SAR Evaluation Report

EUT Information	
Manufacturer	Panasonic
Brand Name	KX-TGEA60
FCC ID	ACJ96NKX-TGEA60
EUT Type	portable device / DECT phone
Prepared by	
Testing Laboratory	IMST GmbH, Test Center Carl-Friedrich-Gauß-Str. 2 – 4 47475 Kamp-Lintfort Germany
Laboratory Accreditation	DAkkS Deutsche Akkreditierungsstelle D-PL-12139-01-00 The Test Center 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. Bundesnetzagentur BNetzA-CAB-16/21-14 The German Bundesnetzagentur (BNetzA) recognizes IMST GmbH as CAB-EMC on the basis of the Council Decision of 22. June 1998 concerning the conclusion of the MRA between the European Community and the United States of America (1999/178/EC) in accordance with § 4 of the Recognition Ordinance of 11. January 2016. The recognition is valid until 20. July 2021 under the registration number: BNetzA-CAB-16/21-14.
Prepared for	
Applicant	Panasonic Corporation 1-62, 4-chome, Minoshima, Hakata-ku Fukuoka 812-8531 Japan
Test Specification	
Applied Rules/Standards	IEEE 1528-2013; FCC CFR 47 § 2.1093
Exposure Category	☒ general public / uncontrolled exposure ☐ occupational / controlled exposure
Report Information	
Data Stored	60320_6171713_KX-TGEA60
Issue Date	November 26, 2017
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Revision Number	1
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.

Table of Contents

1 Subject of Investigation and Test Results

1.1 Technical Data of EUT

Product Specifications	
Model Name	KX-TGEA60
IMEI / SN	IMST_No_01
Operation Mode	DECT UPCS (TDD)
Frequency Range	1921.536 – 1928.448
Modulation	GFSK
Max Duty Cycle	4.17 % (CF 1/24)
Usage Configuration	head and body worn
Antenna Type	integrated pattern (1x DECT)
Max. Output Power	refer chapter 6.3
Power Supply	internal battery DC 2.4V (2 x 1.2V Ni-MH Battery cell)
Used Accessory	belt clip, headset (RP-TCA430)
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
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

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	1924.992	2	Head	Left Cheek	0	3	0.021	1.6	PASS
	1921.536	4	Body	Front	0	7	0.015	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 6.4 on page 18.

Prepared by: ....

Dessislava Patrishkova
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Reviewed by: ....

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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:

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

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.

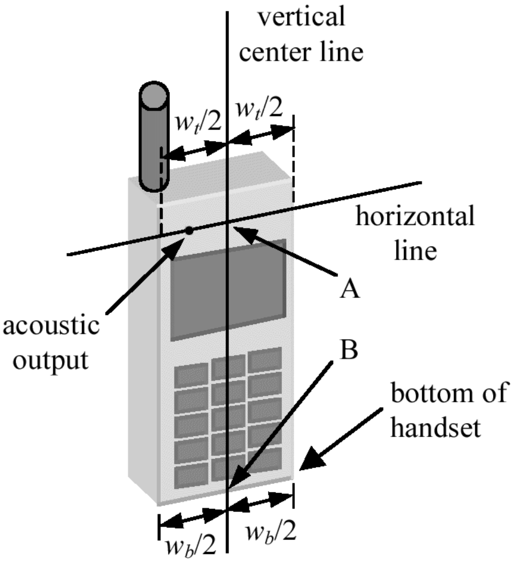

Fig. 2: Geometrical definitions on the telephone (bar phone).

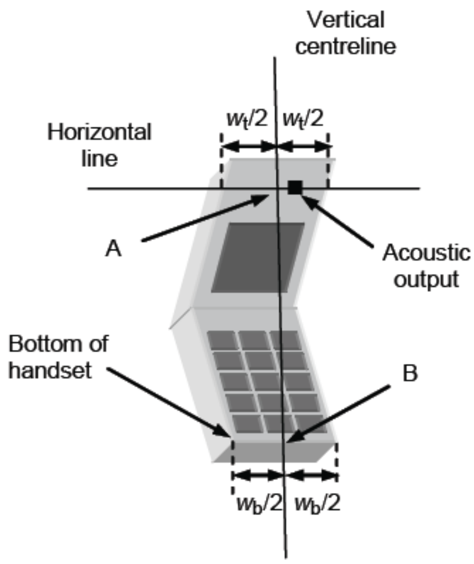

Fig. 3: Geometrical definitions on the telephone (clam shell or flip).

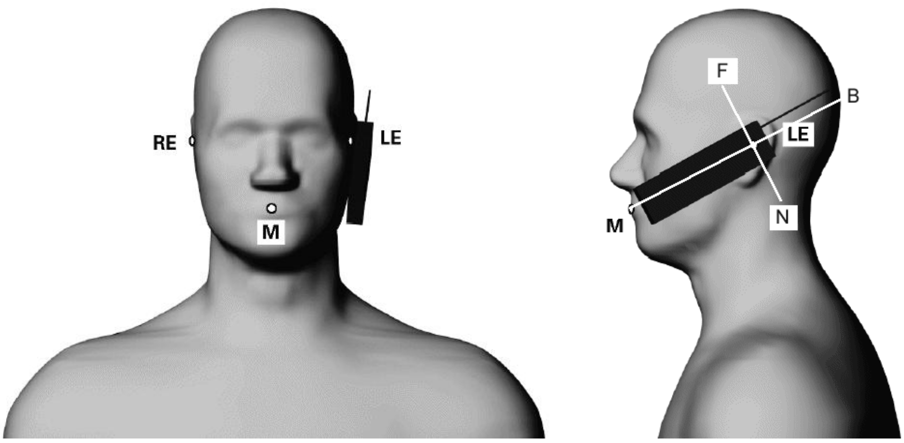

Fig. 4: Phantom reference points.

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.

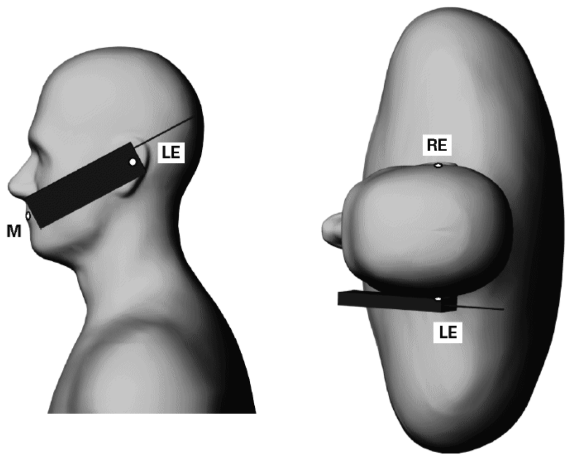

Fig. 5: The cheek position.

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

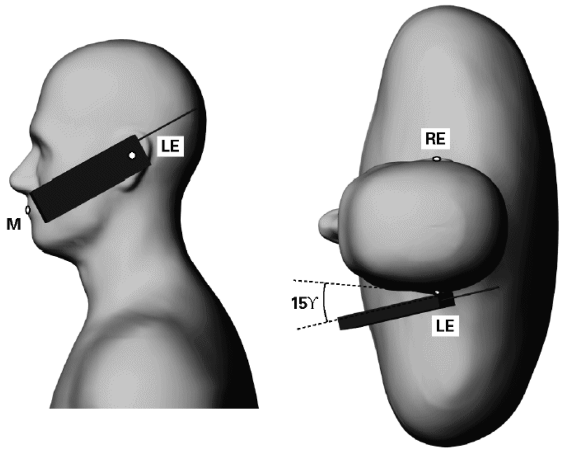

Fig. 6: The tilted position.

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 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

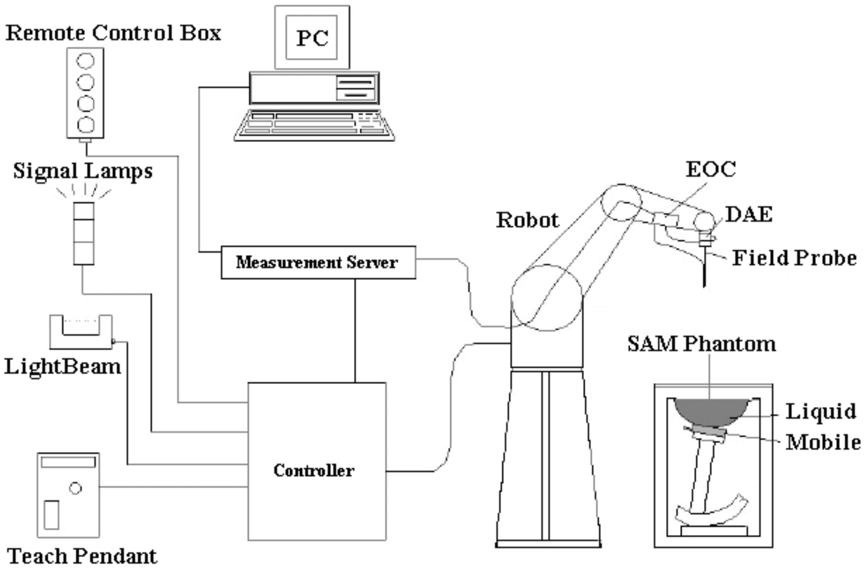

Fig. 7: The DASY4 measurement system.

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	Head	1900	November 07, 2017	November 07, 2017
	Body	1900	November 09, 2017	November 09, 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	Nov. 07, 2017	*1900.0*	*System Check*	*38.9*	*40.0*	*-2.6*	*1.41*	*1.40*	*0.9*
		1921.536	4	38.9	40.0	-2.8	1.43	1.40	2.1
		1924.992	2	38.9	40.0	-2.8	1.43	1.40	2.4
		1928.448	0	38.9	40.0	-2.9	1.44	1.40	2.7
Notes: -									

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	Nov. 09, 2017	*1900.0*	*System Check*	*51.5*	*53.3*	*-3.3*	*1.54*	*1.52*	*1.4*
		1921.536	4	51.6	53.3	-3.2	1.52	1.52	0.3
		1924.992	2	51.6	53.3	-3.3	1.53	1.52	0.9
		1928.448	0	51.5	53.3	-3.3	1.54	1.52	1.2
Notes: -									

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]	Dipole #SN	SAR Values with Head TSL [W/kg]								Date
		Measured				Target		Delta		
		with 250 mW		scaled to 1 W		normalized to 1 W		+/- 10 [%]		
		1g	10g	1g	10g	1g	10g	1g	10g	
1900	D1900V2 #535	9.07	4.86	36.28	19.44	40.10	21.00	-9.53	-7.43	Nov. 07, 2017

Table 9: Dipole target and measured head system check results.

System Check Results										
Frequency [MHz]	Dipole #SN	SAR Values with Body TSL [W/kg]								Date
		Measured				Target		Delta		
		with 250 mW		scaled to 1 W		normalized to 1 W		+/- 10 [%]		
		1g	10g	1g	10g	1g	10g	1g	10g	
1900	D1900V2 #535	9.25	5.02	37.00	20.08	39.70	21.20	-6.80	-5.28	Nov. 09, 2017

Table 10: Dipole target and measured body system check 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

Table 11: 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	20.00
	CH 02	1924.992	20.00
	CH 00	1928.448	20.00

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

6.3 Measured Output Power

6.3.1 DECT UPCS Output Power

Max. Peak Output Power [dBm]			
Mode	**Frequency [MHz]**	**CH**	**Measured Output Power**
DECT UPCS	1921.536	04	19.10
	1924.992	02	19.10
	1928.448	00	19.01
Notes:			

Table 13: Conducted output power values for DECT UPCS.

6.4 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 12. 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	1924.992	2	Left	Cheek	3	0.017	0.187	19.10	20.00	1.230	0.021	1
	1924.992	2	Left	Tilted	4	0.006	-0.081	19.10	20.00	1.230	0.008	-
	1924.992	2	Right	Cheek	5	0.010	-0.035	19.10	20.00	1.230	0.012	-
	1924.992	2	Right	Tilted	6	0.006	-0.142	19.10	20.00	1.230	0.007	-
	1921.536	4	Left	Cheek	3	0.016	0.063	19.10	20.00	1.230	0.020	-
	1928.448	0	Left	Cheek	3	0.016	0.074	19.01	20.00	1.256	0.020	-
Notes: -												

Table 14: 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	1924.992	2	Front	0	7	0.010	-0.071	19.10	20.00	1.230	0.012	-
	1924.992	2	Back	0	8	0.004	0.110	19.10	20.00	1.230	0.005	-
	1921.536	4	Front	0	7	0.012	0.012	19.10	20.00	1.230	0.015	2
	1928.448	0	Front	0	7	0.010	0.010	19.01	20.00	1.256	0.013	-
Notes: SAR measurements have been performed with attached belt clip and headset.												

Table 15: 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 Administrative Measurement Data

7.1 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	09/2018
☐ Dosimetric E-Field Probe	SPEAG	EX3DV4	3860	09/2017	09/2019
☐ Data Acquisition Electronics	SPEAG	DAE 3	335	02/2017	02/2018
☒ Data Acquisition Electronics	SPEAG	DAE 4	631	09/2017	09/2018
☐ 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	05/2017	05/2020
Material Measurement					
☒ Network Analyzer	Agilent	E5071C	MY46103220	08/2017	08/2019
☒ 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	07/2017	07/2019
☐ Power Sensor	Agilent	E9301A	MY41495584	03/2015	03/2017
☒ Power Meter	Anritsu	ML2487A	6K00002319	06/2016	06/2018
☒ Power Sensor	Anritsu	MA2472A	990365	06/2016	06/2018
☒ Power Meter	Anritsu	ML2488A	6K00002078	06/2016	06/2018
☒ Power Sensor	Anritsu	MA2472A	002122	06/2016	06/2018
RF Sources					
☐ Network Analyzer	Agilent	E5071C	MY46103220	08/2017	08/2019
☒ 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 16: Calibration of test equipment.

7.2 Uncertainty Assessment

According to the KDB 865664 D01, SAR Measurement 100 MHz to 6 GHz, when the highest measured 1g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE 1528-2013 is not required in SAR reports submitted for equipment approval.

8 Report History

Revision History				
Revision	**Description of Revision**	**Date**	**Revised Page**	**Revised By**
/	Initial Release	November 26, 2017	-	-
1	Typo on frequency corrected	December 12, 2017	18	dp

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