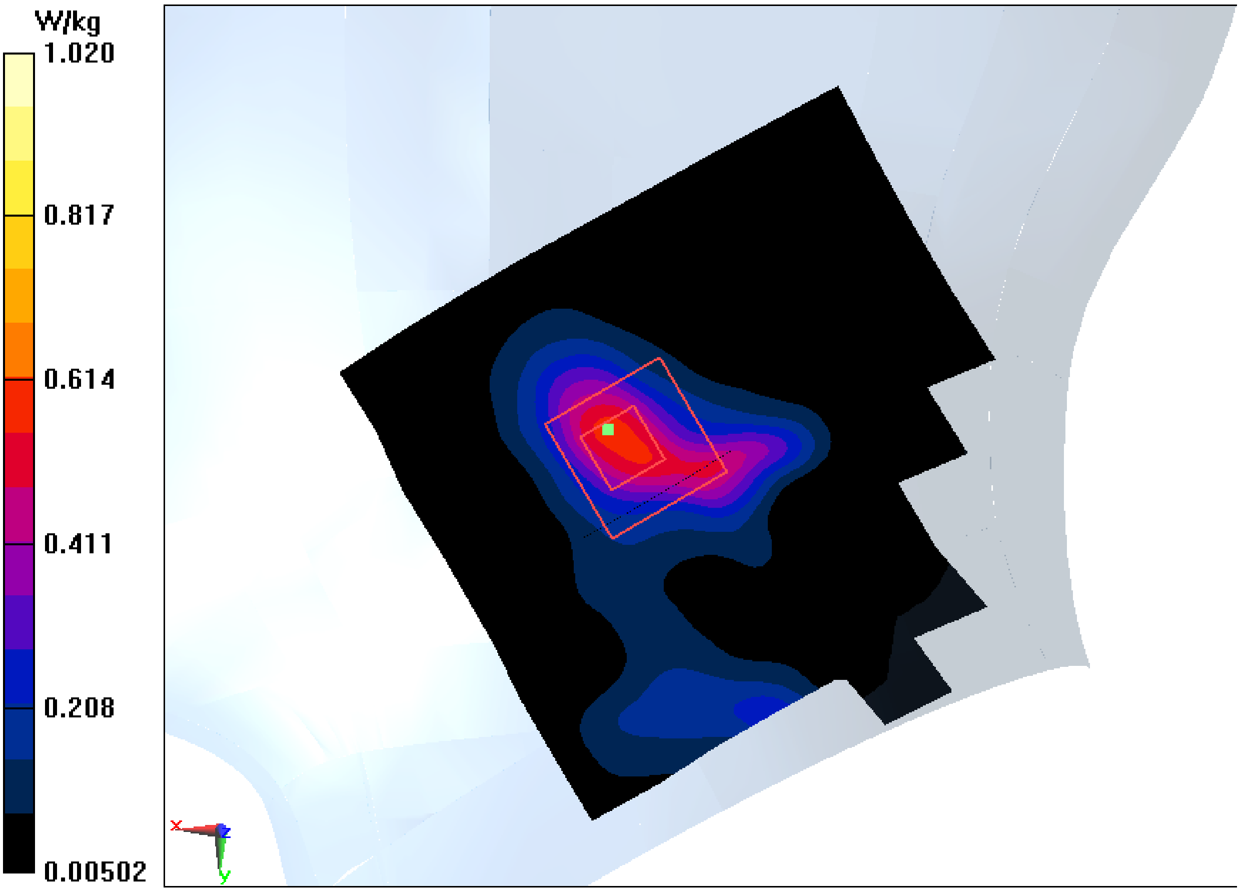


Fig.3 5GHz

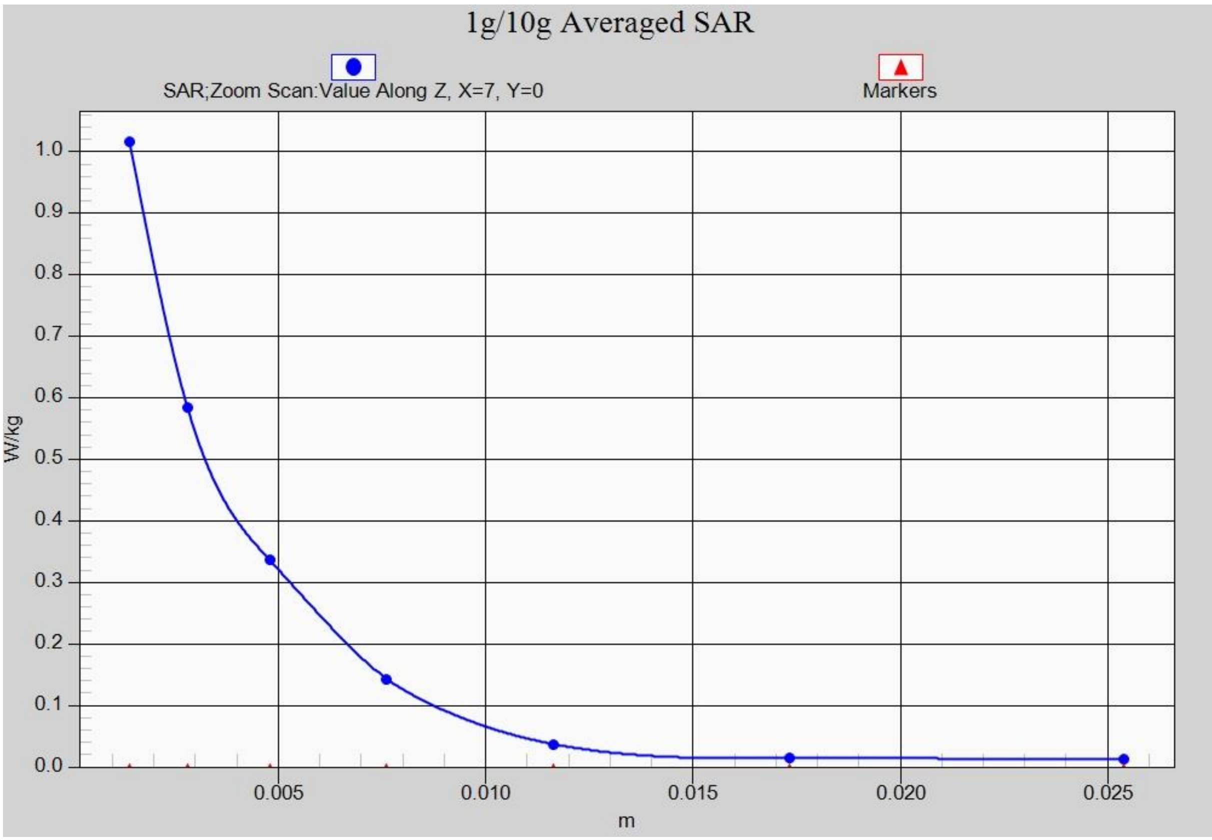


Fig. 3-1 Z-Scan at power reference point (5GHz)

Wifi 802.11a Position 3 Channel 124
Date: 2018-8-15
Electronics: DAE4 Sn1525
Medium: Head 5 GHz
Medium parameters used: f = 5620 MHz; σ = 5.2 mho/m; ε_r = 35.169; ρ = 1000 kg/m^3
Ambient Temperature: 22.9ºC   Liquid Temperature: 22.5ºC
Communication System: WLan 5G Frequency: 5620 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(4.98, 4.98, 4.98)

Area Scan (81x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.286 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 3.474 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.08 W/kg
SAR(1 g) = 0.231 W/kg; SAR(10 g) = 0.072 W/kg
Maximum value of SAR (measured) = 0.582 W/kg

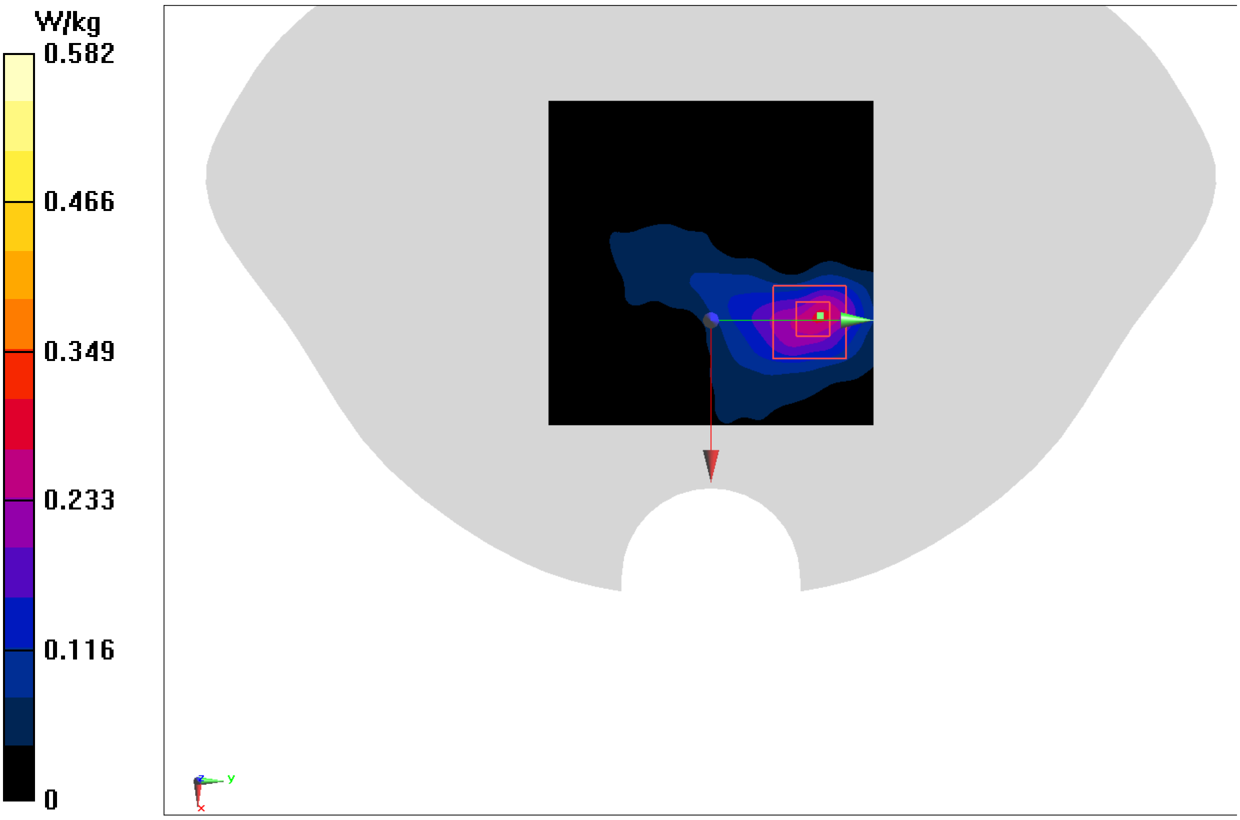


Fig.4 5GHz

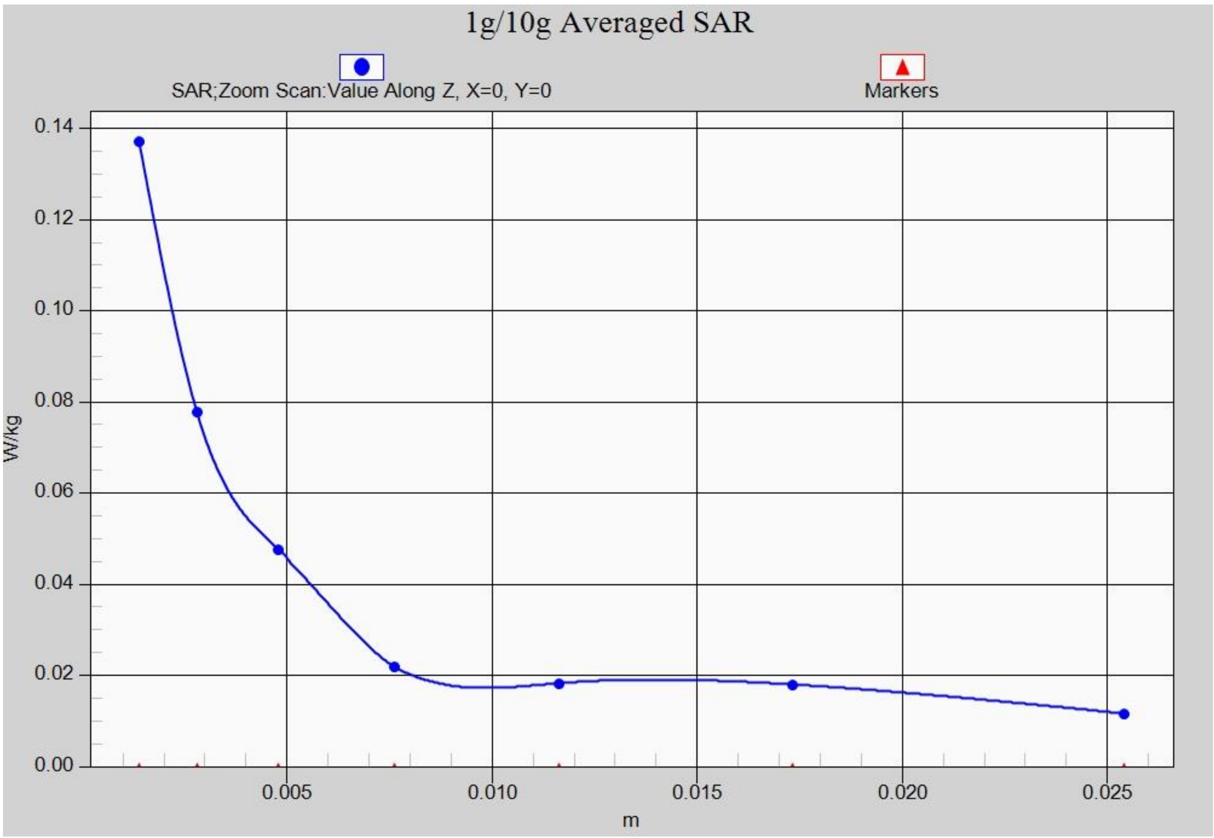


Fig. 4-1 Z-Scan at power reference point (5GHz)

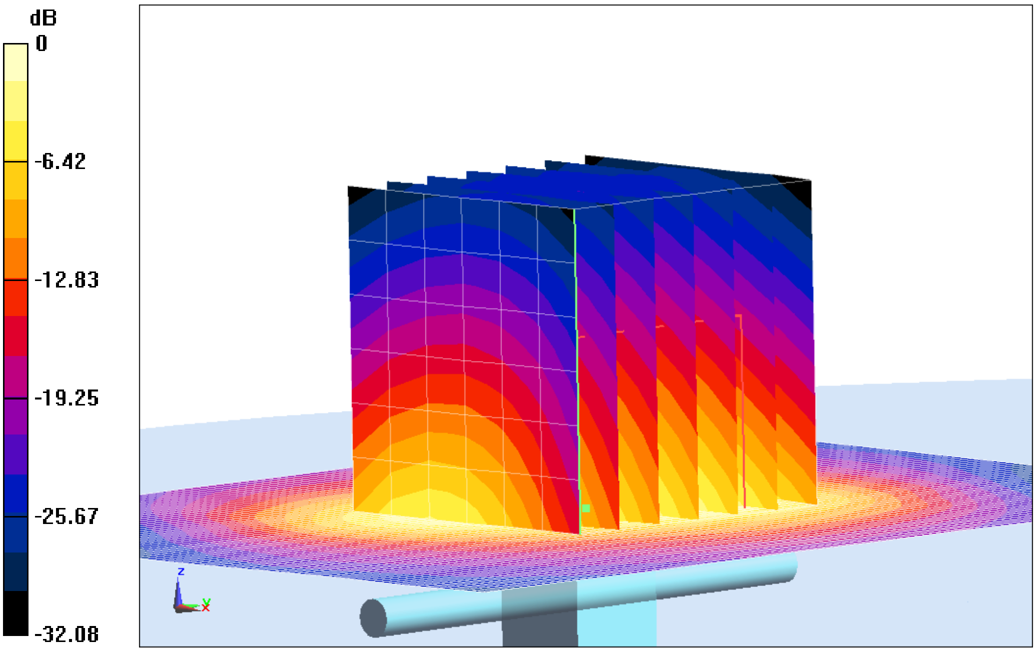
ANNEX B SystemVerification Results

2450MHz

Date: 2018-8-16
Electronics: DAE4 Sn1525
Medium: Body 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.974 S/m; ε_r = 51.98; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(8.09, 8.09, 8.09)

System Validation/Area Scan (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 14.3 W/kg

System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.47 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 24.55 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.07 W/kg
Maximum value of SAR (measured) = 14.5 W/kg



0 dB = 14.5 W/kg = 11.61 dB W/kg

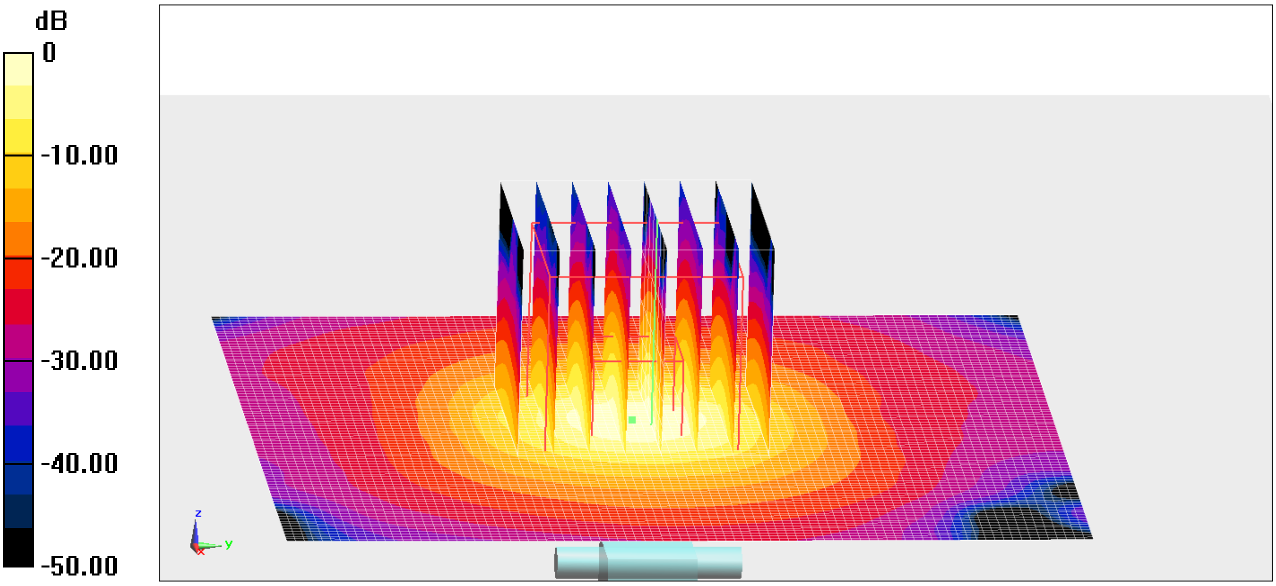
Fig.B.1 validation 2450MHz 250mW

5300MHz

Date: 2018-8-16
Electronics: DAE4 Sn1525
Medium: Body 5 GHz
Medium parameters used: f = 5300 MHz; σ = 5.326 mho/m; ε_r = 47.79; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C   Liquid Temperature: 22.5°C
Communication System: CW Frequency: 5300 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(5.11, 5.11, 5.11)

System Validation /Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 18.4 W/kg

System Validation /Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.59 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 31.61 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.14 W/kg
Maximum value of SAR (measured) = 18.2 W/kg



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

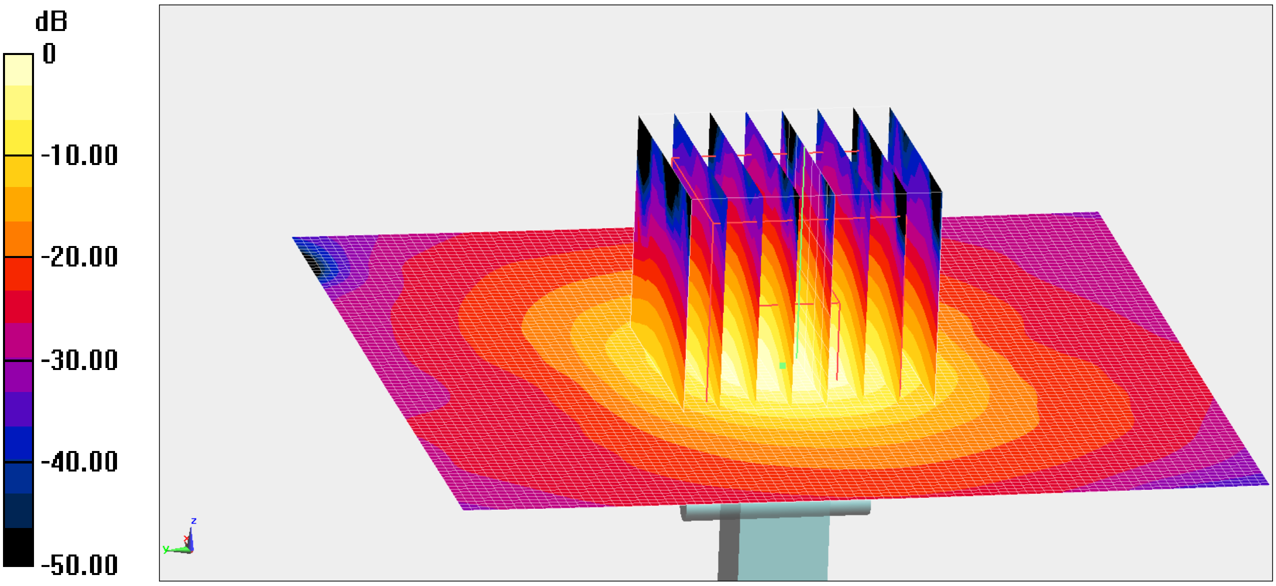
Fig.B.2 validation 5300MHz 100mW

5600MHz

Date: 2018-8-16
Electronics: DAE4 Sn1525
Medium: Body 5 GHz
Medium parameters used: f = 5600 MHz; σ = 5.719 mho/m; ε_r = 47.49; ρ = 1000 kg/m^3
Ambient Temperature: 22.9ºC Liquid Temperature: 22.5ºC
Communication System: CW Frequency: 5600 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(4.50, 4.50, 4.50)

System Validation /Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 20.3 W/kg

System Validation /Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.46 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 37.09 W/kg
SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 20.1 W/kg



0 dB = 20.1 W/kg = 13.03 dBW/kg

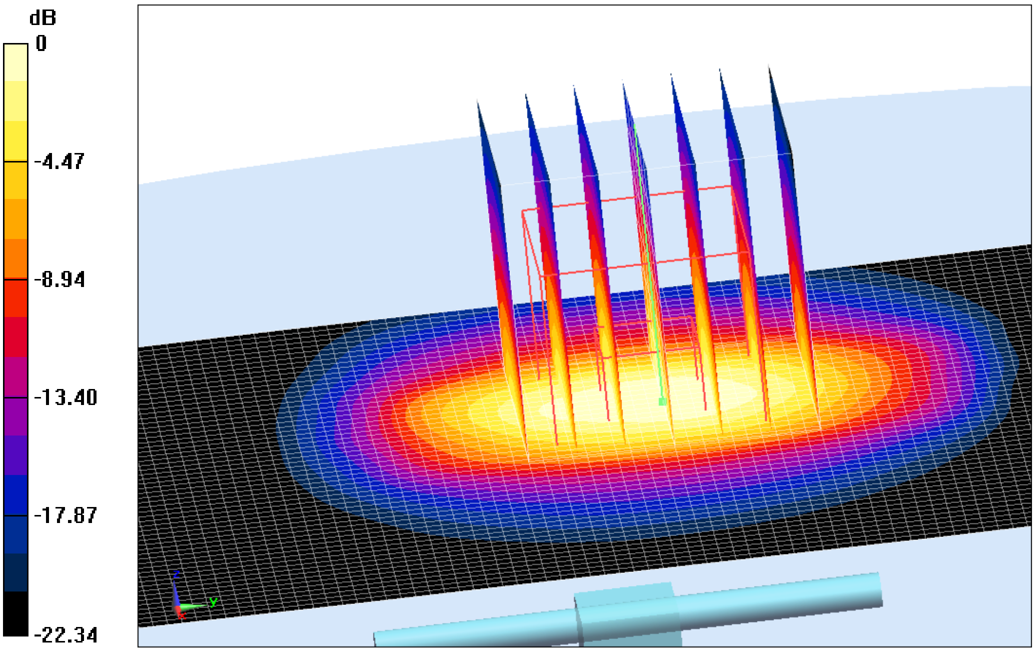
Fig.B.3 validation 5600MHz 100mW

2450MHz

Date: 2018-8-15
Electronics: DAE4 Sn1525
Medium: Head 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.824 mho/m; ε_r = 39.85; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(7.89, 7.89, 7.89)

System Validation /Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 16.4 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.86 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 27.21 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.13 W/kg
Maximum value of SAR (measured) = 16.2 W/kg



0 dB = 16.2 W/kg = 12.10 dBW/kg

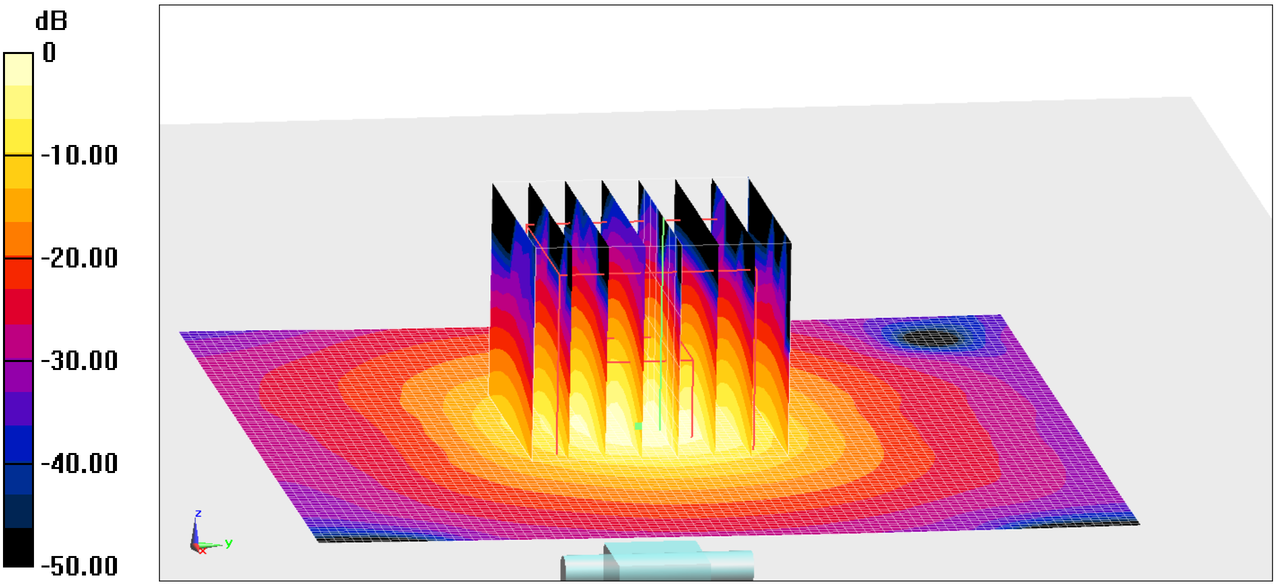
Fig.B.4 validation 2450MHz 250mW

5300MHz

Date: 2018-8-15
Electronics: DAE4 Sn1525
Medium: Head 5 GHz
Medium parameters used: f = 5300 MHz; σ = 4.727 mho/m; ε_r = 36.79; ρ = 1000 kg/m^3
Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C
Communication System: CW Frequency: 5300 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(5.53, 5.53, 5.53)

System Validation /Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 19.3 W/kg

System Validation /Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.1 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 35.36 W/kg
SAR(1 g) = 8.22 W/kg; SAR(10 g) = 2.34 W/kg
Maximum value of SAR (measured) = 19.5 W/kg



0 dB = 19.5 W/kg = 12.90 dBW/kg

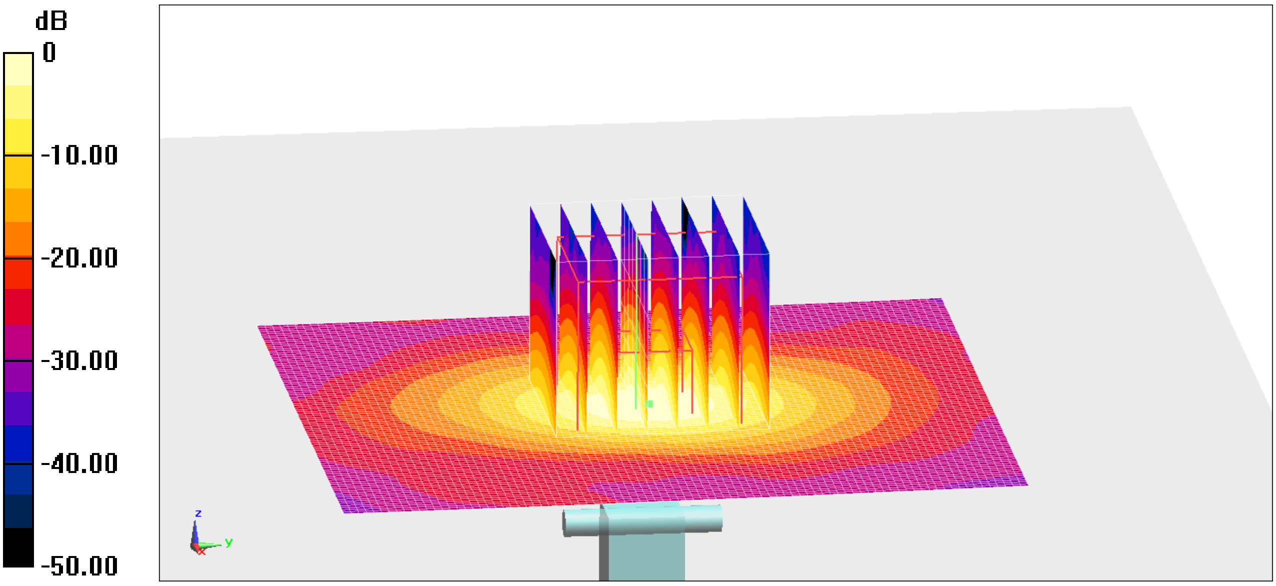
Fig.B.5 validation 5300MHz 100mW

5600MHz

Date: 2018-8-15
Electronics: DAE4 Sn1525
Medium: Head 5 GHz
Medium parameters used: f = 5600 MHz; σ = 5.182 mho/m; ε_r = 35.19; ρ = 1000 kg/m^3
Ambient Temperature: 22.9ºC Liquid Temperature: 22.5ºC
Communication System: CW Frequency: 5600 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN7464 ConvF(4.98, 4.98, 4.98)

System Validation /Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 19.8 W/kg

System Validation /Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 74.81 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 35.49 W/kg
SAR(1 g) = 8.32 W/kg; SAR(10 g) = 2.38 W/kg
Maximum value of SAR (measured) = 19.6 W/kg



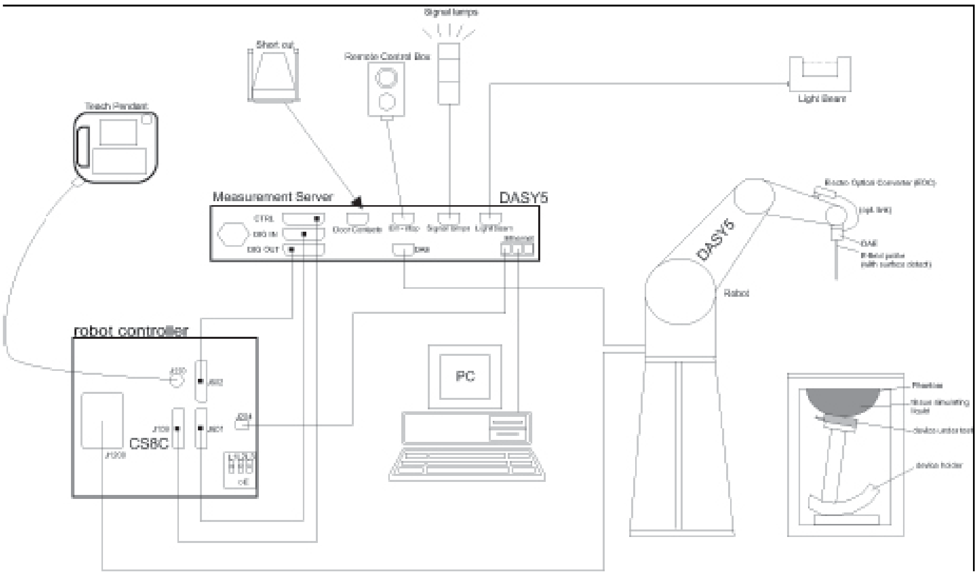
0 dB = 19.6 W/kg = 12.92 dBW/kg

Fig.B.6 validation 5600MHz 100mW

ANNEX C　SAR Measurement Setup

C.1 Measurement Set-up

The Dasy4 or DASY5 system for performing compliance tests is illustrated above graphically. This system consists of the following items:



Picture C.1SAR Lab Test Measurement Set-up

- A standard high precision 6-axis robot (StäubliTX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY4 or DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as
- warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

C.2 Dasy4 or DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 or DASY5 software reads the reflection durning a software approach and looks for the maximum using 2nd ord curve fitting. The approach is stopped at reaching the maximum.

Probe Specifications:

Model: ES3DV3, EX3DV4

Frequency Range: 10MHz — 6.0GHz(EX3DV4)
10MHz — 4GHz(ES3DV3)

Calibration: In head and body simulating tissue at Frequencies from 835 up to 5800MHz

Linearity: ± 0.2dB(30 MHz to 6 GHz) for EX3DV4
± 0.2dB(30 MHz to 4 GHz) for ES3DV3

DynamicRange: 10 mW/kg — 100W/kg

Probe Length: 330 mm

Probe Tip Length: 20 mm

Body Diameter: 12 mm

Tip Diameter: 2.5 mm (3.9 mm for ES3DV3)

Tip-Center: 1 mm (2.0mm for ES3DV3)

Application: SAR Dosimetry Testing
Compliance tests of mobile phones
Dosimetry in strong gradient fields

Picture C.2 Near-field Probe

Picture C.3 E-field Probe

C.3 E-field Probe Calibration

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an RF Signal generator, TEM cell, and RF Power Meter.

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm^2.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where:

Δt = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

ΔT = Temperature increase due to RF exposure.

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

C.4 Other Test Equipment

C.4.1 Data Acquisition Electronics(DAE)

The data acquisition electronics consist 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 with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

PictureC.4: DAE

C.4.2 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90XL; DASY5: RX160L) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

Picture C.5 DASY 4

Picture C.6 DASY 5

C.4.3 Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (dasy4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chip disk (DASY4: 32 MB; DASY5: 128MB), RAM (DASY4: 64 MB, DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O broad, which is directly connected to the PC/104 bus of the CPU broad.

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pin out, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.

Picture C.7 Server for DASY 4

Picture C.8 Server for DASY 5

C.4.4 Device Holder for Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

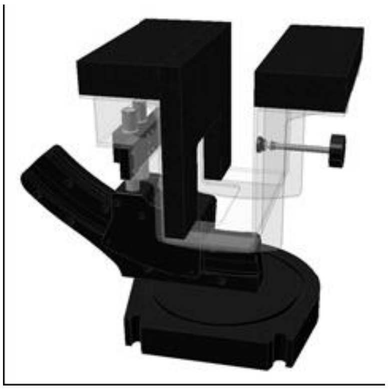
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss
POM material having the following dielectric
parameters: relative permittivity ε =3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin-SAM and ELI phantoms.

Picture C.9-1: Device Holder



Picture C.9-2: Laptop Extension Kit

C.4.5 Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to

Represent the 90th percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

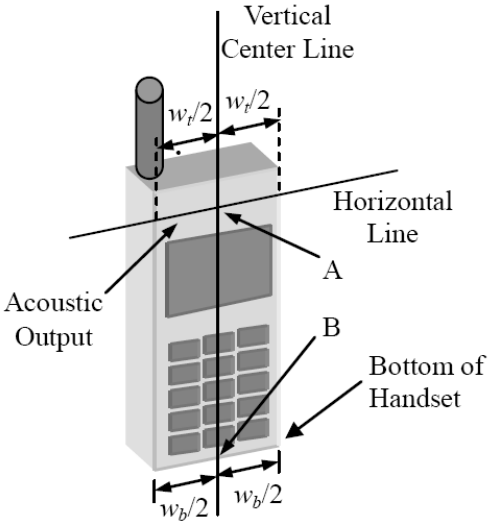
Shell Thickness: 2±0. 2 mm
Filling Volume: Approx. 25 liters
Dimensions: 810 x l000 x 500 mm (H x L x W)
Available: Special

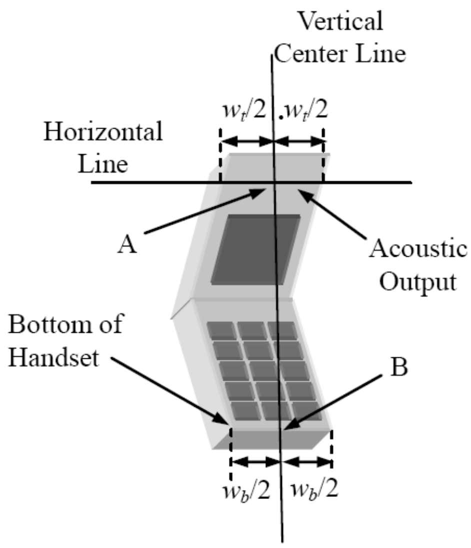
Picture C.10: SAM Twin Phantom

ANNEX D Position of the wireless device in relation to the phantom

D.1 General considerations

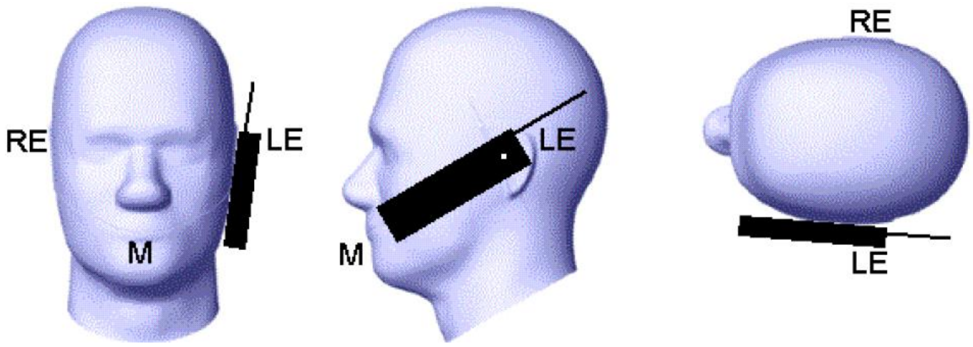
This standard specifies two handset test positions against the head phantom – the “cheek”position and the “tilt” position.



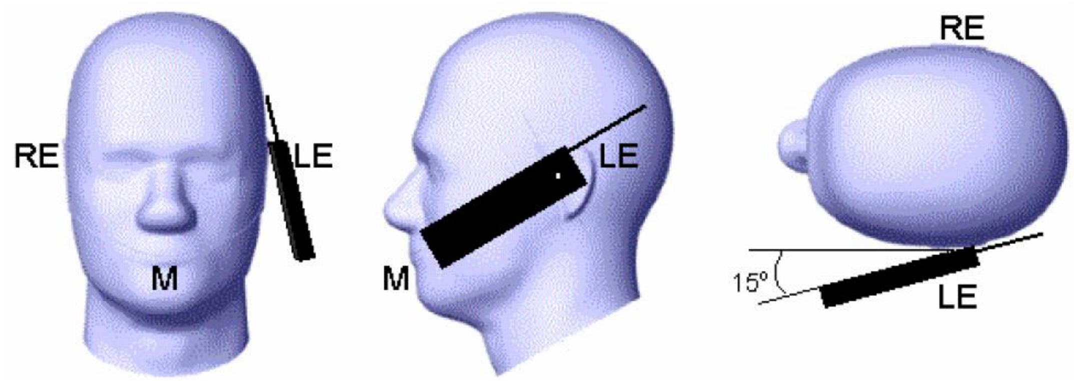


w_t	Width of the handset at the level of the acoustic
w_b	Width of the bottom of the handset
A	Midpoint of the width w_t of the handset at the level of the acoustic output
B	Midpoint of the width w_b of the bottom of the handset

Picture D.1-a Typical “fixed” case handset **Picture D.1-b Typical “clam-shell” case handset**



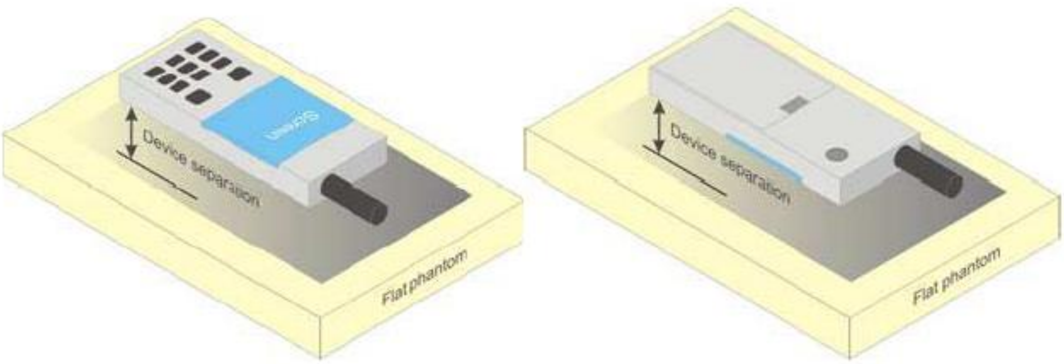
Picture D.2 Cheek position of the wireless device on the left side of SAM



Picture D.3 Tilt position of the wireless device on the left side of SAM

D.2 Body-worn device

A typical example of a body-worn device is a mobile phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer.

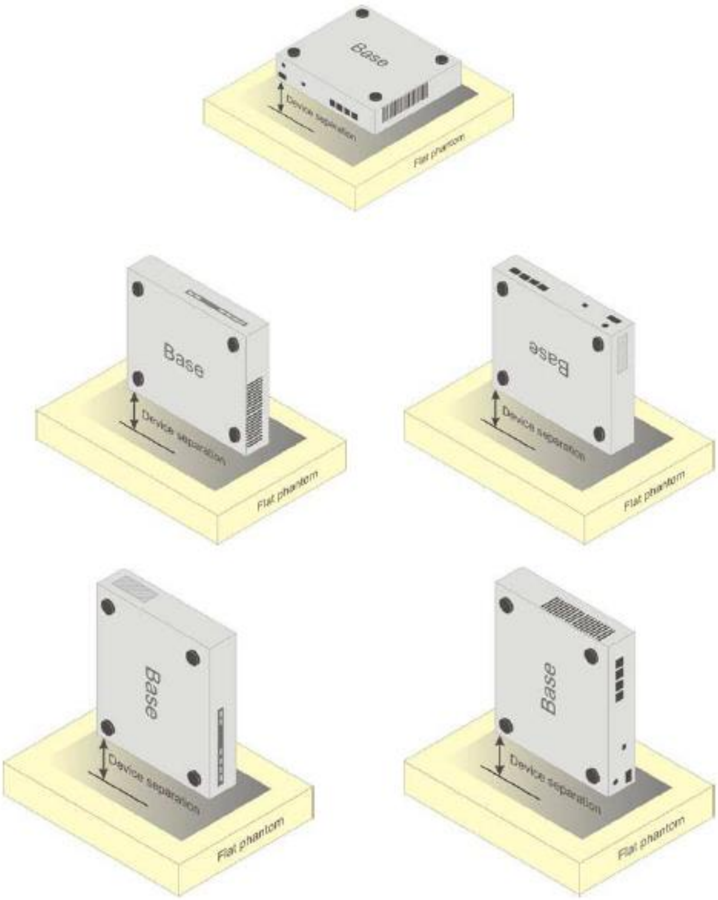


Picture D.4 Test positions for body-worn devices

D.3 Desktop device

A typical example of a desktop device is a wireless enabled desktop computer placed on a table or desk when used.

The DUT shall be positioned at the distance and in the orientation to the phantom that corresponds to the intended use as specified by the manufacturer in the user instructions. For devices that employ an external antenna with variable positions, tests shall be performed for all antenna positions specified. Picture8.5 show positions for desktop device SAR tests. If the intended use is not specified, the device shall be tested directly against the flat phantom.



Picture D.5 Test positions for desktop devices

D.4 DUT Setup Photos

Picture D.6

ANNEX E Equivalent Media Recipes

The liquid used for the frequency range of 800-3000 MHz consisted of water, sugar, salt,preventol, glycol monobutyl and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table E.1 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

TableE.1: Composition of the Tissue Equivalent Matter

Frequency (MHz)	835Head	835Body	1900 Head	1900 Body	2450 Head	2450 Body	5800 Head	5800 Body
Ingredients (% by weight)								
Water	41.45	52.5	55.242	69.91	58.79	72.60	65.53	65.53
Sugar	56.0	45.0	\	\	\	\	\	\
Salt	1.45	1.4	0.306	0.13	0.06	0.18	\	\
Preventol	0.1	0.1	\	\	\	\	\	\
Cellulose	1.0	1.0	\	\	\	\	\	\
Glycol Monobutyl	\	\	44.452	29.96	41.15	27.22	\	\
Diethylenglycol monohexylether	\	\	\	\	\	\	17.24	17.24
Triton X-100	\	\	\	\	\	\	17.24	17.24
Dielectric Parameters Target Value	ε=41.5 σ=0.90	ε=55.2 σ=0.97	ε=40.0 σ=1.40	ε=53.3 σ=1.52	ε=39.2 σ=1.80	ε=52.7 σ=1.95	ε=35.3 σ=5.27	ε=48.2 σ=6.00

Note: There are a little adjustment respectively for 750, 1750, 2600, 5200, 5300 and 5600 based on the recipe of closest frequency in table E.1.

ANNEX F System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components.

Table F.1: System Validation for 7464

Probe SN.	Liquid name	Validation date	Frequency point	Status (OK or Not)
7464	Head 750MHz	Sep.26,2017	750 MHz	OK
7464	Head 850MHz	Sep.26,2017	850 MHz	OK
7464	Head 900MHz	Sep.26,2017	900 MHz	OK
7464	Head 1750MHz	Sep.26,2017	1750 MHz	OK
7464	Head 1810MHz	Sep.26,2017	1810 MHz	OK
7464	Head 1900MHz	Sep.27,2017	1900 MHz	OK
7464	Head 1950MHz	Sep.27,2017	1950 MHz	OK
7464	Head 2000MHz	Sep.27,2017	2000 MHz	OK
7464	Head 2100MHz	Sep.27,2017	2100 MHz	OK
7464	Head 2300MHz	Sep.27,2017	2300 MHz	OK
7464	Head 2450MHz	Sep.27,2017	2450 MHz	OK
7464	Head 2550MHz	Sep.28,2017	2550 MHz	OK
7464	Head 2600MHz	Sep.28,2017	2600 MHz	OK
7464	Head 3500MHz	Sep.28,2017	3500 MHz	OK
7464	Head 3700MHz	Sep.28,2017	3700 MHz	OK
7464	Head 5200MHz	Sep.28,2017	5200 MHz	OK
7464	Head 5500MHz	Sep.28,2017	5500 MHz	OK
7464	Head 5800MHz	Sep.28,2017	5800 MHz	OK
7464	Body 750MHz	Sep.28,2017	750 MHz	OK
7464	Body 850MHz	Sep.25,2017	850 MHz	OK
7464	Body 900MHz	Sep.25,2017	900 MHz	OK
7464	Body 1750MHz	Sep.25,2017	1750 MHz	OK
7464	Body 1810MHz	Sep.25,2017	1810 MHz	OK
7464	Body 1900MHz	Sep.25,2017	1900 MHz	OK
7464	Body 1950MHz	Sep.25,2017	1950 MHz	OK
7464	Body 2000MHz	Sep.29,2017	2000 MHz	OK
7464	Body 2100MHz	Sep.29,2017	2100 MHz	OK
7464	Body 2300MHz	Sep.29,2017	2300 MHz	OK
7464	Body 2450MHz	Sep.29,2017	2450 MHz	OK
7464	Body 2550MHz	Sep.29,2017	2550 MHz	OK
7464	Body 2600MHz	Sep.29,2017	2600 MHz	OK
7464	Body 3500MHz	Sep.24,2017	3500 MHz	OK
7464	Body 3700MHz	Sep.24,2017	3700 MHz	OK
7464	Body 5200MHz	Sep.24,2017	5200 MHz	OK
7464	Body 5500MHz	Sep.24,2017	5500 MHz	OK
7464	Body 5800MHz	Sep.24,2017	5800 MHz	OK

ANNEX G Probe Calibration Certificate

Probe 7464 Calibration Certificate

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 **CTTL-BJ (Auden)**

Certificate No: **EX3-7464_Sep17**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:7464

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: September 12, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ES3DV2	SN: 3013	31-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	SN: 660	7-Dec-16 (No. DAE4-660_Dec16)	Dec-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

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

Issued: September 12, 2017

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

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**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:7464

Manufactured: September 6, 2016
Calibrated: September 12, 2017

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7464

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m)^2)[A]	0.45	0.43	0.45	± 10.1 %
DCP (mV)[B]	101.6	99.3	99.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	150.5	±3.3 %
		Y	0.0	0.0	1.0		144.7	
		Z	0.0	0.0	1.0		147.0	

Note: For details on UID parameters see Appendix.

Sensor Model Parameters

	C1 fF	C2 fF	α V^{-1}	T1 $ms.V^{-2}$	T2 $ms.V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
X	57.86	441.1	37.02	12.02	0.826	5.039	0.00	0.727	1.006
Y	59.82	453.4	36.65	14.84	0.468	5.100	0.25	0.626	1.007
Z	65.01	497.8	37.35	15.97	1.043	5.073	0.00	0.801	1.008

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:7464

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	12.20	12.20	12.20	0.00	1.00	± 13.3 %
300	45.3	0.87	11.77	11.77	11.77	0.09	1.20	± 13.3 %
450	43.5	0.87	11.17	11.17	11.17	0.15	1.20	± 13.3 %
750	41.9	0.89	10.57	10.57	10.57	0.53	0.80	± 12.0 %
835	41.5	0.90	10.28	10.28	10.28	0.48	0.80	± 12.0 %
900	41.5	0.97	10.03	10.03	10.03	0.28	1.09	± 12.0 %
1450	40.5	1.20	9.05	9.05	9.05	0.37	0.80	± 12.0 %
1640	40.2	1.31	8.82	8.82	8.82	0.35	0.80	± 12.0 %
1750	40.1	1.37	8.70	8.70	8.70	0.38	0.80	± 12.0 %
1810	40.0	1.40	8.42	8.42	8.42	0.32	0.85	± 12.0 %
1900	40.0	1.40	8.39	8.39	8.39	0.35	0.80	± 12.0 %
2000	40.0	1.40	8.39	8.39	8.39	0.32	0.89	± 12.0 %
2100	39.8	1.49	8.54	8.54	8.54	0.27	0.86	± 12.0 %
2300	39.5	1.67	8.40	8.40	8.40	0.34	0.95	± 12.0 %
2450	39.2	1.80	7.89	7.89	7.89	0.34	0.93	± 12.0 %
2600	39.0	1.96	7.76	7.76	7.76	0.37	0.92	± 12.0 %
3500	37.9	2.91	7.40	7.40	7.40	0.41	0.94	± 13.1 %
3700	37.7	3.12	7.11	7.11	7.11	0.50	0.84	± 13.1 %
5200	36.0	4.66	5.82	5.82	5.82	0.35	1.80	± 13.1 %
5250	35.9	4.71	5.68	5.68	5.68	0.35	1.80	± 13.1 %
5300	35.9	4.76	5.53	5.53	5.53	0.35	1.80	± 13.1 %
5500	35.6	4.96	5.21	5.21	5.21	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.98	4.98	4.98	0.40	1.80	± 13.1 %
5750	35.4	5.22	5.04	5.04	5.04	0.40	1.80	± 13.1 %
5800	35.3	5.27	5.11	5.11	5.11	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:7464

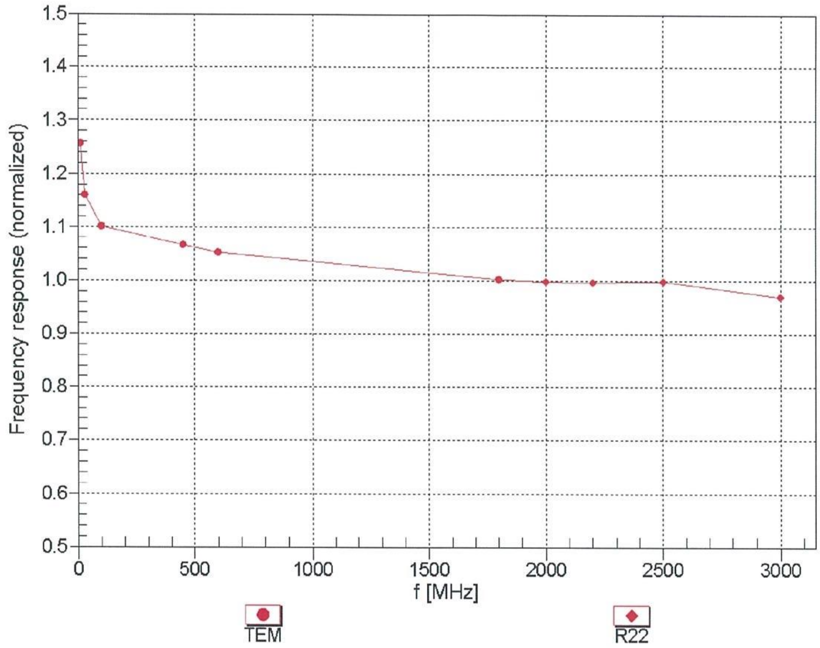
Calibration Parameter Determined in Body Tissue Simulating Media

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	12.19	12.19	12.19	0.00	1.00	± 13.3 %
300	58.2	0.92	11.32	11.32	11.32	0.06	1.20	± 13.3 %
450	56.7	0.94	11.05	11.05	11.05	0.09	1.20	± 13.3 %
750	55.5	0.96	10.63	10.63	10.63	0.49	0.88	± 12.0 %
835	55.2	0.97	10.21	10.21	10.21	0.45	0.80	± 12.0 %
900	55.0	1.05	10.17	10.17	10.17	0.42	0.80	± 12.0 %
1450	54.0	1.30	9.18	9.18	9.18	0.36	0.80	± 12.0 %
1640	53.7	1.42	9.12	9.12	9.12	0.38	0.80	± 12.0 %
1750	53.4	1.49	8.60	8.60	8.60	0.44	0.80	± 12.0 %
1810	53.3	1.52	8.45	8.45	8.45	0.41	0.80	± 12.0 %
1900	53.3	1.52	8.32	8.32	8.32	0.42	0.80	± 12.0 %
2000	53.3	1.52	8.24	8.24	8.24	0.39	0.80	± 12.0 %
2100	53.2	1.62	8.38	8.38	8.38	0.40	0.80	± 12.0 %
2300	52.9	1.81	8.30	8.30	8.30	0.42	0.93	± 12.0 %
2450	52.7	1.95	8.09	8.09	8.09	0.34	0.95	± 12.0 %
2600	52.5	2.16	7.84	7.84	7.84	0.30	0.97	± 12.0 %
3500	51.3	3.31	7.06	7.06	7.06	0.68	0.70	± 13.1 %
3700	51.0	3.55	6.99	6.99	6.99	0.85	0.60	± 13.1 %
5200	49.0	5.30	5.39	5.39	5.39	0.35	1.90	± 13.1 %
5250	48.9	5.36	5.29	5.29	5.29	0.35	1.90	± 13.1 %
5300	48.9	5.42	5.19	5.19	5.19	0.35	1.90	± 13.1 %
5500	48.6	5.65	4.61	4.61	4.61	0.40	1.90	± 13.1 %
5600	48.5	5.77	4.50	4.50	4.50	0.40	1.90	± 13.1 %
5750	48.3	5.94	4.59	4.59	4.59	0.40	1.90	± 13.1 %
5800	48.2	6.00	4.67	4.67	4.67	0.40	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.

Frequency Response of E-Field

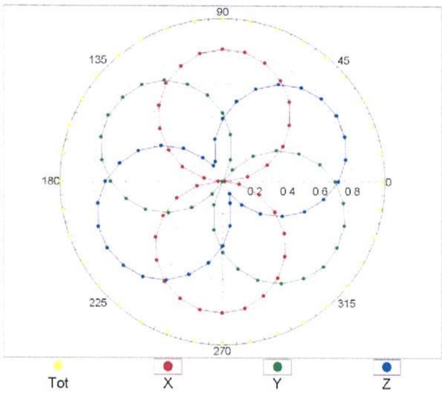
(TEM-Cell:ifi110 EXX, Waveguide: R22)



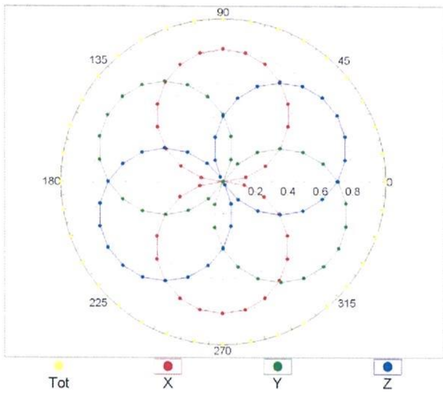
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

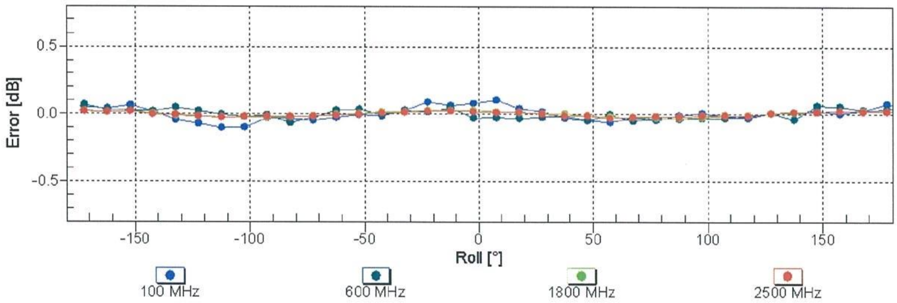
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22





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