

FCC SAR Test Report

APPLICANT	: TAG Heuer, branch of LVMH Swiss Manufactures SA
EQUIPMENT	: Smart watch
BRAND NAME	: TAG HEUER
MODEL NAME	: SBG8A
FCC ID	: 2AUP8SBG8A
STANDARD	: FCC 47 CFR Part 2 (2.1093)
	ANSI/IEEE C95.1-1992
	IEEE 1528-2013

The product was received on Sep. 19, 2019 and testing was completed on Sep. 27, 2019. We, Sporton International (Kunshan) Inc, would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

2050 Warg

Reviewed by: Rose Wang / Supervisor

Lat, Kin

Approved by: Kat Yin / Manager



Sporton International (Kunshan) Inc. No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China



Table of Contents

1. Statement of Compliance	4
2. Administration Data	5
3. Guidance Applied	5
4. Equipment Under Test (EUT) Information	6
4.1 General Information	6
5. RF Exposure Limits	7
5.1 Uncontrolled Environment	7
5.2 Controlled Environment	7
6. Specific Absorption Rate (SAR)	8
6.1 Introduction	8
6.2 SAR Definition	8
7. System Description and Setup	9
7.1 E-Field Probe	10
7.2 Data Acquisition Electronics (DAE)	10
7.3 Phantom	11
7.4 Device Holder	12
8. Measurement Procedures	13
8.1 Spatial Peak SAR Evaluation	13
8.2 Power Reference Measurement	14
8.3 Area Scan	14
8.4 Zoom Scan	15
8.5 Volume Scan Procedures	15
8.6 Power Drift Monitoring	15
9. Test Equipment List	16
10. System Verification	17
10.1 Tissue Simulating Liquids	17
10.2 Tissue Verification	18
10.3 System Performance Check Results	19
11. RF Exposure Positions	20
11.1 Limb-Worn Accessory	20
12. Conducted RF Output Power (Unit: dBm)	21
13. SAR Test Results	24
13.1 Wrist-Worn SAR	25
14. Simultaneous Transmission Analysis	26
15. Uncertainty Assessment	27
16. References	28
Appendix A. Plots of System Performance Check	
Appendix B. Plots of High SAK Measurement	
Appendix C. DASY Calibration Certificate	

Appendix D. Test Setup Photos



Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA991902	Rev. 01	Initial issue of report	Oct. 16, 2019



1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **TAG Heuer**, branch of **LVMH Swiss Manufactures SA**, Smart watch, SBG8A, are as follows.

			Highest SAR Summary
Equipment		Frequency	Wrist-worn SAR
Class		Band	(Separation 0mm)
			10g SAR (W/kg)
DTS	WLAN	2.4GHz WLAN	<0.10
DSS	Bluetooth Bluetooth		<0.10
Date of Testing:		2019/9/27	

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled 10g Extremity SAR (4.0 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.



2. Administration Data

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
FCC Designation No. FCC Test Firm Registration		FCC Test Firm Registration No.	
Test Site No.	CN1257	314309	
Applicant			
Company Name	TAC House branch of LV/MH Swing Manufacture	- SA	

TAG Hedel, blanch of Evilin 1 Swiss Manufactures SA		
Address 6A rue Louis-Joseph Chevrolet, 2300 La Chaux-de-Fonds, Switzerland		
Manufacturer		
Company Name TAG Heuer, branch of LVMH Swiss Manufactures SA		
Address	6A rue Louis-Joseph Chevrolet, 2300 La Chaux-de-Fonds, Switzerland	

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02



4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification		
Equipment Name	Smart watch	
Brand Name	TAG HEUER	
Model Name	SBG8A	
FCC ID	2AUP8SBG8A	
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC : 13.56 MHz(RX only)	
Mode	WLAN 2.4GHz 802.11b/g/n HT20 Bluetooth BR/EDR/LE NFC:ASK (RX only)	
HW Version	LLWM810C1-3	
SW Version	LLDQ9001	
EUT Stage	Identical Prototype	
Remark: 1. 802.11n-HT40 is not sup 2. The device has two type verified the worst case of	oported in 2.4GHz WLAN. e watch wristbands, chose one wristband to perform full SAR testing, and another wristband of the first wristband SAR.	



5. <u>RF Exposure Limits</u>

5.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.



6. Specific Absorption Rate (SAR)

6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$SAR = \frac{d}{dt} \left(\frac{dW}{dm} \right) = \frac{d}{dt} \left(\frac{dW}{\rho dv} \right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

$$SAR = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

7. System Description and Setup



The DASY system used for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.



7.1 <u>E-Field Probe</u>

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG). The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)	
Directivity	±0.3 dB in TSL (rotation around probe axis)	the second s
Dynamic Range	$10 \ \mu\text{W/g} = >100 \ \text{mW/g}$ Linearity: ±0.2 dB (noise: typically <1 μ W/g)	
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	

7.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



Fig 5.1 Photo of DAE



7.3 Phantom

<SAM Tw

<sam phantom="" twin=""></sam>		
Shell Thickness	2 ± 0.2 mm;	
	Center ear point: 6 ± 0.2 mm	· · · · · · · · · · · · · · · · · · ·
Filling Volume	Approx. 25 liters	
Dimensions	Length: 1000 mm; Width: 500 mm; Height:	
	adjustable feet	S
Measurement Areas	Left Hand, Right Hand, Flat Phantom	

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)	
Filling Volume	Approx. 30 liters	
Dimensions	Major ellipse axis: 600mm Minor axis: 400mm	

The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.



7.4 <u>Device Holder</u>

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.



Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.



Mounting Device for Laptops



8. <u>Measurement Procedures</u>

The measurement procedures are as follows:

<Conducted power measurement>

- (a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- (b) Read the WWAN RF power level from the base station simulator.
- (c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
- (d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix D demonstrates.
- (c) Set scan area, grid size and other setting on the DASY software.
- (d) Measure SAR results for the highest power channel on each testing position.
- (e) Find out the largest SAR result on these testing positions of each band
- (f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

8.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values form the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g



8.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	\leq 3 GHz	> 3 GHz		
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	$5 \pm 1 \text{ mm}$	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5 \text{ mm}$		
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^{\circ} \pm 1^{\circ}$	$20^{\circ} \pm 1^{\circ}$		
	\leq 2 GHz: \leq 15 mm 2 - 3 GHz: \leq 12 mm	$3 - 4 \text{ GHz:} \le 12 \text{ mm}$ $4 - 6 \text{ GHz:} \le 10 \text{ mm}$		
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}	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 \leq the corresponding x or y dimension of the test device with at least one measurement point on the test device			



8.4 <u>Zoom Scan</u>

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

			\leq 3 GHz	> 3 GHz		
Maximum zoom scan s	spatial reso	lution: Δx_{Zoom} , Δy_{Zoom}	≤ 2 GHz: ≤ 8 mm 2 - 3 GHz: ≤ 5 mm [*]	$3 - 4 \text{ GHz:} \le 5 \text{ mm}^*$ $4 - 6 \text{ GHz:} \le 4 \text{ mm}^*$		
	uniform	grid: $\Delta z_{Zoom}(n)$	\leq 5 mm	$3 - 4 \text{ GHz:} \le 4 \text{ mm}$ $4 - 5 \text{ GHz:} \le 3 \text{ mm}$ $5 - 6 \text{ GHz:} \le 2 \text{ mm}$		
Maximum zoom scan spatial resolution, normal to phantom surface	graded	$\begin{array}{c c} \Delta z_{\text{Zoom}}(1) \text{: between} \\ 1^{\text{st}} \text{ two points closest} \\ \text{to phantom surface} \end{array} \leq 4 \text{ mm}$		3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm		
	grid	∆z _{Zoom} (n>1): between subsequent points	≤1.5·∆z	Zoom(n-1)		
Minimum zoom scan volume	x, y, z		\geq 30 mm	$3 - 4 \text{ GHz}: \ge 28 \text{ mm}$ $4 - 5 \text{ GHz}: \ge 25 \text{ mm}$ $5 - 6 \text{ GHz}: \ge 22 \text{ mm}$		

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is \leq 1.4 W/kg, \leq 8 mm, \leq 7 mm and \leq 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.

8.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.



9. Test Equipment List

	Nome of Faultament	True /Mendel		Calib	ration	
Manufacturer	Name or Equipment	i ype/iviodei	Serial Number	Last Cal.	Due Date	
SPEAG	2450MHz System Validation Kit	D2450V2	908	2019/3/25	2020/3/24	
SPEAG	Data Acquisition Electronics	DAE4	690	2019/1/23	2020/1/22	
SPEAG	Dosimetric E-Field Probe	EX3DV4	3935	2018/11/26	2019/11/25	
SPEAG	SAM Twin Phantom	QD 000 P40 CB	TP-1754	NCR	NCR	
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR	
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2019/4/17	2020/4/16	
SPEAG	Dielectric Probe Kit	DAK-3.5	1138	2018/11/20	2019/11/19	
Anritsu	Vector Signal Generator	MG3710A	6201682672	2019/1/14	2020/1/13	
R&S	Power Meter	NRVD	102081	2019/8/19	2020/8/18	
R&S	Power Sensor	NRV-Z5	100538	2019/8/19	2020/8/18	
R&S	Power Sensor	NRV-Z5	100539	2019/8/19	2020/8/18	
R&S	CBT BLUETOOTH TESTER	СВТ	101641	2019/1/14	2020/1/13	
EXA	Spectrum Analyzer	FSV7	101631	2019/1/14	2020/1/13	
Testo	Hygrometer	608-H1	1241332126	2019/8/20	2020/8/19	
FLUKE	DIGITAC THERMOMETER	51II	97240029	2019/8/7	2020/8/6	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	No	ote	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	No	ote	
ARRA	Power Divider	A3200-2	N/A	No	ote	
MCL	Attenuation1	BW-S10W5+	N/A	Note		
MCL	Attenuation2	BW-S10W5+	N/A	Note		
MCL	Attenuation3	BW-S10W5+	N/A	Note		
Agilent	Dual Directional Coupler	778D	20500	Note		
Agilent	Dual Directional Coupler	11691D	MY48151020	No	ote	

Note:

Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.



10. System Verification

10.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.1.



Fig 10.1 Photo of Liquid Height for Body SAR



10.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt Preventol (%) (%)		DGBE (%)	Conductivity (σ)	Permittivity (εr)
				For Head				
2450	55.0	0	0	0	0	45.0	1.80	39.2

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε _r)	Conductivity Target (σ)	Permittivity Target (ε _r)	Delta (σ) (%)	Delta (ε _r) (%)	Limit (%)	Date
2450	Head	22.6	1.831	39.196	1.80	39.20	1.72	-0.01	±5	2019/9/27



10.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2019/9/27	2450	Head	250	908	3935	690	6.02	24.20	24.08	-0.50





Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo



11. <u>RF Exposure Positions</u>

11.1 Limb-Worn Accessory

A limb-worn device is a unit whose intended use includes being strapped to the arm of the user while transmitting. The strap shall be opened so that it is divided into two parts as following picture. The device shall be positioned directly against the phantom surface with the strap straightened as much as possible and the back of the device towards the phantom. If the strap cannot normally be opened to allow placing in direct contact with the phantom surface, it may be necessary to break the strap of the device but ensuring to not damage the antenna.





12. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

- 1. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
- 2. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
- 3. For OFDM transmission configurations in the 2.4 GHz, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
- 4. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
 - a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
 - b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
 - c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.



Report No. : FA991902

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
		1	2412	17.82	19.00	
	802.11b 1Mbps	6	2437	17.95	19.00	97.59
		11	2462	<mark>18.38</mark>	19.00	
2.40112 WLAN		1	2412	12.80	14.00	
	802.11g 6Mbps	6	2437	12.66	14.00	87.44
		11	2462	12.60	14.00	
		1	2412	11.83	13.00	
	802.11n-HT20 MCS0	6	2437	11.66	13.00	86.70
		11	2462	11.40	13.00	



<2.4GHz Bluetooth>

General Note:

- 1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power.
- 2. The Bluetooth duty cycle is 76.99 % as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR scaling need further consideration and the theoretical duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation



Mada	Channel	Frequency	Average power (dBm)	Tuno un limit (dPm)	
Mode	Channel	(MHz)	1Mbps	типе-ир шпік (авті)	
	CH 00	2402	10.89		
BR/EDR	CH 39	2441	<mark>11.02</mark>	12.00	
	CH 78	2480	10.55		

Mada	Channel	Frequency	Average power (dBm)
Nioue	Channer	(MHz)	GFSK
	CH 00	2402	<mark>1.15</mark>
LE4.0	CH 19	2440	0.81
	CH 39	2480	0.72
	Tune-up Limit		2.00





13. SAR Test Results

General Note:

- 1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
 - b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
 - c. For WLAN/BT: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
- 2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
 - $\cdot \leq$ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is \leq 100 MHz
 - · ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
 - · ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
- 3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
- 4. The device has two type watch wristbands, chose one wristband to perform full SAR testing, and another wristband verified the worst case of the first wristband SAR.

WLAN Note:

- 1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
- 2. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
- For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
- 4. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

Page 24 of 28



Report No. : FA991902

<WLAN SAR>

Plot No.	Band	Mode	Test Position	configure	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
01	WLAN2.4GHZ	802.11b 1Mbps	Back	wristband1	0	1	2412	17.82	19.00	1.312	97.59	1.025	-0.06	0.010	<mark>0.014</mark>
	WLAN2.4GHZ	802.11b 1Mbps	Back	wristband1	0	6	2437	17.95	19.00	1.274	97.59	1.025	0.02	0.002	0.003
	WLAN2.4GHZ	802.11b 1Mbps	Back	wristband1	0	11	2462	18.38	19.00	1.153	97.59	1.025	0.02	0.002	0.003
	WLAN2.4GHZ	802.11b 1Mbps	Back	wristband2	0	1	2412	17.82	19.00	1.312	97.59	1.025	-0.05	0.004	0.005

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	configure	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	Bluetooth	1Mbps	Back	wristband1	0	0	2402	10.89	12.00	1.291	76.99	1.082	0.02	<0.001	<0.001
	Bluetooth	1Mbps	Back	wristband1	0	39	2441	11.02	12.00	1.253	76.99	1.082	0.07	<0.001	<0.001
	Bluetooth	1Mbps	Back	wristband1	0	78	2480	10.55	12.00	1.396	76.99	1.082	-0.03	<0.001	<0.001
02	Bluetooth	1Mbps	Back	wristband2	0	78	2480	10.55	12.00	1.396	76.99	1.082	0.01	<0.001	<mark><0.001</mark>



14. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations
1.	None

General Note:

1. WLAN2.4GHz and Bluetooth share the same antenna, so WLAN and Bluetooth cannot transmit simultaneously.

Test Engineer: Nick Hu, Yuan Zhao, Jiaxing Chang, Yuankai Kong

-----THE END------



15. Uncertainty Assessment

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be \leq 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

SPORTON LAB. FCC SAR Test Report

16. <u>References</u>

- [1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
- [2] ANSI/IEEE Std. C95.1-1992, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", September 1992
- [3] IEEE Std. 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", Sep 2013
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [6] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.
- [7] FCC KDB 447498 D01 v06, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Oct 2015
- [8] FCC KDB 248227 D01 v02r02, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", Oct 2015.



Report No. : FA991902

Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Head_2450MHz

DUT: D2450V2 - SN:908

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1 Medium: HSL_2450 Medium parameters used: f = 2450 MHz; $\sigma = 1.831$ S/m; $\epsilon_r = 39.196$; $\rho = 1000$ kg/m³ Ambient Temperature : 23.2 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3935; ConvF(7.69, 7.69, 7.69); Calibrated: 2018.11.26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn690; Calibrated: 2019.1.23
- Phantom: SAM2; Type: SAM; Serial: TP:1754
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Pin=250mW/Area Scan (71x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm Maximum value of SAR (interpolated) = 21.4 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 86.03 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 28.8 W/kg **SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.02 W/kg Maximum value of SAR (measured) = 20.8 W/kg**



0 dB = 21.4 W/kg = 13.3 dBW/kg



Report No. : FA991902

Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab

Date: 2019.9.27

01_WLAN2.4GHz_802.11b 1Mbps_Back_0mm_Ch1

Communication System: UID 0, 802.11b (0); Frequency: 2412 MHz;Duty Cycle: 1:1.025 Medium: HSL_2450 Medium parameters used: f = 2412 MHz; $\sigma = 1.787$ S/m; $\epsilon_r = 39.349$; $\rho = 1000$ kg/m³ Ambient Temperature : 23.2 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3935; ConvF(7.69, 7.69, 7.69); Calibrated: 2018.11.26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn690; Calibrated: 2019.1.23
- Phantom: SAM2; Type: SAM; Serial: TP:1754
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Ch1/Area Scan (61x51x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm Maximum value of SAR (interpolated) = 0.0375 W/kg

Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 2.806 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 0.0460 W/kg SAR(1 g) = 0.021 W/kg; SAR(10 g) = 0.010 W/kg Maximum value of SAR (measured) = 0.0357 W/kg



0 dB = 0.0375 W/kg = -14.26 dBW/kg

02_Bluetooth_1Mbps_Back_0mm_Ch78

Communication System: UID 0, Bluetooth (0); Frequency: 2480 MHz;Duty Cycle: 1:1.299 Medium: HSL_2450 Medium parameters used: f = 2480 MHz; $\sigma = 1.866$ S/m; $\varepsilon_r = 39.081$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3935; ConvF(7.69, 7.69, 7.69); Calibrated: 2018.11.26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn690; Calibrated: 2019.1.23
- Phantom: SAM2; Type: SAM; Serial: TP:1754
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Ch78/Area Scan (71x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm Maximum value of SAR (interpolated) = 0.00333 W/kg

Ch78/Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 0 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 0.00169 W/kg SAR(1 g) = 2.65e-005 W/kg; SAR(10 g) = 4.58e-006 W/kg Maximum value of SAR (measured) = 0.00169 W/kg



0 dB = 0.00333 W/kg = -24.78 dBW/kg



Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.





Fax: +86-10-62304633-2504

http://www.chinattl.cn



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 E-mail: cttl@chinattl.com

Client

Sporton

CALIBRATION CERTIFICATE

Certificate No: Z19-60087

Object D2450V2 - SN: 908 Calibration Procedure(s) FF-Z11-003-01 Calibration Procedures for dipole validation kits Calibration date: March 25, 2019 This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3) C and humidity<70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID# Cal Date(Calibrated by, Certificate No.) Scheduled Calibration Power Meter NRP2 20-Aug-18 (CTTL, No.J18X06862) 106277 Aug-19 Power sensor NRP8S 104291 20-Aug-18 (CTTL, No.J18X06862) Aug-19 Reference Probe EX3DV4 SN 3617 31-Jan-19(SPEAG, No.EX3-3617 Jan19) Jan-20 DAE4 SN 1331 06-Feb-19(SPEAG,No.DAE4-1331 Feb19) Feb-20 Secondary Standards ID # Cal Date(Calibrated by, Certificate No.) Scheduled Calibration Signal Generator E4438C MY49071430 23-Jan-19 (CTTL, No.J19X00336) Jan-20 NetworkAnalyzer E5071C MY46110673 24-Jan-19 (CTTL, No.J19X00547) Jan-20 Name Function Signature Calibrated by: Zhao Jing SAR Test Engineer Reviewed by: Lin Hao SAR Test Engineer Approved by: Qi Dianyuan SAR Project Leader Issued: March 28, 2019

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



In Collaboration with
SDEAG

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
 of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed
 point exactly below the center marking of the flat phantom section, with the arms oriented
 parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole
 positioned under the liquid filled phantom. The impedance stated is transformed from the
 measurement at the SMA connector to the feed point. The Return Loss ensures low
 reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.



In Collaboration with

CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.6 ± 6 %	1.84 mho/m ±6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.8 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.8 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.6 W/kg ± 18.7 % (k=2)



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 E-mail: cttl@chinattl.com

Fax: +86-10-62304633-2504 http://www.chinattl.cn

e

a

a

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.3Ω+ 5.18 jΩ	
Return Loss	- 21.6dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.6Ω+ 5.81 jΩ	
Return Loss	- 24.1dB	

General Antenna Parameters and Design

Electrical Delay (one direction) 1.	020 ns
-------------------------------------	--------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Man	ufactured by	SPEAG



In Colleboration with

CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Date: 03.25.2019

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908** Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; σ = 1.841 S/m; ε_r = 39.63; ρ = 1000 kg/m3 Phantom section: Right Section DASY5 Configuration:

> Probe: EX3DV4 - SN3617; ConvF(7.62, 7.62, 7.62) @ 2450 MHz; Calibrated: 1/31/2019

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- · Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.04 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 28.3 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.07 W/kg

Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.50 dBW/kg



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

e

а

a

Impedance Measurement Plot for Head TSL





In Collaboration with e а α

CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908 Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; $\sigma = 2.003$ S/m; $\epsilon_r = 53.78$; $\rho = 1000$ kg/m3 Phantom section: Center Section DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.79, 7.79, 7.79) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP V5.1C ; Type: QD 000 P51CA; Serial: 1062 .
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 . (7450)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.51 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.1 W/kg

SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.91 W/kg

Maximum value of SAR (measured) = 21.4 W/kg



0 dB = 21.4 W/kg = 13.30 dBW/kg

Certificate No: Z19-60087

Date: 03.25.2019



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Body TSL







Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, ChinaTel: +86-10-62304633-2512Fax: +86-10-62304633-2504E-mail: cttl@chinattl.comHttp://www.chinattl.cn

Client :	Sporton
----------	---------

Des

Certificate No: Z19-60028

CALIBRATION	CERTIFIC	ATE	
Object	DAE	4 - SN: 690	
Calibration Procedure(s) FF-Z Calib (DAE	11-002-01 ration Procedure for the Data Acquis x)	sition Electronics
Calibration date:	Janu	ary 23, 2019	
This calibration Certifica measurements(SI). The pages and are part of th	ate documents the measurements ar e certificate.	e traceability to national standards, wh Id the uncertainties with confidence prob	ich realize the physical units of bability are given on the following
All calibrations have be humidity<70%.	een conducted in	the closed laboratory facility: enviro	nment temperature(22±3)°C and
Calibration Equipment u	sed (M&TE critica	for calibration)	
Primary Standards	ID# C	al Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J18X05034)	June-19
	Name	Function	Signatura
Calibrated by:	Yu Zongying	SAR Test Engineer	Auth
Reviewed by:	Lin Hao	SAR Test Engineer	the sector
Approved by:	Qi Dianyuan	SAR Project Leader	302
This calibration certificate	e shall not be repro	ا oduced except in full without written app	ssued: January 24, 2019 roval of the laboratory.



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, ChinaTel: +86-10-62304633-2512E-mail: cttl@chinattl.comHttp://www.chinattl.cn

Glossary: DAE Connector angle

data acquisition electronics information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- DC Voltage Measurement: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- Connector angle: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com Http://www.chinattl.cn

DC Voltage Measurement A/D - Converter Resolution nominal

High Range: 1LSB = 6.1µV, full range = -100...+300 mV Low Range: 1LSB =61nV, full range = -1.....+3mV DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors X		Y	Z	
High Range	404.780 \pm 0.15% (k=2)	$404.400 \pm 0.15\%$ (k=2)	405.364 ± 0.15% (k=2)	
Low Range	$3.96820 \pm 0.7\%$ (k=2)	$3.96625 \pm 0.7\%$ (k=2)	3.99228 ± 0.7% (k=2)	

Connector Angle

Connector Angle to be used in DASY system	306°±1°
---	---------

Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





S Schweizerischer Kalibrierdienst

- C Service suisse d'étalonnage
- Servizio svizzero di taratura
- Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Client Sporton

Certificate No: EX3-3935_Nov18

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3935						
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes						
Calibration date:	November 26, 2018						
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.							

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

		Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards		04 Apr 18 (No. 217-02672/02673)	Apr-19
Power meter NRP	SN: 104778	04-Apr-18 (NO. 217-02072/02073)	Apr 10
Power sensor NRP-791	SN: 103244	04-Apr- <u>18 (No. 217-02672)</u>	Apt-19
Power sensor NRP-791	SN: 103245	04-Apr-1 <u>8 (No. 217-02673)</u>	Apr-19
	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference 20 dB Attenuator		30-Dec-17 (No ES3-3013 Dec17)	Dec-18
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. <u>200-0010</u> <u>20017</u>)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-060_Dec17)	
D days Ober days		Check Date (in house)	Scheduled Check
Secondary Standards		06 Apr. 16 (in house check Jun-18)	In house check: Jun-20
Power meter E4419B	SN: GB41293874		In house check: Jun-20
Power sensor F4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	
	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A		04-Aug-99 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642001700		In house check: Oct-19
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in nouse check Oct-18)	In house on our over to

Calibrated by:	Name Manu Seitz	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	etter
			Issued: November 27, 2018
This calibration certifica	ate shall not be reproduced except	in full without written approval of the lab	oratory.

Calibration Laboratory of Schmid & Partner **Engineering AG** Zeughausstrasse 43, 8004 Zurich, Switzerland





S

С

Schweizerischer Kalibrierdienst

- Service suisse d'étalonnage
- Servizio svizzero di taratura

Accreditation No.: SCS 0108

S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORMx.v.z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A. B. C. D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization 9	9 rotation around an axis that is in the plane normal to probe axis (at measurement center),
	i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from handheld and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORMx, y, z: Assessed for E-field polarization $\vartheta = 0$ (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- $NORM(f)x, y, z = NORMx, y, z * frequency_response$ (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx, y, z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMx (no uncertainty required).

Probe EX3DV4

SN:3935

Manufactured: Calibrated: July 24, 2013 November 26, 2018

Calibrated for DASY/EASY Systems (Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Basic Calibration Parameters

Sensor X	Sensor Y	Sensor Z	Unc (k=2)	
0.48	0.52	0.47	± 10.1 %	
107.8	103.4	108.1		
	0.48 107.8	Sensor X Sensor Y 0.48 0.52 107.8 103.4	Sensor X Sensor Y Sensor Y Sensor Y 0.48 0.52 0.47 107.8 103.4 108.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	С	D dB	VR mV	Unc (k=2)
0	CW	X	0.0	0.0	1.0	0.00	184.3	±3.0 %
		Y	0.0	0.0	1.0		192.9	
		Z	0.0	0.0	1.0		188.3	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

 ^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).
 ^B Numerical linearization parameter: uncertainty not required.
 ^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	10.83	10.83	10.83	0.54	0.80	± 12.0 %
025	41.5	0.90	10.48	10.48	10.48	0.50	0.80	± 12.0 %
000	41.5	0.97	10.38	10.38	10.38	0.50	0.85	± 12.0 %
1750	40.1	1.37	8.91	8.91	8.91	0.39	0.85	± 12.0 %
1/50	40.0	1.40	8.50	8.50	8.50	0.28	0.85	± 12.0 %
2000	40.0	1 40	8.33	8.33	8.33	0.32	0.84	± 12.0 %
2000	39.5	1.67	7.99	7.99	7.99	0.26	0.96	± 12.0 %
2300	30.2	1.80	7.69	7.69	7.69	0.39	0.82	± 12.0 %
2400	39.0	1.96	7.38	7.38	7.38	0.32	0.98	± 12.0 %

Calibration Parameter Determined in Head Tissue Simulating Media

^c Frequency validity above 300 MHz of \pm 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to \pm 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is \pm 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency wildity are the uncertainty of the \pm 110 MHz

validity can be extended to \pm 110 MHz. F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to \pm 5%. The uncertainty is the RSS of measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to \pm 5%. The uncertainty is the RSS of

the ConvF uncertainty for indicated target tissue parameters. ⁶ Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

€ (MUz) C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
	rennitivity						0.04	1 10 0 0/
750	55.5	0.96	10.72	10.72	10.72	0.53	0.81	± 12.0 %
835	55.2	0.97	10.41	10.41	10.41	0.49	0.80	± 12.0 %
000	00.2						0.00	+ 12 0 %
1750	53.4	1.49	8.45	8.45	8.45	0.41	0.80	<u> </u>
1900	53.3	1.52	8.07	8.07	8.07	0.41	0.81	± 12.0 %
2200	52.9	1 81	7.86	7.86	7.86	0.35	0.86	± 12.0 %
2300	02.0				7.00	0.25	0.00	+ 12 0 %
2450	52.7	1.95	7.68	7.68	/.68	0.35	0.69	12.0 /
2600	52.5	2.16	7.52	7.52	7.52	0.29	0.99	± 12.0 %

Calibration Parameter Determined in Body Tissue Simulating Media

^c Frequency validity above 300 MHz of \pm 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to \pm 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is \pm 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to \pm 110 MHz.

validity can be extended to \pm 110 MHz. ^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to \pm 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to \pm 5%. The uncertainty is the RSS of measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to \pm 5%. The uncertainty is the RSS of

the ConvF uncertainty for indicated target tissue parameters. ⁶ Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.





Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)



Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$

Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)



Dynamic Range f(SAR_{head}) (TEM cell , f_{eval}= 1900 MHz)

Uncertainty of Linearity Assessment: ± 0.6% (k=2)



Conversion Factor Assessment

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Other Probe Parameters

	i riandular i
Sensor Arrangement	45.0
Connector Angle (°)	45.8
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
	337 mm
Probe Overall Lengui	10 mm
Probe Body Diameter	0
Tip Length	9 mm
	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	
Recommended Measurement Distance from Surface	1.4 mm