SAR Evaluation Report

EUT Information	
Manufacturer	Remote Diagnostic Technologies Ltd
Model Name	Tempus Pro
FCC ID	contains NCMOMO6012; PV7-WIBEAR11N-DF2
IC Number	contains 2734A-MO6012; 7738A-WB11NDF2
EUT Type	medical vital signs monitor

Prepared by	
Testing Laboratory	IMST GmbH, Test Center Carl-Friedrich-Gauß-Str. 2 – 4 47475 Kamp-Lintfort Germany
Laboratory Accreditation	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. 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. IMST GmbH is recognized as a wireless testing laboratory to perform equipment testing in Canada under the terms of Phase I of the Canada-EU Comprehensive Economic and Trade Agreement (CETA) under CAB identifier: DE0010.

Prepared for	
Applicant / Manufacturer	Remote Diagnostic Technologies Ltd Pavilion C2 Ashwood Park, Ashwood Way, Basingstoke, Hampshire RG23 8BG United Kingdom

Test Specification		
Applied Rules/Standards	IEEE 1528-2013, FCC CFR 47 § 2.1093, RSS-102 Issue 5	
Usage Configuration	body-supported conditions (lap-held)	
Exposure Category	☒ general public / uncontrolled exposure	☐ occupational / controlled exposure
Test Result	☒ PASS	☐ FAIL

Report Information	
Data Stored	60320_6190299
Issue Date	April 15, 2019
Revision Date	July 09, 2019
Revision Number	1 (A new revision replaces all previous revisions and thus, become invalid herewith)
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.

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1 Subject of Investigation

The Tempus Pro is medical vital signs monitor. It is operating in 850 MHz, 1900 MHz and 2.4 GHz frequency range and has three integrated antennas.

1.1 Technical Data of EUT

Product Specifications		
Manufacturer	Remote Diagnostic Technologies Ltd	
Model Name / Number	00-1026-R	
Brand Name	Tempus Pro	
Serial Number of DUT	602426	
IMST DUT Number	01	
Hardware Version	Trizeps VII	
Software Version	V7.01	
Integrated Transmitter	Option GTM601W	U-Blox ELLA W-163
Operation Mode	GSM/GPRS 850/1900, WCDMA B2/B5	IEEE 802.11b/g/n; Bluetooth V2.3/V3.0
Operation Frequency Range	850 MHz, 1900 MHz	2.4 GHz
TX Antenna Type	integrated (1x WWAN, 1x WLAN, 1x BT)	
Usage Configuration	body-supported conditions (lap-held)	
Max. Output Power	refer to chapter 6.2	
Power Supply	internal Li-Ion 7.4V 10.2Ah 75.5 Wh	
DUT Stage	☐ production unit ☒ identical prototype	
Notes: -		

1.2 Picture of the DUT and Antenna Location

Fig. 1: Front view of the DUT.

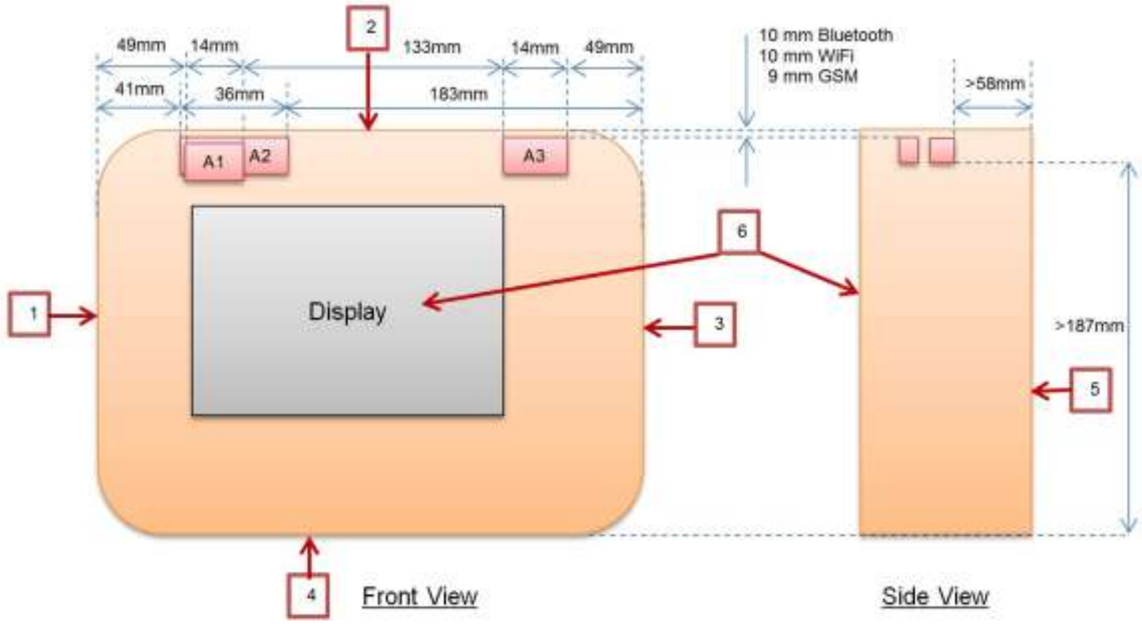

Fig. 2: Antenna location of the DUT.

Antenna Type and Location						
Antenna	BLUETOOTH		WWAN		WLAN	
Reference	A1		A2		A3	
Configuration Edge						
Side of DUT	Left	Top	Right	Bottom	Back	Front
Reference	(1)	(2)	(3)	(4)	(5)	(6)

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 616217 D04 v01r02	SAR for Laptop and Tablets	October 23, 2015
Technology KDB			
☒	KDB 248227 D01 v02r02	802.11 Wi-Fi SAR	October 23, 2015

Table 1: Normative references.

1.4 Attestation of Test Results

Highest Reported SAR1g [W/kg]					
Equipment Class	Band	Body / Back Side of DUT	Simultaneous Transmission	SAR_{1g} Limit [W/kg]	
PCE	WCDMA B5	0.027	**0.427**	1.6	PASS
DTS	WLAN 2.4 GHz	0.006			
DSS	Bluetooth	0.400*			
Notes: To establish a connection at a specific channel and with maximum output power, base station simulator has been used for 2G and 3G testing. Engineering test software has been used for WLAN measurements. All measured SAR results and considered configurations are shown in chapter 7					

Table 2: Highest reported SAR results.

Prepared by: ....

Alexander Rahn
Test Engineer

Reviewed by: ....

Dessislava Patrishkova
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 3: SAR limits specified in IEEE Standard C95.1-2005 and Health Canada's Safety Code 6.

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 4: 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:

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

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.

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: 3. Additionally, Fig: 4 shows the equipment, similar to the installations in other laboratories.

- Fully compliant with all current measurement standards as stated in Fig. 5
- 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

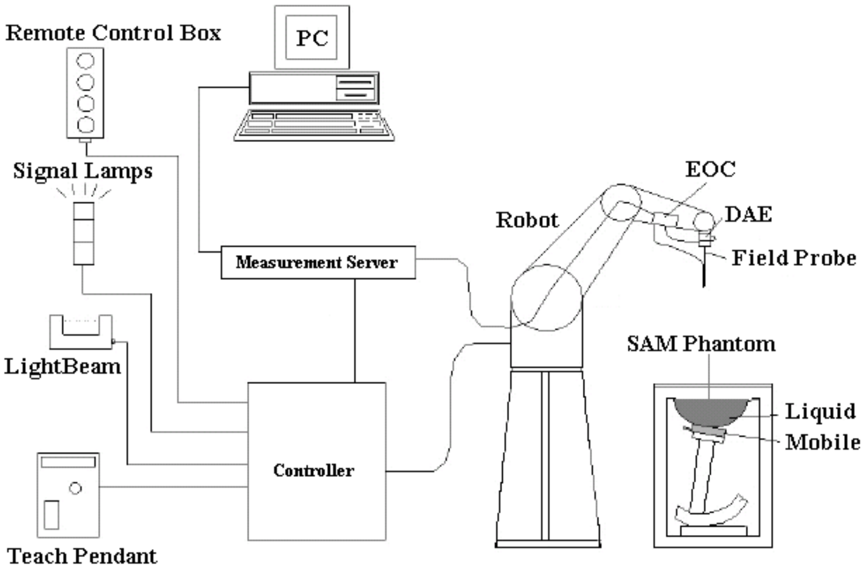

Fig. 3: The DASY4 measurement system.

Fig. 4: The measurement set-up with a DASY system and 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.

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. 6.
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

ELI PHANTOM V4.0	
	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. The details and the Certificate of conformity can be found in Fig. 8
Shell Thickness	2.0 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm Minor axis: 400 mm
Filling Volume	approx. 30 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 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 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	2450 MHz / 2600 MHz / 5250 MHz / 5600 MHz / 5800 MHz for head and body simulating liquid

4 Measurement Procedure

4.1 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.

4.2 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 *5*.
- 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 EEE 1528-2013 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 5: Parameters for SAR scan procedures.

4.3 Additional Information for IEEE 802.11 (WiFi) 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.

4.4 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.

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**
GSM 850 / WCDMA B5	850	April 10, 2019	April 10, 2019
GSM 1900	1900	April 01, 2019	April 01, 2019
WCDMA B2	1900	April 01, 2019	April 02, 2019
IEEE 802.11 b/g/n	2450	March 06, 2019	March 07, 2019

Table 6: Date of testing.

5.2 Environment Conditions

Environment Conditions		
Ambient Temperature[°C]	**Liquid Temperature [°C]**	**Humidity [%]**
22.0 ± 2	22.0 ± 2	40.0 ± 10
Notes: To comply with the required noise level (less than 12 mW/kg) periodically measurements without a DUT were conducted.		

Table 7: Environment Conditions.

5.3 Tissue Simulating Liquid Recipes

Tissue Simulating Liquid								
Frequency Range		**Water**	**Tween 20**	**Tween 80**	**Salt**	**Preventol**	**DGME**	**Triton X/100**
[MHz]		**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**	**[%]**
Head Tissue								
☐	300	50.4	47.3	-	2.2	0.1	-	-
☐	450	50.8	47.5	-	1.6	0.1	-	-
☐	700 - 1000	52.8	46.0	-	1.1	0.1	-	-
☐	1600 - 1800	55.4	44.1	-	0.4	0.1	-	-
☐	1850 - 1980	55.2	44.5	-	0.2	0.1	-	-
☐	2000 - 2700	55.7	45.2	-	-	0.1	-	-
☐	5000 - 6000	65.5	-	-	-	-	17.25	17.25
Body Tissue								
☐	300	70.3	28.6	-	1.0	0.1	-	-
☐	450	71.0	28.0	-	0.9	0.1	-	-
☒	700 - 1000	71.2	28.0	-	0.7	0.1	-	-
☐	1600 - 1800	71.4	28.0	-	0.5	0.1	-	-
☒	1850 - 1980	71.5	28.0	-	0.4	0.1	-	-
☒	2000 - 2700	71.6	28.0	-	0.3	0.1	-	-
☒	5000 - 6000	79.9	-	20.0	-	0.1	-	-
Notes: Used liquid for measurement is checked above.								

Table 8: 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.

Recommended values for the dielectric parameters of the tissue simulating liquids are given in IEEE 1528 and FCC published RF Exposure KDB Procedures. All tests were carried out using liquids with dielectric parameters within +/- 5% of the recommended values. The dielectric properties of the tissue simulating liquid have been measured within 24 h before SAR testing. The depth of the tissue simulant was at least 15.0 cm for all system check and device tests, measured from the ear reference point in case of the SAM phantom and from the inner surface of the flat phantom.

Tissue Simulating Liquids								
Ambient / Liquid Temperature(C) : 22.0 ± 2					Humidity (%) : 40.0 ± 10			
Band	**Frequency**	**Channel**	**Permittivity**			**Conductivity**		
			Measured	**Target**	**Delta**	**Measured**	**Target**	**Delta**
	[MHz]		**ε'**	**ε'**	**+/- 5 [%]**	**σ [S/m]**	**σ [S/m]**	**+/- 5 [%]**
GSM 850	*835.0*	*System Check*	*55.1*	*55.2*	*-0.3*	*0.993*	*0.982*	*1.1*
	824.2	128	55.1	55.2	-0.2	0.99	0.98	1.0
	836.6	190	55.1	55.2	-0.3	0.99	0.98	1.1
	848.8	251	55.0	55.2	-0.3	1.00	0.99	1.3
WCDMA 5	*835.0*	*System Check*	*55.1*	*55.2*	*-0.3*	*0.99*	*0.98*	*1.1*
	826.4	4132	55.1	55.2	-0.2	0.99	0.98	1.0
	836.6	4183	55.1	55.2	-0.3	0.99	0.98	1.1
	846.6	4233	55.0	55.2	-0.3	1.00	0.99	1.2
PCS 1900	*1900.0*	*System Check*	*53.5*	*53.3*	*0.3*	*1.59*	*1.52*	*4.3*
	1850.2	512	53.6	53.3	0.6	1.54	1.52	1.2
	1880.0	661	53.5	53.3	0.4	1.57	1.52	3.1
	1909.8	810	53.4	53.3	0.2	1.60	1.52	4.9
WCDMA 2	*1900.0*	*System Check*	*53.5*	*53.3*	*0.3*	*1.59*	*1.52*	*4.3*
	1852.4	9262	53.6	53.3	0.6	1.54	1.52	1.2
	1880.0	9400	53.5	53.3	0.4	1.57	1.52	3.1
	1907.6	9538	53.4	53.3	0.2	1.60	1.52	4.9
WLAN	*2450*	*System Check*	*51.5*	*52.7*	*-2.2*	*2.02*	*1.95*	*3.7*
	2412	1	51.6	52.8	-2.2	1.98	1.91	3.3
	2437	6	51.6	52.7	-2.2	2.01	1.94	3.6
	2462	11	51.5	52.7	-2.3	2.03	1.96	3.6
Notes: The dielectric properties of the tissue simulating liquid must be measured within 24 h before the SAR testing.								

Table 9: Parameters of the 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 10 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 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	
835	D835V2 #470	2.50	1.67	10.00	6.68	9.56	6.24	4.60	7.05	10. Apr 19
1900	D1900V2 #535	9.46	5.11	37.84	20.44	38.20	20.36	-0.94	0.39	01. Apr 19
2450	D2450V2 #709	13.80	6.37	55.20	25.48	51.20	24.00	7.81	6.17	06. Mar 19

Table 10: Dipole target and measured results.

6 Measurement Conditions

6.1 SAR Test Conditions

Test Conditions				
Band	**TX Range [MHz]**	**Used Channels**	**Crest Factor**	**Phantom**
GSM / GPRS850	824.2 - 848.8	128 / 190 / 251	8.3 / 2	SAM Twin Phantom V4.0
GSM / GPRS1900	1850.2 - 1909.8	512 / 661 / 810	8.3 / 2	
WCDMA 5	826.4 - 846.6	4132 / 4183 / 4233	1	
WCDMA 2	1852.4 - 1907.6	9262 / 9400 / 9538	1	
IEEE 802.11	2412 - 2462	1 / 6 / 11	1	
Notes: To establish a connection at a specific channel and with maximum output power, base station simulator has been used for 2G and 3G testing. Engineering test software has been used for WLAN measurements.				

Table 11: Used channels and crest factors during the test.

6.2 Tune-Up Information

6.2.1 Maximum Transmitting Output Power Values

Output Power Tune-Up Information for 2G

Band / Mode		Frequency Range [MHz]	Averaged Output Power (RMS) [dBm]			
			Tune-Up Limit			
2G GSM	850	824.2 - 848.8	33.0			
	1900	1850.2 - 1909.8	30.0			
2G GPRS / EDGE (GMSK)	number of uplink time slots		1 TX	2 TX	3 TX	4TX
	850	824.2 - 848.8	33.0	31.5	30.0	28.0
	1900	1850.2 - 1909.8	30.0	27.0	25.0	24.0
2G EDGE (8-PSK)	850	824.2 - 848.8	28.0	28.0	26.0	25.0
	1900	1850.2 - 1909.8	26.0	26.0	24.0	23.0
Notes:						

Output Power Tune-Up Information for 3G

Band / Mode		Frequency Range [MHz]	Averaged Output Power (RMS) [dBm]
			Tune-Up Limit
3G WCDMA	Band 2	1852.4 - 1907.6	23.0
	Band 5	826.4 - 846.6	23.0
Notes:			

Output Power Tune-Up Information for Bluetooth

Band / Mode		Frequency Range [MHz]	Averaged Output Power (RMS) [dBm]		
			Max. Output Power u-blox ELLA W1	Internal Loss of K+K Trizeps VII	Tune-Up Limit
Bluetooth Classic	v3.0+HS	2402.0 – 2480.0	10.0	0.5	9.5
	v2.1+EDR	2402.0 – 2480.0	10.0	0.5	9.5
Notes:					

Output Power Tune-Up Information for WLAN

Band / Mode		Frequency Range [MHz]	Averaged Output Power (RMS) [dBm]		
			Max. Output Power u-blox ELLA W1	Internal Loss of K+K Trizeps VII	Tune-Up Limit
WLAN 2.4 GHz DTS	802.11b	2412.0 – 2462.0	19.0	0.5	18.5
		CH1 / CH11	19.0	0.5	18.5
		CH 12 / CH 13	x	x	x
	802.11g	2412.0 – 2462.0	16.0	0.5	15.5
		CH1 / CH11	16.0	0.5	15.5
		CH 12 / CH 13	x	x	x
	802.11n	2412.0 – 2462.0	16.0	0.5	15.5
		CH1 / CH11	16.0	0.5	15.5
		CH 12 / CH 13	x	x	x
Notes: Product hardware has the capability to operate on channel 12 and 13. However, these channels will be disabled via software and will not be accessible to user.					

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

6.3 Measured Output Power

6.3.1 Output Power Values for 2G

This device supports GPRS/EDGE multislot class 12. According the following tables, GPRS 850/1900 with 4 TX represent the worst case, therefore measurements with four active time slots are conducted for GPRS 850/1900.

Max. Burst-Averaged Output Power (RMS) [dBm]											
Band	Frequency [MHz]	CH	GSM	GPRS (GMSK / CS1)				EDGE (8PSK / MCS5)			
				1 TX	2 TX	3 TX	4 TX	1 TX	2 TX	3 TX	4 TX
850	824.2	128	32.3	32.3	29.0	27.6	26.4	26.7	26.4	24.2	23.0
	836.6	190	32.0	32.0	29.0	27.3	26.5	26.9	26.5	24.7	23.3
	848.8	251	31.7	31.7	28.9	27.2	26.4	26.7	26.3	24.3	23.1
1900	1850.2	512	29.4	29.4	26.3	24.7	23.8	26.0	26.0	24.4	23.2
	1880.0	661	29.3	29.3	26.0	24.4	23.4	25.7	25.9	23.8	22.6
	1909.8	810	29.3	29.3	25.8	23.9	23.0	25.6	25.2	23.5	22.2
Max. Frame-Averaged Output Power (RMS) [dBm]											
Band	Frequency [MHz]	CH	GSM	GPRS (GMSK / CS1)				EDGE (8PSK / MCS5)			
				1 TX	2 TX	3 TX	4 TX	1 TX	2 TX	3 TX	4 TX
850	824.2	128	23.3	23.3	23.0	23.3	23.4	17.7	20.4	19.9	20.0
	836.6	190	23.0	23.0	23.0	23.0	23.5	17.9	20.5	20.4	20.3
	848.8	251	22.7	22.7	22.9	22.9	23.4	17.7	20.3	20.0	20.1
1900	1850.2	512	20.4	20.4	20.3	20.4	20.8	17.0	20.0	20.1	20.2
	1880.0	661	20.3	20.3	20.0	20.1	20.4	16.7	19.9	19.5	19.6
	1909.8	810	20.3	20.3	19.8	19.6	20.0	16.6	19.2	19.2	19.2

Notes: The frame-averaged output power is linearly scaled burst averaged power over 8 time slots as shown below:

Frame-averaged power = maximum burst avg. power for 1 TX slot – 9.0 dB

Frame-averaged power = maximum burst avg. power for 2 TX slots – 6.0 dB

Frame-averaged power = maximum burst avg. power for 3 TX slots – 4.26 dB

Frame-averaged power = maximum burst avg. power for 4 TX slots – 3.0 dB

Table 13: Measured output power for 2G bands.

6.3.2 Output Power Values for 3G

For measurements in WCDMA, without HSDPA or HSUPA, the default test configuration is to establish a radio link between the DUT and a communication test set using a 12.2 kbps RMC configured Test Loop Mode 1 and TPC bits configured to all "1". The SAR will be tested for all bands using a Rel99 call configured to transmit at maximum output power per 3GPP 34.121 [3GPP 34.121]. The Rel99 parameters are summarized in Table 14.

WCDMA was tested in RMC mode without HSPA. According KDB 941225 D01 HSPA SAR is not required when the averaged output power of the HSPA subtests are not higher than 0.25 dB then measured in RMC mode and the assessed SAR value in this mode is not higher than 1.2 W/kg.

Max. Averaged Output Power (RMS) [dBm]												
Band	**Freq. [MHz]**	**CH**	**WCDMA RMC**	**HSDPA**				**HSUPA**				
				Subt. 1	**Subt. 2**	**Subt. 3**	**Subt. 4**	**Subt. 1**	**Subt. 2**	**Subt. 3**	**Subt. 4**	**Subt. 5**
850 (FDD 5)	826.4	4132	21.0	20.9	21.0	20.7	20.6	21.0	20.9	20.6	20.9	20.8
	836.6	4183	21.3	21.2	21.2	20.7	20.8	20.9	21.0	20.5	20.9	20.7
	846.6	4233	21.0	21.1	21.1	20.7	20.6	20.6	21.0	20.6	21.0	20.8
1900 (FDD 2)	1852.4	9626	23.0	23.0	23.0	22.6	22.7	23.0	23.0	22.6	22.7	22.5
	1880.0	9400	23.0	23.0	23.0	22.8	22.8	23.0	23.0	22.5	23.0	22.8
	1907.6	9538	22.5	22.5	22.5	22.1	22.0	22.5	22.2	22.1	22.3	22.1
βc				2/15	12/15	15/15	15/15	11/15	6/15	15/15	2/15	15/15
βd				15/15	15/15	8/15	4/15	15/15	15/15	9/15	15/15	15/15
ΔACK. ΔNACK. ΔCQI				8	8	8	8	8	8	8	8	8

Table 14: Measured output power for 3G bands.

6.3.3 Output Power Values for WLAN 2.4 GHz

<table>
<tr><th colspan="11">Max. Averaged Output Power (RMS) [dBm]</th></tr>
<tr><th rowspan="2">Mode</th><th rowspan="2">Frequency [MHz]</th><th rowspan="2">CH</th><th colspan="8">Data Rate [Mbit/s]</th></tr>
<tr><th colspan="2">1</th><th colspan="2">2</th><th colspan="2">5.5</th><th colspan="2">11</th></tr>
<tr><td rowspan="3">b</td><td>2412</td><td>1</td><td colspan="2">15.70</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td></tr>
<tr><td>2437</td><td>6</td><td colspan="2">17.50</td><td colspan="2">17.50</td><td colspan="2">17.50</td><td colspan="2">17.50</td></tr>
<tr><td>2462</td><td>11</td><td colspan="2">17.50</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">-</td></tr>
<tr><th rowspan="2">Mode</th><th rowspan="2">Frequency [MHz]</th><th rowspan="2">CH</th><th colspan="8">Data Rate [Mbit/s]</th></tr>
<tr><th>6.0</th><th>9</th><th>12</th><th>18</th><th>24</th><th>36</th><th>48</th><th>54</th></tr>
<tr><td rowspan="3">g</td><td>2412</td><td>1</td><td>13.6</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>2437</td><td>6</td><td>13.7</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>2462</td><td>11</td><td>13.7</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><th rowspan="2">Mode</th><th rowspan="2">Frequency [MHz]</th><th rowspan="2">CH</th><th colspan="8">MCS Index No.</th></tr>
<tr><th>MCS0</th><th>MCS1</th><th>MCS2</th><th>MCS3</th><th>MCS4</th><th>MCS5</th><th>MCS6</th><th>MCS7</th></tr>
<tr><td rowspan="3">n
HT20</td><td>2412</td><td>1</td><td>13.6</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>2437</td><td>6</td><td>13.7</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>2462</td><td>11</td><td>13.9</td><td>13.9</td><td>13.9</td><td>13.9</td><td>13.9</td><td>13.9</td><td>13.9</td><td>13.9</td></tr>
<tr><td rowspan="3">n
HT40</td><td>2422</td><td>3</td><td>13.9</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>2437</td><td>6</td><td>13.9</td><td>13.8</td><td>13.8</td><td>13.8</td><td>13.8</td><td>13.8</td><td>13.8</td><td>13.8</td></tr>
<tr><td>2452</td><td>9</td><td>13.8</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="11">Notes: CH12/13 are disabled by manufacturer and will not be accessible to user.</td></tr>
</table>

Table 15: Conducted output power for WLAN 2.4 GHz.

6.4 Standalone SAR Test Exclusion

SAR test exclusion is determined for the EUT according to KDB 447498 D01 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.

Transmission Scenario for Test Exclusion Considerations							
Exposure Position	Exposure Configuration	**Body**	**Body**	**Body**	**Body**	**Body**	**Body**
	Antenna	WLAN 2.4	Bluetooth	GPRS 850	GPRS 1900	WCDMA 2	WCDMA 5
	Frequency [GHz]	2.412	2.402	0.824	1.850	1.852	0.826
	Frame Avg. Power [dBm]	18.5	9.5	25.0	21.0	23.0	23.0
	Frame Avg. Power [mW]	70.8	8.9	316.2	125.9	199.5	199.5
Back	Antenna to user [mm]	58.0	58.0	58.0	58.0	58.0	58.0
	SAR exclusion threshold	176.6	176.8	209.2	190.3	190.2	209.1
	SAR testing required?	**no**	**no**	**yes**	**no**	**yes**	**no**
	Estimated SAR [W/kg]	measured	0.400	measured	measured	measured	measured
Bottom	Antenna to user [mm]	187.0	187.0	187.0	187.0	187.0	187.0
	SAR exclusion threshold	1466.6	1466.8	917.8	1480.3	1480.2	919.5
	SAR testing required?	**no**	**no**	**no**	**no**	**no**	**no**
Notes: According to the customer's requirements SAR measurements have been performed for all supported bands on the back side of DUT (body supported / lap-held conditions). BT test has been excluded due to the output power below the given threshold.							

Table 16: SAR test exclusion for body-supported exposure configuration against different device edges according to KDB 447498.

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*

7 SAR Test 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 13 – Table 15. According to KDB 447498 D01, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance limit shown in Table 12.

Reported SAR is calculated by the following formulas:

- Scaling factor tune up limit = tune-up limit power (mW) / RF power (mW)
- Scaling factor max. duty cycle = max. possible duty cycle / used duty cycle for SAR measurement
- Reported SAR = measured SAR * scaling factor tune up limit * scaling factor max. duty cycle

The plots with the highest measured SAR values are shown in Appendix B - SAR Distribution Plots.

SAR Measurement Results for WWAN												
Band / Mode		Freq. [MHz]	CH	Test Position	Gap [mm]	Pic. No.	Measured SAR_{1g} [W/kg]	Drift [dB]	Tune-Up Scaling Factor	Reported SAR_{1g} [W/kg]	SAR_{1g} Limit [W/kg]	Plot No.
GSM 850	Voice 1TX	836.6	190	back	0	3	0.017	-0.125	1.259	0.021	1.6	
	GPRS 4TX	836.6	190	back	0	3	0.017	-0.181	1.445	0.025		
		824.2	128	back	0	3	0.016	0.177	1.413	0.023		
		848.8	251	back	0	3	0.018	0.060	1.445	0.026		1
GSM 1900	Voice 1TX	1880.0	661	back	0	3	0.009	0.142	1.175	0.011	1.6	
	GPRS 4TX	1880.0	661	back	0	3	0.011	0.048	1.047	0.012		
		1850.2	512	back	0	3	0.013	0.069	1.148	0.015		2
		1909.8	810	back	0	3	0.006	-0.073	1.259	0.008		
WCDMA B5	RMC	836.6	4183	back	0	3	0.017	-0.106	1.585	0.027	1.6	3
		826.4	4132	back	0	3	0.014	-0.014	1.479	0.021		
		846.8	4233	back	0	3	0.012	0.081	1.585	0.019		
WCDMA B2	RMC	1880.0	9400	back	0	3	0.019	0.134	1.000	0.019	1.6	
		1852.0	9262	back	0	3	0.017	0.134	1.000	0.017		
		1908.0	9538	back	0	3	0.022	0.115	1.122	0.025		4
Notes:												

Table 17: SAR results for 2G and 3G bands.

SAR Measurement Results for WLAN												
Band / Mode		Freq. [MHz]	CH	Test Position	Gap [mm]	Pic. No.	Measured SAR_{1g} [W/kg]	Drift [dB]	Tune-Up Scaling Factor	Reported SAR_{1g} [W/kg]	SAR_{1g} Limit [W/kg]	Plot No.
IEEE 802.11 b	1 Mbps	2437	6	back	0	3	0.005	-0.110	1.259	0.006	1.6	5
		2412	1	back	0	3	0.002	0.092	1.905	0.004		
		2462	11	back	0	3	0.005	0.119	1.259	0.006		
Notes:												

Table 18: SAR results for IEEE 802.11 b.

General Note:

According to the declaration of the manufacturer the Tempus Pro device is intended to be used in body-supported conditions (lap-held) with the back or bottom side towards the human body. Therefore, only two sides of DUT have been considered for testing. The bottom side of DUT has been excluded from testing according to Table 16.

Measured maximum SAR is < 0.8 W/kg, thus measurement variability assessment according to KDB 865664 is not applicable.

8 Simultaneous Transmission Consideration

Simultaneous Transmission Capabilities of DUT		
WWAN	**WLAN**	**Bluetooth**
X	X	X
V	X	V
X	V	V
Notes: Only WWAN + BT or WLAN + BT antennas are able to transmit simultaneously.		

Table 19: Simultaneous transmission capabilities.

For the following simultaneous transmission analysis the worst case SAR results shown in Table 17 – Table 18 have been used.

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.

Simultaneous Transmission Analysis					
Exposure Position of DUT	**WWAN max SAR [W/kg]**	**WLAN max SAR [W/kg]**	**Bluetooth max SAR [W/kg]**	**Σ SAR1g [W/kg]**	**SPLSR Analysis**
Back	0.027	X	0.400*	0.427	NO
	X	0.006	0.400*	0.406	NO
Notes: Analysis taken into consideration of the simultaneous transmission capabilities is shown in Table 19. *Estimated SAR values according to Table 17.					

Table 20: SAR for simultaneous transmission scenario.

9 Administrative Measurement Data

9.1 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	02/2018	02/2019
☒	Dosimetric E-Field Probe	SPEAG	ET3DV6R	1669	02/2019	02/2020
☒	Dosimetric E-Field Probe	SPEAG	EX3DV4	3536	09/2018	09/2020
☐	Dosimetric E-Field Probe	SPEAG	EX3DV4	3860	09/2017	09/2019
☒	Data Acquisition Electronics	SPEAG	DAE 3	335	02/2018	02/2019
☒	Data Acquisition Electronics	SPEAG	DAE 4	631	09/2018	09/2019
☐	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	03/2018	03/2021
☒	System Validation Dipole	SPEAG	D835V2	470	03/2018	03/2021
☐	System Validation Dipole	SPEAG	D1640V2	311	09/2018	09/2021
☐	System Validation Dipole	SPEAG	D1750V2	1005	03/2018	03/2021
☒	System Validation Dipole	SPEAG	D1900V2	535	03/2018	03/2021
☒	System Validation Dipole	SPEAG	D2450V2	709	11/2018	11/2021
☐	System Validation Dipole	SPEAG	D2600V2	1019	11/2018	11/2021
☐	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	02/2018	02/2020
☒	Thermometer	LKMelectronic	DTM3000	3511	02/2018	02/2020
Power Meters and Sensors						
☒	Power Meter	Anritsu	ML2487A	6K00002319	06/2018	06/2020
☒	Power Sensor	Anritsu	MA2472A	990365	06/2018	06/2020
☒	Power Meter	Anritsu	ML2488A	6K00002078	06/2018	06/2020
☒	Power Sensor	Anritsu	MA2472A	002122	06/2018	06/2020
☒	Spectrum Analyzer	Rohde & Schwarz	FSP7	100433	04/2018	04/2020
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	04/2018	04/2020
☐	Radio Communication Tester	Anritsu	MT8820C	6200918336	04/2018	04/2020
Notes: Used test equipment for measurement is checked above.						

Table 21: Calibration of test equipment.

9.2 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.)	5.0	Normal	1	0.78	0.71	3.9	3.6	∞
Liquid permittivity (meas.)	5.0	Normal	1	0.23	0.26	1.2	1.3	∞
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						11.1	11.0	
Coverage Factor for 95%						kp=2		
Expanded Standard Uncertainty						**22.2**	**21.9**	
Notes: *Worst case probe calibration uncertainty has been applied for all available probes and frequencies.*								

Table 22: 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.)	5.0	Normal	1	0.78	0.71	3.9	3.6	∞
Liquid permittivity (meas.)	5.0	Normal	1	0.23	0.26	1.2	1.3	∞
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						10.7	10.6	
Coverage Factor for 95%						kp=2		
Expanded Standard Uncertainty						**21.5**	**21.2**	
Notes: *Worst case probe calibration uncertainty has been applied for all available probes and frequencies.*								

Table 23: Uncertainty budget for SAR system validation.

10 Report History

Revision History				
Revision	**Description of Revision**	**Date**	**Revised Page**	**Revised By**
/	Initial Release	April 15, 2019	-	-
1	IC No. corrected (typo), test date included on each SAR plot, description of tissue simulating liquid depth included	July 09, 2019	1, 14, 31-38	AR

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