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SAR Test Report

Dosimetric Assessment of the Portable Device KX-TGLA40 from Panasonic

(FCC ID: ACJ96NKX-TGLA40)

According to the FCC Requirements

November 5, 2015

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Executive Summary

The KX-TGLA40 is a new cordless phone (Portable Device) from Panasonic operating in the 1920 MHz -- 1930 MHz frequency range. The device has an integrated antenna and works in US DECT standard.

The objective of the measurements done by IMST was the dosimetric assessment of one device in a worst case setup in head configuration. Since there was a special test software available, SAR tests were conducted with a specific channel and maximum output power during the measurement. The examinations have been carried out with the dosimetric assessment system „DASY4“.

The measurements were made according to the 47 CFR § 2.1093 [47CFR] for evaluating compliance of mobile and portable devices with FCC limits for human exposure (general population) to radiofrequency emissions.

Additional information and guidelines given by the following FCC documents were used:

- SAR Measurement Requirements for 100 MHz to 6 GHz [KDB 865664 D01 v01r04]
- Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies [KDB 447498 D01 v06]

All measurements have been performed in accordance to the recommendations given by the system manufacturer SPEAG AG, Switzerland.

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Compliance Statement

The Panasonic KX-TGLA40 cordless phone (FCC ID: ACJ96NKX-TGLA40) is in compliance with the following standards for uncontrolled exposure:

- 47 CFR § 2.1093 [47CFR],
- ANSI / IEEE C95.1-1999 [IEEE C95.1-1999]

The maximum results of SAR for the KX-TGLA40 are as follows:

Worst Case SAR Results									
Band	**Frequency [MHz]**	**CH**	**Phantom Configuration**		**Fig. No.**	**Plot No.**	**Highest Reported SAR_{1g} [W/kg]**	**SAR_{1g} Limit [W/kg].**	
US DECT	1924.992	2	Left Head	Cheek	13	1	0.033	1.6	PASS

Prepared by: ..... Reviewed by: .....

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Subject of Investigation

The KX-TGLA40 is a new cordless phone (Portable Device) from Panasonic operating in the 1920 MHz -- 1930 MHz frequency range. The device has an integrated antenna and works in US DECT standard.

Fig. 1: Pictures of the device under test.

The objective of the measurements done by IMST was the dosimetric assessment of one device in a worst case setup in head configuration. Since there was a special test software available, SAR tests were conducted with a specific channel and maximum output power during the measurement. The examinations have been carried out with the dosimetric assessment system „DASY4“.

1 FCC Exposure Criteria

In the USA the FCC exposure criteria [KDB 865664] are based on the withdrawn IEEE Standard C95.1-1999 [IEEE C95.1-1999].

In this report the comparison between the FCC 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.

Having in mind a worst case consideration, the SAR limit is valid for uncontrolled environment and mobile respectively portable transmitters. According to Table 1 the SAR values have to be averaged over a mass of 1 g (SAR_{1g}) with the shape of a cube.

Rule	SAR Limit [W/kg]
47 CFR § 2.1093 (d)(2)	1.6

Table 1: Relevant spatial peak SAR limit averaged over a mass of 1 g.

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1.1 Distinction Between Exposed Population, Duration of Exposure and Frequencies

The American Standard [IEEE C95.1-1999] distinguishes between controlled and uncontrolled environment. Controlled environments are locations where there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment or by other cognizant persons. Uncontrolled environments are locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces. For exposure in controlled environments higher field strengths are admissible. In addition the duration of exposure is considered.

Due to the influence of frequency on important parameters, as the penetration depth of the electromagnetic fields into the human body and the absorption capability of different tissues, the limits in general vary with frequency.

1.2 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:

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

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.

For the relevant frequency range the maximum permissible exposure may be exceeded if the exposure can be shown by appropriate techniques to produce SAR values below the corresponding limits.

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2 The FCC Measurement Procedure

2.1 General Requirements

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.

2.2 Device Operating Next to a Person's Ear

2.2.1 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.

2.2.2 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 IEEE 1528 [IEEE 1528] requires two test positions. For an exact description helpful geometrical definitions are introduced and shown in Fig. 2 - 3.

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 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 two lines intersect at point A.

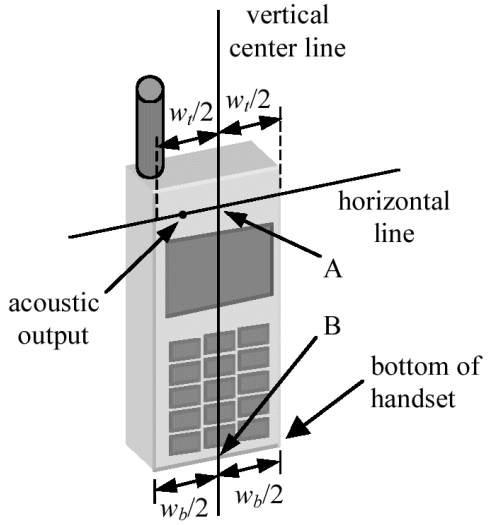

Fig. 2: Handset vertical and horizontal reference lines.

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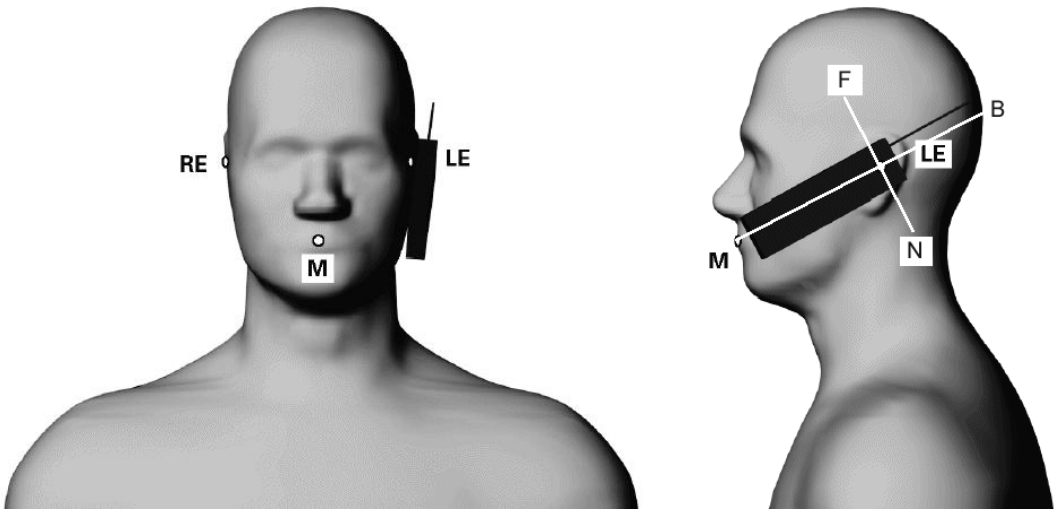

Fig. 3: Phantom reference points.

According to Fig. 3 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. 3. 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. 4):**

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. 3), 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.

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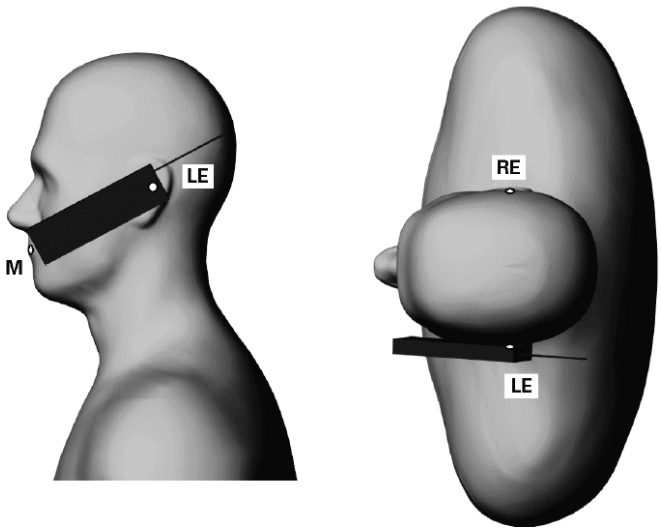

Fig. 4: The cheek position.

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

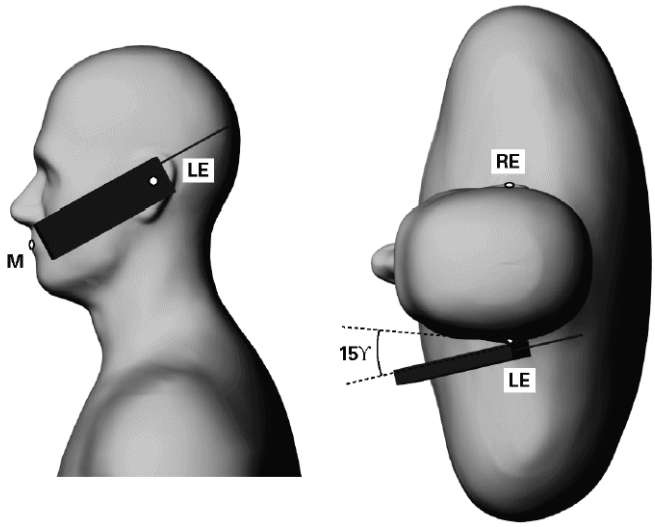

Fig. 5: The tilted position.

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.

2.2.3 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

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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 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: 6. Additional Fig: 7 show 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

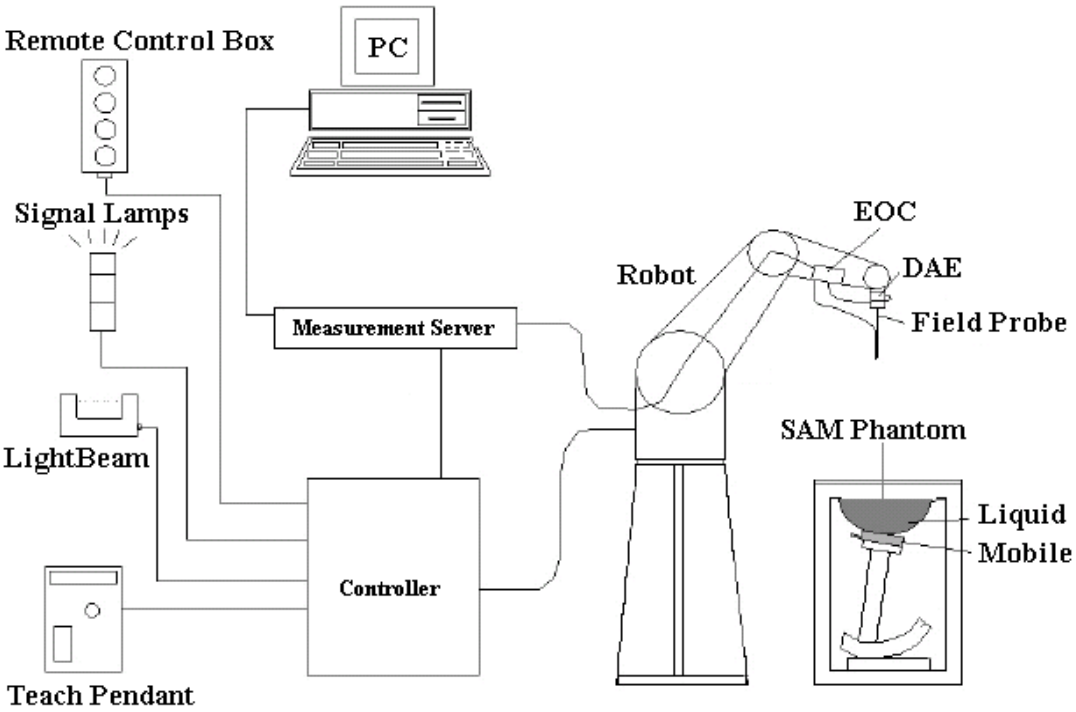

Fig. 6: The DASY4 measurement system.

Fig. 7: The measurement set-up with two SAM phantoms containing tissue simulating liquid.

The mobile phone 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. The measurement time takes about 20 minutes.

3.1 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

3.2 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 KDB 865664 and IEEE 1528 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

3.3 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 2.
- 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.

			≤ 3 GHz	≥ 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}			≤ 2 GHz: ≤ 15 mm 2 - 3 GHz: ≤ 12 mm	3 - 4 GHz: ≤ 12 mm 4 - 6 GHz: ≤ 10 mm
			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.	
Maximum zoom scan spatial resolution: ΔX_{Zoom}, ΔY_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 - 3 GHz: ≤ 5 mm*	3 - 4 GHz: ≤ 5 mm* 4 - 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	Uniform grid: $\Delta Z_{Zoom}(n)$		≤ 5 mm	3 - 4 GHz: ≤ 4 mm 4 - 5 GHz: ≤ 3 mm 5 - 6 GHz: ≤ 2 mm
	graded grid	$\Delta Z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 - 4 GHz: ≤ 3 mm 4 - 5 GHz: ≤ 2.5 mm 5 - 6 GHz: ≤ 2 mm
		$\Delta Z_{Zoom}(n>1)$: between subsequent points	≤ 1.5· $\Delta Z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 - 4 GHz: ≥ 28 mm 4 - 5 GHz: ≥ 25 mm 5 - 6 GHz: ≥ 22 mm
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				

Table 2: Parameters for SAR scan procedures.

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3.4 Uncertainty Assessment

Table 3 includes the worst case uncertainty budget suggested by the KDB 865664 and determined by Schmid & Partner Engineering AG. The expanded uncertainty (K=2) is assessed to be ± 21.6%.

Uncertainty Budget of DASY4						
Error Sources	**Uncertainty Value**	**Probability Distribution**	**Divisor**	**c_i**	**Standard Uncertainty**	**v_i^2 or v_{eff}**
Measurement System						
Probe calibration	± 5.9 %	Normal	1	1	± 5.9 %	∞
Axial isotropy	± 4.7 %	Rectangular	√3	0.7	± 1.9 %	∞
Hemispherical isotropy	± 9.6 %	Rectangular	√3	0.7	± 3.9 %	∞
Boundary effects	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Linearity	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
System detection limit	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Readout electronics	± 1.0 %	Normal	1	1	± 1.0 %	∞
Response time	± 0.8 %	Rectangular	√3	1	± 0.5 %	∞
Integration time	± 2.6%	Rectangular	√3	1	± 1.5 %	∞
RF ambient conditions	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
Probe positioner	± 0.4 %	Rectangular	√3	1	± 0.2 %	∞
Probe positioning	± 2.9 %	Rectangular	√3	1	± 1.7 %	∞
Algorithm for max SAR eval.	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Test Sample Related						
Device positioning	± 2.9 %	Normal	1	1	± 2.9 %	145
Device holder	± 3.6 %	Normal	1	1	± 3.6 %	5
Power drift	± 5.0 %	Rectangular	√3	1	± 2.9 %	∞
Phantom and Set-up						
Phantom uncertainty	± 4.0 %	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (target)	± 5.0 %	Rectangular	√3	0.64	± 1.8 %	∞
Liquid conductivity (meas.)	± 2.5 %	Normal	1	0.64	± 1.6 %	∞
Liquid permittivity (target)	± 5.0 %	Rectangular	√3	0.6	± 1.7 %	∞
Liquid permittivity (meas.)	± 2.5 %	Normal	1	0.6	± 1.5 %	∞
Combined Uncertainty					**± 10.8 %**	

Table 3: Uncertainty budget of DASY4.

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4 Output Power Values and Tune-Up Information

Average Measured and Maximum Transmit Output Power [dBm]				
Mode	**Freq. [MHz]**	**CH**	**Measured Output Power**	**Tune-Up Limit**
DECT	1921.536	00	19.1	20.0
	1924.992	02	19.3	20.0
	1928.448	04	19.2	20.0

Table 4: Conducted output power and maximum transmit power values for Panasonic KX-TGLA40.

5 SAR Results

The tables below contain the measured SAR values averaged over a mass of 1 g. SAR assessment was conducted in the worst case configuration with output power values according Table 4.

According KDB 447498 D01 V06, 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 Configuration										
Band	**Freq. [MHz]**	**CH**	**Phantom Configuration**		**Figure No.**	**Measured SAR_{1g} [W/kg]**	**Power Drift [dB]**	**Tune-Up Scaling Factor**	**Reported SAR_{1g} [W/kg]**	**Plot No.**
US DECT	1924.992	2	Left Head	Cheek	13	0.028	-0.146	1.175	0.033	1
				Tilted	14	0.017	0.008	1.175	0.020	2
			Right Head	Cheek	15	0.025	0.006	1.175	0.029	3
				Tilted	16	0.020	-0.057	1.175	0.023	4

Table 5: Measurement results for Panasonic KX-TGLA40.

Since the measured max SAR is < 0.8 W/kg measurement variability assessment according KDB 865664 is not applicable.

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6 Appendix

6.1 Administrative Data

Date of Validation:	November 03, 2015
Date of Measurement:	November 03, 2015
Data Stored:	Nemko_60320_6150609
Contact:	IMST GmbH Carl-Friedrich-Gauß-Straße 2 - 4 47475 Kamp-Lintfort email: SAR@imst.de

6.2 Device under Test and Test Conditions

MTE:	Panasonic KX-TGLA40
Date of Receipt:	October 27, 2015
SN:	N.A.
FCC ID:	ACJ96NKX-TGLA40
Equipment Class:	Portable device
RF Exposure Environment:	General Population / Uncontrolled
Power Supply:	internal battery
Antenna:	integrated
Method to Establish a Call:	test software
Used Accessory:	-

Panasonic KX-TGLA40	TX Range [MHz]	RX Range [MHz]	Used Channels	Used Crest Factor	Phantom
US DECT	1921.536 - 1928.448	1921.536 - 1928.448	02	24	SAM Twin Phantom V4.0

Table 6: Used channels and crest factors during the test.

6.3 Tissue Recipes

The following recipes are provided in percentage by weight.

1900 MHz, Head:	45.65%	Diethylenglykol-monobutylether
	54.00%	De-Ionized Water
	0.35%	Salt

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6.4 Material Parameters

For the measurement of the following parameters the HP 85070B dielectric probe kit is used, representing the open-ended coaxial probe measurement procedure. The measured values should be within ± 5% of the recommended values given by the FCC.

Tissue Simulating Liquids					
Frequency		**ε_r**	**σ [S/m]**	**Temperature**	
				Ambient [°C]	**Liquid [°C]**
1900 MHz Head	Recommended Value	40.0 ± 2.00	1.40 ± 0.07	20.0 - 26.0	-
	Measured Value (Validation)	41.30	1.43	22.0	21.2
	Measured Value (CH 02)	41.20	1.47		

Table 7: Parameters of the tissue simulating liquid.

6.5 Simplified Performance Checking

The simplified performance check was realized using the dipole validation kits. The input power of the dipole antennas were 250 mW (cw signal) and they were placed under the flat part of the SAM phantom. The target and measured results are listed in the table 8 and shown in figure 8 - **Fehler! Textmarke nicht definiert.**. The target values were adopted from the calibration certificates which are attached in the appendix. Table 9 includes the uncertainty assessment for the system performance checking which was suggested by the KDB 865664 and determined by Schmid & Partner Engineering AG. The expanded uncertainty (K=2) is assessed to be ± 16.8%. To justify the two year calibration interval of the used validation dipoles, IMST consider the requirements in 3.2.2 of KDB 865664. The result of the annual SAR target, impedance and return loss assessment, conducted by IMST, show no significant deviation to dipole calibration results.

Dipole Target Results					
Band	**Dipole**		**SAR_{1g} [W/kg]**	**ε_r**	**σ [S/m]**
DECT	D1900V2 SN #535	Target Values Head	10.05	41.40	1.43
Dipole Validation Results					
DECT	D1900V2 SN #535	Measured Values Head	9.44	41.30	1.43

Table 8: Dipole target and measured results.

Test Laboratory: IMST GmbH, DASY Blue (I); File Name: 031115_b_1669_631.da4

DUT: Dipole 1900 MHz SN: 535; Type: D1900V2; Serial: D1900V2 - SN535
Program Name: System Performance Check at 1900 MHz

; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.43 mho/m; ε_r = 41.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1669; ConvF(5.16, 5.16, 5.16); Calibrated: 19.02.2015
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn631; Calibrated: 16.09.2015
- Phantom: SAM Sugar 1059; Type: Speag; Serial: 1059
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (8x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 9.18 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 92.0 V/m; Power Drift = 0.021 dB
Peak SAR (extrapolated) = 16.3 W/kg
SAR(1 g) = 9.44 mW/g; SAR(10 g) = 4.96 mW/g
Maximum value of SAR (measured) = 10.8 mW/g

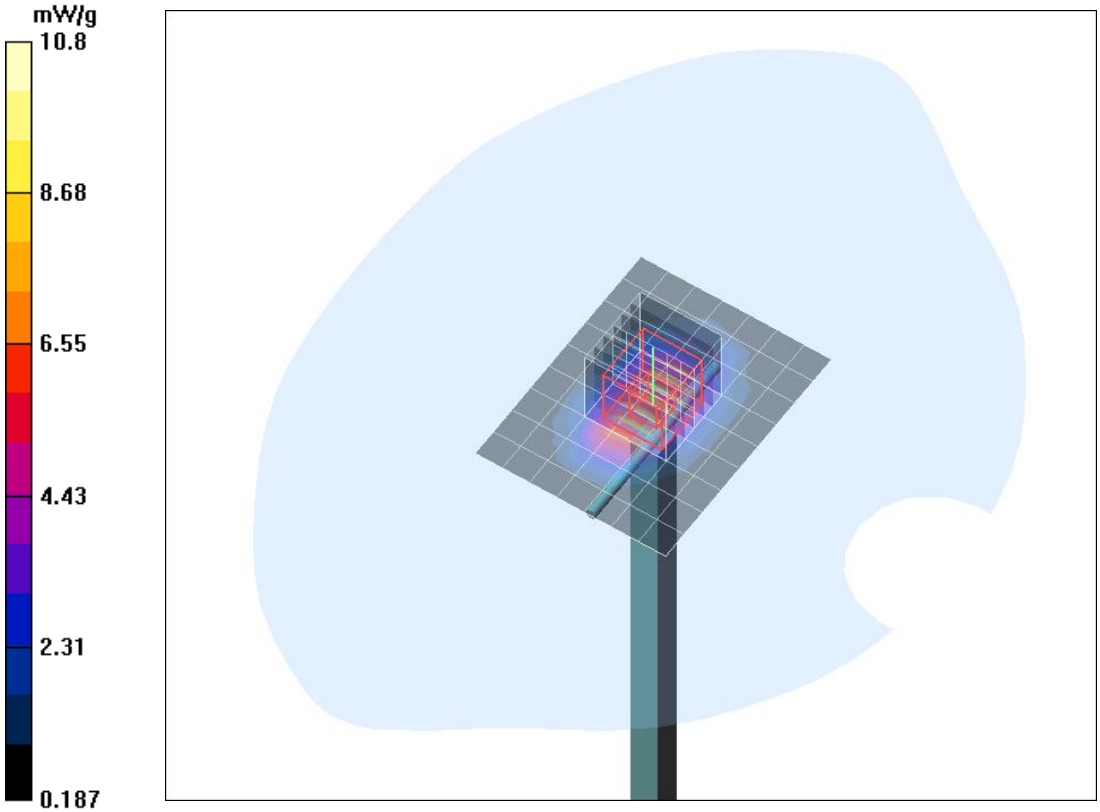

Fig. 8: Validation measurement 1900 MHz Head (November 03, 2015), coarse grid.

Uncertainty Budget						
Error Sources	**Uncertainty Value**	**Probability Distribution**	**Divisor**	**c_i**	**Standard Uncertainty**	**v_i^2 or v_{eff}**
Measurement System						
Probe calibration	± 4.8 %	Normal	1	1	± 4.8 %	∞
Axial isotropy	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
Hemispherical isotropy	± 0 %	Rectangular	√3	1	± 0 %	∞
Boundary effects	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Linearity	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
System detection limit	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Readout electronics	± 1.0 %	Normal	1	1	± 1.0 %	∞
Response time	± 0 %	Rectangular	√3	1	± 0 %	∞
Integration time	± 0%	Rectangular	√3	1	± 0 %	∞
RF ambient conditions	± 3.0 %	Rectangular	√3	1	± 1.7 %	∞
Probe positioner	± 0.4 %	Rectangular	√3	1	± 0.2 %	∞
Probe positioning	± 2.9 %	Rectangular	√3	1	± 1.7 %	∞
Algorithms for max SAR eval.	± 1.0 %	Rectangular	√3	1	± 0.6 %	∞
Dipole						
Dipole Axis to Liquid Distance	± 2.0 %	Rectangular	1	1	± 1.2 %	∞
Input power and SAR drift mea.	± 4.7 %	Rectangular	√3	1	± 2.7 %	∞
Phantom and Set-up						
Phantom uncertainty	± 4.0 %	Rectangular	√3	1	± 2.3 %	∞
Liquid conductivity (target)	± 5.0 %	Rectangular	√3	0.64	± 1.8 %	∞
Liquid conductivity (meas.)	± 2.5 %	Normal	1	0.64	± 1.6 %	∞
Liquid permittivity (target)	± 5.0 %	Rectangular	√3	0.6	± 1.7 %	∞
Liquid permittivity (meas.)	± 2.5 %	Normal	1	0.6	± 1.5 %	∞
Combined Uncertainty					± 8.4 %	

Table 9: Uncertainty budget for the system performance check.

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6.6 Environment

To comply with the required noise level (less than 12 mW/kg) periodically measurements without a DUT were conducted.

Humidity: 40% ± 5 %

6.7 Test Equipment

SAR Equipment				
Test Equipment	**Model**	**Serial Number**	**Last Calibration**	**Next Calibration**
DASY4 Systems				
Software Versions DASY4	V4.7	N/A	N/A	N/A
Software Versions SEMCAD	V1.8	N/A	N/A	N/A
Dosimetric E-Field Probe	ET3DV6	1669	02/2015	02/2016
Data Acquisition Electronics	DAE 4	631	09/2015	09/2016
Phantom	SAM	1059	N/A	N/A
Phantom	SAM	1176	N/A	N/A
Phantom	SAM	1340	N/A	N/A
Phantom	SAM	1341	N/A	N/A
Dipoles				
Validation Dipole	D1900V2	535	03/2015	03/2017
Material Measurement				
Network Analyzer	E5071C	MY46103220	07/2015	07/2017
Dielectric Probe Kit	HP85070B	US33020263	N/A	N/A

Table 10: SAR equipment.

Test Equipment				
Test Equipment	**Model**	**Serial Number**	**Last Calibration**	**Next Calibration**
Power Meters				
Power Meter. Agilent	E4416A	GB41050414	02/2015	02/2017
Power Meter. Agilent	E4417A	GB41050441	02/2015	02/2017
Power Meter. Anritsu	ML2487A	6K00002319	02/2014	02/2016
Power Meter. Anritsu	ML2488A	6K00002078	02/2014	02/2016
Power Sensors				
Power Sensor. Agilent	E9301H	US40010212	03/2015	03/2017
Power Sensor. Agilent	E9301A	MY41495584	03/2015	03/2017
Power Sensor. Anritsu	MA2481B	031600	02/2014	02/2016
Power Sensor. Anritsu	MA2490A	031565	02/2014	02/2016
RF Sources				
Network Analyzer	E5071C	MY46103220	07/2015	07/2017
Rohde & Schwarz	SME300	100142	N/A	N/A
Amplifiers				
Mini Circuits	ZHL-42	D012296	N/A	N/A
Mini Circuits	ZHL-42	D031104#01	N/A	N/A
Mini Circuits	ZVE-8G	D031004	N/A	N/A
Radio Tester				
Rohde & Schwarz	CMU200	835305/050	N/A	N/A

Table 11: Test equipment, General.

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6.8 Certificates of Conformity

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Certificate of conformity

Item	Dosimetric Assessment System DASY4
Type No	SD 000 401A, SD 000 402A
Software Version No	DASY 4.7
Manufacturer / Origin	Schmid & Partner Engineering AG Zeughausstrasse 43, CH-8004 Zürich, Switzerland

References

[1] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
[2] EN 50361:2001, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)", July 2001
[3] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005
[4] IEC 62209 – 2, Draft Version 0.9, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation and Procedures
Part 2: Procedure to determine the Specific Absorption Rate (SAR) for ... including accessories and multiple transmitters", December 2004
[5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
[6] ANSI-C63.19-2006, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", June 2006
[7] ANSI-C63.19-2007, "American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids", June 2007

Conformity

We certify that this **system is designed to be fully compliant** with the standards [1 – 7] for RF emission tests of wireless devices.

Uncertainty

The uncertainty of the measurements with this system was evaluated according to the above standards and is documented in the applicable chapters of the DASY4 system handbook.
The uncertainty values represent current state of methodology and are subject to changes. They are applicable to all laboratories using DASY4 provided the following requirements are met (responsibility of the system end user):

1) the system is used by an experienced engineer who follows the manual and the guidelines taught during the training provided by SPEAG,
2) the probe and validation dipoles have been calibrated for the relevant frequency bands and media within the requested period,
3) the DAE has been calibrated within the requested period,
4) the "minimum distance" between probe sensor and inner phantom shell and the radiation source is selected properly,
5) the system performance check has been successful,
6) the operational mode of the DUT is CW, CDMA, FDMA or TDMA (GSM, DCS, PCS, IS136, PDC) and the measurement/integration time per point is ≥ 500 ms,
7) if applicable, the probe modulation factor is evaluated and applied according to field level, modulation and frequency,
8) the dielectric parameters of the liquid are conformant with the standard requirement,
9) the DUT has been positioned as described in the manual.
10) the uncertainty values from the calibration certificates, and the laboratory and measurement equipment dependent uncertainties, are updated by end user accordingly.

Date 24.4.2008 **Signature / Stamp**

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Fig. 9: Certificate of conformity for the used DASY4 system:

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Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 BA
Series No	TP-1002 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles.
Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

Standards

[1] CENELEC EN 50361
[2] IEEE P1528-200x draft 6.5
[3] IEC PT 62209 draft 0.9
(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 18.11.2001

Signature / Stamp Schmid & Partner Engineering AG
Zeughausstrasse 43, CH-8004 Zurich
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

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Fig. 10: Certificate of conformity for the used SAM phantom.

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6.9 Pictures of the Device under Test

Figure 11 - 12 show the device under test.

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Fig. 11: Pictures of the front side of the device under test.

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Fig. 12: Pictures of the back side of the device under test.

6.10 Test Positions for the Device under Test

Figure 13 - 16 show the test positions for the SAR measurements.

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Fig. 13: Cheek position, left side.

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Fig. 14: Tilted position, left side.

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Fig. 15: Cheek position, right side.

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Fig. 16: Tilted position, left side

6.11 Pictures to Demonstrate the Required Liquid Depth

Figure 17 shows the liquid depth in the used SAM phantom.

Fig. 17: Liquid depth for 1900 MHz Head measurements

SAR_Report_FCC_DECT_WiFi_Head_Body_1.0/10.12.2013/AR

7 References

[IEEE C95.1-1999]	IEEE Std C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., 1999.
[IEEE C95.1-2005]	IEEE Std C95.1-2005: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., 2005.
[ICNIRP 1998]	ICNIRP: Guidelines for Limiting Exposure to Time-varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), In: Health Physics, Vol. 74, No. 4, 494-522, 1998.
[DASY4]	Schmid & Partner Engineering AG: DASY4 Manual. April 2008
[KDB 447498]	447498 D01 General RF Exposure Guidance v06, October 03, 2015
[KDB 865664]	865664 D01SAR Measurement 100 MHz to 6 GHz v01r04, August 07, 2015
[47 CFR]	Code of Federal Regulations; Title 47, Telecommunications