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Dosimetric Assessment of the Portable Device SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited

(FCC ID ZDLST2)

Test Report for SAR Evaluation According to the FCC Requirements

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Executive Summary

The SmartTag Location S1-BUD-B-TE2RA-WIUS is a new ankle worn tracking device (portable device) from buddi Limited operating in the 850 MHz and 1900 MHz frequency range. The device has an integrated antenna and works in the GPRS 850 (Class 12), GPRS 1900 (Class 12), WCDMA 2, WCDMA 5 and 900 MHz SRD standards. Since the SmartTag Location S1-BUD-B-TE2RA-WIUS is an ankle worn device, according KDB 447498 D01, IMST has conducted SAR measurements for extremity exposure configuration.

The objective of the measurements done by IMST was the dosimetric assessment of one device in GPRS 850, GPRS 1900, WCDMA 2 and WCDMA 5, worst case configuration according the applicable KDB. Measurements for SRD are not required since the output power is below the power threshold. The examinations have been carried out with the dosimetric assessment system „DASY4“.

Since the housing of the device has a curved surface, SAR assessment was conducted as well without housing and with zero separation distance to the flat part of the SAM phantom.

Measurements are performed according to the 47 CFR § 2.1093 [47CFR] for evaluating compliance of portable devices with FCC limits for human exposure (general population) to radiofrequency emissions and IEEE 1528-2013 [IEEE1528-2013].

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]
- RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices
  [KDB 447498 D01 v06]
- 3G SAR Measurement Procedures
  [KDB 941225 D01 v03r01]

All measurements have been performed in accordance to the recommendations given by SPEAG.

Compliance Statement

The assessed SAR values for SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited (FCC ID ZDLST2) are in compliance with the SAR limits according to:

- 47 CFR § 2.1093 [47CFR]
- ANSI / IEEE C95.1-1999 [IEEE C95.1-1999]
- IEEE 1528-2013 [IEEE1528-2013]

SAR assessment was conducted with a closest distance of 0 mm between the flat part of the phantom in 3 different configurations. All measured SAR results and configurations are shown in Chapter 5, Table 10 - 11. The highest results of SAR for the SmartTag Location S1-BUD-B-TE2RA-WIUS are as follows:

Highest MeasuredSAR_{10g} [W/kg] in Extremity Exposure Condition									
Band	Test Configuration	Freq. [MHz]	CH	Position	Gap [mm]	Fig No.	SAR_{10g} Reported	SAR_{10g} Limit	
GPRS 850 4TX	Config. 2	824.2	128	back	0	16	0.015	4.0	PASS
GPRS 1900 4TX	Config. 1	1850.0	512	back	0	15	0.031		PASS
WCDMA 2	Config. 1	1880.0	9400	back	0	15	1.261		PASS
WCDMA 5	Config. 1	826.4	4132	back	0	15	0.634		PASS

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Subject of Investigation

The SmartTag Location S1-BUD-B-TE2RA-WIUS is a new ankle worn tracking device (portable device) from buddi Limited operating in the 850 MHz and 1900 MHz frequency range. The device has an integrated antenna and works in the GPRS 850 (Class 12), GPRS 1900 (Class 12), WCDMA 2, WCDMA 5 and 900 MHz SRD standards. Since the SmartTag Location S1-BUD-B-TE2RA-WIUS is an ankle worn device, according KDB 447498 D01, IMST has conducted SAR measurements for extremity exposure configuration.

Fig. 1: Picture of the SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited.

The objective of the measurements done by IMST was the dosimetric assessment of one device in GPRS 850, GPRS 1900, WCDMA 2 and WCDMA 5, worst case configuration according the applicable KDB. Measurements for SRD are not required since the output power is below the power threshold. 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]	
	Body (SAR 1g)	Extremity (SAR 10g)
47 CFR § 2.1093 (d)(2)	1.6	4.0

Table 1: Relevant spatial peak SAR limit averaged over a mass of 1 g and 10 g.

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:

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

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.

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.

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.

3 Body-worn Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. Per FCC KDB 648474 [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 [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.

3.1 Extremity exposure conditions

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e. hands, wrist, feet and ankles, may require extremity SAR evaluation according 4.2.3 of KDB 447498 D01.

3.2 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 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 Additional Information for 3G Devices

When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

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: 2. Additional Fig: 3 show the equipment, similar to the installations in other laboratories.

- Fully compliant with all current measurement standards as stated in Fig. 6
- 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

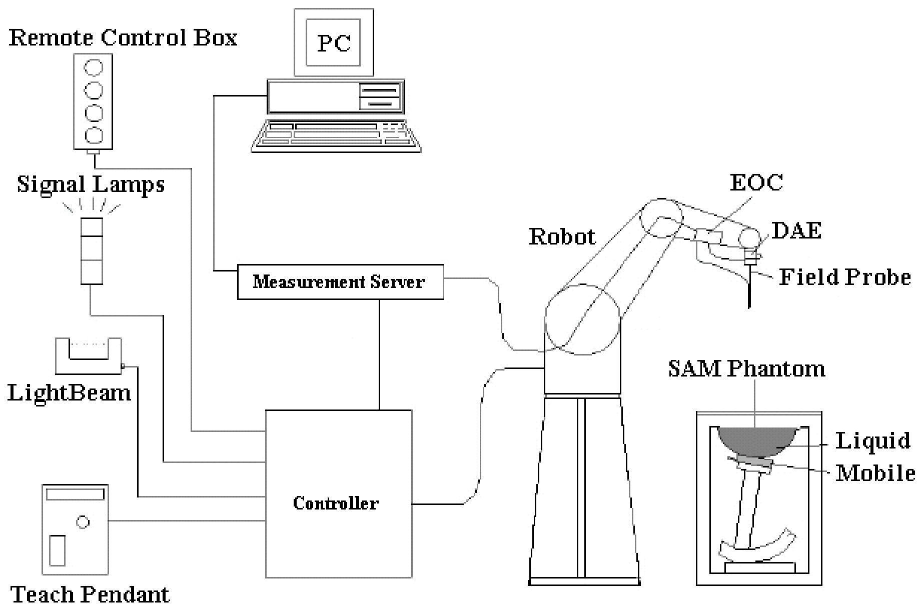


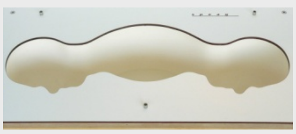
Fig. 2: The DASY4 measurement system.

Fig. 3: The measurement set-up with two SAM phantoms containing tissue simulating liquid.

The transmitter 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. 7.
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 KDB 865664 and IEEE [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 connection with the maximum output power with a base station simulator or by software. The connection between the DUT 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.

<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 2: Parameters for SAR scan procedures.

4.4 Uncertainty Assessment

Table 3 includes the worst case uncertainty budget suggested by KDB 865664 and IEEE 1528-2013 and determined by Schmid & Partner Engineering AG. The expanded uncertainty (K=2) is assessed to be ± 21.7%. The requirements for the validity and the Certificate of conformity can be found in Fig. 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.

5 Output Power Values

5.1 Output Power Values for GSM Bands

This device supports GPRS multislot class 12 and it is a class B device without DTM support. The device does not support voice mode. According the following tables, GPRS 850/1900 with 4 TX represent the worst case, therefore measurements with 4 active time slots are conducted for GPRS 850/1900.

Max. Burst-Averaged Output Power (RMS) [dBm]										
Band	Freq. [MHz]	CH	GPRS (GMSK / CS1)				EDGE (GMSK / MCS1)			
			1 TX	2 TX	3 TX	4 TX	1 TX	2 TX	3 TX	4 TX
850	824.2	128	32.1	32.0	31.2	30.1	32.1	32.0	31.2	30.1
	836.6	190	32.2	32.1	31.4	30.2	32.2	32.1	31.4	30.2
	848.8	251	32.4	32.3	31.5	30.3	32.3	32.3	31.5	30.3
1900	1850.2	512	30.9	30.8	30.0	28.7	30.9	30.8	30.0	28.7
	1880.0	661	30.9	30.9	30.1	28.8	30.9	30.9	30.1	28.8
	1909.8	810	31.0	31.0	30.1	28.9	31.0	31.0	30.1	28.8
Max. Frame-Averaged Output Power (RMS) [dBm]										
Band	Freq. [MHz]	CH	GPRS (GMSK / CS1)				EDGE (GMSK / MCS1)			
			1 TX	2 TX	3 TX	4 TX	1 TX	2 TX	3 TX	4 TX
850	824.2	128	23.1	26.0	26.9	27.1	23.1	26.0	26.9	27.1
	836.6	190	23.2	26.1	27.1	27.2	23.2	26.1	27.1	27.2
	848.8	251	23.4	26.3	27.2	27.3	23.3	26.3	27.2	27.3
1900	1850.2	512	21.9	24.8	25.7	25.7	21.9	24.8	25.7	25.7
	1880.0	661	21.9	24.9	25.8	25.8	21.9	24.9	25.8	25.8
	1909.8	810	22.0	25.0	25.8	25.9	22.0	25.0	25.8	25.8

Table 4: Measured output power for the used SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited.

5.2 Output Power Values for WCDMA Bands

WCDMA was tested in RMC mode without HSPA according to the statement made from the manufacturer that the device does not support HSDPA or HSUPA.

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”.

Maximum Peak-Averaged Output Power [dBm]			
Band	Freq. [MHz]	CH	WCDMA RMC
850 (FDD 5)	826.4	4132	23.9
	836.6	4183	24.0
	846.6	4233	24.0
1900 (FDD 2)	1852.4	9626	24.0
	1880.0	9400	23.6
	1907.6	9538	23.6

Table 5: Measured max. averaged output power for WCMDA for the used SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited.

5.3 Tune-Up Information for WWAN Antenna

Tune-up procedure according KDB 447498 D01v06 is applicable. The measured SAR values are scaled according the tune-up information given by the manufacturer, shown below.

Tune-Up Information for WWAN Antenna [dBm]					
Antenna	Band	GPRS (GMSK / CS1)			
		1 TX	2 TX	3 TX	4 TX
WWAN	**850**	34.0	34.0	33.2	32.0
	1900	31.0	31.0	30.2	29.0

Table 6: Output power tune-up information for GSM bands of SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited.

Tune-Up Information for WWAN Antenna [dBm]		
Antenna	Band	WCDMA (RMC)
WWAN	**FDD5**	24.0
	FDD2	24.0

Table 7: Output power tune-up information for WCDMA bands of SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited.

5.4 SAR Test Exclusion Consideration according KDB 447498

Standalone SAR Test Exclusion Considerations for Extremity Exposure						
Communication System	**Freq. [MHz]**	**Distance [mm]**	**Pavg [dBm]**	**Pavg [mW]**	**Threshold 10g Comparison Values**	**SAR Test Exclusion (Yes/No)**
SRD 900	921	5	6.0	4	0.8	Yes

Table 8: SAR test exclusion for extremity exposure.

The above table shows the SAR test exclusion consideration for the applicable modes against the different device edges with the relevant distances.

The 1g and 10g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50mm are determined by:

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

≤ 7.5 for 10g extremity SAR

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

6 SAR Results

Following KDB 447498 D01, 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.

Since the device has a curved shape (for ankle worn usage) and would not sit flat on the phantom the plastic periphery material was cut out and removed in order to get a flat surface and as such to be tested as shown in Chapter 7.9. There have been three configurations that have been applied as test positions for SAR measurements which are described in the following tables and could be seen in Chapter 7.10

6.1 SAR Results for GPRS Mode

The SmartTag Location S1-BUD-B-TE2RA-WIUS transmits a burst of data approximately 12 seconds long every 15 minutes as per the statement made from the manufacturer.

Low Duty Factor RF Exposure Evaluation			
Maximum Transmission Time [sec]	**Duty Cycle Period**		**Duty Factor**
	Min	**Sec**	
12	15	900	1.33 %

Table 9: Duty factor calculation for data transmission of SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited.

According to the table above, the worst case data transmission duty cycle would result in a scaling of 12/900 = 1.33% applicable to the measured SAR values as shown in Table 10.

SAR Results for WWAN Antenna (GPRS Bands)												
Band	**Freq. [MHz]**	**CH**	**Test Configuration***	**Spacing [mm]**	**Fig. No.**	**Measured SAR10g [W/kg]**	**EUT Output Power [dBm]**	**Tune Up Limit [dBm]**	**Power Drift [dBm]**	**Scaling Factor**	**Reported SAR10g [W/kg]**	**Plot No.**
Measured SAR Results for GPRS												
GPRS 850 (4TX)	836.6	190	config. 1, back	0	15	0.097	30.2	32	-0.107	1.514	0.147	1
			config. 2, back		16	0.460	30.2		-0.040	1.514	0.696	2
			config. 3, back		17	0.037	30.2		-0.171	1.514	0.056	3
	824.2	128	config. 2, back		16	0.711	30.1		0.199	1.549	1.101	4
	848.8	251	config. 2, back		16	0.419	30.3		-0.105	1.479	0.620	5
GPRS 1900 (4TX)	1880	661	config. 1, back	0	15	2.030	28.8	29	-0.137	1.047	2.126	6
			config. 2, back		16	1.040	28.8		-0.180	1.047	1.089	7
			config. 3, back		17	0.324	28.8		-0.176	1.047	0.339	8
	1850	512	config. 1, back		15	2.140	28.7		-0.018	1.072	2.293	9
	1910	810	config. 1, back		15	1.840	28.9		-0.087	1.023	1.883	10
Scaled SAR Results for GPRS to 1.33% Duty Factor Transmission												
GPRS 850 (4TX)	836.6	190	config. 1, back	0	15	0.001	30.2	32	-0.107	1.514	0.002	-
			config. 2, back		16	0.006	30.2		-0.040	1.514	0.009	-
			config. 3, back		17	0.000	30.2		-0.171	1.514	0.001	-
	824.2	128	config. 2, back		16	0.009	30.1		0.199	1.549	0.015	-
	848.8	251	config. 2, back		16	0.006	30.3		-0.105	1.479	0.008	-
GPRS 1900 (4TX)	1880	661	config. 1, back	0	15	0.027	28.8	29	-0.137	1.047	0.028	-
			config. 2, back		16	0.014	28.8		-0.180	1.047	0.015	-
			config. 3, back		17	0.004	28.8		-0.176	1.047	0.005	-
	1850	512	config. 1, back		15	0.029	28.7		-0.018	1.072	0.031	-
	1910	810	config. 1, back		15	0.025	28.9		-0.087	1.023	0.025	-

Table 10: SAR results for GPRS bands for SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited.

Notes: configuration 1 - device with housing at back position towards the phantom*

configuration 2 - device without housing at back position towards the phantom

configuration 3 - device with housing and on body charger (OBC) at back position towards the phantom

6.2 SAR Results for WCDMA Mode

SAR Results for WWAN Antenna (WCDMA Bands)												
Band	Freq. [MHz]	CH	Test Configuration*	Spacing [mm]	Fig. No.	Measured SAR10g [W/kg]	EUT Output Power [dBm]	Tune Up Limit [dBm]	Power Drift [dBm]	Scaling Factor	Reported SAR10g [W/kg]	Plot No.
FDD 2 (RMC)	1880	9400	config. 1, back	0	15	1.150	23.6	24	-0.105	1.096	1.261	11
			config. 2, back	0	16	1.110	23.6	24	-0.071	1.096	1.217	12
			config. 3, back	0	17	0.204	23.6	24	-0.174	1.096	0.224	13
	1852	9262	config. 2, back	0	16	0.802	24.0	24	-0.009	1.000	0.802	14
	1908	9538	config. 2, back	0	16	0.648	23.6	24	-0.163	1.096	0.711	15
FDD 5 (RMC)	836.6	4183	config. 1, back	0	15	0.278	24.0	24	-0.076	1.000	0.278	16
			config. 2, back	0	16	0.634	24.0	24	0.109	1.000	0.634	17
			config. 3, back	0	17	0.088	24.0	24	0.020	1.000	0.088	18
	826.4	4132	config. 2, back	0	15	0.573	23.9	24	-0.064	1.023	0.586	19
	846.8	4233	config. 2, back	0	15	0.533	24.0	24	-0.141	1.000	0.533	20

Table 11: SAR results for WCDMA bands for SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited.

Notes: configuration 1 - device with housing at back position towards the phantom*

configuration 2 - device without housing at back position towards the phantom

configuration 3 - device with housing and on body charger (OBC) at back position towards the phantom

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: (Drift [dB]). This ensures that the power drift during one measurement is within 5%.

6.3 Estimated SAR for Standalone SAR Excluded Modes according KDB 447498

Since the GSM and SRD antennas can´t transmit simultaneously, for SRD standard a SAR estimation based on KDB 447498 for SAR excluded modes is not applicable.

6.4 Multiple Transmitter Information

According KDB 447498, simultaneous transmission consideration for multiple transmitters needs to be addressed, if applicable. According the information given by the manufacturer, GSM and SRD can´t be active at the same time.

7 Appendix

7.1 Administrative Data

Date of Validation:	835 MHz Body (GPRS850):	May 11, 2016
	1900 MHz Body (GPRS1900):	May 24, 2016
	835 MHz Body (WCDMA5):	May 11, 2016
	1900 MHz Body (WCDMA2):	May 24, 2016

Date of Measurement: May 11, 2016 - May 25, 2016
Data Stored: Nemko_60320_6160067
Contact: IMST GmbH
Carl-Friedrich-Gauß-Str. 2 - 4
47475 Kamp-Lintfort
Germany
email: SAR@imst.de

7.2 Device under Test and Test Conditions

MTE: SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited
Date of Receipt: February 09, 2016
IMEI: Radiated samples for SAR measurements:
353162072671416 for GPRS850 and GPRS1900
353162072574099 for WCDMA2 and WCDMA5

Conducted samples for Power Output measurements:
353162072681951 for GPRS850 and GPRS1900
353162072665806 for WCDMA2 and WCDMA5

FCC ID: ZDLST2
Equipment Class: Portable device
RF Exposure Environment: General Population / Uncontrolled
Power Supply: Internal Battery
Accessory: on body charger (OBC), P/N T5-SMS-OBCKBK-0
Antenna: integrated

Standard	TX Range [MHz]	RX Range [MHz]	Used Channels	Crest Factor	Phantom
GPRS 850	824.2 – 848.8	869.2 – 893.8	128, 190, 251	2	SAM Twin Phantom V4.0
GPRS 1900	1850.2 –1909.8	1930.2 – 1989.8	512, 661, 810	2	
WCDMA 5 (FDD)	826.4 – 846.6	871.4 – 891.6	4132, 4183, 4233	1	
WCDMA 2 (FDD)	1852.4 – 1907.6	1932.4 – 1987.6	9262, 9400, 9538	1	

Table 12: Used channels and crest factors during the test.

7.3 Tissue Recipes

The following recipes are provided in percentage by weight.

835 MHz Body:	52.40 %	De-Ionized Water
	01.50 %	Salt
	45.00 %	Sugar
	00.10 %	Preventol D7
	01.00 %	Hydroxyetyl-Cellulose
1900 MHz Body:	29.68 %	Diethylenglykol-monobutylether
	70.00 %	De-Ionized Water
	0.32 %	Salt

7.4 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	**Delta [%]**	**σ [S/m]**	**Delta [%]**
835 MHz Body	Recommended Value	55.20	+/- 5	0.97	+/- 5
GPRS 850	Measured Value (Ch. 128)	53.4	-3.3	0.98	1.0
	Measured Value (Ch. 190)	53.3	-3.4	0.99	2.1
	Measured Value (Ch. 251)	53.2	-3.6	1.00	3.1
1900 MHz Body	Recommended Value	53.30	+/- 5	1.52	+/- 5
GPRS 1900	Measured Value (Ch. 512)	51.4	-3.6	1.52	0.0
	Measured Value (Ch. 661)	51.3	-3.8	1.55	2.0
	Measured Value (Ch. 810)	51.2	-3.9	1.58	3.9
835 MHz Body	Recommended Value	55.20	+/- 5	0.97	+/- 5
WCDMA 5	Measured Value (Ch. 4132)	53.4	-3.3	0.98	1.0
	Measured Value (Ch. 4183)	53.3	-3.4	0.99	2.1
	Measured Value (Ch. 4233)	53.2	3.6	1.00	3.1
1900 MHz Body	Recommended Value	53.30	+/- 5	1.52	+/- 5
WCDMA 2	Measured Value (Ch. 9262)	51.4	-3.6	1.52	0.0
	Measured Value (Ch. 9400)	51.3	-3.8	1.55	2.0
	Measured Value (Ch. 9538)	51.2	-3.9	1.58	3.9

Table 13: Parameters of the tissue simulating liquids.

7.5 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 14 and shown in Figures 4 - 5. The target values were adopted from the calibration certificates which are attached in the appendix. Table 15 includes the uncertainty assessment for the system performance checking which was suggested by the [IEEE 1528-2013] and determined by Schmid & Partner Engineering AG. The expanded uncertainty (K=2) is assessed to be ± 16.8%.

Measured and Target System Check Results			
Available Dipoles		**SAR_{1g} [W/kg]**	**Delta [%]**
D835V2, SN #470 (GPRS 850 + WCDMA5)	Target Values Body	2.34	+/- 10
	Measured Values	2.45	4.93
D1900V2, SN #535 (GPRS 1900 + WCDMA 2)	Target Values Body	9.93	+/- 10
	Measured Values	9.74	-1.86

Table 14: Measured and target system check results as given by the calibration certificates.

Test Laboratory: IMST GmbH, DASY Yellow (II); File Name: 110516_y_1579_335.da4

DUT: Dipole 835 MHz SN470; Type: D835V2; Serial: D835V2 - SN:470
Program Name: System Performance Check at 835 MHz

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.99 mho/m; ε_r = 53.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1579; ConvF(6.4, 6.4, 6.4); Calibrated: 2/23/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 2/16/2016
- Phantom: SAM Sugar 1341; Type: QD 000 P40 CB; Serial: TP-1341
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW/Area Scan (5x9x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (measured) = 2.59 mW/g
d=10mm, Pin=250mW/Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=6mm, dy=6mm, dz=5mm
Reference Value = 53.1 V/m; Power Drift = 0.067 dB
Peak SAR (extrapolated) = 3.54 W/kg
SAR(1 g) = 2.45 mW/g; SAR(10 g) = 1.6 mW/g
Maximum value of SAR (measured) = 2.62 mW/g

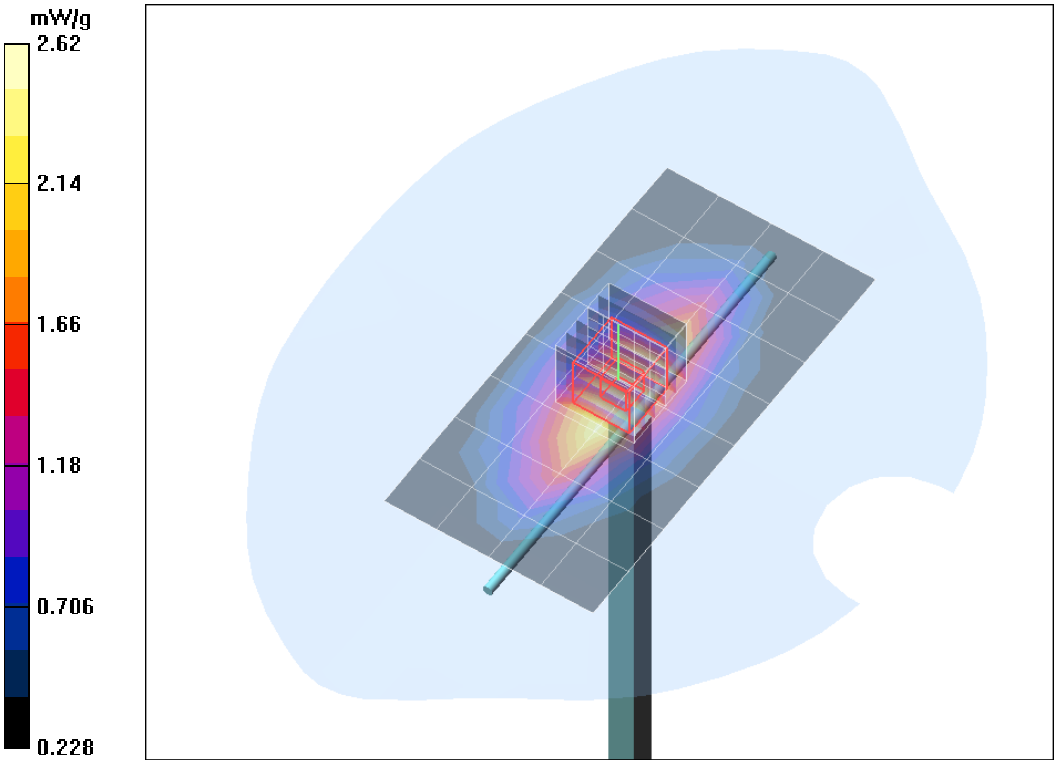


Fig. 4: System check measurement 835 MHz Body (GPRS 850; WCDMA5, May 11, 2016).

Test Laboratory: IMST GmbH, DASY Yellow (II); File Name: 240516_y_1579_631.da4

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

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.57 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6R - SN1579; ConvF(4.63, 4.63, 4.63); Calibrated: 2/23/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn335; Calibrated: 2/16/2016
- Phantom: SAM 1340; Type: QD 000 P40 CB; Serial: TP-1340
- 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) = 9.89 mW/g
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.1 V/m; Power Drift = 0.057 dB
Peak SAR (extrapolated) = 15.9 W/kg
SAR(1 g) = 9.74 mW/g; SAR(10 g) = 5.26 mW/g
Maximum value of SAR (measured) = 11.1 mW/g

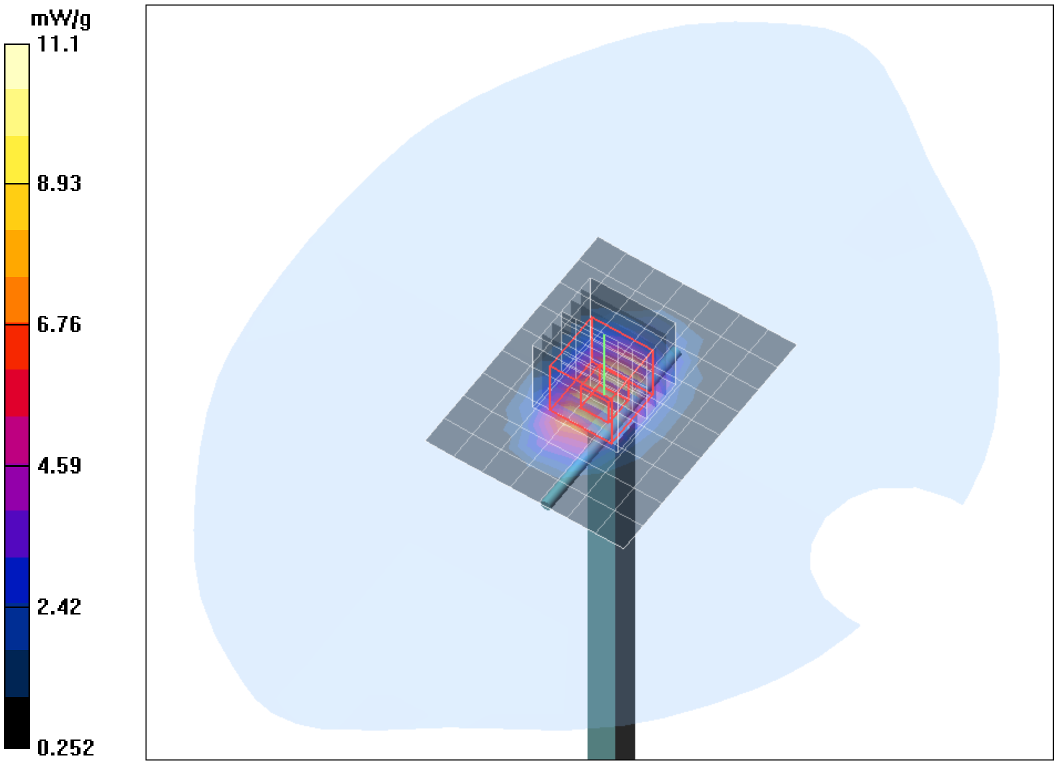


Fig. 5: System check measurement 1900 MHz Body (GPRS1900, WCDMA 2; May 24, 2016).

Uncertainty Budget up to 3 GHz						
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	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	± 0.3 %	Normal	1	1	± 0.3 %	∞
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					± 9.2 %	

Table 15: Uncertainty budget for the system performance check up to 3 GHz.

7.6 Environment

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

Humidity: 40% ± 5 %

7.7 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	ET3DV6R	1579	02/2016	02/2017
Data Acquisition Electronics	DAE 3	335	02/2016	02/2017
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	D835V2	470	03/2015	03/2017
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 16: 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 Sensors				
Power Sensor. Agilent	E9301H	US40010212	03/2015	03/2017
Power Sensor. Agilent	E9301A	MY41495584	03/2015	03/2017
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				
Anritsu	MT8815B	6200576536	04/2016	04/2018

Table 17: Test equipment.

7.8 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. 6: Certificate of conformity for the used DASY4 system

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

Doc No 881 – QD 000 P40 BA – B Page 1 (1)

Fig. 7: Certificate of conformity for the used SAM phantom.

7.9 Pictures of the Device under Test

Figures 8 - 14 show the device under test, antenna locations and assigned sides for the purposes of testing.

Fig. 8: *Front view of the SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited with pointed cellular antenna position.*

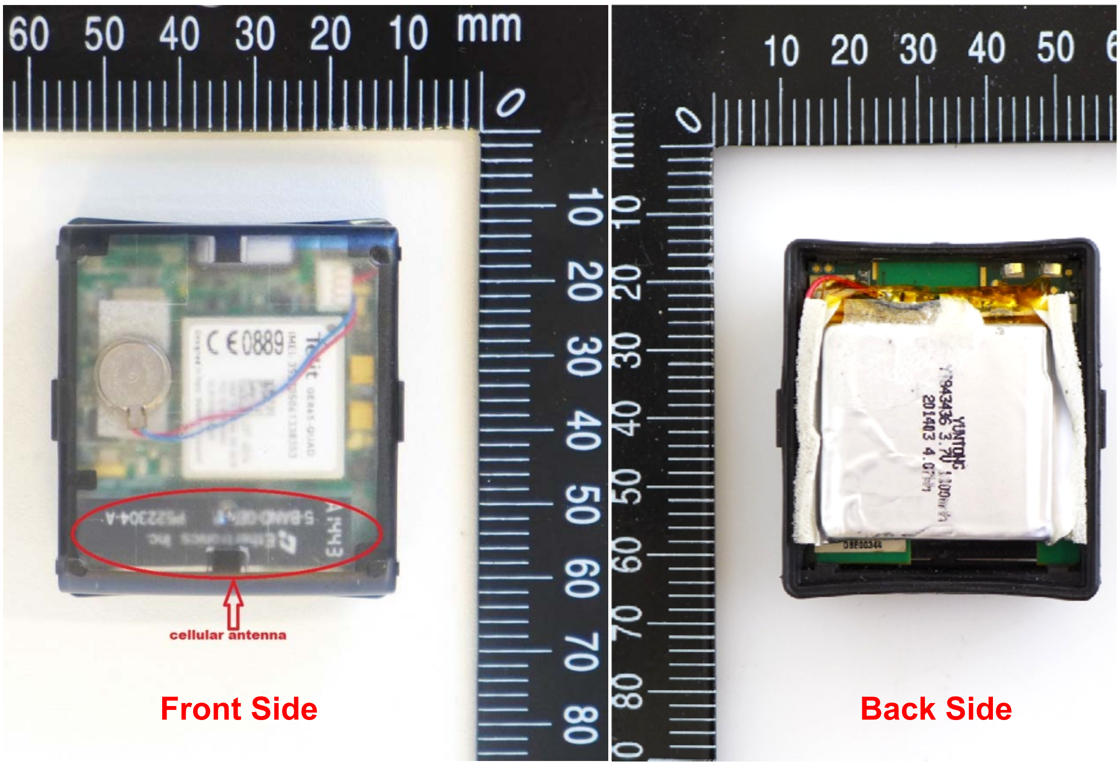

Fig. 9: *Front and back views of the SmartTag Location S1-BUD-B-TE2RA-WIUS from buddi Limited without housing with pointed cellular antenna position.*

Fig. 10: Pictures of the DUT for GSM bands.

Fig. 11: Pictures of the DUT for WCDMA bands.

Fig. 12: Pictures of the conducted sample for GSM bands.

Fig. 13: Pictures of the conducted sample for WCDMA bands.

Fig. 14: Pictures of the DUT attached to the On Body Charger.

7.10 Test Positions for the Device under Test

Figures 15 - 17 show the test positions for the SAR measurements.

Fig. 15: Configuration 1 - back side towards the phantom, 0 mm distance.

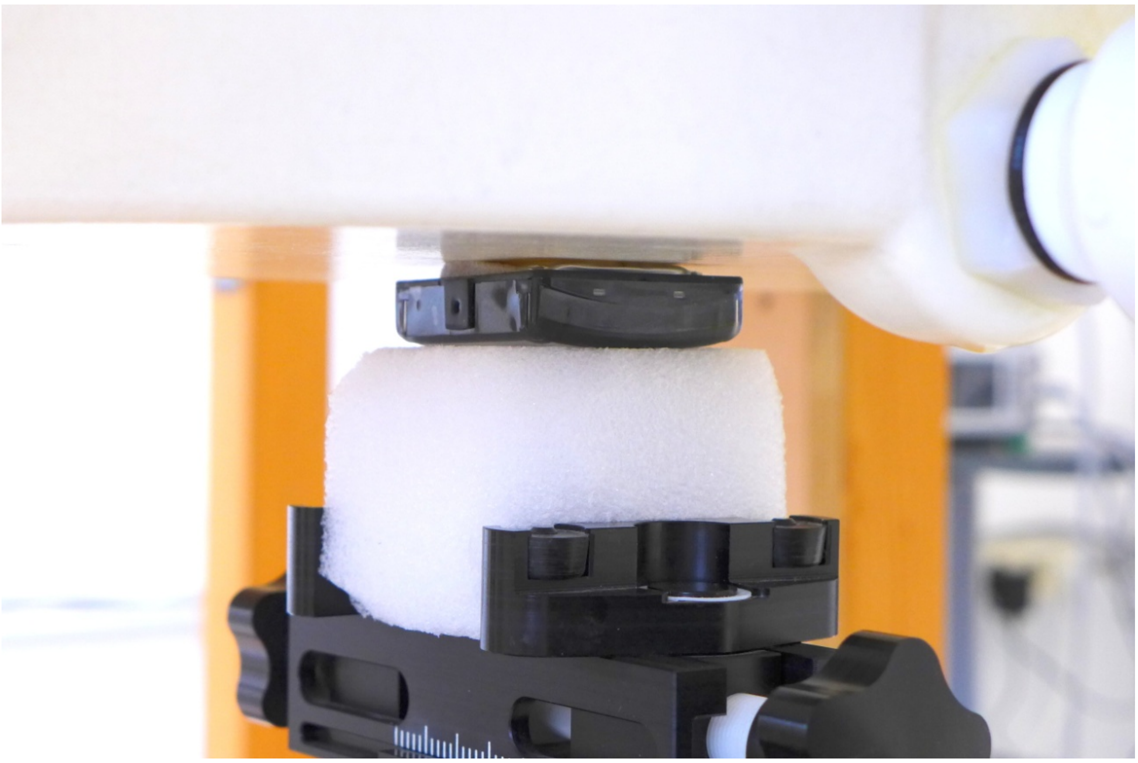

Fig. 16: Configuration 2 – back side, without housing towards the phantom, 0 mm distance.

Fig. 17: Configuration 3 - back side towards the phantom with OBC attached, 0 mm distance.

7.11 Pictures to Demonstrate the Required Liquid Depth

Figure 18 - 19 show the liquid depth in the used SAM phantom.

Fig. 18: Liquid depth for GPRS 850 and WCDMA 5 body measurements.

Fig. 19: Liquid depth for GPRS 1900 and WCDMA2 body measurements.

8 Revision History

Revision History of Test Report				
Revision	**Name of Test Report**	**Date**	**Revised Page**	**Comments**
Original	_6160067_FCC_850_1900_FDD_2_5_buddi_SmartTag	04/07/2016	-	-
V2	_6160067_FCC_850_1900_FDD_2_5_buddi_SmartTag_v2	08/08/2016	*.*	DUT model name changed
			3	typo corrected (GPRS800 -> 850)
			2, 5	wrong KDB reference deleted
			10, 12, 20, 37	typos corrected
			3, 18 , 19	SAR1g values changed to SAR10g values

9 References

[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.

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[KDB 865664] 865664 D01 v01r04 SAR measurement 100 MHz to 6 GHz August 07, 2015

[KDB 447498] 447498 D01 v01r06 General RF Exposure Guidance v05, October 23, 2015

[KDB 941225] 941225 D01 3G SAR Procedures v03r01, Oct. 23, 2015

10 Appendices

Refer to separated files for the following appendices:

- SAR Distribution Plots
  SAR_Report_60320_6160067_FCC_850_1900_FDD_2_5_buddi_SmartTag_Plots
- Calibration Data
  SAR_Report_60320_6160067_FCC_850_1900_FDD_2_5_buddi_SmartTag_CalData