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

IMST

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SAR Evaluation Report

EUT Information	
Manufacturer	GN Audio A/S
Model Name	Jabra Link 370 END040W
FCC ID	BCE-END040W
IC number	2386C-END040W
EUT Type	BT USB dongle
Prepared by	
Testing Laboratory	IMST GmbH, Test Center Carl-Friedrich-Gauß-Str. 2 – 4 47475 Kamp-Lintfort Germany
Prepared for	
Applicant	GN Audio A/S Lautrupbjerg 7 2750 Ballerup Denmark
Test Specification	
Standard Applied	FCC CFR 47 § 2.1093; ISED RSS-102 Issue 5 and the published KDBs
Exposure Category	General Public / Uncontrolled Exposure
Exposure Conditions	Body Exposure Configuration
Report Information	
Data Stored	60320_61701478_Jabra_END040W
Issue Date	March 27, 2017
Revision Date	-
Revision Number	-
Remarks	This report relates only to the item(s) evaluated. This report shall not be reproduced, except in its entirety, without the prior written approval of IMST GmbH. The results and statements contained in this report reflect the evaluation for the certain model described above. The manufacturer is responsible for ensuring that all production devices meet the intent of the requirements described in this report.

Table of Contents

1 EUT Information and Test Results

1.1 Technical Data of EUT

Product Specifications	
Manufacturer	GN Audio A/S Lautrupbjerg 7 2750 Ballerup Denmark
SN	0024414491
Hardware Version	28-04843
Software Version	1.3.0
Firmware Version	1.3.0
Operation Mode	Bluetooth 3.0 + BLE
Frequency Band	2402 – 2480 MHz
Exposure Conditions	Body Exposure Configuration
Antenna Type	integrated
Max. Output Power	see chapter 6.2
Power Supply	5.0 V via USB host device
Used Accessory	-
Notes:	

1.2 Antenna Configuration

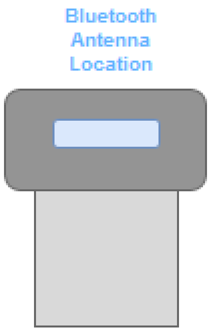

Fig. 1: Antenna location of the EUT.

1.3 Test Specification / Normative References

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

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

1.4 Attestation of Test Results

Highest SAR_{1g} [W/kg]								
Band	**Frequency [MHz]**	**CH**	**Exposure Side of EUT**	**Gap [mm]**	**Pic. No.**	**Highest Reported SAR1g [W/kg]**	**Body Exposure SAR1g Limit [W/kg]**	
Bluetooth Classic	2441	39	Front / Pos. 1	0	3	0.515	1.6	PASS

Notes: To establish a connection at a specific channel and with maximum output power, engineering test software has been used.

All measured SAR results and configurations are shown in chapter 6.7 on page 14.

Prepared by: ....

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2 Exposure Criteria and Limits

The exposure criteria are based on the withdrawn IEEE Standard C95.1-1999 and Health Canada's Safety Code 6. The standards distinguish between uncontrolled and controlled environment.

General population / uncontrolled environments are defined as 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.

Occupational / 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.

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 and trunk	1.6	1 g of tissue*	8.0	1 g of tissue*
Peak spatially-averaged SAR in the limbs	4.0	10 g of tissue*	20.0	10 g of tissue*
Notes: *Defined as a tissue volume in the shape of a cube				

Table 1: Human exposure SAR limits.

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

2.1 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.

2.2 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:

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

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

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

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

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

- Fully compliant with all current measurement standards as stated in Fig. 4
- 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

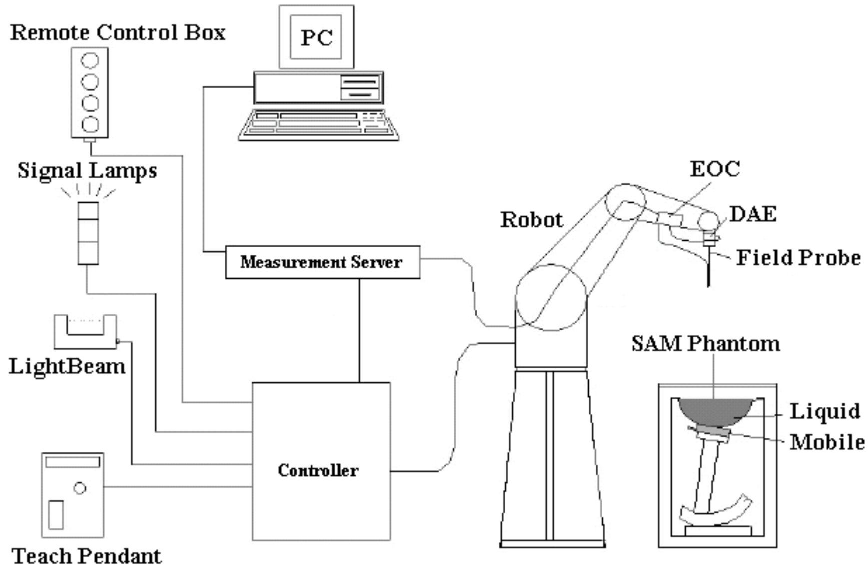

Fig. 2: The DASY4 measurement system.

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

The 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. 5.
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)
Dimensions	Length: 1000 mm; Width: 500 mm Height: adjustable feet
Filling Volume	approx. 25 liters

3.2 E-Field-Probes

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

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

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

4 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.

4.2 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.

4.3 Measurement Variability

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

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

4.4 Parameters for SAR Scan Procedure

The following steps are used for each test position:

- Establish a call with the maximum output power with a base station simulator. The connection between the mobile phone and the base station simulator is established via air interface.
- Measurement of the local E-field value at a fixed location (P1). This value serves as a reference value for calculating a possible power drift.
- Measurement of the SAR distribution with resolution settings for area scan and zoom scan according KDB 865664 D01 as shown in Table 2.
- The used extrapolation and interpolation routines are all based on the modified Quadratic Shepard´s method [DASY4].
- Repetition of the E-field measurement at the fixed location (P1) and repetition of the whole procedure if the two results differ by more than ± 0.21dB.

<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">$\leq 1.5 \cdot \Delta Z_{Zoom}(n-1)$</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">Notes: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium: see draft standard IEEE P1528-2013 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 2: Parameters for SAR scan procedures.

5 System Verification and Test Conditions

5.1 Date of Testing

Date of Testing				
Band		Frequency [MHz]	Date of System Check	Date of SAR Measurement
Bluetooth	Body	2450	March 23, 2017	March 23, 2017

Table 3: Date of testing.

5.2 Environment Conditions

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

Table 4: Environment Conditions.

5.3 Tissue Simulating Liquid Recipes

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

Table 5: Recipes of the tissue simulating liquid.

5.4 Tissue Parameters

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

Tissue Simulating Liquids								
Ambient Temperature(C) : 22.0 ± 2			Liquid Temperature(C): 22.2			Humidity (%) : 40.0 ± 5		
Band	Frequency [MHz]	Channel	Permittivity			Conductivity		
			Measured	Target	Delta	Measured	Target	Delta
			ε'	ε'	+/- 5 [%]	σ [S/m]	σ [S/m]	+/- 5 [%]
Bluetooth	2450	System Check	50.7	52.7	-3.8	2.02	1.95	3.6
	2402	0	50.9	52.8	-3.6	1.96	1.90	3.1
	2441	39	50.7	52.7	-3.8	2.01	1.94	3.4
	2480	78	50.6	52.7	-3.9	2.06	1.99	3.3

Table 6: 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 signal) and it was placed under the flat part of the SAM phantom. The target and measured results are listed in the table 7 and shown in Appendix C - System Verification Plots. The target values were adopted from the calibration certificates found also in the appendix.

System Check Results									
Frequency [MHz]	Tissue	Dipole	Dipole SN	SAR_{1g} [W/kg]			SAR_{10g} [W/kg]		
				Measured	Target	Delta [%]	Measured	Target	Delta [%]
2450	Body	D2450V2	709	14.0	13.08	7.03	6.53	6.18	5.66

Table 7: Dipole target and measured results.

6 SAR Measurement Conditions and Results

6.1 Test Conditions

Test Conditions					
Band	TX Range [MHz]	RX Range [MHz]	Used Channels	Crest Factor	Phantom
Bluetooth Classic CW	2402.0 – 2480.0	2402.0 – 2480.0	0, 39, 78	1	SAM Twin Phantom V4.0

Table 8: Used channels and crest factors during the test.

6.2 Tune-Up Information

Tune-Up Information					
Band	Mode	Frequency [MHz]	Nominal Target Power [dBm]	Power Tolerance [dB]	Max. Tune-Up Tolerance Limit [dBm]
Bluetooth	Classic	2402 - 2480	8.0	+/- 2	10.0
Bluetooth	Low Energy	2402 - 2480	4.0	+/- 2	6.0

Table 9: Maximum transmit output power values declared by the manufacturer.

6.3 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.

Standalone SAR Test Exclusion								
Mode	Frequency [MHz]	Distance [mm]	Pavg [dBm]	Pavg [mW]	Calculated Values	Exclusion Threshold for 1g SAR	SAR Testing Exclusion	SAR Testing Required
						HEAD/BODY	HEAD/BODY	HEAD/BODY
BT Classic	2441	5	10.0	10.00	3.12	≤ 3.0	NO	YES
BT Low Energy	2440	5	6.0	3.98	1.24	≤ 3.0	YES	NO

Table 10: Standalone SAR test exclusion for the applicable transmitter.

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

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

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

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

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

6.4 Measured Output Power for Bluetooth

Measurements has been performed in worst case configuration with test software settings for maximum output power level with un-modulated CW signal.

Measured Average Output Power [dBm]			
Mode	Freq. [MHz]	CH	Measured Output Power [dBm]
Bluetooth Classic CW	2402	0	8.2
	2441	39	8.4
	2480	78	8.8
Bluetooth LE	2440	19	excluded

Table 11: Conducted output power values for Bluetooth.

6.5 SAR Test Considerations for USB dongles

According to chapter 5.2.3 of KDB 447498 D01 peripheral transmitters that operate through user accessible external interface connections must be tested conservatively as required by the published RF exposure KDB procedures or according to a minimum test separation distance applicable to all operating configurations and exposure conditions required by the host platform.

A test separation distance ≤ 5 mm is required for these types of peripheral transmitters to operate in host devices that transmit next to users. When a peripheral transmitter, such as a USB dongle, must be connected to the host through an external cable or adapter, a test separation distance ≤ 15 mm should be applied to test the required device orientations.

6.6 Single and Multiple Host Platform Considerations for USB dongles

According to chapter 5.2.2 b of KDB 447498 D01 peripheral transmitters may be approved to operate in multiple host platforms when the highest reported 1-g SAR is > 0.4 W/kg and ≤ 0.8 W/kg.

6.7 SAR Results

SAR assessment was conducted in the worst case configuration with output power values according to Table 11. According 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.

SAR Results for Bluetooth

Band	Freq. [MHz]	CH	EUT Configuration	Gap [mm]	Pic. No.	Measured SAR1g [W/kg]	Power Drift [dB]	Output Power [dB]		Tune-Up Scaling Factor	Reported SAR1g [W/kg]	Plot No.
								measured	limit			
BT Classic CW	2441	39	Front / Pos. 1	0	3	0.356	-0.077	8.4	10.0	1.445	0.515	1
			Back / Pos. 2	0	4	0.343	-0.086	8.4	10.0	1.445	0.496	-
			Left / Pos. 3	0	5	0.228	-0.079	8.4	10.0	1.445	0.330	-
			Right / Pos. 4	0	6	0.289	-0.154	8.4	10.0	1.445	0.418	-
			Top / Pos. 5	0	7	0.061	-0.087	8.4	10.0	1.445	0.088	-
	2402	0	Front / Pos. 1	0	3	0.219	0.033	8.2	10.0	1.514	0.331	-
	2480	78	Front / Pos. 1	0	3	0.362	0.034	8.8	10.0	1.318	0.477	-

Notes:
Since the measured max SAR is < 0.8 W/kg measurement variability assessment according to KDB 865664 is not applicable.
To establish a connection at a specific channel and with maximum output power, engineering test software has been used. Measurements have been performed in direct contact to the flat part of the SAM phantom.

Table 12: SAR measurement results.

To control the output power stability during the SAR test the used DASY4 system calculates the power drift by measuring the e-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in the above tables labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

7 Administrative Measurement Data

7.1 Calibration of Test Equipment

Test Equipment Overview						
	Test Equipment	**Manufacturer**	**Model**	**Serial Number**	**Last Calibration**	**Next Calibration**
DASY System Components						
☒	Software Versions DASY4	SPEAG	V4.7	N/A	N/A	N/A
☒	Software Versions SEMCAD	SPEAG	V1.8	N/A	N/A	N/A
☐	Dosimetric E-Field Probe	SPEAG	ET3DV6R	1579	02/2016	02/2018
☐	Dosimetric E-Field Probe	SPEAG	ET3DV6R	1669	02/2017	02/2018
☒	Dosimetric E-Field Probe	SPEAG	EX3DV4	3536	09/2016	09/2017
☐	Dosimetric E-Field Probe	SPEAG	EX3DV4	3860	09/2015	09/2017
☐	Data Acquisition Electronics	SPEAG	DAE 3	335	02/2017	02/2018
☒	Data Acquisition Electronics	SPEAG	DAE 4	631	09/2016	09/2017
☐	Phantom	SPEAG	SAM	1059	N/A	N/A
☒	Phantom	SPEAG	SAM	1176	N/A	N/A
☐	Phantom	SPEAG	SAM	1340	N/A	N/A
☐	Phantom	SPEAG	SAM	1341	N/A	N/A
☐	Phantom	SPEAG	ELI4	1004	N/A	N/A
Dipoles						
☐	System Validation Dipole	SPEAG	D450V2	1014	03/2015	03/2018
☐	System Validation Dipole	SPEAG	D835V2	470	03/2015	03/2018
☐	System Validation Dipole	SPEAG	D900V2	006	11/2015	11/2018
☐	System Validation Dipole	SPEAG	D1640V2	311	09/2015	09/2018
☐	System Validation Dipole	SPEAG	D1750V2	1005	03/2015	03/2018
☐	System Validation Dipole	SPEAG	D1900V2	535	03/2015	03/2018
☒	System Validation Dipole	SPEAG	D2450V2	709	11/2015	11/2018
☐	System Validation Dipole	SPEAG	D2600V2	1019	11/2015	11/2018
☐	System Validation Dipole	SPEAG	D5GHzV2	1028	06/2014	06/2017
Material Measurement						
☒	Network Analyzer	Agilent	E5071C	MY46103220	07/2015	07/2017
☒	Dielectric Probe Kit	SPEAG	DAK-3.5	1234	01/2016	01/2018
☒	Thermometer	LKMelectronic	DTM3000	3511	01/2016	01/2018
Power Meters and Sensors						
☐	Power Meter	Agilent	E4416A	GB41050414	02/2015	02/2017
☐	Power Sensor	Agilent	E9301H	US40010212	03/2015	03/2017
☐	Power Meter	Agilent	E4417A	GB41050441	02/2015	02/2017
☐	Power Sensor	Agilent	E9301A	MY41495584	03/2015	03/2017
☒	Power Meter	Anritsu	ML2487A	6K00002319	06/2016	06/2018
☒	Power Meter	Anritsu	ML2488A	6K00002078	06/2016	06/2018
☒	Power Sensor	Anritsu	ML2472A	002122	06/2016	06/2018
☒	Power Sensor	Anritsu	MA2472A	990365	06/2016	06/2018
☒	Spectrum Analyzer	Rohde & Schwarz	FSP7	100433	04/2016	04/2018
RF Sources						
☒	Network Analyzer	Agilent	E5071C	MY46103220	07/2015	07/2017
☒	RF Generator	Rohde & Schwarz	SM300	100142	N/A	N/A
Amplifiers						
☒	Amplifier 10 MHz – 4200 MHz	Mini Circuits	ZHL-42-42W	D080504-1	N/A	N/A
☐	Amplifier 2 GHz – 6 GHz	Ciao Wireless	CA26-451	37452	N/A	N/A
Radio Tester						
☐	Radio Communication Tester	Anritsu	MT8815B	6200576536	04/2016	04/2018
☐	Radio Communication Tester	Anritsu	MT8820C	6200918336	04/2016	04/2018
Notes: Used test equipment for measurement is checked above.						

Table 13: Calibration of test equipment.

7.2 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 14: 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 15: Uncertainty budget for SAR system validation.

8 Report History

Revision History				
Revision	**Description of Revision**	**Date**	**Revised Page**	**Revised By**
/	Initial Release	March 27, 2017	-	-
-	-	-		

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