DAkkS Deutsche Akkreditierungsstelle D-PL-12139-01-00

The Testcenter facility 'Dosimetric Test Lab' within IMST GmbH is accredited by the German National 'Deutsche Akkreditierungsstelle GmbH (DAkkS)' for testing according to the scope as listed in the accreditation certificate: D-PL-12139-01-00.

SAR Evaluation Report

EUT Information	
Manufacturer	ASCOM
Model Name	SH1-ABBA, SH1-ABBB*
FCC ID	BXZSH1B2
IC number	3724B-SH1B2
EUT Type	portable device / smartphone
Prepared by	
Testing Laboratory	IMST GmbH, Test Center Carl-Friedrich-Gauß-Str. 2 – 4 47475 Kamp-Lintfort Germany
Prepared for	
Applicant	Ascom Sweden AB Grimbodalen 2 40276 Göteborg Sweden
Test Specification	
Standard Applied	IEEE 1528-2013; RSS-102 Issue 5; FCC CFR 47 § 2.1093
Exposure Category	General Public / Uncontrolled Exposure
Usage Configuration	head and body worn
Report Information	
Data Stored	60320_6170144_ASCOM-ABBA
Issue Date	May 5, 2017
Revision Date	May 30, 2017
Revision Number	2
Remarks	This report relates only to the item(s) evaluated. This report shall not be reproduced, except in its entirety, without the prior written approval of IMST GmbH. The results and statements contained in this report reflect the evaluation for the certain model described above. The manufacturer is responsible for ensuring that all production devices meet the intent of the requirements described in this report. * According to a statement from the manufacturer the difference between SH1-ABBA vs. SH1-ABBB is only a software feature for Google Mobile Service (GMS).

Table of Contents

1 Subject of Investigation and Test Results

1.1 Technical Data of EUT

Product Specifications	
Model Name	SH1-ABBA, SH1-ABBB
IMEI / SN	radiated sample T261062CKB; conducted sample: 00013E1BF412
Operation Mode	DECT UPCS (TDD); IEEE 802.11 (2,4 GHz and 5 GHz)
Usage Configuration	head and body worn
Antenna Type	integrated (2x DECT; 1x WLAN)
Max. Output Power	refer chapter 6.3
Power Supply	internal battery DC 3.7V (1520 mAh)
Used Accessory	belt clip, headset
Notes:	

1.2 Antenna Configuration

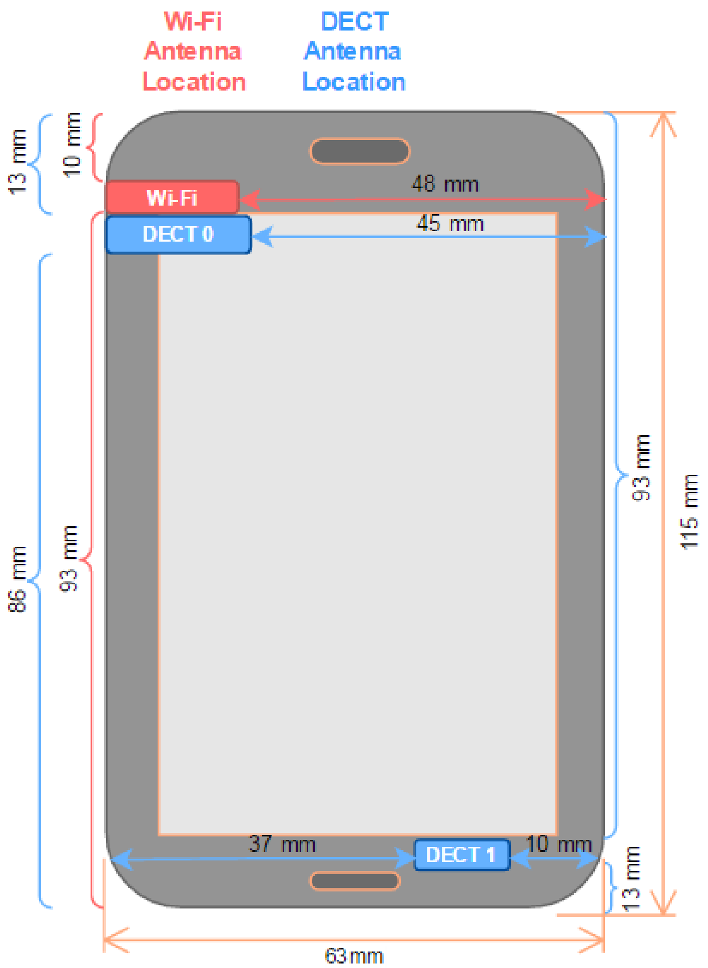

Fig. 1: Antenna location of the EUT.

1.3 Test Specification / Normative References

The tests documented in this report were performed according to the standards and rules described below.

Test Specifications			
	Test Standard / Rule	**Description**	**Issue Date**
☒	IEEE 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.	June 14, 2013
☐	FCC CFR 47 § 2.1091	Code of Federal Regulations; Title 47. Radiofrequency radiation exposure evaluation: **Mobile Devices.**	October 01, 2010
☒	FCC CFR 47 § 2.1093	Code of Federal Regulations; Title 47. Radiofrequency radiation exposure evaluation: **Portable Devices.**	October 01, 2010
☒	RSS-102, Issue 5	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)	March, 2015
Measurement Methodology KDB			
☒	KDB 865664 D01 v01r04	SAR measurement 100 MHz to 6 GHz	August 07, 2015
☒	KDB 865664 D02 v01r01	Exposure Reporting	October 23, 2015
Product KDB			
☒	KDB 447498 D01 v06	General RF Exposure Guidance	October 23, 2015
☒	KDB 648474 D04 v01r03	Handset SAR	October 23, 2015
Technology KDB			
☒	KDB 248227 D01 v02r02	802.11 Wi-Fi SAR	October 23, 2015

1.4 Attestation of Test Results

Highest SAR_{1g} [W/kg]									
Band	**Frequency [MHz]**	**CH**	**Exposure Configuration**		**Gap [mm]**	**Pic. No.**	**Highest Reported SAR1g [W/kg]**	**SAR1g Limit [W/kg]**	
DECT UPCS Ant 0	1924.992	2	Head	Right Tilt	0	*6*	0.006	1.6	PASS
	1924.992	2	Body Worn	Back	0	*8*	0.019	1.6	PASS
DECT UPCS Ant 1	1928.448	0	Head	Left Cheek	0	*3*	0.029	1.6	PASS
	1924.992	2	Body Worn	Back	0	*8*	0.092	1.6	PASS
WiFi 2.4 GHz	2412	1	Head	Left Cheek	0	*3*	0.143	1.6	PASS
	2462	11	Body Worn	Front	0	*7*	0.197	1.6	PASS
WiFi 5 GHz	5500	100	Head	Right Cheek	0	*5*	0.324	1.6	PASS
	5640	128	Body Worn	Front	0	*7*	0.518	1.6	PASS

Notes: To establish a connection at a specific channel and with maximum output power, engineering test software has been used.
All measured SAR results and configurations are shown in chapter 6.5 on page 26.

Simultaneous Transmission Scenario [W/kg]						
Exposure Configuration / Position	**Highest Reported SAR_{1g} Values**				**Σ SAR_{1g}**	
	DECT / Ant 0	**DECT / Ant 1**	**WLAN 2.4 GHz**	**WLAN 5 GHz**		
Head / Right Cheek		0.017		0.324	0.341	PASS
Body / Front		0.067		0.518	0.585	PASS

Prepared by: ....

Dessislava Patrishkova
Test Engineer

Reviewed by: ....

Alexander Rahn
Quality Assurance

2 Exposure Criteria and Limits

2.1 SAR Limits

Human Exposure Limits				
Condition	**Uncontrolled Environment** (General Population)		**Controlled Environment** (Occupational)	
	SAR Limit [W/kg]	**Mass Avg.**	**SAR Limit [W/kg]**	**Mass Avg.**
SAR averaged over the whole body mass	0.08	whole body	0.4	whole body
Peak spatially-averaged SAR for the head, neck & trunk	1.6	1g of tissue*	8.0	1g of tissue*
Peak spatially-averaged SAR in the limbs	4.0	10g of tissue*	20.0	10g of tissue*
Note: *Defined as a tissue volume in the shape of a cube				

Table 1: SAR limits.

In this report the comparison between the exposure limits and the measured data is made using the spatial peak SAR; the power level of the device under test guarantees that the whole body averaged SAR is not exceeded.

2.2 Exposure Categories

General Public / Uncontrolled Exposure
General population comprises individuals of all ages and of varying health status, and may include particularly susceptible groups or individuals. In many cases, members of the public are unaware of their exposure to electromagnetic fields. Moreover, individual members of the public cannot reasonably be expected to take precautions to minimize or avoid exposure.
Occupational / Controlled Exposure
The occupationally exposed population consists of adults who are generally exposed under known conditions and are trained to be aware of potential risk and to take appropriate precautions.

Table 2: RF exposure categories.

2.3 Distinction between Maximum Permissible Exposure and SAR Limits

The biological relevant parameter describing the effects of electromagnetic fields in the frequency range of interest is the specific absorption rate SAR (dimension: power/mass). It is a measure of the power absorbed per unit mass. The SAR may be spatially averaged over the total mass of an exposed body or its parts. The SAR is calculated from the r.m.s. electric field strength E inside the human body, the conductivity σ and the mass density ρ of the biological tissue:

$$SAR = \sigma \frac{E^2}{\rho} = c \left. \frac{\partial T}{\partial t} \right|_{t \to 0+} \quad . \qquad (1)$$

The specific absorption rate describes the initial rate of temperature rise $\partial T / \partial t$ as a function of the specific heat capacity c of the tissue. A limitation of the specific absorption rate prevents an excessive heating of the human body by electromagnetic energy.

As it is sometimes difficult to determine the SAR directly by measurement (e.g. whole body averaged SAR), the standard specifies more readily measurable maximum permissible exposures in terms of external electric E and magnetic field strength H and power density S, derived from the SAR limits. The limits for E, H and S have been fixed so that even under worst case conditions, the limits for the specific absorption rate SAR are not exceeded.

3 Measurement Procedure

3.1 General Requirement

The test shall be performed in a laboratory with an environment which avoids influence on SAR measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature shall be in the range of 20°C to 26°C and 30-70% humidity. All tests have been conducted according the latest version of all relevant KDBs.

3.2 Device Operating next to a Person's Ear

3.2.1 Phantom Requirements

The phantom is a simplified representation of the human anatomy and comprised of material with electrical properties similar to the corresponding tissues. The physical characteristics of the phantom model shall resemble the head and the neck of a user since the shape is a dominant parameter for exposure.

3.2.2 Test Positions

As it cannot be expected that the user will hold the mobile phone exactly in one well defined position, different operational conditions shall be tested. The standards require two test positions. For an exact description helpful geometrical definitions are introduced and shown in Fig. 2 - 4. There are two imaginary lines on the mobile, the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width w_t of the handset at the level of the acoustic output (point A on Fig. 2 and 4), and the midpoint of the width w_b of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Fig. 2). The horizontal line is also tangential to the face of the handset at point A. The two lines intersect at point A.

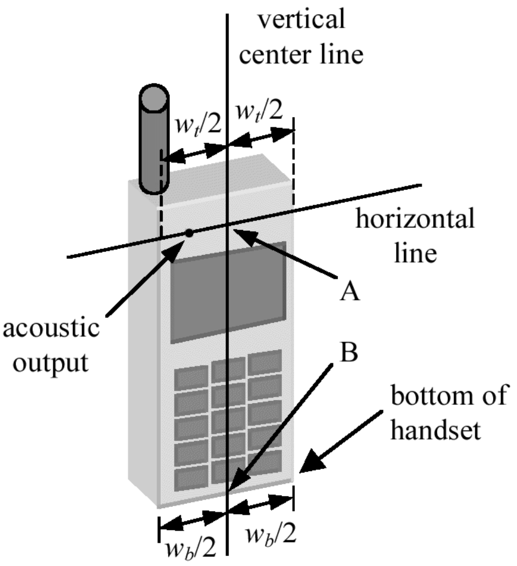

Fig. 2: Geometrical definitions on the telephone (bar phone).

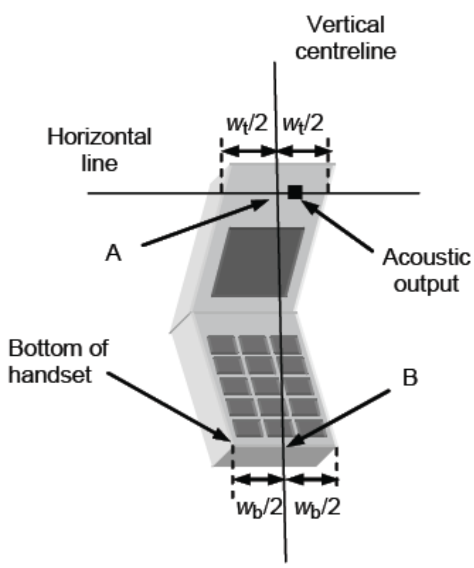

Fig. 3: Geometrical definitions on the telephone (clam shell or flip).

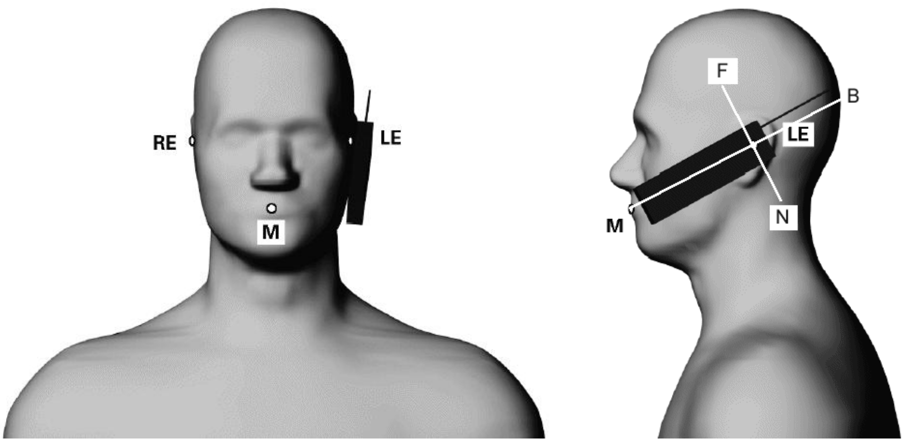

Fig. 4: Phantom reference points.

According to Fig. 4 the human head position is given by means of the following three reference points: auditory canal opening of both ears (RE and LE) and the center of the closed mouth (M). The ear reference points are 15 - 17 mm above the entrance to the ear canal along the BM line (back-mouth), as shown in Fig. 4. The plane passing through the two ear canals and M is defined as the reference plane. The line NF (Neck-Front) perpendicular to the reference plane and passing through the RE (or LE) is called the reference pivoting line. Line BM is perpendicular to the NF line. With this definitions the test positions are given by

- **Cheek Position (see Fig. 5):**

Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Fig. 4), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom. Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane). Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the ear.

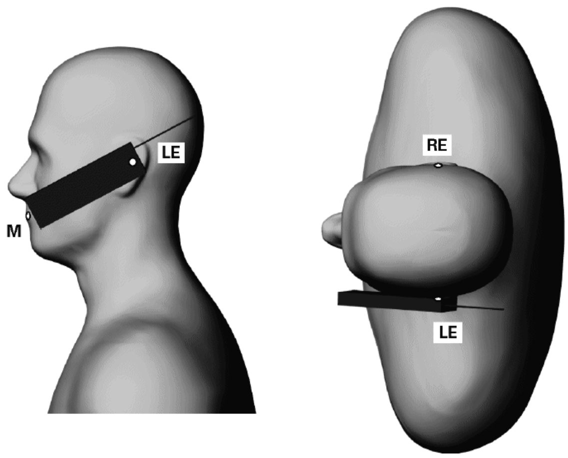

Fig. 5: The cheek position.

- **Tilted Position (see Fig. 6):**

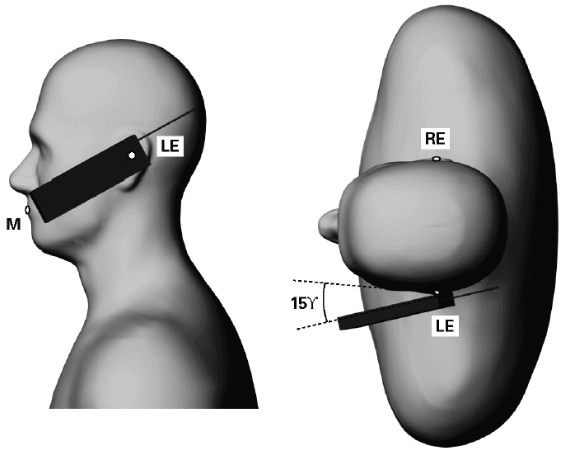

Fig. 6: The tilted position.

While maintaining the orientation of the phone retract the phone parallel to the reference plane far enough to enable a rotation of the phone by 15°. Rotate the phone around the horizontal line by 15°. While maintaining the orientation of the phone, move the phone parallel to the reference plane until any part of the phone touches the head. In this position, point A will be located on the line RE-LE.

3.2.3 Test to be Performed

The SAR test shall be performed with both phone positions described above, on the left and right side of the phantom. The device shall be measured for all modes operating when the device is next to the ear, even if the different modes operate in the same frequency band.

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional.

3.3 Device Operating next to a Person's Body

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

For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body.

For multiple accessories that contain metallic components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested.

Devices that are designed to operate on the body of users using lanyards and straps, or without requiring additional body worn accessories, must be tested for SAR compliance using a conservative minimum test separation distance ≤ 5 mm to support compliance. Nevertheless, all accessories that contain metallic components must be tested for compliance additionally.

Other separation distances may be used, but they shall not exceed 2.5 cm.

3.3.1 Phantom Requirements

For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

3.3.2 Test to be Performed

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at the middle channel resp. that channel with the highest output power for each test configuration is < 0.4 W/kg, testing at the high and low channels is optional.

3.4 Information for IEEE 802.11 (Wi-Fi) Transmitters

For both DSSS and OFDM wireless modes an initial test position must be established for each applicable exposure configuration using either:

- Design implementation defined by the manufacturer, or
- Investigative results by the test lab based on:
  - Exclusions based on the distance from the antenna to the surface, or
  - Highest measured SAR from the area-scan-only measurements on all applicable test positions at the Initial Test Configuration, if found to require SAR tests.

Then, the initial test position procedure defines the required complete SAR scan measurements on each exposure configuration as following:

- When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurements is not required for the remaining test positions in that configuration as well as 802.11 transmission mode combinations within the frequency or aggregated band.
- When the reported SAR of the initial test position is > 0.4 W/kg, further SAR measurements is required in the initial test position or next closest/smallest test separation distance based on

manufacturer justification, on the following highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions are tested.

- When the reported SAR for all initial and subsequent test positions is > 0.8 W/kg, further SAR measurements is required on these positions on the subsequent next highest measured output power channels, until the reported SAR is ≤ 1.2 W/kg or all required channels have been tested.

For OFDM transmission configurations in 2.4 GHz and 5 GHz bands, it is important to determine SAR Initial Test Configuration for each stand alone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units. The procedure is as following:

- Highest output power channel is chosen; if there are channels with same maximum output power then the closest to the mid-band frequency is preferred. If there are more than one channel with same maximum output power and same distance to the mid-band frequency, then the channel with the higher frequency is preferred.
- When SAR measurement is required for a subsequent test configuration and the channel bandwidth is smaller than that in the initial test configuration, all channels in the subsequent test configuration that overlap with the larger bandwidth channel tested in the initial test configuration should be used to determine the highest maximum output power channel in the subsequent test configuration.

Along with the initial test position reduction guidelines, the following procedures are also applied to SAR measurement requirements when multiple OFDM configurations are supported:

- When the reported SAR of the initial test configuration with the highest output power channel is > 0.8 W/kg, further SAR measurements is required for next highest output power channel in the initial test configuration, until the reported SAR is ≤ 1.2 W/kg or all required channels have been tested.
- When the reported SAR of the subsequent test configuration with the highest output power channel is > 1.2 W/kg, further SAR measurements is required for next highest output power channel in this test configuration, until the reported SAR is ≤ 1.2 W/kg or all required channels have been tested.
- When the reported SAR of the subsequent test configuration is > 1.2 W/kg, further SAR measurements for the following subsequent test configurations are required.

3.5 Measurement Variability

According KDB 865664 repeated measurements are required only when the measured SAR is ≥ 0.80 W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with ≤ 20% variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. 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; steps 2) 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 ≥ 1.45 W/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.

4 The Measurement System

DASY is an abbreviation of „Dosimetric Assessment System“ and describes a system that is able to determine the SAR distribution inside a phantom of a human being according to different standards. The DASY4 system consists of the following items as shown in Fig: 7. Additionally, Fig: 8 shows the equipment, similar to the installations in other laboratories.

- Fully compliant with all current measurement standards as stated in Fig. 9
- High precision robot with controller
- Measurement server (for surveillance of the robot operation and signal filtering)
- Data acquisition electronics DAE (for signal amplification and filtering)
- Field probes calibrated for use in liquids
- Electro-optical converter EOC (conversion from the optical into a digital signal)
- Light beam (improving of the absolute probe positioning accuracy)
- Two SAM phantoms filled with tissue simulating liquid
- DASY4 software
- SEMCAD

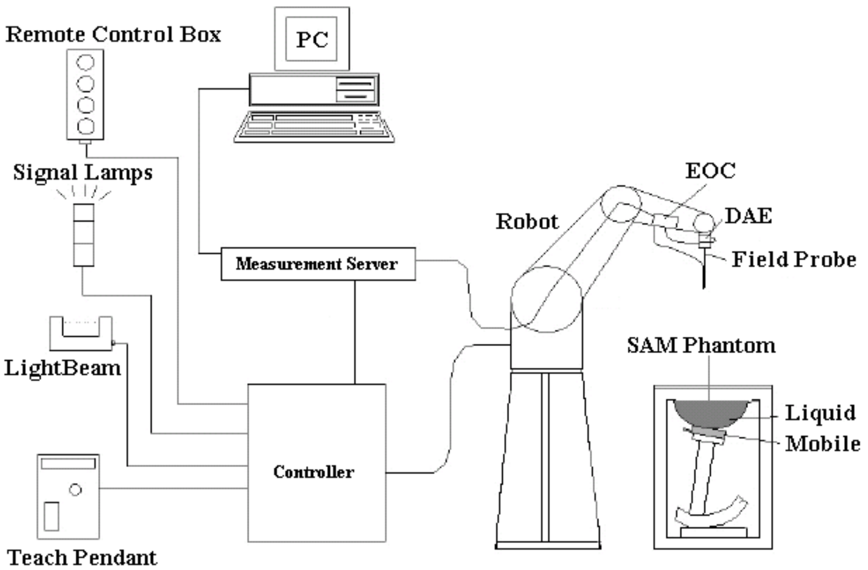

Fig. 7: The DASY4 measurement system.

Fig. 8: The measurement set-up with two SAM phantoms containing tissue simulating liquid.

The EUT operating at the maximum power level is placed by a non-metallic device holder (delivered from Schmid & Partner) in the above described positions at a shell phantom of a human being. The distribution of the electric field strength *E* is measured in the tissue simulating liquid within the shell phantom. For this miniaturised field probes with high sensitivity and low field disturbance are used. Afterwards the corresponding SAR values are calculated with the known electrical conductivity σ and the mass density ρ of the tissue in the SEMCAD FDTD software. The software is able to determine the averaged SAR values (averaging region 1 g or 10 g) for compliance testing.

The measurements are done by two scans: first a coarse scan determines the region of the maximum SAR, afterwards the averaged SAR is measured in a second scan within the shape of a cube.

4.1 Phantoms

TWIN SAM PHANTOM V4.0	
	Specific Anthropomorphic Mannequin defined in IEEE 1528 and IEC 62209-1 and delivered by Schmid & Partner Engineering AG. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. The details and the Certificate of conformity can be found in Fig. 10.
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)
Dimensions	Length: 1000 mm; Width: 500 mm Height: adjustable feet
Filling Volume	approx. 25 liters

4.2 E-Field-Probes

For the measurements the Dosimetric E-Field Probes ET3DV6R or EX3DV4 with following specifications are used. They are manufactured and calibrated in accordance with FCC and IEEE 1528-2013 recommendations annually by Schmid & Partner Engineering AG.

ET3DV6R	
Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system (ET3DV6 only) Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Dimensions	Overall length: 337 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm
Frequency	10 MHz to 2.3 GHz Linearity: ± 0.2 dB (30 MHz to 2.3 GHz)
Directivity	Axial isotropy: ± 0.2 dB in TSL (rotation around probe axis) Spherical isotropy: ± 0.4 dB in TSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Calibration Range	450 MHz / 750 MHz / 900 MHz / 1750 MHz / 1900 MHz / 1950 MHz for head and body simulating liquid

EX3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	Axial isotropy: ± 0.3 dB in TSL (rotation around probe axis) Spherical isotropy: ± 0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Calibration Range	1950 MHz / 2450 MHz / 2600 MHz / 3500 MHz / 5200 MHz / 5300 MHz / 5600 MHz / 5800 MHz for head and body simulating liquid

4.3 Measurement Procedure

The following steps are used for each test position:

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile phone and the base station simulator is established via air interface.
- Measurement of the local E-field value at a fixed location (P1). This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with resolution settings for area scan and zoom scan according KDB 865664 D01 as shown in Table *3*.
- The used extrapolation and interpolation routines are all based on the modified Quadratic Shepard´s method [DASY4].
- Repetition of the E-field measurement at the fixed location (P1) and repetition of the whole procedure if the two results differ by more than ± 0.21dB.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>≥ 3 GHz</th></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>≤ 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: ≤ 8 mm
2 - 3 GHz: ≤ 5 mm*</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">≤ 1.5· $\Delta Z_{Zoom}(n-1)$</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>

Table 3: Parameters for SAR scan procedures.

5 System Verification and Test Conditions

5.1 Date of Testing

Date of Testing					
Band		Frequency [MHz]	Date of System Check	Date of SAR Measurement
DECT UPCS / Ant 0	Head	1900	April 11, 2017	April 11, 2017
DECT UPCS / Ant 1		1900	April 11, 2017	April 12, 2017
IEEE 802.11 / WLAN 2.4 GHz		2450	April 26, 2017	April 26-27, 2017
IEEE 802.11 / WLAN 5 GHz		5250 / 5600 / 5750	April 27, 2017	April 27, 2017
DECT UPCS / Ant 0	Body	1900	March 23, 2017	March 23, 2017
DECT UPCS / Ant 1		1900	March 23, 2017	March 23, 2017
IEEE 802.11 / WLAN 2.4 GHz		2450	April 27, 2017	April 27, 2017
IEEE 802.11 / WLAN 5 GHz		5250 / 5600 / 5750	April 24, 2017	April 24, 2017

Table 4: Date of testing.

5.2 Environment Conditions

Environment Conditions		
Ambient Temperature[°C]	Liquid Temperature [°C]	Humidity [%]
22.0 ± 2	22.0 ± 2	40.0 ± 5
Notes: To comply with the required noise level (less than 12 mW/kg) periodically measurements without a DUT were conducted.		

Table 5: Environment Conditions.

5.3 Tissue Simulating Liquid Recipes

Tissue Simulating Liquid										
	Frequency Range [MHz]	Water [%]	Sugar [%]	Cellulose [%]	Salt [%]	Preventol [%]	DGBE [%]	Triton X/100 [%]	TWEEN 80 [%]	GERMABEN [%]
Head Tissue										
☐	300	37.1	56.1	0.9	5.8	0.2	-	-	-	-
☐	450	38.9	56.9	0.3	3.8	0.1	-	-	-	-
☐	835	40.3	57.9	0.2	1.4	0.2	-	-	-	-
☐	900	40.3	57.9	0.2	1.4	0.2	-	-	-	-
☐	1800	55.2	-	-	0.3	-	44.5	-	-	-
☒	1900	55.4	-	-	0.1	-	44.5	-	-	-
☒	2450	55.0	-	-	-	-	45.0	-	-	-
☐	2600	54.8	-	-	0.1	-	45.1	-	-	-
☒	5000 - 6000	65.5	-	-	-	-	17.2	17.25	-	-
Body Tissue										
☐	450	46.2	51.2	0.2	2.3	0.1	-	-	-	-
☐	835	52.4	45.0	1.0	1.5	0.1	-	-	-	-
☐	900	50.8	48.2	-	0.9	0.1	-	-	-	-
☐	1800	70.2	-	-	0.4	-	29.4	-	-	-
☒	1900	69.8	-	-	0.2	-	30.0	-	-	-
☒	2450	68.6	-	-	-	-	31.4	-	-	-
☐	2600	68.1	-	-	0.1	-	31.8	-	-	-
☒	5000 - 6000	79.7	-	-	-	-	-	-	20.0	0.3

Table 6: Recipes of the tissue simulating liquid.

5.4 Tissue Simulating Liquid Parameters

For the measurement of the following parameters the Speag DAK-3.5 dielectric probe kit is used, representing the open-ended coaxial probe measurement procedure.

Tissue Simulating Liquids Head									
Ambient Temperature(C) : 22.0 ± 2				Liquid Temperature(C) : 22.0 ± 2			Humidity(%) : 40.0 ± 5		
Band	**Date**	**Frequency**	**Channel**	**Permittivity**			**Conductivity**		
				Measured	**Target**	**Delta**	**Measured**	**Target**	**Delta**
		[MHz]		**ε'**	**ε'**	**+/- 5 [%]**	**σ [S/m]**	**σ [S/m]**	**+/- 5 [%]**
DECT	April 11, 2017	*1900.0*	*System Check*	*39.8*	*40.0*	*-0.5*	*1.38*	*1.40*	*-1.7*
		1921.536	4	39.8	40.0	-0.6	1.39	1.40	-0.5
		1924.992	2	39.8	40.0	-0.6	1.40	1.40	-0.1
		1928.448	0	39.7	40.0	-0.7	1.40	1.40	0.3
WLAN 2.4 GHz	April 26, 2017	*2450.0*	*System Check*	*38.4*	*39.2*	*-2.1*	*1.86*	*1.80*	*3.1*
		2412.0	1	38.5	39.3	-1.9	1.81	1.76	2.7
		2437.0	6	38.4	39.2	-2.1	1.84	1.79	3.0
		2462.0	11	38.3	39.2	-2.2	1.87	1.81	3.1
WLAN 5 GHz U-NII-1 U-NII-2A	April 27, 2017	*5250.0*	*System Check*	*34.9*	*35.9*	*-2.8*	*4.59*	*4.71*	*-2.6*
		5180.0	36	35.1	36.0	-2.6	4.50	4.63	-2.8
		5240.0	48	34.9	35.9	-2.8	4.57	4.70	-2.6
		5260.0	52	34.9	35.9	-2.8	4.59	4.72	-2.6
		5320.0	64	34.8	35.8	-3.1	4.66	4.78	-2.6
WLAN 5 GHz U-NII-2C	April 27, 2017	*5600.0*	*System Check*	*34.1*	*35.5*	*-4.1*	*4.98*	*5.07*	*-1.8*
		5500.0	100	34.3	35.6	-3.7	4.86	4.96	-2.1
		5580.0	116	34.1	35.6	-4.0	4.95	5.04	-1.8
		5640.0	128	34.0	35.5	-4.2	5.03	5.11	-1.5
WLAN 5 GHz U-NII-3	April 27, 2017	*5750.0*	*System Check*	*33.8*	*35.4*	*-4.5*	*5.16*	*5.22*	*-1.1*
		5745.0	149	33.8	35.4	-4.5	5.15	5.21	-1.2
Notes: Liquid depth is at least 15 cm for all frequency ranged measurements.									

Table 7: Parameters of the head tissue simulating liquid.

Tissue Simulating Liquids Body									
Ambient Temperature(C) : 22.0 ± 2				Liquid Temperature(C) : 22.0 ± 2			Humidity(%) : 40.0 ± 5		
Band	Date	Frequency	Channel	Permittivity			Conductivity		
				Measured	Target	Delta	Measured	Target	Delta
		[MHz]		ε'	ε'	+/- 5 [%]	σ [S/m]	σ [S/m]	+/- 5 [%]
DECT	March 23, 2017	*1900.0*	*System Check*	*51.3*	*53.3*	*-3.7*	*1.54*	*1.52*	*1.5*
		1921.536	4	51.3	53.3	-3.7	1.56	1.52	2.5
		1924.992	2	51.3	53.3	-3.8	1.56	1.52	2.8
		1928.448	0	51.3	53.3	-3.8	1.57	1.52	3.1
WLAN 2.4 GHz	April 27, 2017	*2450.0*	*System Check*	*51.9*	*52.7*	*-1.5*	*2.01*	*1.95*	*2.8*
		2412.0	1	52.0	52.8	-1.4	1.96	1.91	2.5
		2437.0	6	51.9	52.7	-1.5	1.99	1.94	2.7
		2462.0	11	51.9	52.7	-1.6	2.02	1.96	2.7
WLAN 5 GHz U-NII-1 U-NII-2A	April 24, 2017	*5250.0*	*System Check*	*48.9*	*48.9*	*-0.2*	*5.43*	*5.36*	*1.3*
		5180.0	36	49.0	49.0	0.0	5.32	5.28	0.9
		5240.0	48	48.9	49.0	-0.2	5.41	5.35	1.3
		5260.0	52	48.8	48.9	-0.2	5.44	5.37	1.3
		5320.0	64	48.7	48.9	-0.4	5.53	5.44	1.7
WLAN 5 GHz U-NII-2C	April 24, 2017	*5600.0*	*System Check*	*48.0*	*48.5*	*-1.0*	*5.96*	*5.77*	*3.3*
		5500.0	100	48.2	48.6	-0.8	5.80	5.65	2.7
		5580.0	116	48.0	48.5	-1.0	5.93	5.74	3.2
		5640.0	128	47.9	48.4	-1.1	6.02	5.81	3.6
WLAN 5 GHz U-NII-3	April 24, 2017	*5750.0*	*System Check*	*47.6*	*48.3*	*-1.3*	*6.20*	*5.94*	*4.3*
		5745.0	149	47.6	48.3	-1.4	6.19	5.94	4.3
Notes: Liquid depth is at least 15 cm for all frequency ranged measurements.									

Table 8: Parameters of the body tissue simulating liquid.

5.5 Simplified Performance Checking

The simplified performance check was realized using the dipole validation kit. The input power of the dipole antenna was 250 mW (CW) and it was placed under the flat part of the SAM phantom. The target and measured results are listed in the table 9 and shown in Appendix C - System Verification Plots. The target values were adopted from the calibration certificates found also in the appendix.

System Check Results									
Frequency [MHz]	Tissue	Dipole	Dipole SN	SAR_{1g} [W/kg]			SAR_{10g} [W/kg]		
				Measured	Target	Delta [%]	Measured	Target	Delta [%]
1900	Head	D1900V2	535	9.28	10.05	-7.66	5.03	5.25	-4.19
2450		D2450V2	709	14.3	13.18	8.50	6.59	6.15	7.15
5250		D5GHzV2	1028	20.4	20.45	-0.24	5.78	5.85	-1.20
5600		D5GHzV2	1028	21.4	20.88	2.49	6.05	5.93	2.02
5750		D5GHzV2	1028	20.4	20.33	0.34	5.78	5.78	0.00
1900	Body	D1900V2	535	9.34	9.93	-5.94	5.04	5.3	-4.91
2450		D2450V2	709	14.0	13.08	7.03	6.51	6.18	5.34
5250		D5GHzV2	1028	18.4	19.43	-5.30	5.11	5.45	-6.24
5600		D5GHzV2	1028	18.9	20.6	-8.25	5.23	5.7	-8.25
5750		D5GHzV2	1028	17.8	19.38	-8.15	5.01	5.38	-6.88

Table 9: Dipole target and measured results.

6 SAR Measurement Conditions and Results

6.1 Test Conditions

Test Conditions					
Band	**TX Range [MHz]**	**RX Range [MHz]**	**Used Channels**	**Crest Factor**	**Phantom**
DECT UPCS	1921.536 - 1928.448	1921.536 - 1928.448	04, 02, 00	24	SAM Twin Phantom V4.0
WLAN 2.4 GHz	2412.0 – 2462.0	2412.0 – 2462.0	1, 6, 11	1*	
WLAN 5 GHz U-NII-1 / U-NII-2A	5180.0 – 5320.0	5180.0 – 5320.0	36, 48, 52, 64	1*	
WLAN 5 GHz U-NII-2C	5500.0 – 5700.0	5500.0 – 5700.0	100, 116, 128	1*	
WLAN 5 GHz U-NII-3	5750.0 – 5825.0	5750.0 – 5825.0	149	1*	
Notes: * WiFi testing has been performed with configuration of100% continues wave with engineering test mode.					

Table 10: Used channels and crest factors during the test.

6.2 Tune-Up Information

Tune-Up Information			
Band	**CH / Mode**	**Frequency [MHz]**	**Max. Tune-Up Tolerance Limit [dBm]**
DECT UPCS	CH 04	1921.536	20.8
	CH 02	1924.992	20.8
	CH 00	1928.448	20.8

Table 11: Maximum transmitting output power values declared by the manufacturer for DECT.

Tune-Up Information			
Band	**CH / Mode**	**Frequency [MHz]**	**Max. Tune-Up Tolerance Limit [dBm]**
WLAN 2.4 GHz	b-mode	2412 – 2462	18.0
	g-mode		17.0
	n-mode HT20		17.0
WLAN 5 GHz U-NII-1 U-NII-2A	a-mode	5180 – 5320	17.0
	n-mode HT20		17.0
WLAN 5 GHz U-NII-2C	a-mode	5500 - 5700	17.0
	n-mode HT20		17.0
WLAN 5 GHz U-NII-3	a-mode	5745 - 5825	16.0
	n-mode HT20		16.0

Table 12: Maximum transmitting output power values declared by the manufacturer for WLAN.

6.3 Measured Output Power

6.3.1 DECT UPCS Output Power

Max. Averaged Output Power [dBm]			
Mode	**Frequency [MHz]**	**CH**	**Measured Output Power**
DECT UPCS Ant. 0 / Ant. 1	1921.536	04	19.1
	1924.992	02	18.8
	1928.448	00	19.0
Notes: According to the manufacturer both antennas are transmitting with same power output values.			

Table 13: Conducted output power values for DECT UPCS.

6.3.2 WLAN 2.4 GHz Output Power

Measurements for IEEE 802.11 b/g/n has been performed with test software settings with power level supported by the device and provided by the manufacturer.

Max. Averaged Output Power (RMS) [dBm]										
Mode	**Frequency [MHz]**	**CH**	**Data Rate [Mbit/s]**							
			1		**2**		**5.5**		**11**	
2.4 GHz Range										
b	2412	1	16.4		16.3		16.4		16.3	
	2437	6	16.1		-		-		-	
	2462	11	16.0		-		-		-	
Mode	**Frequency [MHz]**	**CH**	**Data Rate [Mbit/s]**							
			6.0	**9**	**12**	**18**	**24**	**36**	**48**	**54**
g	2412	1	15.8	15.7	15.7	15.7	15.7	15.7	15.7	15.6
	2437	6	15.5	-	-	-	-	-	-	-
	2462	11	15.5	-	-	-	-	-	-	-
Mode	**Frequency [MHz]**	**CH**	**MCS Index No.**							
			MCS0	**MCS1**	**MCS2**	**MCS3**	**MCS4**	**MCS5**	**MCS6**	**MCS7**
n HT20	2412	1	15.8	15.7	15.7	15.7	15.7	15.7	15.7	15.7
	2437	6	15.5	-	-	-	-	-	-	-
	2462	11	15.5	-	-	-	-	-	-	-
Notes: SAR measurement have been performed on channel 1, 6 and 11, representing the worst case scenarios with the highest output power being at channel 1, but the end product will be with reduced power output on channel 1 and 11 in order to fulfill band edge requirements.										

Table 14: Conducted output power values for IEEE 802.11 b/g/n.

6.3.3 WLAN 5 GHz Output Power

Measurements for IEEE 802.11 a/n have been performed with test software settings with power level supported by the device and provided by the manufacturer. According to the manufacturer the device is supporting only 20 MHz bandwidth for all bands.

Max. Averaged Output Power (RMS) [dBm]										
Mode	Frequency [MHz]	Data Rate [Mbit/s]								
		CH	6.0	9	12	18	24	36	48	54
5.2 - 5.3 GHz Range										
a U-NII-1	5180	36	16.1	16.0	16.0	16.0	16.0	16.0	16.0	16.0
	5200	40	15.8	-	-	-	-	-	-	-
	5220	44	15.9	-	-	-	-	-	-	-
	5240	48	15.7	-	-	-	-	-	-	-
a U-NII-2A	5260	52	15.6	15.5	15.5	15.5	15.5	15.5	15.5	15.5
	5280	56	15.6	-	-	-	-	-	-	-
	5300	60	15.6	-	-	-	-	-	-	-
	5320	64	15.5	-	-	-	-	-	-	-
5.5 - 5.8 GHz Range										
a U-NII-2C	5500	100	15.2	15.1	15.0	15.0	15.0	15.0	15.0	15.0
	5560	112	14.5	-	-	-	-	-	-	-
	5580	116	15.0	-	-	-	-	-	-	-
	5640	128	15.0	-	-	-	-	-	-	-
	5660	132	15.1	-	-	-	-	-	-	-
a U-NIII-3	5745	149	15.7	15.6	15.6	15.6	15.6	15.6	15.6	15.6
	5825	165	15.6	-	-	-	-	-	-	-

Table 15: Conducted output power values for IEEE 802.11 a - 5 GHz.

Max. Averaged Output Power (RMS) [dBm]										
Mode	Frequency [MHz]	CH	Data Rate [Mbit/s]							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
5.2 - 5.3 GHz Range										
n - HT20 U-NII-1	5180	36	16.0	15.9	15.9	15.9	15.9	15.9	15.9	15.9
	5200	40	15.9	-	-	-	-	-	-	-
	5220	44	15.7	-	-	-	-	-	-	-
	5240	48	15.6	-	-	-	-	-	-	-
n - HT20 U-NII-2A	5260	52	15.6	15.5	15.5	15.5	15.5	15.5	15.5	15.5
	5280	56	15.6	-	-	-	-	-	-	-
	5300	60	15.6	-	-	-	-	-	-	-
	5320	64	15.5	-	-	-	-	-	-	-
5.5 - 5.8 GHz Range										
n - HT20 U-NII-2C	5500	100	15.2	15.1	15.0	15.0	15.0	15.0	15.0	15.0
	5560	112	14.3	-	-	-	-	-	-	-
	5580	116	15.0	-	-	-	-	-	-	-
	5640	128	15.0	-	-	-	-	-	-	-
	5660	132	15.1	-	-	-	-	-	-	-
n - HT20 U-NII-3	5745	149	15.7	15.6	15.6	15.6	15.6	15.6	15.6	15.6
	5825	165	15.6	-	-	-	-	-	-	-

Table 16: Conducted output power values for IEEE 802.11 n - 5 GHz.

6.4 Standalone SAR Test Exclusion

SAR test exclusion is determined for the EUT according to KDB 447498 D01v05 with 1g SAR exclusion thresholds for 100 MHz to 6GHz at test separation distances ≤ 50 mm determined by:

*[(max power of channel. incl. tune-up tolerance. mW) / (min test separation distance. mm)] * [√f(GHz)]*

≤ 3.0 for 1g SAR and ≤ 7.5 for 10g extremity SAR, where

• f(GHz) is the RF channel transmit frequency in GHz
• Power and distance are rounded to the nearest mW and mm before calculation
• The result is rounded to one decimal place for comparison

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Standalone SAR Test Exclusion								
Mode	**Frequency [MHz]**	**Distance [mm]**	**Pavg [dBm]**	**Pavg [mW]**	**Calculated Values**	**Exclusion Threshold SAR 1g**	**Testing Exclusion**	**Testing Required**
DECT	1900	5	20.8	120.23	33.1	≤ 3.0	NO	YES
WLAN	2450	5	18.0	63.10	19.8	≤ 3.0	NO	YES
	5250	5	17.0	50.12	23.0	≤ 3.0	NO	YES
	5600	5	17.0	50.12	23.7	≤ 3.0	NO	YES
	5750	5	16.0	39.81	19.1	≤ 3.0	NO	YES

Table 17: Standalone SAR test exclusion for the applicable transmitter.

When the standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas the standalone SAR must be estimated according to KDB 447498 in order to determine simultaneous transmission SAR test exclusion:

- *(max. power of channel. including tune-up tolerance. mW)/(min. test separation distance. mm)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm;*

  where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

- *0.4 W/kg for 1g SAR and 1.0 W/kg for 10g SAR. when the test separation distance is > 50 mm*

6.5 SAR Results

The tables below contain the measured SAR values averaged over a mass of 1g. SAR assessment was conducted in the worst case configuration with output power values according to Table 11 - 16. According KDB 447498 D01 V05, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.

- Scaling Factor = tune-up limit power (mW) / RF power (mW)
- Reported SAR = measured SAR * scaling factor

Furthermore, testing of other required channels within the operating mode of frequency band is not required when the reported SAR for the mid-band or highest output power channel is ≤ 0.4 W/kg for transmission band ≥ 200 MHz.

SAR Measurement Results in Head Configurations												
Band	Freq. [MHz]	CH	Position of EUT		Pic. No.	Measured SAR1g [W/kg]	Power Drift [dB]	Output Power [dBm]		Scaling Factor	Reported SAR1g [W/kg]	Plot No.
								Measured	Limit			
DECT Ant. 0	1921.992	2	Left	Cheek	3	0.004	-0.081	18.8	20.8	1.585	0.006	-
	1921.992	2	Left	Tilted	4	0.003	-0.127	18.8	20.8	1.585	0.005	-
	1921.992	2	Right	Cheek	5	0.003	0.190	18.8	20.8	1.585	0.005	-
	1921.992	2	Right	Tilted	6	0.004	0.156	18.8	20.8	1.585	0.006	1
DECT Ant. 1	1921.992	2	Left	Cheek	3	0.016	-0.090	18.8	20.8	1.585	0.025	-
	1921.992	2	Left	Tilted	4	0.005	-0.087	18.8	20.8	1.585	0.008	-
	1921.992	2	Right	Cheek	5	0.011	-0.014	18.8	20.8	1.585	0.017	-
	1921.992	2	Right	Tilted	6	0.006	-0.188	18.8	20.8	1.585	0.010	-
	1921.536	4	Left	Cheek	3	0.015	0.118	19.1	20.8	1.479	0.022	-
	1928.448	0	Left	Cheek	3	0.019	-0.001	19.0	20.8	1.514	0.029	2
IEEE 802.11 b 2.4 GHz	2412	1	Left	Cheek	3	0.099	0.114	16.4	18.0	1.445	0.143	3
	2412	1	Left	Tilted	4	0.050	0.190	16.4	18.0	1.445	0.072	-
	2412	1	Right	Cheek	5	0.076	-0.002	16.4	18.0	1.445	0.110	-
	2412	1	Right	Tilted	6	0.065	-0.002	16.4	18.0	1.445	0.094	-
	2437	6	Left	Cheek	3	0.086	0.191	16.1	18.0	1.549	0.133	-
	2462	11	Left	Cheek	3	0.086	0.015	16.0	18.0	1.585	0.136	-
IEEE 802.11 a U-NII-1 U-NII-2A	5180	36	Left	Cheek	3	0.192	-0.006	16.1	17.0	1.230	0.236	-
	5180	36	Left	Tilted	4	0.106	-0.161	16.1	17.0	1.230	0.130	-
	5180	36	Right	Cheek	5	0.199	-0.127	16.1	17.0	1.230	0.245	-
	5180	36	Right	Tilted	6	0.166	-0.103	16.1	17.0	1.230	0.204	-
	5240	48	Right	Cheek	5	0.229	0.171	15.7	17.0	1.349	0.309	4
	5260	52	Right	Cheek	5	0.218	0.139	15.6	17.0	1.380	0.301	-
	5320	64	Right	Cheek	5	0.215	-0.195	15.5	17.0	1.413	0.304	-
IEEE 802.11 a U-NII-2C U-NII-3	5500	100	Right	Cheek	5	0.214	-0.184	15.2	17.0	1.514	0.324	5
	5580	116	Right	Cheek	5	0.186	-0.115	15.0	17.0	1.585	0.295	-
	5640	128	Right	Cheek	5	0.176	-0.200	15.0	17.0	1.585	0.279	-
	5745	149	Right	Cheek	5	0.144	0.141	15.7	16.0	1.072	0.154	-
Notes: SAR measurement have been performed on channel 1, 6 and 11, representing the worst case scenarios with the highest output power being at channel 1, but the end product will be with reduced power output on channel 1 and 11 in order to fulfill band edge requirements.												

Table 18: SAR measurement results in head configuration.

SAR Measurement Results in Body Worn Configurations												
Band	**Freq. [MHz]**	**CH**	**Edge of EUT**	**Gap [mm]**	**Pic. No.**	**Measured SAR1g [W/kg]**	**Power Drift [dB]**	**Output Power [dBm]**		**Scaling Factor**	**Reported SAR1g [W/kg]**	**Plot No.**
								Measured	**Limit**			
DECT Ant.0	1921.992	2	front	0	7	0.004	0.118	18.8	20.8	1.585	0.006	-
	1921.992	2	back	0	8	0.012	-0.188	18.8	20.8	1.585	0.019	6
	1921.536	4	back	0	8	0.012	0.115	19.1	20.8	1.479	0.018	-
	1928.448	0	back	0	8	0.011	-0.076	19.0	20.8	1.514	0.017	-
DECT Ant.1	1921.992	2	front	0	7	0.042	0.037	18.8	20.8	1.585	0.067	-
	1921.992	2	back	0	8	0.058	0.192	18.8	20.8	1.585	0.092	7
	1921.536	4	back	0	8	0.056	0.154	19.1	20.8	1.479	0.083	-
	1928.448	0	back	0	8	0.053	0.185	19.0	20.8	1.514	0.080	-
IEEE 802.11 b 2.4 GHz	2412	1	front	0	7	0.131	0.024	16.4	18	1.445	0.131	-
	2412	1	back	0	8	0.132	0.194	16.4	18	1.445	0.191	-
	2437	6	front	0	7	0.104	-0.157	16.1	18	1.549	0.161	-
	2462	11	front	0	7	0.124	0.028	16.0	18	1.585	0.197	8
IEEE 802.11 a U-NII-1 U-NII-2A	5180	36	front	0	7	0.302	0.108	16.1	17.0	1.230	0.372	9
	5180	36	back	0	8	0.143	-0.186	16.1	17.0	1.230	0.176	-
	5240	48	front	0	7	0.246	0.103	15.7	17.0	1.349	0.332	-
	5260	52	front	0	7	0.247	0.184	15.6	17.0	1.380	0.341	-
	5260	52	back	0	8	0.137	-0.090	15.6	17.0	1.380	0.189	-
	5320	64	front	0	7	0.258	-0.119	15.5	17.0	1.413	0.364	-
IEEE 802.11 a U-NII-2C U-NII-3	5500	100	front	0	7	0.303	0.005	15.2	17.0	1.514	0.459	-
	5580	116	front	0	7	0.322	0.078	15.0	17.0	1.585	0.510	-
	5640	128	front	0	7	0.327	0.171	15.0	17.0	1.585	0.518	10
	5745	149	front	0	7	0.245	-0.041	15.7	16.0	1.072	0.263	-
Notes: SAR measurement have been performed on channel 1, 6 and 11, representing the worst case scenarios with the highest output power being at channel 1, but the end product will be with reduced power output on channel 1 and 11 in order to fulfill band edge requirements.												

Table 19: SAR measurement results in body worn configuration.

To control the output power stability during the SAR test the used 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 the above tables labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

7 Simultaneous Transmission Consideration

According to KDB 447498, the following table gives an overview about the ∑SAR for simultaneous transmitting modes. When ∑SAR > 1.6 W/kg a SAR test exclusion is determined by the SAR to peak location separation ratio.

The ratio is determined by $(SAR1 + SAR2)^{1.5}/Ri$ rounded to two decimal digits and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. Where Ri is the separation distance between the peak SAR locations for the antenna pair in mm. When SAR is measured for both antennas in a pair the peak location separation distance is computed by the square root of $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$ where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the area scans or extrapolated peak SAR locations in the zoom scans as appropriate.

Simultaneous Transmission Scenario in Head Configuration [W/kg]								
Exposure Position	**Highest Reported SAR_{1g} Values**						**Σ SAR_{1g}**	
	DECT Ant.0	**DECT Ant.1**	**WLAN 2.4 GHz**	**WLAN 5.2 GHz**	**WLAN 5.6 GHz**	**WLAN 5.8 GHz**		
Left Cheek	0.006		0.143				0.149	PASS
Left Tilted	0.005		0.072				0.077	PASS
Right Cheek	0.005		0.110				0.115	PASS
Right Tilted	0.006		0.094				0.100	PASS
Left Cheek	0.006			0.236			0.242	PASS
Left Tilted	0.005			0.130			0.135	PASS
Right Cheek	0.005			0.309			0.314	PASS
Right Tilted	0.006			0.204			0.210	PASS
Left Cheek	0.006				-		0.006	PASS
Left Tilted	0.005				-		0.005	PASS
Right Cheek	0.005				0.324		0.329	PASS
Right Tilted	0.006				-		0.006	PASS
Left Cheek	0.006					-	0.006	PASS
Left Tilted	0.005					-	0.005	PASS
Right Cheek	0.005					0.154	0.159	PASS
Right Tilted	0.006					-	0.006	PASS
Note: -								

Table 20: Simultaneous transmission consideration for DECT (Ant 0) and WLAN transmissions in head configurations.

Simultaneous Transmission Scenario in Head Configuration [W/kg]								
Exposure Position	Highest Reported SAR_{1g} Values						Σ SAR_{1g}	
	DECT Ant.0	DECT Ant.1	WLAN 2.4 GHz	WLAN 5.2 GHz	WLAN 5.6 GHz	WLAN 5.8 GHz		
Left Cheek		0.029	0.143				0.172	PASS
Left Tilted		0.008	0.072				0.080	PASS
Right Cheek		0.017	0.110				0.127	PASS
Right Tilted		0.010	0.094				0.104	PASS
Left Cheek		0.029		0.236			0.265	PASS
Left Tilted		0.008		0.130			0.138	PASS
Right Cheek		0.017		0.309			0.326	PASS
Right Tilted		0.010		0.204			0.214	PASS
Left Cheek		0.029			-		0.029	PASS
Left Tilted		0.008			-		0.008	PASS
Right Cheek		0.017			0.324		0.341	PASS
Right Tilted		0.010			-		0.010	PASS
Left Cheek		0.029				-	0.029	PASS
Left Tilted		0.008				-	0.008	PASS
Right Cheek		0.017				0.154	0.171	PASS
Right Tilted		0.010				-	0.010	PASS
Note: For the calculation of the simultaneous transmission consideration at the different edges with the worst case results have been taken.								

Table 21: Simultaneous transmission consideration for DECT (Ant 1) and WLAN transmissions in head configurations.

Simultaneous Transmission Scenario in Body Worn Configuration [W/kg]								
Exposure Position	Highest Reported SAR_{1g} Values						Σ SAR_{1g}	
	DECT Ant.0	DECT Ant.1	WLAN 2.4 GHz	WLAN 5.2 GHz	WLAN 5.6 GHz	WLAN 5.8 GHz		
Front	0.006		0.197				0.203	PASS
Back	0.019		0.191				0.210	PASS
Front	0.006			0.372			0.378	PASS
Back	0.019			0.189			0.208	PASS
Front	0.006				0.518		0.524	PASS
Back	0.019				-		0.019	PASS
Front	0.006					0.263	0.269	PASS
Back	0.019					-	0.019	PASS
Front		0.067	0.197				0.264	PASS
Back		0.092	0.191				0.283	PASS
Front		0.067		0.372			0.439	PASS
Back		0.092		0.189			0.281	PASS
Front		0.067			0.518		0.585	PASS
Back		0.092			-		0.092	PASS
Front		0.067				0.263	0.330	PASS
Back		0.092				-	0.092	PASS
Note: -								

Table 22: Simultaneous transmission consideration for DECT and WLAN transmissions in body worn configuration.

8 Administrative Measurement Data

8.1 Calibration of Test Equipment

Test Equipment Overview						
	Test Equipment	Manufacturer	Model	Serial Number	Last Calibration	Next Calibration
DASY System Components						
☒	Software Versions DASY4	SPEAG	V4.7	N/A	N/A	N/A
☒	Software Versions SEMCAD	SPEAG	V1.8	N/A	N/A	N/A
☐	Dosimetric E-Field Probe	SPEAG	ET3DV6R	1579	02/2016	02/2018
☒	Dosimetric E-Field Probe	SPEAG	ET3DV6R	1669	02/2017	02/2018
☒	Dosimetric E-Field Probe	SPEAG	EX3DV4	3536	09/2016	09/2017
☐	Dosimetric E-Field Probe	SPEAG	EX3DV4	3860	09/2015	09/2017
☒	Data Acquisition Electronics	SPEAG	DAE 3	335	02/2017	02/2018
☒	Data Acquisition Electronics	SPEAG	DAE 4	631	09/2016	09/2017
☒	Phantom	SPEAG	SAM	1059	N/A	N/A
☒	Phantom	SPEAG	SAM	1176	N/A	N/A
☒	Phantom	SPEAG	SAM	1340	N/A	N/A
☐	Phantom	SPEAG	SAM	1341	N/A	N/A
☐	Phantom	SPEAG	ELI4	1004	N/A	N/A
Dipoles						
☐	System Validation Dipole	SPEAG	D450V2	1014	03/2015	03/2018
☐	System Validation Dipole	SPEAG	D835V2	470	03/2015	03/2018
☐	System Validation Dipole	SPEAG	D900V2	006	11/2015	11/2018
☐	System Validation Dipole	SPEAG	D1640V2	311	09/2015	09/2018
☐	System Validation Dipole	SPEAG	D1750V2	1005	03/2015	03/2018
☒	System Validation Dipole	SPEAG	D1900V2	535	03/2015	03/2018
☒	System Validation Dipole	SPEAG	D2450V2	709	11/2015	11/2018
☐	System Validation Dipole	SPEAG	D2600V2	1019	11/2015	11/2018
☒	System Validation Dipole	SPEAG	D5GHzV2	1028	06/2014	06/2017
Material Measurement						
☒	Network Analyzer	Agilent	E5071C	MY46103220	07/2015	07/2017
☒	Dielectric Probe Kit	SPEAG	DAK-3.5	1234	01/2016	01/2018
☒	Thermometer	LKMelectronic	DTM3000	3511	01/2016	01/2018
Power Meters and Sensors						
☐	Power Meter	Agilent	E4416A	GB41050414	02/2015	02/2017
☐	Power Sensor	Agilent	E9301H	US40010212	03/2015	03/2017
☐	Power Meter	Agilent	E4417A	GB41050441	02/2015	02/2017
☐	Power Sensor	Agilent	E9301A	MY41495584	03/2015	03/2017
☒	Power Meter	Anritsu	ML2488A	6K00002319	06/2016	06/2018
☒	Power Sensor	Anritsu	MA2490A	6K00002078	06/2016	06/2018
☒	Power Sensor	Anritsu	ML2472A	002122	06/2016	06/2018
☒	Power Meter	Anritsu	MA2472A	990365	06/2016	06/2018
RF Sources						
☒	Network Analyzer	Agilent	E5071C	MY46103220	07/2015	07/2017
☒	RF Generator	Rohde & Schwarz	SM300	100142	N/A	N/A
Amplifiers						
☒	Amplifier 10 MHz – 4200 MHz	Mini Circuits	ZHL-42-42W	D080504-1	N/A	N/A
☒	Amplifier 2 GHz – 6 GHz	Ciao Wireless	CA26-451	37452	N/A	N/A
Radio Tester						
☐	Radio Communication Tester	Anritsu	MT8815B	6200576536	04/2016	04/2018
☐	Radio Communication Tester	Anritsu	MT8820C	6200918336	04/2016	04/2018
Notes: Used test equipment for measurement is checked above.						

Table 23: Calibration of test equipment.

8.2 Uncertainty Assessment

Uncertainty Budget for SAR Measurements according to IEEE 1528-2013
(300 MHz - 6 GHz)

Error Sources	Uncertainty Value [± %]	Probability Distribution	Divisor	ci	ci	Standard Uncertainty [± %]		vi² or veff
Measurement System				1g	10g	1g	10g	
Probe calibration	6.7	Normal	1	1	1	6.7	6.7	∞
Axial isotropy	0.3	Rectangular	√3	√0.5	√0.5	0.1	0.1	∞
Hemispherical isotropy	1.3	Rectangular	√3	√0.5	√0.5	0.5	0.5	∞
Boundary effects	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Linearity	0.3	Rectangular	√3	1	1	0.2	0.2	∞
System detection limit	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Modulation response	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Readout electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.8	Rectangular	√3	1	1	0.5	0.5	∞
Integration time	1.4	Rectangular	√3	1	1	0.8	0.8	∞
RF ambient conditions - noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF ambient conditions - refl.	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe positioner mech. tol.	0.4	Rectangular	√3	1	1	0.2	0.2	∞
Probe positioning	2.9	Rectangular	√3	1	1	1.7	1.7	∞
Algorithms for max SAR eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Test Sample Related								
Test sample positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device holder uncertainty	3.6	Normal	1	1	1	3.6	3.6	5
SAR drift measurement (< 0.2 dB)	4.7	Rectangular	√3	1	1	2.7	2.7	∞
SAR scaling	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Phantom and Set-up								
Phantom uncertainty	4.0	Rectangular	√3	1	1	2.3	2.3	∞
SAR correction for perm./cond.	1.9	Normal	1	1	0.84	1.9	1.6	∞
Liquid conductivity (meas.)	1.5	Normal	1	0.78	0.71	1.2	1.1	∞
Liquid permittivity (meas.)	1.2	Normal	1	0.23	0.26	0.3	0.3	∞
Liquid conductivity temp. unc.	2.9	Rectangular	√3	0.78	0.71	1.3	1.2	∞
Liquid permittivity temp. unc.	1.8	Rectangular	√3	0.23	0.26	0.2	0.3	∞
Combined Standard Uncertainty						10.4	10.3	
Coverage Factor for 95%						kp=2		
Expanded Standard Uncertainty						**20.8**	**20.7**	
Notes: *Worst case probe calibration uncertainty has been applied for all available probes and frequencies.*								

Table 24: Uncertainty budget for SAR measurements.

Uncertainty Budget for SAR System Validation according to IEEE 1528-2013 (300 MHz - 6 GHz)								
Error Sources	**Uncertainty Value [± %]**	**Probability Distribution**	**Divisor**	**ci**	**ci**	**Standard Uncertainty [± %]**		**vi² or veff**
Measurement System				1g	10g	1g	10g	
Probe calibration	6.7	Normal	1	1	1	6.7	6.7	∞
Axial isotropy	0.3	Rectangular	√3	1	1	0.1	0.1	∞
Hemispherical isotropy	1.3	Rectangular	√3	0	0	0.0	0.0	∞
Boundary effects	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Linearity	0.3	Rectangular	√3	1	1	0.2	0.2	∞
System detection limit	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Modulation response	0.0	Rectangular	√3	0	0	0.0	0.0	∞
Readout electronics	0.3	Normal	1	1	1	0.3	0.3	∞
Response time	0.0	Rectangular	√3	0	0	0.0	0.0	∞
Integration time	0.0	Rectangular	√3	0	0	0.0	0.0	∞
RF ambient conditions - noise	1.0	Rectangular	√3	1	1	0.6	0.6	∞
RF ambient conditions - refl.	1.0	Rectangular	√3	1	1	0.6	0.6	∞
Probe positioner mech. tol.	0.4	Rectangular	√3	1	1	0.2	0.2	∞
Probe positioning	2.9	Rectangular	√3	1	1	1.7	1.7	∞
Algorithms for max SAR eval.	4.0	Rectangular	√3	1	1	2.3	2.3	∞
Validation Dipole								
Dev. of exp. dipole from num.	5.0	Normal	1	1	1	5.0	5.0	∞
Input power and SAR drift (< 0.2 dB)	4.7	Rectangular	√3	1	1	2.7	2.7	∞
Dipole axis to liquid distance (< 2deg)	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Phantom and Set-up								
Phantom uncertainty	4.0	Rectangular	√3	1	1	2.3	2.3	∞
SAR correction for perm./cond.	1.9	Normal	1	1	0.84	1.9	1.6	∞
Liquid conductivity (meas.)	1.5	Normal	1	0.78	0.71	1.2	1.1	∞
Liquid permittivity (meas.)	1.2	Normal	1	0.23	0.26	0.3	0.3	∞
Liquid conductivity temp. unc.	2.9	Rectangular	√3	0.78	0.71	1.3	1.2	∞
Liquid permittivity temp. unc.	1.8	Rectangular	√3	0.23	0.26	0.2	0.3	∞
Combined Standard Uncertainty						10.0	10.0	
Coverage Factor for 95%						kp=2		
Expanded Standard Uncertainty						**20.0**	**19.9**	
Notes: *Worst case probe calibration uncertainty has been applied for all available probes and frequencies.*								

Table 25: Uncertainty budget for SAR system validation.

9 Report History

Revision History				
Revision	**Description of Revision**	**Date**	**Revised Page**	**Revised By**
/	Initial Release	May 5, 2017	-	-
1	Corrected FCC IC and IC number	May 12, 2017	1, 34	dpa
2	Typo corrected	May 30, 2017	19	dpa
2	Additional information provided reg. liquid depths	May 30, 2017	18,19	dpa
2	Additional information provided reg. WiFi duty cycle	May 30, 2017	21	dpa
2	Additional information provided reg. WiFi 2,4 GHz power output	May 30, 2017	22,26,27	dpa

END OF THE SAR REPORT

Please refer to separated appendix file for the following data:

- Appendix A - Pictures
- Appendix B - SAR Distribution Plots
- Appendix C - System Verification Plots
- Appendix D – Certificates of Conformity
- Appendix E – Calibration Certificates for DAEs
- Appendix F – Calibration Certificates for E-Field Probes
- Appendix G – Calibration Certificates for Dipoles